

Behavioural Changes in Belugas (*Delphinapterus leucas*) During a Killer Whale (*Orcinus orca*) Attack in Southwest Hudson Bay

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Killer Whales (*Orcinus orca*) were observed on 4 August 2012 attacking Belugas (*Delphinapterus leucas*) at high tide near the mouth of the Seal River (59°9'19"N, 94°45'28"W) in southwest Hudson Bay, near the location where six Belugas had been fitted with satellite transmitters three weeks earlier. The distribution of Belugas was analyzed before, during, and after the attack. In the presence of Killer Whales, the six Belugas altered their behaviour by reducing their combined range size from 285 km² four days before the attack to 172 km² on the day of the attack. Their range more than tripled, to 655 km², in the days immediately following the attack before returning to the pre-attack size. Following the attack, the tagged Belugas expanded their range northward, going from a mean pre-attack distance of 9.4 km from the attack site to a maximum of 23.5 km. Visual observations of Belugas clumping together and moving toward shore corroborated satellite data. This evasive behaviour by Belugas was different from that reported for Narwhals (*Monodon monoceros*) suggesting that the two monodontid species may have evolved different survival strategies related to the risk of Killer Whale predation. With predicted changes to Arctic sea ice, the summering habitat of Belugas will be available to their main predator for longer periods. A better understanding of Beluga behaviour and risk of predation is required for Beluga conservation and stock management.

Key Words: Beluga Whale; *Delphinapterus leucas*; home range; Hudson Bay; Killer Whale; *Orcinus orca*; Orca; predation; sea ice

Introduction

Over the last 30 years, Hudson Bay has experienced a dramatic loss in sea ice. Spring sea ice concentration (percentage of sea ice cover) has decreased 15.1–20.4% per decade in western and southwestern Hudson Bay (Hochheim *et al.* 2011), with spring break up advancing 15–40 days between 1971 and 2003 in James Bay and southern and western Hudson Bay (Gagnon and Gough 2005). For an ice-associated species, such as the Beluga Whale (*Delphinapterus leucas*), less sea ice and longer periods of open water mean that more habitat is available to previously seasonally excluded top predators, such as Killer Whales (*Orcinus orca*). The presence of Killer Whales in the eastern Canadian Arctic, and specifically in Hudson Bay, is increasing (Higdon and Ferguson 2009; Higdon *et al.* 2012) and this trend is expected to continue as sea ice diminishes. Killer Whales in the eastern Canadian Arctic prey on marine mammals and are known to kill and consume Bowhead Whales (*Balaena mysticetus*), Narwhals (*Monodon monoceros*), seals, Walrus (*Odobenus rosmarus*), and Belugas; however, their dietary intake and their effect on prey populations in the Arctic are largely unknown (Ferguson *et al.* 2012).

On 4 August 2012, Killer Whales were observed and photographed attacking Belugas at high tide near the mouth of the Seal River (59°9'19"N, 94°45'28"W). Three weeks before this event, six Belugas in this area had been caught and fitted with satellite transmitters for a larger study on their habitat and estuary use in Manitoba. We took this opportunity to analyze behaviour that may elucidate more generally how Belugas respond to a relatively new predator. We tested dispersal of tagged Beluga Whales in the days immediately following the Killer Whale attack and the distance of Belugas from the attack site before and after the event.

Methods

In July 2012, six Belugas near the Seal River in northern Manitoba were fitted with satellite transmitters with the support of the Hunters and Trappers Association of the closest Inuit community, Arviat (Table 1). All whales, male and female adults and mature juveniles, were caught using the hoop net technique described by Orr *et al.* (2001) between 11 and 16 July and fitted with SPLASH satellite-linked transmitters (Wildlife Computers, Redmond, Washington, USA). The transmitters were attached near the dorsal ridge of each

TABLE 1. Characteristics of Belugas (*Delphinapterus leucas*) fitted with satellite-linked transmitters in 2012 near the Seal River estuary, Hudson Bay, Canada.

Tag no.	Tagging date, day-month-year	Sex	Body length, cm	Fluke width, cm
118957	11-07-2012	M	326	79
118958	11-07-2012	F	323	72
118955	13-07-2012	M	402	106
118956	15-07-2012	M	380	92
118960	15-07-2012	F	298	68
118959	16-07-2012	M	375	94

animal using nylon pins and washers; they were configured to transmit location and dive information up to 400 times daily.

Location data were filtered using Jonsen's state-space model (Jonsen *et al.* 2005) and estimated locations generated by the model (in a 4-h time step) were plotted in ArcGIS 10.4 (Esri, Redlands, California, USA). Beluga Whale home range and distance from the attack site were compared for the days leading up to, the day of, and the days following the Killer Whale attack. Distance metrics and kernel density estimates were calculated using ArcGIS 10.4. The number of days included in analysis on either side of the attack was determined by availability of data from each of the six tagged animals. For the purposes of this analysis, four days on either side of the attack were used.

Observations

Tourists and experienced guides (who were in communication with a local pilot flying the area) were inter-

viewed (August 2012) and their observations of the Killer Whale attack were summarized. They confirmed that Killer Whales were not seen in the area immediately before or after the attack. The attack began on 4 August at 0930, almost exactly at high tide, and ended at 1045. There were 10–12 Killer Whales in two groups (seven and four or five) that included three large males. Most of the time, they were offshore in about 150 m of water, but, at some point, four Killer Whales came close to shore, chasing Belugas. The whales engaged in some breaching activity, pushing Belugas out of the water, and it was clear that they were hunting the Belugas although no direct observations of kills were seen.

During the attack, Belugas were observed moving quickly, porpoising, thrashing in the water, and clumping together close to shore in < 2 m of water (Figure 1) as they moved southward along the coast. On the day following the attack, few Belugas were observed near the southern outflow of the Seal River, a location where they are typically seen in high numbers at this time of



FIGURE 1. A Polar Bear (*Ursus maritimus*) looks on as Belugas (*Delphinapterus leucas*) clump together near shore in less than 2 m of water during a Killer Whale (*Orcinus orca*) attack near the mouth of the Seal River, Hudson Bay. Photo: Andy Morley.

year, and Killer Whales were spotted further south in the bay, near Churchill.

Results

Leading up to the day of the attack, the tagged Belugas consistently used the waters immediate adjacent to the mouth of the Seal River, staying within 10 km of the attack site. In the presence of Killer Whales, the six Belugas altered their behaviour by reducing their combined range size from 285 km² four days before the attack to 172 km² on the day of the attack. Following the attack, the Belugas expanded their range northward, from a mean distance of 9.4 km over the four days before the attack to a highest mean distance of 23.5 km two days after the attack (Figure 2), and increasing their 75th percentile kernel density area from 172 km² on the day of the attack to 655 km² two days later (Figure 3). This area and mean distance from the attack site then declined, returning to levels similar to those observed before the attack by the fourth day. Data from before the attack also indicate that the Beluga home ranges decreased before and on the day of the Killer Whale attack. Visual observations were consistent with the satellite data.

Discussion

Satellite telemetry results from this research have provided the first detailed insight into the movements of Belugas in the presence of marine mammal-eating

Killer Whales. Here, Belugas clumped together during a predation event and dispersed after it. This clear change in behaviour, both visually observed and remotely recorded via satellite-tracked movements, indicates that Belugas differ from Narwhals under similar circumstances. As reported by Laidre *et al.* (2006), Narwhals exhibit slow quiet movements and increase their home range during attack, indicating a different strategy to reduce risk of attack that may be linked to the characteristics of their preferred summering habitat. Whereas the western Hudson Bay Belugas prefer the shallow estuaries of Manitoba (Richard 2004) in summer, high Arctic Narwhals prefer deep fiords of northern Baffin Island (Richard *et al.* 1994). Tidal flats are broad in this area and extend up to 10 km offshore. Belugas may restrict their movements to these flats where Killer Whales are too large to enter without risk of at least temporary stranding.

As the Arctic sea ice has changed and the summering grounds of Belugas have become free of sea ice for longer periods, Killer Whale predation on Belugas has likely increased. In a traditional knowledge study on Killer Whales in Hudson Bay and around Baffin Island in Nunavut (Westdal *et al.* 2013), some of the hunters and elders interviewed in three communities suggested that Killer Whale numbers were causing a decline in the availability of locally harvested species, such as Beluga Whales. Conversely, other hunters in the same study proposed that Killer Whale predation was not

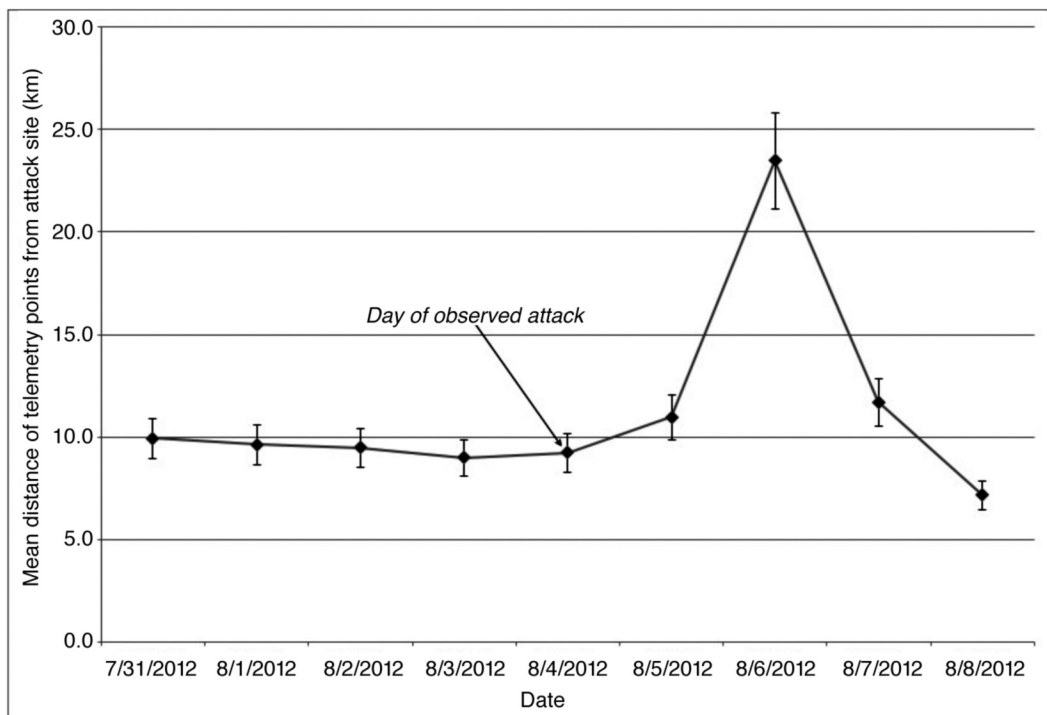


FIGURE 2. Mean distance of all tagged Belugas (*Delphinapterus leucas*; \pm 10% standard error) from site of attack by Killer Whales (*Orcinus orca*) before and after the attack near the Seal River estuary, Hudson Bay.

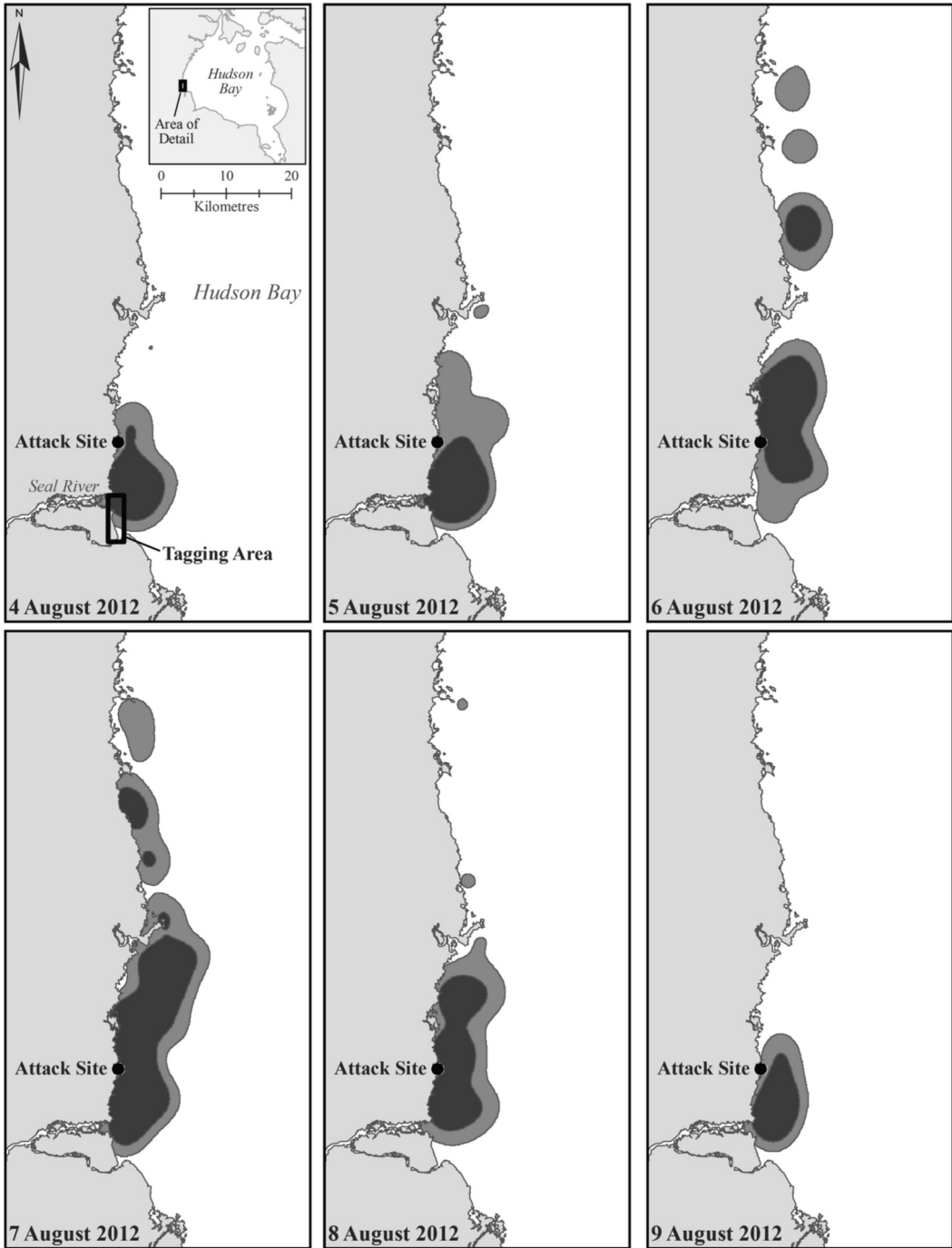


FIGURE 3. Kernel density of tagged Belugas (*Delphinapterus leucas*) showing their dispersal in the days immediately following a Killer Whale (*Orcinus orca*) attack on 4 August 2012 and their eventual return to the pre-attack area near the Seal River estuary, Hudson Bay. Dark grey shading indicates 50th percentile; lighter grey shows 75th percentile.

extensive enough to cause a decline of other marine mammals in the region. The impact of Killer Whales on prey such as Belugas in Hudson Bay is difficult to assess scientifically because the size of the Killer Whale population that visits the region is unknown and population trend data for Belugas are lacking (Ferguson *et al.* 2010).

However, non-lethal impacts of predation at the individual or group scale may have consequences. Cetaceans are known to exhibit a range of anti-predator adaptations in response to predation (Ford and Reeves 2008) including living in large groups (Norris and Dohl 1980), which may be the case for Belugas in southwest Hudson Bay. Responses to individual predation events include short-term grouping (Curé *et al.* 2013), a change in vocalizations, and directional swimming away from the threat (Ford and Reeves 2008). Here, short-term changes in distribution were recorded in relation to a predation event. This change, if occurring multiple times during the longer ice-free season, could have significant biological consequences related to energy expenditure and success in calf rearing. Belugas are known to spend summers in the shallows and estuaries of western Hudson Bay and hypotheses for this habitat preference include a dependence on warmer waters for calf rearing. The consequences of short-term but repeated abandonment of this habitat are unknown.

Overall, the lack of knowledge of Killer Whale numbers, predation activity, and possible changes in Beluga distribution and abundance in response to Killer Whale predation results in uncertainty over the future of Hudson Bay Belugas. A better understanding of Beluga behaviour and risk of predation, acquired through telemetry, and continued collection of information on Killer Whale sightings through community-based research are required for conservation and management. Conservation measures directed at Beluga habitat should ensure that more than just core summering areas are protected, as core areas alone are likely to be insufficient in light of the behaviour observed in August 2012.

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