Brown bears and wolves scavenge humpback whale carcass in Alaska

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Abstract: Brown bears (*Ursus arctos*) are generally solitary animals, although they are known to aggregate at concentrated food resources. Using remote cameras, we documented brown bears aggregating while scavenging a whale carcass from 19 May to 17 September 2010 in Glacier Bay National Park, Alaska, USA. Such aggregations have not been reported in Glacier Bay, a recently deglaciated fjord where bear food resources are dispersed and less diverse than in other regions of coastal Alaska. We documented multiple brown bears and wolves (*Canis lupus*) scavenging the carcass—at times, simultaneously. This study provided a rare opportunity to document brown bear–wolf interactions over several months associated with a large-magnitude resource event with little evidence of aggression between species. Our results suggest that the humpback whale (*Megaptera novaeangliae*) carcass provided a substantial food resource for brown bears and wolves in Glacier Bay, potentially influencing space use and interspecific interactions.

Key words: Alaska, brown bear, *Canis lupus*, feeding aggregations, humpback whale, *Megaptera novaeangliae*, scavenging, *Ursus arctos*, wolf

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Although brown bears (*Ursus arctos*) exhibit a solitary lifestyle and may defend discreet resources such as ungulates carcasses, this species is known to tolerate conspecifics at high-volume, concentrated food sources (Bunnell and Tait 1981, Stirling and Derocher 1990, Smith et al. 2005). Brown bear feeding aggregations are seen most often in areas where perennial food resources are predictable and abundant, such as at salmon (*Oncorhynchus* spp.) spawning streams or garbage dumps (Bunnell and Tait 1981, Stirling and Derocher 1990, Smith et al. 2005). Although unpredictable, whale carcasses that wash ashore represent large resource pulses that can result in aggregations of foraging brown and polar bears (*U. maritimus;* Miller 2005, Van Daele 2007). We describe observations of brown bears scavenging a humpback whale carcass (*Megaptera novaeangliae*) in Glacier Bay National Park and Preserve in Alaska, USA, and describe interactions between brown bears and wolves (*Canis lupus*) at this concentrated food resource.

Glacier Bay National Park and Preserve (13,289 km^2) is characterized by a 100-km-deep fjord, ice fields, tidewater glaciers, rugged mountains up to 4,633 m, and cool summers and wet winters (Boggs et al. 2008). Rapid deglaciation over the past 260 years has given rise to diverse vegetation communities, including mature spruce (*Picea* spp.) -dominated forests near the mouth of Glacier Bay, coastal beach meadows with diverse herbaceous vegetation (reviewed in Lewis 2012), and nearly barren ground surfaces in mountainous upper reaches near remaining tide-water glaciers (Chapin et al. 1994). Although some herbaceous forage is available in the West Arm of Glacier Bay where the whale carcass was located (58°50′N, 136°39′W), the dominant vegetation type is closed scrub (e.g., alder [*Alnus rubra*], willow [*Salix* spp.]) and the interior is dominated by rock and ice. Other possible brown bear food resources may include moose (*Alces alces*), mountain goats (*Oreamnos americanus*), voles (*Myodes* and *Mycrotus* spp.), and intertidal invertebrates. Salmon resources are limited in the West Arm of Glacier Bay because abundance and distribution of anadromous fish is generally low in recently deglaciated watersheds (Milner et al. 2000).

A 12.5-m, intact humpback whale carcass was located on the beach in the West Arm of Glacier Bay on 5 May 2010. The whale was believed to have been dead for several weeks. On 13 May 2010 we deployed a Trail Watcher motion-detecting digital camera (Model 2035; Monticello, Georgia, USA) set on a 10-second delay between image captures and a Pentax Optio (Model W200; RICOH Imaging Company, LTD, Tokyo, Japan) set on a 15-minute time-lapse to record scavenging activities at the carcass. We attached cameras to a tree trunk about 20 m from the carcass and set to record images of

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animals within about 50 m of the carcass. No flash or infrared settings were used. We exchanged data cards and batteries every 10–14 days. We accessed the study site by a motor vessel, from which observers used high-powered binoculars to determine whether scavengers were present at the carcass. If bears or wolves were present, the vessel remained ≥100 m from shore until the animals departed, to avoid disturbance to the animals. The land surrounding the carcass was closed to all other human use by the National Park Service for the duration of the study. Based on site visits and photographs, we estimated 30–50% of the flesh and blubber remained on the carcass by the end of August. On 4 September 2010, the bulk of the carcass floated away, leaving the skull and an assortment of vertebrae, other bones, and baleen. The time-lapse camera continued to operate until camera retrieval on 17 September 2010.

For each image, we recorded date, time, and number of individual bears and wolves observed. We used the time-lapse camera to measure weekly (no. of images with target animal[s]/total no. of images per week) and hourly (no. of images with target animal[s]/total no. of images per hr [0–23]) bear and wolf activity. Images from the motion-sensing camera were not standardized, so we only report findings that were not documented by the time-lapse camera. Images taken when it was too dark to see animals were excluded from analysis.

We also conducted a bear-sign survey on 7 October 2010 in which 2 surveyors walked 4 adjacent parallel strip-transects (each about 7 m x 1,500 m) within the beach, meadows, and open shrublands surrounding the whale carcass (delineated by mean high tide, cliffs, and dense shrubs) and recorded all mark trees, beds, and mark trails with Global Positioning System units. We used a Geographic Information System (ArcGIS 9.3.1; Environmental Systems Research Institute, Redlands, California, USA) to compare the number of mark trees, beds, and mark tails to results from a bear-sign survey that was conducted in 2001 using identical geographic range and methods.

The time-lapse camera recorded 6,073 usable images (i.e., with enough light to count animals, of 8,176 total) during 89 days of operation from 19 May to 17 September 2010. Brown bears were detected at the whale carcass in 1,752 images and were recorded at least once per day from 19 May to 11 September with the exception of 1 June. Most images of bears (67%) were of single adults; however, 21% were of 2 bears, 9% were of 3 bears, 2% were of 4 bears, 1% was of 5 bears, and we recorded a single image of 6 bears. We also recorded images of a pair of brown bears mating at the carcass site on 10 July 2010. We did not identify any brown bear family groups with the time-lapse camera. The motion-detecting camera, however, recorded one image of a female bear with 2 large cubs, which was the only family group documented during the study. From May through September, weekly brown bear activity at the whale carcass increased from 8.1% in early June to 63.2% in late August before declining to 0% in mid-September after the carcass had floated away (Fig. 1a). Brown bear activity showed strong diel variation, with <10% of images recording bear presence during 2300 to 0200 hours, whereas >40% of images recorded bear presence during 0400 to 0800 hours and again from 1900 to 2200 hours (Fig. 1b).

We recorded 71 images of wolves feeding on the whale carcass. Of these 71 images, 83% were of individuals and the maximum number of wolves detected in one image was 7, which included 3 adults and 4 pups. Repeated observation of a distinctive silver adult wolf present with other darker adults and pups led us to believe that most of the wolves frequenting the carcass were members of a single pack. From May through September, weekly wolf activity at the whale carcass ranged from 0% to 3.7% of images per week (Fig. 1a). Wolf activity showed diel variation ranging from <1% of images recording wolf presence in most hours from 1100 to 0300 hours to a high of 3–6% of images documenting wolf presence from 0500 to 0800 hours (Fig. 1b).

Thirty-seven images recorded brown bears and wolves at the carcass site simultaneously. Of these images, 31 suggested no interaction between species, in 3 images a brown bear and wolf appeared nose to nose, and on 3 occasions a brown bear appeared to be following a wolf; in 2 of these images the wolf exhibited submissive posture. In addition, the motion-detecting camera recorded both brown bears and wolves marking vegetation and animal trails leading to and from the carcass.

Our results demonstrate that the humpback whale carcass provided an abundant and persistent (>4 months) marine-derived meat resource for brown bears and wolves in the West Arm of Glacier Bay. Increased meat consumption, particularly from marine sources, has been shown to have direct

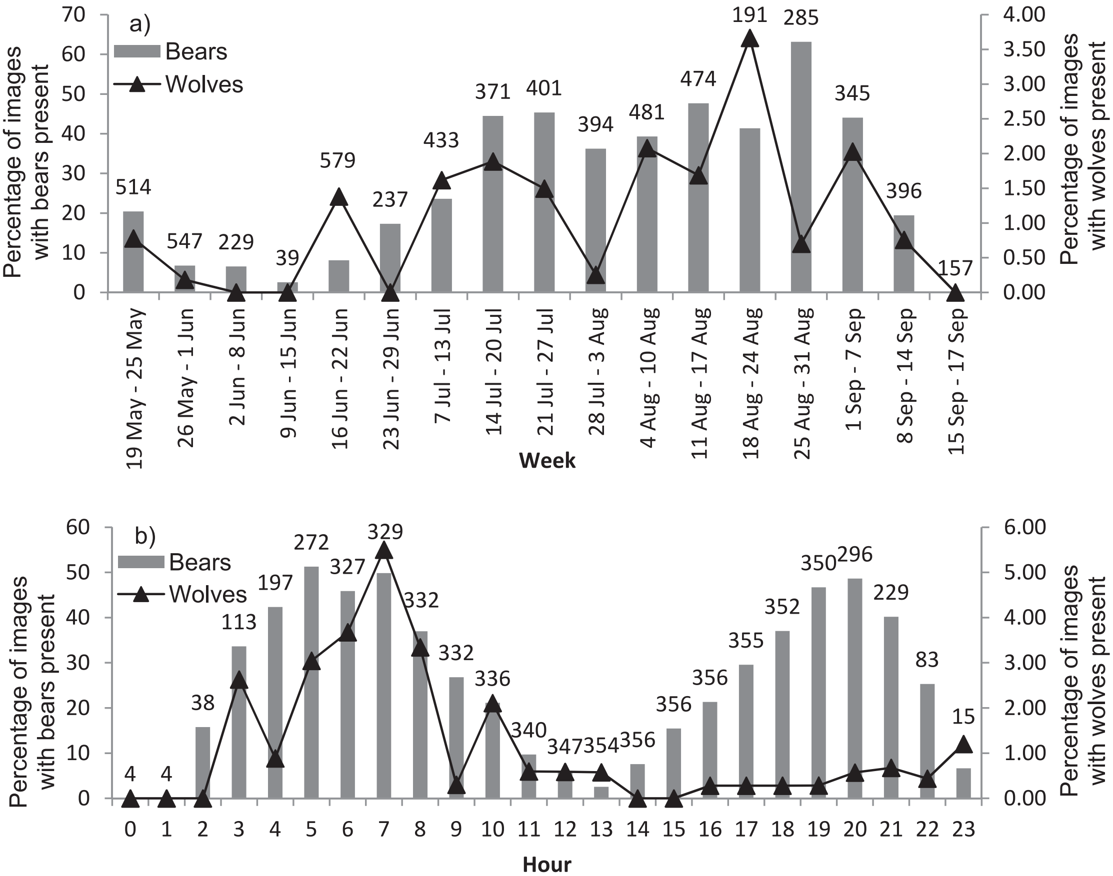

Fig. 1. Brown bear and wolf activity rates from 19 May to 17 September 2010 at a humpback carcass in Glacier Bay, Alaska, USA. Weekly (panel a) and hourly (panel b) activity measured by calculating percentage of images containing one or more target species for each week or hour, respectively. Numbers above bars represent the total number of usable images per hour or week.

positive effects on body size and productivity of brown bears (Hilderbrand et al. 1999). Rose and Polis (1998) found that coyotes (*Canis latrans*) lived at higher densities in shoreline areas influenced by marine-derived food resources. Although caloric content data for humpback whale blubber are not available, bowhead whale (*Balaena mysticetus*) blubber (a traditional food for arctic people) contains approximately 8.7 kilocalories/g (kcal/g) compared with 1.3 kcal/g for pink salmon (*O. gorbuscha*) and 0.6 kcal/g for wild blueberries (*Vaccinium* sp.; USDA 2013). Using equations developed by Lockyer (1976), we estimated that a 12.5-m humpback whale weighing approximately 27.2 metric tons consists of about 20% or 5.44 metric tons of blubber containing nearly 47,328,000 kcal. Moreover, almost 97% of calories in whale blubber are lipids, compared with just 4% in salmon and 0.8% in blueberries (USDA 2013). In addition to blubber, scavengers also had access to muscle, internal organs, connective tissue, and bones over the course of the summer; this suggests that the humpback whale carcass provided an unparalleled energy resource for brown bears and wolves throughout the summer.

Brown bear and wolf activity at the whale carcass generally increased from May through August, and may have continued to increase in September had most of the remaining carcass not floated away. Late summer through early autumn corresponds with the hyperphagic period in which bears gain fat stores by consuming high-calorie food before denning (Powell et al. 1997). Brown bear activity exhibited a strong crepuscular pattern, with greatest activity in the early mornings and evenings. Brown bears have been found to exhibit crepuscular or nocturnal activity, particularly when human use occurs during the day (Roth 1983, Warner 1987, Olson et al. 1998) and it is possible that brown bear activity at the carcass was influenced by daytime vessel-based wildlife viewing. Vessels, ranging from 5-m kayaks to 300-m cruise ships, were observed stopping and approaching the carcass to observe scavengers daily throughout the study period, particularly mid-morning through early evening (T. M. Lewis, personal observation). Wolf activity was greatest in the early morning and generally low at other times of day; this pattern possibly also was influenced by daytime human use.

Brown bear tolerance of other mammalian scavengers is uncommon. We did not record black bears (*U. americanus*) at the whale carcass; they are subordinate to brown bears (McLellan 1993, Belant et al. 2006) and may have avoided this area because of potentially elevated predation risk associated with increased brown bear activity in the area. On Barter Island in the Beaufort Sea, brown bears are known to displace polar bears from beached bowhead whale carcasses (Miller 2005). To our knowledge, this study is the first to document brown bears and wolves feeding simultaneously on a whale carcass. Previous studies have shown that brown bear–wolf interactions often are antagonistic or aggressive, particularly at kill sites (Koene et al. 2002, Ballard et al. 2003, Gunther and Smith 2004). Ballard et al. (2003) summarized 108 brown bear–wolf interactions outside of Yellowstone National Park and found that only 6% involved brown bears and wolves feeding at the same carcass, 7% involved brown bears and wolves in the same vicinity, 24% involved brown bears and wolves fighting and chasing each other, and 21% involved brown bears displacing wolves from kill sites. Milleret (2011) found that wolves stayed closer to their prey carcasses after brown bear den emergence than before brown bear emergence, possibly to defend their prey from the larger scavenger. Koene et al. (2002) hypothesized that carcass size has a role in bear–wolf conflict severity with conflict over larger carcasses being less severe. Our results from a large carcass support this assertion because we saw little evidence of aggression between species—no instances of wolves attempting to displace brown bears and few instances of brown bears displacing wolves. It is possible that wolves exhibited avoidance when brown bears were present, as evidenced by low observations of wolves at the carcass (1% of photos), but brown bears were present in >50% of the photos with wolves, indicating some level of tolerance. Smith et al. (2003) documented brown bears and wolves feeding and traveling together on several occasions at abundant salmon streams in Alaska. We observed similar tolerance between multiple brown bears and 7 members of a wolf pack sharing a humpback whale carcass and exhibiting similar diel patterns for >4 months. Our results provide supporting evidence that the frequency and severity of bear–wolf conflicts may decrease at large-magnitude food resources.

During the 2010 bear-sign survey, we recorded 21 mark trees, 67 bear beds, and 48 sections of brown bear repeat-use mark trail. The 2001 brown bear–sign survey of this section of shoreline meadow documented 0 mark trees, 0 bear beds, and only 1 section of mark trail (T. M. Lewis, unpublished data). This comparison suggests that the whale carcass may have influenced brown bear space use in the West Arm of Glacier Bay. The number of bear mark trees, bear beds, and mark trails along the shoreline surrounding the whale carcass was greater than in any other area in Glacier Bay previously surveyed for bear sign (T. M. Lewis, unpublished data). Bear-marked trails and rub trees have been hypothesized to be associated with travel routes (Green and Mattson 2003) and communication (McTavish and Gibeau 2010). Prevalence of bear sign near the whale carcass suggests that markings were more abundant in this area because of high bear concentrations, frequent bear travel to and from the carcass, and communication among bears required during feeding aggregations. Cortés-Avizanda et al. (2009) found that aggregations of scavengers had negative effects on prey-species abundance by increasing the probability of predator–prey encounters. Higher concentrations of scavenging predators present at the whale carcass in Glacier Bay may have affected other surrounding animal communities.

Although brown bears may tolerate each other at abundant food sources (Bunnell and Tait 1981, Stirling and Derocher 1990, Smith et al. 2005), female bears with young of the year were not documented at the carcass and only one family group with large dependent young (2–3 yr old) was recorded. Cannibalism of young bears by adult brown bears has been documented (Olson 1993, Hessing and Aumiller 1994); thus, female brown bears with dependent young may reduce risk of infanticide by avoiding areas where adult male bears are present or where brown bears are concentrated (Ben-David et al. 2004).

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