

## ARTICLE

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# Wolves foraging on berries is likely a widespread behavior in southern boreal ecosystems

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**Handling Editor:** Matthew A. Mumma**Abstract**

Wolves are opportunistic generalists that can respond quickly to new and unique food sources. Wolves in some ecosystems will consume berries and other fruits when they are abundant and available; however, many aspects of this behavior remain unknown. In the Greater Voyageurs Ecosystem (GVE), Minnesota, USA, wolves consistently consume berries, particularly blueberries, when they are available. We deployed remote cameras in blueberry patches to record wolves foraging on berries over several years. We captured footage of wolves of all age classes, social statuses, and sex foraging on blueberries alone or with other wolves. Our observations indicate berry consumption by wolves is a widespread behavior in the GVE and likely in similar southern boreal ecosystems. We hope our work spurs researchers across wolf range to examine whether berry consumption by wolves is a widespread and ubiquitous behavior for wolves.

**KEYWORDS**alternate prey, blueberries, *Canis lupus*, diet, dietary flexibility, wolf pups

## INTRODUCTION

Wolves (*Canis lupus*) are opportunistic generalists that can respond quickly to new and unique food sources (Newsome et al., 2016; Zlatanova et al., 2014). In most ecosystems, wolf diets primarily consist of ungulates and, at times, other non-ungulate prey such as beaver (*Castor canadensis*), snowshoe hare (*Lepus americanus*), sea otters (*Enhydra lutris*), and other small mammals (Gable et al., 2018; Messier & Crête, 1985; Roffler et al., 2022; Stahler et al., 2006). Wolf predation on non-ungulate species is often driven by the vulnerability and abundance of non-ungulate prey (Metz et al., 2012). For instance, wolves that primarily prey on caribou in Nunavut will switch to target abundant waterfowl when they are molting and most vulnerable (Wiebe et al., 2009). Similarly, wolves in Lake Clark National Park and

Preserve in Alaska, USA, take advantage of seasonally abundant Pacific salmon (*Oncorhynchus* spp.) as a food source (Stanek et al., 2017).

Aside from prey, wolves in some ecosystems will consume berries and other fruits when they are abundant and available (Bosch et al., 2015). In northern Italy, fruits including apples (*Malus* spp.), pears (*Pyrus* spp.), and blackberries (*Rubus* spp.), made up about 25% of wolf diets in the region (Meriggi et al., 1991). Similarly, wolves in several southern boreal forest ecosystems in North America consume fruits and berries (Gable et al., 2018; Tremblay et al., 2001; Van Ballenberghe et al., 1975). One of the best documented examples of this behavior is from the Greater Voyageurs Ecosystem (GVE), Minnesota, USA, where wolves regularly consumed berries (mainly blueberries [*Vaccinium* spp.] and raspberries [*Rubus idaeus*]) in late summer (Gable et al., 2017b). Previous

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research in the GVE indicated that up to 83% of the weekly diet of wolf packs during July–August consisted of berries (Gable et al., 2018). Further, an adult wolf was observed regurgitating blueberries for five pups at a rendezvous site in the GVE, suggesting wolves provision pups with berries (Homkes et al., 2020).

However, observing wolves foraging on berries is difficult, and to our knowledge, no direct observations or descriptions of this behavior exist in the scientific literature. As a result, many aspects of this behavior remain unknown. For example, do wolves of all ages and social statuses use berries as a food source? Do pups actively forage on berries as some have suggested (Van Ballenberghe et al., 1975) or are they simply provisioned by adults (Homkes et al., 2020)? Previous work in northeastern Minnesota documented rendezvous sites where pup and adult scats were filled with berries and where there were well-used trails leading to nearby raspberry patches (Van Ballenberghe et al., 1975). Herein we describe rare remote camera observations of wolves foraging for blueberries in northern Minnesota, and discuss what these observations reveal about the ecology and behavior of wolves in boreal ecosystems.

## METHODS

Our study was part of the Voyageurs Wolf Project, which studies wolves in the GVE in Northern Minnesota, USA. The GVE is a 2338-km<sup>2</sup> southern boreal forest ecosystem that includes Voyageurs National Park and a large area south of the park. Several wolves (typically 12–15) in the GVE are collared and ear-tagged annually, which enables the individual identification of some wolves on remote camera videos (see Gable et al., 2021 for details on wolf capture and collaring). Blueberries and raspberries are relatively abundant in the GVE and are primarily available from mid-July through mid-August (Homkes et al., 2020). However, the abundance and temporal availability of berries varies annually based on weather conditions (Krebs et al., 2009). Blueberries are primarily found in open coniferous forests on rocky ridges and hilltops as well as in logged or burned black spruce (*Picea mariana*) bogs.

During 2019–2022, we opportunistically deployed trail cameras (23 in 2019, 8 in 2020, and 3 in 2022) in blueberry patches across three wolf pack territories during mid-July to late August to record wolves foraging on blueberries. Trail cameras were set to take 20-s videos with a 1-s delay between videos. We considered a “berry foraging event” to be sequential videos that were <10 min apart (Freund et al., 2023; Gable et al., 2023) in which wolves were actively consuming berries. If >10 min elapsed between sequential videos, then we considered the videos to be part

of separate events (Freund et al., 2023). For each event where wolves consumed blueberries, we recorded the number of wolves observed, marked wolves that were present (if any), age class (pups or adults), social status and sex (if known), and behavior observed.

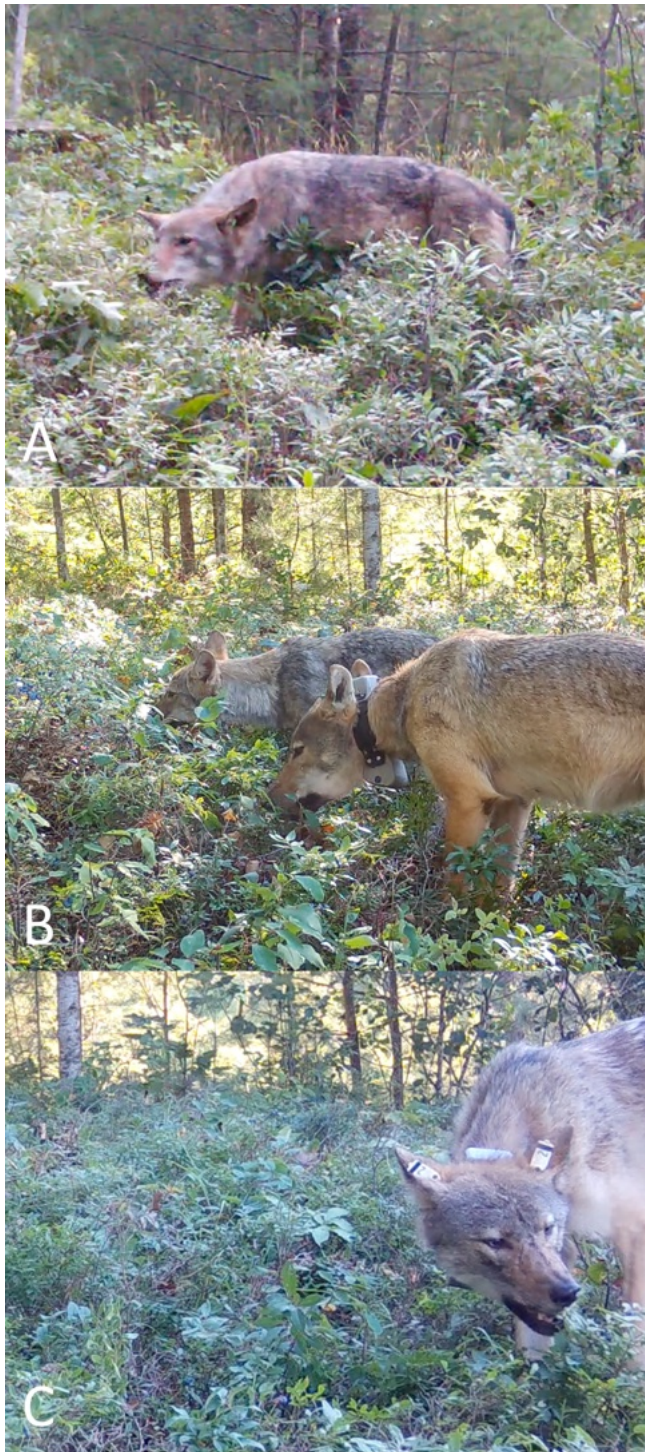
## RESULTS

We captured a total of 22 berry foraging events by at least 17 different wolves (at least 10 pups and 7 adults) from three packs during 2019–2022 (Videos S1–S3). Of these, 14 events featured five ear-tagged and/or collared wolves, whereas the other eight events featured unmarked wolves that did not have ear tags or collars. We observed wolves eating blueberries alone in 77% of events and multiple wolves eating blueberries together in 23% of events. In one event, a breeding female traveled through a blueberry patch with three pups. The three pups consumed blueberries but the breeding female did not. Most notably, we had three observations of pups in two different packs foraging on berries alongside the breeding female (i.e., their mother) (Figure 1). In two events, pups (2 and 4 pups) foraged on berries without any observable adults. We did not record any observations of two adult wolves foraging together.

When foraging on berries, wolves moved slowly but continuously through berry patches. Wolves rarely stopped moving when foraging, choosing instead to chew berries while moving from one berry plant to the next. Wolves procured berries using two main methods: (1) grabbing blueberry branches in their mouths and pulling up to strip berries off the plants and (2) gently removing small clumps of berries with their incisors. In some instances, wolves used both methods interchangeably. In one event, a subordinate wolf quickly and vigorously foraged for berries by grabbing blueberry plants in its mouth and stripping them, almost as if the wolf was attacking the plants (Video S2).

## DISCUSSION

Our observations provide rare insight into the blueberry foraging behavior of wolves. In particular, our observations demonstrate that foraging on berries is a widespread behavior in which most wolves in the GVE likely engage. Indeed, we documented wolves of all age classes, social statuses, and sex foraging on blueberries. In 2022, for example, we observed all four members of a pack (breeding pair, yearling subordinate, and 4-month-old pup) foraging on blueberries in the same area (Figure 1). This finding is consistent with previous scat-based diet estimates from the



**FIGURE 1** All four members of the Paradise Pack foraging on berries in the same blueberry patch in August 2022 in the Greater Voyageurs Ecosystem, Minnesota, USA: (A) the breeding male foraging alone; (B) the breeding female (collared wolf) foraging for berries with her pup; and (C) a yearling male foraging alone. Photo credit: Voyageurs Wolf Project.

GVE that demonstrated every pack studied consumed berries to some extent in summer (Gable et al., 2017b). The acute response of wolves to blueberries in mid-summer

across the GVE is likely due to the fact that white-tailed deer fawns are less susceptible to predation by early to mid-July due to their increased mobility and that beavers may be spending less time on land because they rely largely on aquatic vegetation during July and August (Severud, 2013; Van Ballenberghe et al., 1975). Scat analysis in the GVE revealed an abrupt decrease in deer fawns in mid-July that coincided with a dramatic increase in berries in wolf diets with berries remaining the primary food source for wolves into early August (Gable et al., 2018). Thus, the widespread consumption of berries by wolves in the GVE is likely driven by the reduced availability of their primary prey that coincides with the peak berry season. This shift is evident in wolf diets as berries can be the primary food source for wolves, in terms of biomass, from mid-July to August—a stark change from June to early July when deer fawns are the primary prey (Gable et al., 2018).

Our observations indicate that wolf pups forage blueberries by themselves and with the breeding female of the pack. Although berries can constitute >30% of wolf pup diet biomass during summer in the GVE (Gable et al., 2017a), it was not known whether pups foraged for berries by themselves or were simply provisioned by adults (Homkes et al., 2020). Because wolf pups are able to forage for blueberries independently, blueberry patches may serve as ideal locations for rendezvous sites since pups would be able to provision themselves with berries when adults are not around. This, in turn, may reduce the amount of food adults need to acquire to meet the energetic demands of pups during a period of reduced prey availability in mid-to-late summer (Gable et al., 2023). Further, foraging of pups on berries almost certainly increases the caloric intake of pups, to an extent, during this period because pups can consume berries between meals provided by pack members. However, the relationship between berry consumption and pup survival has not been examined.

Berries and other fruits are less nutritionally and calorically valuable than meat for canids and felids because these animals have short digestive tracts that evolved to efficiently digest animal prey and not plant matter, the latter of which generally requires a more complex digestive tract to efficiently digest (Peterson & Ciucci, 2003; Yoshimura et al., 2021). For example, experimental work has shown that red foxes (*Vulpes vulpes*) lost body mass when fed diets high in fruits, in part, because fruits consumed by foxes were poorly digested (Larivière et al., 2001; Litvaitis & Mautz, 1976). Field-based investigations of coyote (Andelt & Andelt, 1984) and wolf scats (T. D. Gable, personal observation) have noted similar patterns where scats are filled with undigested or partially digested fruits (Figure 2). Additionally, aside from



**FIGURE 2** An example of a wolf scat comprised of digested, partially digested, and undigested blueberries. The photo was taken during July in the Greater Voyageurs Ecosystem. Photo credit: Thomas D. Gable.

digestibility, wild blueberries only contain 0.51 kcal/g, whereas ungulate prey contain 1.87 kcal/g (Gable et al., 2017a; Peterson & Ciucci, 2003; Usui et al., 1994). Canids consuming large amounts of fruits—like wolves in the GVE during mid-to-late summer—likely only do so because prey availability and/or abundance has decreased (Larivière et al., 2001). If prey was readily available, it seems unlikely that wolves and other canids would spend much time foraging on lower calorie and more difficult to digest berries. Nonetheless, even though berries are less calorically valuable to wolves relative to mammalian prey, our observations, in combination with other evidence (Gable et al., 2018; Homkes et al., 2020), suggest berries are a seasonally important and abundant food source for wolves and their pups in the GVE and similar southern boreal ecosystems (Gable et al., 2017a).

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#### CONFLICT OF INTEREST STATEMENT

The authors declare no conflicts of interest.

#### DATA AVAILABILITY STATEMENT

Data (Evavold et al., 2024) are available from the Data Repository for the University of Minnesota: <https://doi.org/10.13020/3dhm-wk53>.

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## SUPPORTING INFORMATION

Additional supporting information can be found online in the Supporting Information section at the end of this article.

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