

Most Northerly Observation of a Grizzly Bear (*Ursus arctos*) in Canada: Photographic and DNA Evidence from Melville Island, Northwest Territories

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ABSTRACT. During geological studies in 2003 and 2004 on Melville Island, Northwest Territories, Canada, field parties photographed and gathered genetic information on one or more grizzly bears (*Ursus arctos*). To our knowledge, these data constitute the most northerly observations made of this species in North America. The DNA of a hair sample collected on Melville Island in 2004 is genetically indistinguishable from DNA collected from a population of grizzly bears around Paulatuk, Northwest Territories, along the northern mainland coast. It is also distinct from the DNA of the Viscount Melville polar bear (*Ursus maritimus*) population. Our evidence and review suggest that, at a minimum, transient grizzly bears are now regular visitors to the Canadian Arctic Archipelago. More research will be required to understand the significance of these observations, but a small viable population of grizzly bears may now be using areas in or around Melville Island.

Key words: grizzly bear, High Arctic, hybrid, Melville Island, microsatellite analysis, Northwest Territories, Paulatuk, polar bear, *Ursus arctos*, Viscount Melville Sound

RÉSUMÉ. Dans le cadre d'études géologiques réalisées en 2003 et en 2004 sur l'île Melville, dans les Territoires du Nord-Ouest, au Canada, des chercheurs sur le terrain ont photographié et recueilli de l'information génétique sur un ou plusieurs grizzlys (*Ursus arctos*). À notre connaissance, il s'agit des données représentant les observations sur cette espèce qui ont été recueillies les plus au nord de l'Amérique du Nord. L'ADN d'un échantillon de poil prélevé sur l'île Melville en 2004 est indifférenciable, du point de vue génétique, de l'ADN prélevé au sein d'une population de grizzlys de la région de Paulatuk, Territoires du Nord-Ouest, le long de la côte nord. Par ailleurs, il est distinct de l'ADN de la population d'ours polaires du Vicomte de Melville (*Ursus maritimus*). D'après les preuves que nous avons recueillies et notre analyse, à tout le moins, les grizzlys de passage sont maintenant des visiteurs habituels dans l'archipel Arctique canadien. D'autres recherches devront être effectuées afin de comprendre l'importance de ces observations, mais une population petite, bien que viable, de grizzlys pourrait maintenant utiliser les régions de l'île Melville ou situées tout près.

Mots clés : grizzly, Extrême-Arctique, hybride, île Melville, analyse par microsatellite, Territoires du Nord-Ouest, Paulatuk, ours polaire, *Ursus arctos*, détroit du Vicomte de Melville

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INTRODUCTION

Ursus arctos, commonly referred to as the grizzly bear in western North America and the brown bear in Eurasia and coastal Alaska, is well adapted to living on Arctic tundra. Although the brown bear has been recorded as far north as 74° latitude in Siberia (Stroganov, 1969), the northern range of the grizzly bear in Canada is usually considered to end at the Arctic mainland (> 66° to 70° N, e.g., Pasitschniak-Arts, 1993). However, several grizzly bear sightings have occurred on the sea ice and islands north of the Canadian mainland (Fig. 1). Schwatka (1885:27) reported that the Inuit of the Simpson Strait had, on rare occasions, encountered animals whose description could only be attributed to grizzly bears. In 1938, a pair of grizzly bears was observed on the sea ice 24 km west of the

Perry River (Gavin, 1945). In the winter of 1951, a hunter killed a grizzly bear in the Masik River valley of Banks Island (Manning and Macpherson, 1958), and Banfield (1959) considered this to be the first report of a grizzly bear from the Canadian Arctic Islands. In 1986, an adult male grizzly bear was killed near Ulukhaktok (Holman), western Victoria Island, and another was suspected to be in the area (R. Gau, pers. comm. 2006). Since the early 1990s, there have been numerous reports of grizzly bears on the sea ice off the mainland coast, extending from Hudson Bay in the east to the Beaufort Sea in the west (Struzik, 2003). The best-documented sighting during this period was by biologist Mitch Taylor: during a helicopter survey of Viscount Melville Sound on 4 May 1991, he observed a grizzly bear on the sea ice (73° 47' N, 112° 17' W) about 60 km south of the Dundas Peninsula, Melville

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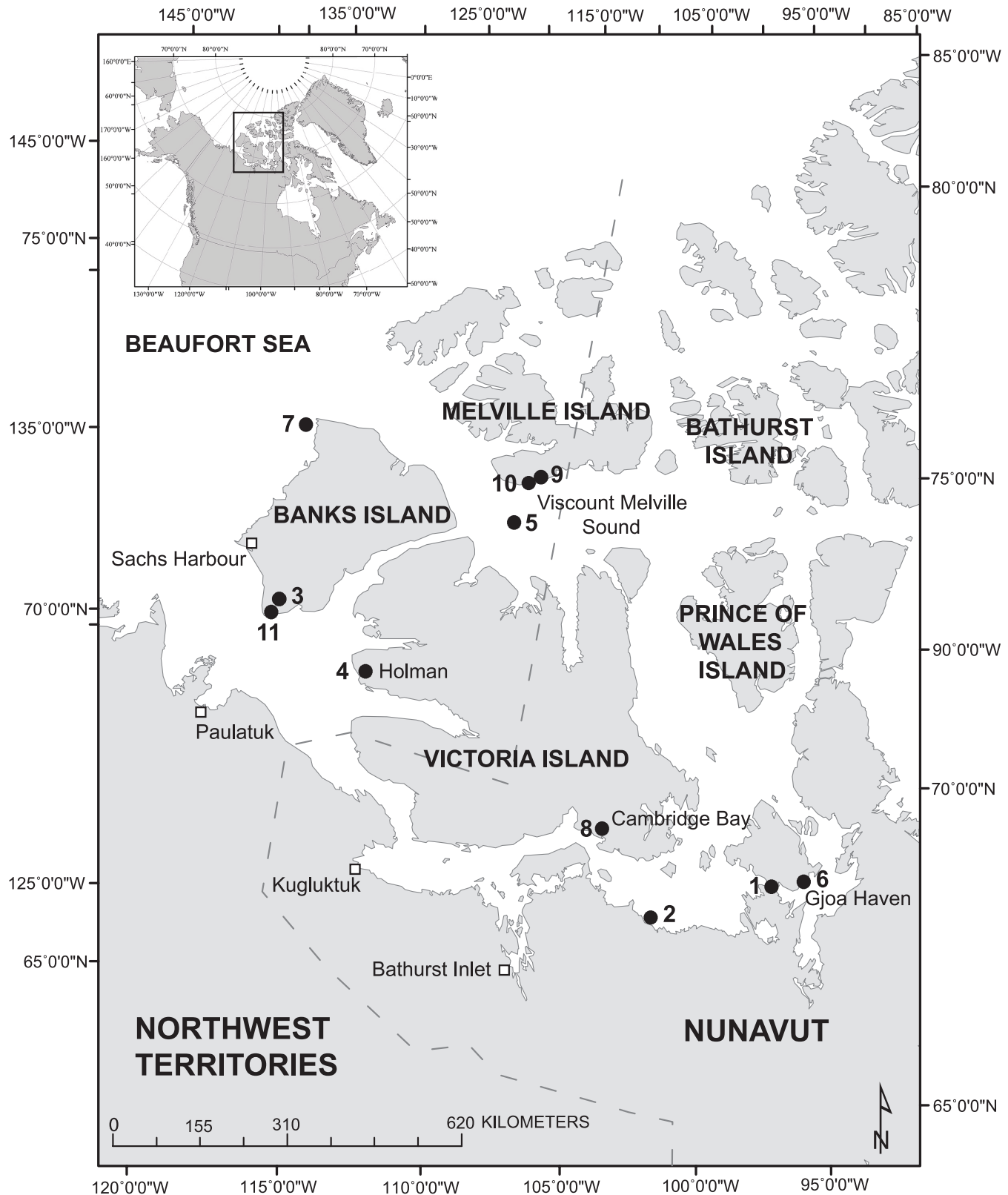


FIG. 1. Selected examples of grizzly bear sightings in the southern Canadian Arctic Archipelago. 1) Schwatka (1885) interprets the “unusual animals” sighted by Inuit in the Simpson Strait area as grizzly bears; 2) 1938: pair of grizzlies observed on the sea ice 24 km west of Perry River; 3) 1951: hunter kills grizzly bear in Masik River valley, Banks Island; 4) 1986: one bear shot, another suspected in Holman; 5) 1991: bear tranquillized and examined on sea ice, 60 km south of Melville Island; 6) 1996–2002: five kill records in Gjoa Haven; 7) five-year-old male grizzly harvested around Gore Islands; 8) 2001: bear denned within 20 km of Cambridge Bay; 9) 2003: most northerly sighting of a grizzly bear in Canada, Cape Clarendon (this study); 10) 2004: tracks observed, DNA obtained, Cape Providence (this study); 11) 2006: grizzly–polar bear hybrid killed, Nelson Head.

Island (Taylor, 1995). This bear was tranquilized and examined; it weighed 320 kg and was apparently in good health. The bear's tracks, and the remains of two seal pup kills in the vicinity, suggested that it had been hunting on the sea ice. Three days later, Ulukhaktok resident Joseph Haluksit observed a grizzly bear. Taylor (1995) suggested that this could have been the same bear, and that it had probably killed a two-year-old polar bear cub (*Ursus maritimus*), whose partially eaten carcass had been found nearby. In 2001, a five-year-old male grizzly bear was harvested around the Gore Islands, off W. Banks Island (74° 20' N, 125° 00' W; M. Branigan, pers. comm. 2006). In the same year, a grizzly bear denned within 20 km of Cambridge Bay, S.E. Victoria Island, and sightings were also reported in the interior and northern parts of the island, including bears searching for seals on the sea ice near Cambridge Bay (Stern, 2004). In April 2006, a grizzly–polar bear hybrid was shot on the south tip of Banks Island at Nelson Head (71° 06' N, 122° 43' W; M. Branigan, pers. comm. 2006).

Although several observations now exist of grizzly bears in the southern Canadian Arctic Archipelago, the early historical literature does not record this species in the vicinity of Melville Island. For example, in his review of the distribution of grizzly bears in northern Canada, Banfield (1959:50) notes that Rae did not mention the species on Victoria Island in 1852, and that in 1910–12, "Eskimos reported that they were absent from Victoria Island." A subsequent review paper on the distribution of the barren-ground grizzly bear in northern Canada does not record any sightings in the region around Melville Island either (Harrington et al., 1962). In the writings of the 19th century explorers who overwintered and conducted extensive traverses across Melville Island, including Parry in 1819–20 and M'Clintock in 1851–52, there are no records of grizzly bears (Parry, 1968; M'Clintock, 1972). Environmental surveys in the 1960s and 1970s also make no mention of grizzly bears (Tener, 1963; Canadian Wildlife Service, 1972; Wooley, 1974).

The photographic and DNA evidence we gathered during the course of two field seasons (2003 and 2004) while mapping the Quaternary geology of Dundas Peninsula on Melville Island provide unequivocal evidence of at least one grizzly bear and possibly the onset of a northern expansion of the species. Our original sighting is, to our knowledge, the most northerly grizzly bear ever reported.

2003 FIELD SEASON

During a helicopter survey of southern Dundas Peninsula, Melville Island, on 25 July 2003, a field party was dropped off by helicopter inland of Viscount Melville Sound, near Cape Clarendon. After the helicopter departed, a bear was sighted immediately downvalley along an unnamed river flanking the south side of Mt. Bruit (74° 36' N, 111° 27' W). It was initially assumed that this



FIG. 2. Most northerly sighting of a grizzly bear in Canada, Cape Clarendon, Melville Island, Northwest Territories, 2003. This bear exhibits distinctive grizzly bear features, including its brown coat, shortened face, and pronounced shoulder hump. This photograph was taken from a helicopter.

was a polar bear, but the helicopter pilot, David Bursey, recognized the bear's unusual coloration. A closer view revealed that this bear had the key distinguishing features of a grizzly bear: a tan to darker brown coat, an especially distinctive hump above its shoulders, and a shortened face (Fig. 2). The bear appeared to be mature and in good health.

2004 FIELD SEASON

During July 2004, the authors continued Quaternary geological mapping of southern Melville Island, and in the course of a helicopter survey, made a stopover at an unoccupied polar bear research cabin at Cape Providence (74° 27.5' N, 112° 08.5' W). The helicopter pilot, Benedict Gudmanson, noted that some new bear tracks had appeared around the cabin in the week or so since he had last stayed there. We recorded that these tracks had the more elongated form and extended claw marks characteristic of a grizzly bear, as opposed to the broader form and shorter claw marks of a polar bear (Fig. 3). This print, from a front foot, had a width of ~15 cm. In a study of grizzly bears along the western Beaufort Sea coast, the average forepaw pad width of 62 adult males (> 7 yrs.) was 15.3 ± 0.34 cm, and the corresponding average for adult females was 12.9 ± 0.82 cm. The maximum width reached by a female was 14.9 cm (for an extraordinarily large, food-conditioned female; R. Shideler, pers. comm. 2006). Although the size of the tracks can often be exaggerated by the substrate they are left in, we conclude that the footprints observed at Cape Providence were likely left by a male bear.

The tracks continued right up to one of the cabin's walls. Small hairs had become lodged in the wood boards of the exterior siding of the cabin, and also in a guy wire that anchored an aerial at the side of the cabin. It was suspected that these hairs had been left behind when the



FIG. 3. Grizzly bear footprint at Cape Providence, Melville Island, 2004. Note the 50 mm diameter lens cap for scale. The claw marks extend much farther from the pad of the foot than is the case for a polar bear. These tracks were only a few metres away from the cabin where hair samples were found, one of which produced DNA identified as that of a male grizzly bear.

same bear used the cabin exterior as a scratching post. This unintended hair trap worked similarly to those hair traps specifically designed for bear genetics studies (Woods et al., 1999). Samples of these hairs were placed in a sealed plastic bag for genetic analysis.

METHODS

Genetic analysis of the hair samples collected at Cape Providence was conducted at Wildlife Genetics International (Nelson, BC, Canada). The goal of microsatellite analysis is to assay length differences in repetitive sequences of DNA (e.g., CACACACACA). From one generation to the next, these sequences can gain or lose CA groups through mutation, thus changing in length. The frequencies of different length variants (alleles) differ between populations, so the relative probability of an observed allele occurring in different populations can help identify the population where an individual was born, particularly if probabilities are multiplied across a number of genetic markers (a genetic “assignment test”; Paetkau et al., 1997).

Two brown hairs and about 30 white underfur hairs were chosen for DNA extraction. One of the brown hairs faded towards its tip in a manner very characteristic of grizzly bear hairs, whereas the other was brown along its entire length. Three separate DNA extractions were attempted: one each from the two brown hairs, and one from the group of white underfur hairs. Only the solid brown hair, which appeared to have dried skin at its base, yielded sufficient DNA for analysis of nuclear genetic markers. From this sample, a complete 15-locus microsatellite genotype was obtained. These 15 markers included all but one of the 16 markers used in previous analyses of polar bear populations (Paetkau et al., 1999), and all eight of the

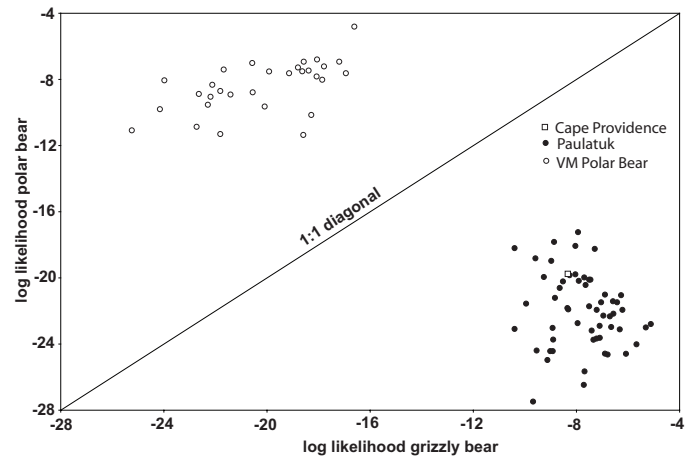


FIG. 4. DNA microsatellite analysis comparing submitted hair sample to samples from two reference populations. The hair sample from Cape Providence, Melville Island, Northwest Territories, closely matches the DNA of a sample population of mainland grizzly bears from near Paulatuk, Northwest Territories, and clearly differs from that of a sample of polar bears from Viscount Melville Sound.

markers used in grizzly/brown bear population genetics publications (Paetkau et al., 1997). The 15 markers from the sample we collected allowed for adequate identification of the source population.

RESULTS OF THE DNA ANALYSIS

The species identity of the hair sample was assessed by compiling reference allele frequency data from two populations: 1) the Viscount Melville polar bear population (30 samples, 15 markers; Paetkau et al., 1999) and 2) the barren-ground grizzly bears from a study area south of Paulatuk (56 samples, 8 markers; Paetkau et al., 1997). An assignment test was then performed to determine the probability of drawing the Cape Providence hair sample's genotype from either reference population (Paetkau et al., 1999). The reference grizzly bear sample with the least extreme ratio of genotype likelihoods was 10 million times as likely to be drawn from the Paulatuk grizzly bear population as from the Viscount Melville polar bear population, and the polar bears all had genotypes that were similarly unlikely to have come from a grizzly bear. Our analysis of the Cape Providence hair shows that it clusters with samples obtained from other barren-ground grizzly bears and is well separated from the Viscount Melville polar bear group (Fig. 4).

A total of 29 alleles were identified in the hair sample from 15 different markers (one marker was homozygous; a copy of the same allele). In the Viscount Melville polar bear population, 16 of these 29 alleles have never been observed (Table 1), further indicating that the hair sample is not from this population. The 15 alleles of the hair sample for which corresponding barren-ground grizzly bear data were available have all been observed in this population. Thus the DNA microsatellite analysis ruled

TABLE 1. The frequency in two reference populations of each allele measured in the hair sample from Cape Providence. Note that 16 of the alleles measured are not even found in the Viscount Melville polar bear population (highlighted in bold). Marker G10C was homozygous.

Marker	Allele	Viscount Melville Polar Bears	Paulatuk Grizzly Bears
G1A	184	0	0.67
	194	0.68	0.29
G10B	154	0.32	0.04
	156	0.18	0.08
G1D	176	0	0.30
	177	0	0.04
G10L	155	0	0.46
	157	0	0.38
G10M	208	0.13	0.13
	210	0.38	0.57
G10P	141	0	0.03
	153	0.15	0.14
G10X	131	0	0.32
	141	0.02	0.34
G10C	205	0.05	0.77
	157	0	N/A
CXX110	159	0	N/A
	223	0	N/A
G10H	231	0	N/A
	190	0.32	N/A
G10J	196	0	N/A
	223	0	N/A
MU59	239	0.20	N/A
	127	0	N/A
CXX20	133	0.02	N/A
	128	0.05	N/A
MU50	130	0.33	N/A
	175	0	N/A
G10U	179	0	N/A

out a Viscount Melville polar bear as the source of the Cape Providence hair sample, and indicated that the DNA is consistent with that of a barren-ground grizzly bear. An additional genetic test of length polymorphism in the amelogenin gene (Ennis and Gallagher, 1994) indicated that the hair sample was derived from a male bear.

CONCLUSION

At least one grizzly bear was present on Melville Island during the summer months of 2003 and 2004. Our evidence and the review of past sightings in this region suggest that at a minimum, transient grizzly bears are now regular visitors to the southern Canadian Arctic Archipelago. When such visits began is difficult to determine. The probability of a sighting depends on the number of bears and observers present, as well as on the particular survey method used. Furthermore, the relatively low number of sightings makes any statistical analysis problematic. However, there are no reports of grizzly bears from the early explorers of Melville Island, and fossil evidence is lacking.

Although Melville Island is well outside the traditionally defined grizzly bear range, it is worth remembering

that individual barren-ground grizzly bears wander farther in search of food than any other grizzly bear subpopulation in North America, perhaps as a result of the higher proportion of marginal habitats in the tundra environment (McLoughlin et al., 2003). Melville Island and the surrounding sea ice offer several plant and animal species that provide components of the grizzly bear diet. On the island, there are abundant caribou (*Rangifer tarandus pearyi*) and muskoxen (*Ovibos moschatus*), both species that grizzly bears have been known to consume (Clarkson and Liepins, 1993; Gau et al., 2002). On the sea ice of Viscount Melville Sound, the remains of seals, as well as female polar bears and their cubs, have been attributed to kills by grizzly bears (Taylor, 1995). The island also offers vegetation, such as sedges (*Carex* spp.), that a grizzly bear could exploit (Gau et al., 2002). As for possible overwintering on Melville Island, evidence of grizzly bear dens has yet to be reported, although many barren-ground grizzly bear dens collapse partially or fully after one use, making them difficult to detect (McLoughlin et al., 2002). If the observations of the 2003 and 2004 field seasons involved the same bear, then it is possible that the bear denned on Melville Island.

Whether a small viable population of grizzly bears now exists on Melville Island, or simply transient (seasonal) visitors, the sighting nonetheless raises important ecological questions. Of particular interest is the possible interspecific competition between grizzly bears and polar bears for food and space, including the potential for adult grizzly bear attacks on polar bears (especially cubs). It is also possible that polar bears, being more active in the winter, could prey upon denning grizzly bears. Another consideration involves the potential for grizzly–polar bear hybrids in the wild. This possibility has received attention for many years, as there are numerous reports of cross-breeding of the two species in captivity (Gray, 1972). Recently, DNA testing confirmed the identity of a grizzly–polar bear hybrid that was shot in April 2006 by a hunter at Nelson Head on the southern tip of Banks Island. In captivity, hybrid bears have successfully mated with other polar bears and grizzly bears (Kowalska, 1969).

More research will be required to place our observation of the northernmost grizzly bear in context. It is not yet understood whether these sightings are part of a recent expansion of grizzly bear range or merely isolated incidents. If a range expansion is indeed occurring, the possible influence of climatic factors, competition between mainland grizzlies for territory and resources, and increased presence of humans on the barren lands need to be assessed.

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