Yes, they can: polar bears *Ursus maritimus* successfully hunt Svalbard reindeer *Rangifer tarandus platyrhynchus*

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Abstract

The polar bear *Ursus maritimus* is one of the species most endangered by the rapidly declining sea–ice cover in the Arctic, which they use as a platform to hunt fatty, high-energy seals. In recent decades, more polar bears have been forced to remain longer on land, so their access to seals is limited. The importance of terrestrial food to polar bears is disputable, and more data are needed. Terrestrial ungulates could be an attractive substitute prey for them. Svalbard reindeer *Rangifer tarandus platyrhynchus* are prevalent and their distribution is completely within the range of polar bears. They constitute an attractive potential prey offering a significant energy return. Pre-2000 sources state that polar bears do not attack Svalbard reindeer. This report is the first description and documentation of the complete course of a polar bear hunt for adult reindeer in Hornsund, SW Spitsbergen, and also of the bear's hunting behaviour and the reindeer's response. Further, we report several other recent instances of bear–reindeer interactions in Svalbard, suggesting that polar bears now hunt reindeer more frequently than they used to. This increase in hunting is probably linked to the reduced ice cover, with bears spending more time on land, and a growing reindeer population. This study adds to earlier papers on how polar bears in Svalbard have increasingly shifted to a more terrestrial diet, and indicates that they may have an enhanced role as an apex predator in the terrestrial ecosystem.

Keywords Polar bear · Svalbard reindeer · Predation · Spitsbergen

Introduction

The top predator dependent on sea ice in the Arctic ecosystem, the polar bear *Ursus maritimus* is classified as a marine mammal (Amstrup 2003). Wherever its populations exist, its main prey consists of sea–ice-dependent seal species, particularly ringed seal *Pusa hispida*, but in many areas also bearded seal *Erignathus barbatus*. In Svalbard in summer, the latter is even more important (55% by biomass of food consumed) than the former (63% by numbers) (Derocher et al. 2002) because of the bearded seal's large size (4–5

times larger than ringed seal). Polar bears have a unique ability to digest seal blubber; seals therefore supply most of the energy necessary for bears to survive in the cold Arctic (Best 1977). When on ice, polar bears also occasionally hunt ice-locked cetaceans (Smith and Sjare 1990; Derocher 2012; Aars et al. 2015) and walrus *Odobenus rosmarus* resting on beaches (Donaldson et al. 1995).

Polar bears compelled by the shrinking sea ice extent to stay longer on land, where access to seals is limited, feed opportunistically on whatever resources are available, e.g., dead fish and cetaceans washed ashore, but also numerous terrestrial mammals from rodents to reindeer *Rangifer tarandus* (Gormezano and Rockwell 2013). They may also explore landfills near settlements containing offal and the remains of marine mammals hunted by local people (Russell 1975; Lunn and Stirling 1985).

During the bird breeding season, some polar bears visit bird colonies, eating eggs, chicks and adults caught on the nests. Although only a few specialized bears visit such colonies, they often significantly affect bird breeding success (Rockwell and Gormezano 2009; Prop et al. 2015). They penetrate near-shore waterfowl colonies (Rockwell and

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Gormezano 2009; Iverson et al. 2014; Prop et al. 2015), Little Auks *Alle alle* on debris-covered mountain slopes (Stempniewicz 1993), and the seemingly inaccessible colonies of Brünnich's Guillemot *Uria lomvia* and Black-legged Kittiwake *Rissa tridactyla*, located on steep cliffs (Donaldson et al. 1995). Sometimes, they catch birds at sea by attacking them from below the water or chasing them across the water (Stempniewicz 2006; Stempniewicz et al. 2014). Polar bears also eat marine and terrestrial plants (Russell 1975; Gormezano and Rockwell 2013; Stempniewicz 2017).

Most evidence from the Canadian Arctic suggests that terrestrial food sources cannot normally ensure the survival of polar bears if they have no access to seals at least seasonally (Ramsay and Hobson 1991; Rode et al. 2015a; Pilfold et al. 2016; Molnár et al. 2020). This applies to the growing number of bears forced to stay on land for ever longer periods, fasting because reduced access to sea ice prevents them from hunting seals (Stirling et al. 1999; Derocher et al. 2004; Rode et al. 2010; Derocher 2012; Stirling and Derocher 2012). Despite spending most their time resting to save energy and eating a variety of complementary terrestrial foods, bears on land around the southern Beaufort Sea and western Hudson Bay still lose weight (Stirling et al. 1999). In some other areas, e.g. the Chukchi Sea, polar bears lose no weight when on land (Rode et al. 2015b). Svalbard supports a large and growing population of Svalbard reindeer *R. tarandus platyrhynchus* (henceforth “reindeer”), estimated at 22,000 individuals (Le Moullec et al. 2019). Their distribution is completely within the range of polar bears. Sufficiently large (summer adults weigh 70–90 kg; Reimers 1984) and numerous, they provide enough energy to reduce or prevent bears losing weight while onshore, assuming that they can utilise this resource. Earlier reports suggested that polar bears were incapable of taking reindeer, so typically ignored them (Lønø 1970; Larsen 1978). In Western Hudson Bay, Brook and Richardson (2002) reported a failed attempt by a young bear to hunt caribou. Stempniewicz et al. (2014) described a similar case from Spitsbergen. However, Derocher et al. (2000) reported several cases where there was either firm evidence of polar bears successfully depredating reindeer in Svalbard, or at least strong signs of such predation. Nonetheless, these authors concluded that reindeer were probably of minor importance to the foraging ecology of polar bears in Svalbard at that time.

Assuming that several decades ago, polar bears in Svalbard hunted reindeer only occasionally, there are two possible explanations. First, more sea ice during most of the year meant that polar bears had longer access to seals. Probably concentrating on hunting high-energy, readily available seals on the sea ice, they could then ignore the less profitable reindeer as alternative terrestrial prey. In much of Svalbard, the sea ice habitat suitable for seals and the polar bears hunting them now occurs several degrees farther north than just

a few decades ago (Lone et al. 2018), so some bears now have to spend more time on land (Prop et al. 2015; Hamilton et al. 2017). The first reports of bears hunting reindeer come from the 1990s (Derocher et al. 2000), when the reduction of available sea ice in Svalbard became evident. Some years later (2003–2010), Iversen et al. (2013) reported that reindeer remains were fairly common in bear scats (9.2% of scats). Secondly, people in Svalbard intensively hunted both polar bears and reindeer until these animals gained protection, polar bears in 1973, and reindeer in 1925. Reindeer hunting had led to local extirpation in several areas, and by 1959 the population could have numbered less than 2000 individuals (Lønø 1959). Further recovery means that the current estimated population of 22,000 Svalbard reindeer now inhabits the entire historical range of this species in the Archipelago (Le Moullec et al. 2019). Thus, many more reindeer are now accessible, and at the same time, polar bears and reindeer are co-occurring more frequently in the same land areas.

This is the first detailed description, documented by video and photographs, of the entire course of a single young adult female polar bear pursuing and taking an adult reindeer in Hornsund, SW Spitsbergen. Based on this and other sightings, we discuss whether Derocher's et al. (2000) statement that reindeer are probably of minor importance to Svalbard polar bears should be revisited, and if so, whether a warmer climate and the more time that polar bears spend on land (e.g., Prop et al. 2015) have altered the importance of reindeer to them, thus leading to a change in their hunting behaviour.

Recent records of polar bear hunting reindeer in Svalbard

Here, we list all records known to us of polar bear predation and scavenging on reindeer from the Svalbard archipelago after the period covered by Derocher et al. (2000), which ended in 1999 (Table 1).

Description of the hunt

At 18:00 h on 21 August 2020, a polar bear was spotted ca 200 m from the Polish Polar Station in Hornsund (point 1 on the map; ca 77° 00' N, 15° 57' E), apparently a young adult female in good condition. The sky was overcast, the air temperature was + 5.4 °C, the water temperature 0.0 °C, and there was a slight ENE wind (3 m/s). The bear was walking east towards the shore of Isbjørnhamna and disregarded some rather noisy people, who were about 100 m away. The bear frequently raised its head, sniffing intensely. Five to seven reindeer were grazing and resting nearby. They were

Table 1 Records of polar bear *Ursus maritimus* hunting reindeer *Rangifer tarandus platyrhynchus* in the Svalbard archipelago

Area	Coordinates	Date	Short description	Data source
Svarttangen (SW Edgeøya)	77° 31' N, 20° 55' E	August 1998	PB* sneaking up, catching and killing R** (unknown sex/age of PB and R)	S. Onarheim, pers. comm
N Spitsbergen and Van Mijenfjorden, Bellsund		IX, X, XI, II 2008–2015	3 kills and 1 likely; 2 ad ♀♀ and 2 ♂♂ PB involved; prey caught after a short chase from the spot where R was surprised (2 cases); PB chasing 150 m before catching ad ♂R (1 case)	Sandal (2015)
Magdalene-fjorden, NW Spitsbergen	79° 34' N, 11° 07' E	25 VII 2011	Prolonged chasing of ad ♂R by subad PB, both on land and in the sea	Stempniewicz et al. (2014)
Blåbukta, E Edgeøya	78° 05' N, 23° 15' E	IX 2013	Freshly killed ad R found with a 2-year old ♂ PB eating from it; R's skull was punctured, signs on ground indicated that PB ambushed R from a crag above	NPI PB mp ***
Van Mijenfjorden, Bellsund		21 VI 2015	♀PB observed hunting R while her cubs were plundering eider nests; this was one of PBs reported by Sandal (2015) as taking R in Van Mijenfjorden, Bellsund	J. Prop (pers. comm.)
N Edgeøya	78° 21' N, 22° 20' E	IV 2018	2-Year old ♂PB found with freshly killed R of unknown sex/age	NPI PB mp
Wijdefjorden, N Spitsbergen	79° 25' N, 15° 80' E	IV 2018	R calf bitten in neck, found freshly killed by ad ♀PB; calf possibly weakened by starvation and unable to escape from PB	NPI PB mp
Skansbukta, Billefjorden	78° 55' N, 16° 25' E	3 IX 2018	Well-fed ad ♂PB feeding on fresh carcass of ad R	Kavan (2018)
Van Keulenfjorden	78° 20' N, 16° 25' E	XI 2019	R killed by PB after ambush (unknown sex/age of PB and R)	F. Strøm (pers. comm.)
Blomstrandhalvøya, Kongsfjorden	77° 33' N, 15° 04' E	VIII 2020	Fresh carcass of ad ♂R found with PB (unknown sex/age) eating from it	Pedersen (pers. comm.)
Alkehornet, Isfjorden	78° 13' N, 13° 49' E	VII 2020	Ad ♀PB with two cubs seen beside fresh R kill; this was one of PBs reported by Sandal (2015) as taking R in Van Mijenfjorden, Bellsund	J. Mosbacher (pers. comm.)
Vinodden, Isfjorden	78° 20' N, 16° 25' E	19 X 2020	Ad ♀PB with cub of the year killing young R	S. Onarheim (pers. comm.)

*PB – polar bear(s)

**R – reindeer(s)

***NPI PB mp – Norwegian Polar Institute, polar bear monitoring programme

separated by the pipeline from the station, which could have been difficult to cross. Most of the reindeer were between the station and the sea, two were beyond the pipeline. The bear proceeded directly towards the latter. Initially, the bear

and these two reindeer were ca 500 m apart, and it took the bear ca 2 min to cover this distance. As the bear crossed the path from the station to the observatory, it must have seen one of the two reindeer and accelerated, no longer raising its

head or sniffing. The terrain there is flat with scattered rocks, which could conceal both bear and reindeer. On entering a depression in the tundra, the bear vanished from the observers' sight. A few seconds later, it sprang out of the hollow and galloped towards the nearest reindeer, an adult male in good physical condition, which was facing away from the bear and only now noticed the attacker (point 2). It got up – this took a moment – and ran directly to the seashore about 30 m away. The bear dashed into the water behind the fleeing prey (Fig. 1).

Initially, the reindeer was about 4 m ahead of the bear, but he swam very fast, quickly catching up with the reindeer (point 3). On reaching its prey, about 25 m offshore, the bear first grasped the reindeer's rump, then sank its claws into it, bringing its prey to a halt. It then climbed onto the reindeer, using its weight to submerge the prey, so that only the latter's head and neck were still visible above the water. Then with its teeth it grabbed the reindeer by the nape and immersed it completely. Prey and attacker struggled for a while, parts of each animal appearing alternately on the surface. Then, the bear gripped the reindeer's neck from below and dispatched it within about a minute. The bear then turned the reindeer over, submerging it repeatedly for about 15 min, even though it was already dead (Fig. 2; Online Resources).

The bear now dragged the reindeer ashore to some 7 m above the waterline, then began to rip it open and eat its flesh. This continued for about 2 h, during which time it ate ca 60% of the flesh. The bear guarded the carcass, chasing

away Arctic foxes *Vulpes lagopus* and Glaucous Gulls *Larus hyperboreus*, while continuing to feed until it had eaten most of the meat. It covered the carcass with stones before leaving it to reduce the chance of kleptoparasitism by scavengers visually detecting carrion (Stirling et al. 2019). Then, it walked to the nearby rocks where it rested or slept for 12 h until the next morning. During that time, three foxes and about ten Glaucous Gulls fed on the remains of the carcass. By noon the next day, the bear alternately lay near the carcass or went to eat the leftovers. In all, it consumed ca 80% of the reindeer's flesh. Around noon, it moved a kilometre inland, where it lay in the foothills until evening (Fig. 3; Online Resources).

The next day (23 August) a field team sailing to the Hans glacier spotted the bear on the rocks in Isbjørnhamna next to another freshly killed reindeer (point 4; Fig. 1; 3). After about 20 min, the bear dragged its prey ashore at the base of Cape Baranowski, ca 500 m away, and started eating it (point 5). However, being apparently less hungry than when taking the first reindeer two days earlier, it now actively consumed the reindeer's flesh for only about an hour during the five hours which it spent near the prey. This time it did not chase away foxes or Glaucous Gulls competing for the meat. It then left the carcass and went to its previous resting place, where it lay for the next two days, moving only short distances. It had eaten ca 40% of the soft body parts of the second reindeer, leaving so much meat that the foxes and gulls were able to feed on the carcass for another 10 days.

Fig. 1 Observation area: (1) bear's initial position; (2) first reindeer's initial position; (3) pursuit in the sea; (4) here, the bear spotted the second reindeer; (5) here, the second reindeer was pulled ashore and eaten

Fig. 2 The next stages **a, b, c, d** of the chase and killing of a Svalbard reindeer *Rangifer tarandus platyrhynchus* by a polar bear *Ursus maritimus* in the sea. Photo: I. Kulaszewicz and P. Ulandowska-Monarcha

Fig. 3 Polar bear *Ursus maritimus* with a killed reindeer *Rangifer tarandus platyrhynchus* on skerries (**a**), dragging it on to the beach (**b**), eating it (**c**) and trying to bury it (**d**). Photos: P. Klicz and P. Nowosad

Four days after the first observation, the bear disappeared and was not seen again in the vicinity.

Discussion

These observations provide the first detailed description of a complete and successful polar bear hunt of a fully functional, adult Svalbard reindeer. Polar bears can travel very quickly over short distances (Derocher 2012), so

presumably most reindeer taken by polar bears are killed because the attacking bear gets close up to the reindeer before the latter can react. The most interesting aspect of this particular observation is that the bear drove the reindeer male into the water and was then able to catch it because it could swim faster than the reindeer, although an earlier observation (Stempniewicz et al. 2014) showed that a reindeer was capable of escaping from a younger polar bear in open water. The differences in predation success may depend on both the distance between hunter and prey at the beginning of the pursuit, and individual factors relating to the two animals, such as age, size and physical condition. The second reindeer, killed only two days later by the same bear seemingly using much the same method, may indicate that this particular bear has become specialized in hunting reindeer, and possibly, that reindeer may be an important prey to that bear, at least in summer, when the lack of sea ice may prevent it from taking seals.

In general, reindeer run faster and have greater stamina than polar bears over longer distances (Brook and Richardson 2002). This also applies to the Svalbard reindeer, despite its shorter legs, compact body, and therefore, slower speed. A bear is a short-distance runner and can overheat if it has to run fast for a longer time (Hurst et al. 1982; Pagano et al. 2018), although chasing prey in cold water minimizes this risk. Whenever possible, a polar bear uses the terrain to creep up to within a few metres of its prey before the attack. This method of hunting is possible thanks to its ability to smell potential prey from a distance. When chasing prey, the bear was observed accelerating rapidly. It performed such a charge right at the beginning of the attack, but might also have repeated it later. This behaviour of polar bears (three instances) has been observed both on land and in water when they hunted caribou/reindeer (Brook and Richardson 2002; Stempniewicz et al. 2014) and flightless geese (Stempniewicz 2006).

Polar bears may succeed in driving the deer into the water, especially where the water is shallow and the bottom is rocky and uneven. They can also gain an advantage in areas where the reindeer are hindered by the terrain. Reindeer often feed on steep mountain slopes. There have been many observations of crippled reindeer found in such rubble-covered areas in Svalbard, and these animals may be easy prey for bears (Derocher et al. 2000; Stempniewicz et al. 2014). Reindeer can break their legs when trying to escape a bear on steep scree, but also when they feed on steep icy slopes in winter and lose their footing. In addition, to the reindeer they actually kill, other carcasses may be available to bears and contribute to their diet. The high frequency of reindeer remains found in polar bear scats from Svalbard, reaching 27.3% in summer, suggests that reindeer may be a significant part of the polar bear's diet in that area, whether from carcasses or predation (Iversen et al. 2013).

The level of alertness observed among Svalbard reindeer is very low. When selecting feeding and resting sites, they appear to underestimate the risk of a bear attack. In Hornsund they often graze and lie among the rocks, which limit their field of view; this makes it even easier for a predator to hide and catch a reindeer by surprise. In addition, the relatively long time it takes for a reindeer to get to its feet also reduces its chances of escaping when ambushed by a bear. Our own observations of the reactions of reindeer to people walking on the tundra seem to confirm this low level of vigilance. This modest reaction of Svalbard reindeer to an approaching bear was known to trappers (Lønø 1970). Part of the reason may be the absence of other large terrestrial predators in Svalbard. This behaviour may also be a pointer to the past, perhaps a period when, due to over-hunting by humans, both bears and reindeer became rare in Svalbard and the frequency of their contacts was very low. At the same time, the cold climate continued to favour the availability of seals to bears. Under such conditions, polar bears may have had no interest in hunting reindeer. Reimers et al. (2011), however, showed that the flight distance of reindeer in different parts of Svalbard was the greatest on Edgeøya, where the probability of interaction with polar bears was high. Elsewhere in the polar bear's distribution, they coexist on shores with brown bears *Ursus arctos*, which hunt caribou. Thus, the greater use of reindeer in Svalbard relative to that of caribou by polar bears elsewhere in the Arctic could be a result both of competition with brown bears and wolves *Canis lupus*, and the heightened vigilance of caribou in areas where these predators occur, making reindeer a more challenging prey for polar bears. As the frequency of bears hunting for reindeer increases, strong selection pressure may come into play in favour of increased vigilance and other adaptations against predators in Svalbard reindeer.

The number of direct observations of polar bears hunting Svalbard reindeer appear to have been increasing in recent years. In addition, there are now a significant number of cases where predation can be assumed (Table 1). Although bears in the area are most likely to be fully dependent on the much more energy-rich seals hunted on sea ice, at least from spring to early summer, the rather frequent reports of the successful hunting of reindeer by Svalbard polar bears may mean that the importance of such prey in their diet has either been underestimated, or more likely, that this phenomenon has become more common in recent years. It is hard to believe that such behaviour was ubiquitous before the 1970s, when Lønø (1970) stated that bears did not hunt reindeer, given all the extensive knowledge he had accumulated as a trapper and scientist himself, and from other trappers that had hunted in the area for decades.

Land-based food sources cannot provide bears with sufficient energy, and bears in the southern Beaufort Sea and western Hudson Bay lose weight when on land (Stirling

et al. 1999; Rode et al. 2010). In other areas (e.g., the Chukchi Sea), increased land use has occurred but without weight loss among bears in the population (Rode et al. 2015a, 2015b). In Svalbard, reindeer are numerous and easily available. As prey, they may offer bears a considerable energy return. In late summer, the Svalbard reindeer are in prime condition. The average body weight of adult males shot in August was ca 118 kg, including lean body weight (37 kg), digestive tract (30 kg), skin, head, hooves (23 kg) and fat (28 kg) (Reimers 1984). The bear observed in Hornsund ate ca 80% of the soft body parts of the first reindeer it killed and ca 40% of the second one, an estimated consumption of ca 70–80 kg of meat, innards and fat. This is a large amount of food, equivalent in weight to one adult or two young ringed seals, even though reindeer carcasses may provide only about half the energy per weight unit (Best 1977). Even before the hunt, the bear we observed was in excellent condition. Moreover, the ease with which it hunted two adult reindeer within a short time strongly suggests that it had few problems maintaining an energy balance.

Currently, nearly 300 polar bears live in Svalbard all the year round (Aars et al. 2017), and the number of local bears in Spitsbergen (W Svalbard) has increased significantly in recent decades (Prop et al. 2015). They have been shown to be highly philopatric, using the same area year after year, and also over generations. If polar bear mothers learn to hunt reindeer efficiently, their offspring, which stay with their mothers for over two years, may also become reindeer hunters. Reindeer numbers in the area may continue to increase, given the increased productivity of the tundra as the climate warms. The local bears, numbering about a tenth of the Barents Sea population where most hunt along the ice edge and visit the islands more sporadically (Aars et al. 2017), may become an increasingly important component of Svalbard's terrestrial ecosystem. Their impact on colonial birds, not only on the reindeer population, is expected to increase, although one can assume that predation on sea ice of the associated seal species in spring and early summer will still provide the major item in their diet.

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Author contributions L. S. conceived the study and drafted the manuscript. I. K. performed and described the field observations. J. A. compiled other observations of polar bear-reindeer interactions collected by the Norwegian Polar Institute. All the authors read and approved the final manuscript.

Declarations

Conflict of interest The authors declare that they have no competing interests.

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