

Note

Observation of an Eastern Wolf (*Canis* sp. cf. *lycaon*) Caching Food in a *Sphagnum* Bog in Algonquin Provincial Park, Ontario

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We report summer caching of a partial carcass of a White-tailed Deer (*Odocoileus virginianus*) fawn by an Eastern Wolf (*Canis* sp. cf. *lycaon*) in a *Sphagnum* bog in Algonquin Provincial Park, Ontario, Canada. The microhabitat conditions in bogs (i.e., low temperature, acidity, and organochemical compounds) likely inhibit food spoilage, making bogs potentially important sites for food caching. Wolves in Algonquin Park experience low summer food availability and high pup mortality from starvation. Caches likely serve as necessary reserve food stores for adults and pups. Recent research has shown that wetland habitats are important den and rendezvous sites for Algonquin Eastern Wolves based on prey availability and, we suggest, perhaps for food storage and accessibility. This caching behaviour was recorded on video. We recommend that future research investigate Eastern Wolf selection of food-caching sites, as a complement to other spatial ecology studies.

Key Words: Bog; *Canis lycaon*; *Canis* sp. cf. *lycaon*; Eastern Wolf; food cache; *Odocoileus virginianus*; prey; *Sphagnum*; White-tailed Deer

Food caching is an important strategy used by animals to overcome periods of food scarcity. Food-caching behaviour has been observed in multiple canid species, including Gray Wolves (*Canis lupus*; Murie 1944; Mech 1970; Adams *et al.* 1995; Mech and Adams 1999; Schultz 2010; Nelson 2011; Nelson and Mech 2011), Coyote (*C. latrans*; Knowlton *et al.* 1999; Way and Cabral 2009), Red Fox (*Vulpes vulpes*; Mech 1967, 1970; Macdonald 1976; Maccarone and Montevecchi 1981), Arctic Fox (*V. lagopus*; Maccarone and Montevecchi 1981, citing personal communication with D. Macdonald), and Gray Fox (*Urocyon cinereoargenteus*; Fox 1971). Canids cache a wide variety of food items in a diversity of microhabitats (Vander Wall 1990) and are known to do so as pups and adults (Phillips *et al.* 1990b, as cited by Packard 2003). Eggs of ground-nesting birds (Maccarone and Montevecchi 1981), partly consumed prey, regurgitated food (Mech and Adams 1999; Mech *et al.* 1999), and/or inanimate objects (Nelson and Mech 2011) may be buried in snow (Murie 1944; Cowan 1947; Mech 1970; Adams *et al.* 1995; Schultz 2010; Nelson 2011; Nelson and Mech 2011), underground in shallow surface pits or dens, rock crevices, mud, leaf litter, or rotting logs (Young 1944; Cowan 1947; Mech 1988; Mech *et al.* 1998; Nelson and Mech 2011), at bed sites (Nelson and Mech 2011), or remain *in situ* with individuals revisiting the site to continue feeding (Mech 1970). However, most records of prey caching among wolves are limited to caching in snow (e.g., Adams *et al.* 1995; Mech *et al.* 1998; Nelson 2011; Nelson and Mech 2011). Reports describing caching in seasons other

than winter tend to be vague about the local cache environment (e.g., Cowan 1947; Macdonald 1976; Nelson and Mech 2011), which limits inference about the characteristics of food-cache sites. Here, we document an observation of an Eastern Wolf (*Canis* sp. cf. *lycaon*) caching the partial carcass of a White-tailed Deer (*Odocoileus virginianus*) fawn in a *Sphagnum* bog, a little documented environment for canid food caching with relevance to food preservation and the species' spatial ecology.

Eastern Wolves are largely restricted to Algonquin Provincial Park and the surrounding area of central Ontario and Quebec, forming a genetically distinct population (Rutledge *et al.* 2010, 2012; Benson *et al.* 2012). The species is threatened in Canada (COSEWIC 2015) and Ontario (COSSARO 2016). Recent genetic and morphological evidence has demonstrated Eastern Wolf hybridization with Coyotes (*C. latrans*) and Gray Wolves (*C. lupus*) in Algonquin Park and adjacent regions (Rutledge *et al.* 2010; Benson *et al.* 2012; COSEWIC 2015; COSSARO 2016).

Our observation took place at Broadwing Lake (45.59806°N, 78.52806°W, WGS84) in the Wildlife Research Area of western Algonquin Park. The region is characterized by upland hardwood forest dominated by Sugar Maple (*Acer saccharum* Marshall), Yellow Birch (*Betula alleghaniensis* Britton), and Eastern Hemlock (*Tsuga canadensis* (L.) Carrière) atop the Precambrian shield of the Algonquin dome (Forbes and Theberge 1993). Broadwing Lake is approximately 5.8 ha in open water area with an additional 1.9 ha of riparian, floating

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bog characterized by *Sphagnum* moss, Leatherleaf (*Chamaedaphne calyculata* (L.) Moench), and Large Cranberry (*Vaccinium macrocarpon* Aiton). The lake is surrounded by Black Spruce (*Picea mariana* (Miller) Britton, Stems & Poggenburgh) and hardwood forest.

On 5 June 2013 at about 0945 Eastern Daylight Time, a single Eastern Wolf was observed exiting the forest and crossing the *Sphagnum* bog area on the western side of Broadwing Lake. Carrying an unidentified prey item in its mouth, the wolf proceeded to the centre of the bog before dropping the prey. Over the course of 2–3 minutes the wolf dug at the bog mat with its forefeet, deposited the prey item in the depression, and covered the cavity with forward strokes of its downturned muzzle, packing with the forelimbs and muzzle (Video S1). After the prey was buried, the wolf retreated back to the forest.

When the wolf had left the vicinity, one of us (H.K.) visited the site and uncovered the food cache. The partial carcass of a White-tailed Deer fawn was buried at a depth of approximately 10–15 cm in saturated *Sphagnum* moss. The carcass consisted of the anterior half of the fawn, including the head, neck, two forelimbs, and thoracic cavity with ribcage. The fawn was eviscerated. Fresh blood was present on the carcass indicating that the predation was recent. The fawn carcass was not weighed or measured. No additional monitoring of the cache site was conducted.

To our knowledge, this is one of the first descriptions of the use of a bog site for food caching by a canid and the first record of food caching by an Eastern Wolf. The observed caching behaviour was similar to that described for Gray Wolves (Murie 1944), Arctic Grey Wolves (*C. lupus arctos*; Mech 1988), Coyotes (Phillips *et al.* 1990b, 1991; Knowlton *et al.* 1999), and Red Foxes (Macdonald 1976). This caching sequence, including forelimb digging and substrate scooping and tamping with the snout, is highly stereotyped in canids (Phillips *et al.* 1990a,b, 1991). Although we have characterized the observed canid as a putative Eastern Wolf, we recognize that the animal could have been admixed with a combination of ancestry derived from Eastern Wolf, Coyote, and/or Gray Wolf (which could only be affirmed through genetic analysis; Rutledge *et al.* 2010; Benson *et al.* 2012).

Bogs provide a unique set of environmental traits that may promote food preservation (Hoppe 1977, cited in Elgmork 1982; Verhoeven and Liefveld 1997). First, sub-surface temperatures in bogs remain cool during mid-summer providing natural refrigeration of the cache. For instance, at a depth of 10–15 cm, temperatures among the saturated *Sphagnum* moss measure 4–6°C, approximately 20°C cooler than the ambient daytime air temperature during midsummer in Algonquin Park (P.D.M., unpublished data). In addition, the low pH of *Sphagnum* bogs (typically 4.0–4.8; Gorham and Janssens 1992) may inhibit spoilage of the cache. Organochemical compounds found in *Sphagnum*, such

as phenolic acids, exhibit bactericide and fungicide properties, thereby suppressing decomposition (Hoppe 1977, cited in Elgmork 1982; Verhoeven and Liefveld 1997).

Mech (1970) speculated that wolves lose a large portion of cached food to scavengers. Domestic Dogs (*C. lupus familiaris*) are adept at finding wolf food caches (Cowan 1947) and scavengers frequenting wolf kill sites, such as Red Foxes, Black Bears (*Ursus americanus*), Ravens (*Corvus corax*), and insects, are capable of locating and exploiting food caches (Murie 1944; Peterson and Ciucci 2003). Food cached in bogs may be difficult to detect because of the delayed onset of spoilage and, thus, may be less likely to be lost to scavengers. Gray Wolves in Denali National Park, Alaska, have been reported caching a Caribou (*Rangifer tarandus*) calf in the muddy substrate of a flowing stream, and several cached calves have been found submerged along the edge of spruce bogs (Mech *et al.* 1998). According to Egmark (1982), half of the caching sites used by Brown Bear (*Ursus arctos*) in Norway were *Sphagnum* bogs.

The diet of wolves in Algonquin Park consists largely of American Beaver (*Castor canadensis*), Moose (*Alces americanus*), and White-tailed Deer (Kolenosky 1972; Voigt *et al.* 1976; Forbes and Theberge 1996; Benson and Patterson 2013). Young animals are particularly vulnerable to wolf predation (Pimlott 1975; Voigt *et al.* 1976; Mech and Petersen 2003; Mech *et al.* 2015). Based on the relative size of the fawn carcass and date of the caching observation, the prey fawn was likely < 1 month old (in Algonquin Park, White-tailed Deer fawning begins in late May; Voigt 1976). Birth weight of White-tailed Deer fawns ranges from 1.8 to 3.8 kg (Smith 1991; Geist 1998). Food consumption rates have been estimated at 0.10 kg/kg wolf/day (2.9 kg/wolf/day) in Algonquin Park (Kolenosky 1972) and 0.14 kg/kg wolf/day (5.4 kg/wolf/day) based on a review of studies across North America (Peterson and Ciucci 2003). Thus, given the consumption rates of wolves, the deer fawn was likely killed and partly consumed by the single wolf. If multiple wolves had been involved, the small carcass would likely have been consumed in its entirety. This conclusion is supported by findings from Benson and Paterson (2015) that wolves in western Algonquin Park spend most of their time apart from packmates and, presumably, hunting alone during non-winter months. Furthermore, wolves are more likely to cache food in the absence of conspecifics (Townsend 1996).

Caches serve as reserve food sources in the event that a hunt is unsuccessful, and they are especially important in providing a regular food supply for pups (Mech 1988; Mech *et al.* 1998). In western Algonquin Park, infrequent predation of Moose and low deer abundance in summer (Forbes and Theberge 1996; Theberge *et al.* 1996; Benson *et al.* 2015), as well as low American Beaver densities (Benson *et al.* 2013), con-

tribute to food limitation for wolves. This food limitation appears to pose a serious risk for pup survival (Benson *et al.* 2013, 2015). High pup mortality in western Algonquin Park resulting from starvation (Benson *et al.* 2013) illustrates the importance of cached food stores during summer, particularly when adult wolves are hunting and leave pups at dens or bog rendezvous sites (Benson *et al.* 2015). Recent research in Algonquin Park has demonstrated that wolf packs that had lost pups to starvation selected dens and rendezvous sites closer to wetlands than other packs (Benson *et al.* 2015). Thus, home-sites close to bog habitats may confer advantages not only for hunting (Benson *et al.* 2015), but also for food storage and accessibility.

Sphagnum bog habitats, given their spoilage-inhibiting environmental conditions, seem to be suitable caching sites for a diversity of food-caching species in northern regions. However, the importance of bogs as food-caching sites remains to be studied. Cryptic caching behaviour and location of caches (Mech *et al.* 1998) make study difficult. We recommend that future reports of food caching in the wild be accompanied by detailed descriptions of behaviour and/or the local cache environment (e.g., Elgmork 1982) so that inferences can be made about cache structure and conditions, which may, in turn, inform aspects of species' biology (e.g., interspecific interactions, habitat use). Future research may investigate the potential relation between den and rendezvous site selection in Eastern Wolves related to the spatial distribution of cache sites.

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SUPPLEMENTARY MATERIAL:

VIDEO S1. Eastern Wolf (*Canis* sp. cf. *lycaon*) demonstrating food-caching behaviour in a *Sphagnum* bog, Algonquin Provincial Park, Ontario, Canada. Video by Hugo Kitching. <https://youtu.be/Pj5hKJTMD5U>.