Comparison of Black Bear Diets in Eastern Oklahoma Across Seasons and Regions

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Abstract

Black bears (*Ursus americanus*) are omnivorous and therefore consume a wide variety of foods. Food availability, however, changes by season and an understanding of what is consumed during the different seasons can provide useful information for management. Although black bears are capable of catching small mammals and newborn ungulates, the majority of their diet in the southeastern U.S. is made up of vegetation and insects. Climate has a large impact on what foods are available for bears to eat, which is why it is important for us to understand their habits and diet as populations move and grow into the warmer, more southern states. Because black bears were extirpated from Oklahoma in the early 1900's, knowledge of their current diet will help manage the new population and mitigate human-wildlife conflict. The goal of this study was to identify food types in scat samples in a recolonizing population of black bears in southeastern Oklahoma and to make a comparison of black bear diets across seasons. The study population is located in the Ouachita National Forest (ONF) and surrounding areas and focuses on the change in their diet throughout the seasons. Oklahoma in particular is a mix of prairie and woodland, with fragments of each intermingling. Vegetation (including leaves, stems, flowers, and seeds) is the predominant food type consumed by black bears in this study. Berries in particular make up a large proportion of the bears' diets. While Oklahoma black bears also consumed a large amount of insects, they seem not to be as common in the diet as has been seen in more northern studies. The frequency of occurrence of mammals in southeastern Oklahoma black bear diets appeared small, at only 0.144. Although they do consume acorns, these do not make up a significant portion of their diet, even during the denning season. Corn is more common in samples from the Ozarks than the southeastern sites, and there is a noticeable increase in corn consumption during

the late summer compared to early summer and the denning season. This pattern could lead to a potential increase in human-bear conflicts in the northeastern part of Oklahoma.

Introduction

In areas where black bears (*Ursus americanus*) are recolonizing territory, such as Oklahoma, knowledge of their diet can be important in reducing human-bear conflicts. As bears recolonize land and search for potential food sources, anthropogenic foods such as trash or deer corn can present themselves as easy opportunities for foraging. Agricultural lands and crops are also utilized by bears, particularly when native food is harder to find (Connor et al., 2019, Kirby et al., 2017, Baruch-Mordo et al., 2008). Easy access to food often encourages bears to continue seeking out human land and buildings (Kirby et al., 2017). Black bear populations in the northwestern states rarely hunt, and the little meat they do consume usually comes from young, small prey (Schlegel, 1976). In the northeast, populations of black bears have been known to scavenge for carrion (Arner, 1948). There are some populations, however, that consume larger amounts of meat than what is typically observed for the species (Connor et al., 2019, Baruch-Mordo et al., 2008). In some Colorado populations, for example, black bears are more carnivorous and a human-bear conflict has developed involving predation on livestock (Baruch-Mordo et al., 2008). Black bears in Oklahoma and surrounding states have a preference for nuts and seeds in the fall months, possibly because it contributes to milk quality in the spring when they have their cubs (Connor et al., 2019, McDonald and Fuller, 2005). If black bears are unable to find important food sources, they must attempt to substitute them with other food types. In the case of acorns, a shortage may have direct effects on the health and survival of cubs. If bears are unable to find or capture prey, they may consume more insects as a source of protein or search

for livestock. Food availability can provide clues to their behavior, such as whether they will seek out more anthropogenic sources.

There are multiple factors that affect how bear diets change from season to season or region to region (Graber and White, 1983). Berry and seed production can naturally vary, and is also affected by the weather (Yaklin, 2017, Graber and White, 1983). The severity of the weather, particularly in winter, can greatly affect insect populations for the following seasons (Graber and White, 1983). During droughts when less animal and fruit food sources are available, bears have been known to increase their consumption of green plants (Graber and White, 1983). In Oregon, the resident population of black bears significantly increased their consumption of animals during the months of June and October, although vegetation and insects still made up the bulk of their diet (Torgersen et al., 2001). Vegetation and climate affect the food that is available to the bears, and consequently their behavior. Understanding differences in diet between regions can help both with management of the population and keeping human-bear conflicts to a minimum.

My primary goal was to investigate the summer black bear diet in southeastern Oklahoma with respect to anthropogenic versus natural foods, and changes with phenology and conditions between early and late summer. My secondary goal was to compare the southeastern Oklahoma black bear diet and the Oklahoma Ozarks black bear diet. I predicted that diet would differ between early and late summer because of the emergence of fruits and acorns as well as the introduction of bait corn by humans in the late summer. In southeastern Oklahoma, there is little row-crop agriculture, but baiting is allowed in hunting white-tailed deer (*Odocoileus virginianus*) in the fall. I predicted that the anthropogenic component of the diet would increase in the late summer with the introduction of deer corn, and that black bears would also venture closer to

humans and consume more trash in their search for deer corn. The bears also need to eat more during this time to prepare for hibernation. Comparison of corn between southeastern and OZ populations is interesting because in the ONF it is illegal to bait, so access to corn will be much more limited. While Oklahoma is on the western fringe of southeastern deciduous ecosystems, I predicted the Oklahoma black bear diet to be more similar to that of eastern black bears than western black bears, i.e. more vegetarian and less carnivorous.

Methods

A common method to determine the diets of animals is to perform a scat analysis. Undigested food matter, such as plant material, hairs, bones, or exoskeletons, is removed from the sample through cleaning. The food types are then weighed or data is compiled through calculating frequency of occurrence (Nilson et al., 2012).

The majority of black bear scat samples were collected from the Ouachita National Forest in Oklahoma, although a small portion were from the more northern Oklahoma Ozarks Plateau. Both sites are similar in elevation and rainfall, and abundant in oak (*Quercus* spp.) and hickory (*Carya* spp.), although the southeastern site also has a substantial population of pine (*Pinus* spp.) (Artz, 2016). Much of the land in the Ozarks is privately owned, aside from public parks and wildlife areas, and anthropogenic food sources are relatively abundant (Lustig, 2018). The overall climate is warm and dry, with patches of both grassland and woodland.

Most of the scat collection took place in the summer months, 2014-2019, during fieldwork on a larger study of the black bear populations. Scats were mostly collected at black bear capture sites, although many were collected opportunistically. Scats were frozen until they could be processed. Scats were washed through a series of sieves to collect undigested food

parts, which were then dried in a drying oven to constant weight and weighed. Foods have different levels of digestibility, so weights would be more useful in comparing the same or similar food types across time and region. Plant matter was identified using field guides and comparison to seed libraries, and hairs were identified under a microscope. I made casts of the outer surface of hairs by gently pressing the hairs into partially solidified drops of clear nail polish on a microscope slide, then removing them. I made permanent slides with the same hair sample by placing the sample on a clean microscope slide and applying the clear nail polish and a slip cover over the sample. Under the microscope, cast slides showed impressions from the scales of the hair. The permanent slides showed the medulla, the dark center of the hair that typically has a specific pattern and width depending on the species or family. Using the color of the hair, the scaling pattern, and the characteristics of the medulla, I was able to compare samples from the black bear scat to other identified specimens in databases or scientific journals (De Marinis and Asprea, 2006, Debelica and Thies, 2009).

There were three main time periods being studied; denning season (February-April), early summer (May-June), and late summer (July-August). There were 6 samples from the denning season, 41 samples from early summer, and 23 samples from late summer. I calculated the frequency of occurrence and the percent of total weight of food-type categories. The categories consisted of grass, unknown vegetation, blackberry (*Rubus* spp.), black cherry (*Prunus serotina*), blueberry (*Vaccinium* spp.), unknown seeds, insects, mammal hair, corn, anthropogenic, debris, pokeweed (*Phytolacca* spp.), sand plum (*Prunus angustifolia*), acorn, hackberry (*Celtis* spp.), pinecones, and Carolina buckthorn (*Rhamnus caroliniana*). Debris refers to any sort of typical natural woodland ground cover, such as oak leaves (*Quercus* spp.), pebbles, pine needles, or twigs. The consumption of oak leaves may have been intentional, as it made up the largest

proportion of debris. Human trash and other unnatural items have been categorized as anthropogenic. Corn was considered a separate category because of the importance of the diet item and its connection with human-bear conflict.

Results

Table 1: Total data from 76 black bear scat samples collected during denning season, early summer, and late summer from 2014-2019 in the Oklahoma Ozarks and southeastern Oklahoma.

Category	Frequency	Number	Weight (grams)	% of Total Weight
Grass	0.236	18	167.687	6.9
Unknown Vegetation	0.263	20	236.02	9.8
Blackberry	0.447	34	781.454	32.5
Black Cherry	0.052	4	145.957	6.0
Blueberry	0.355	27	235.142	9.7
Unknown Seeds	0.131	10	50.989	2.1
Insects	0.460	35	44.487	1.8
Mammal Hair	0.144	11	47.813	1.9
Corn	0.171	13	506.936	21.1
Anthropogenic	0.092	7	94.341	3.9
Debris	0.381	29	138.355	5.7
Pokeweed	0.078	6	6.38	0.2
Sand Plum	0.026	2	6.238	0.2
Acorn	0.052	4	59.021	2.4
Hackberry	0.105	8	47.574	1.9
Pine Cones	0.052	4	6.531	0.2
Carolina Buckthorn	0.013	1	23.768	0.9

Figure 1: Comparison of black bear food type frequencies at the southeastern and Ozarks sites.

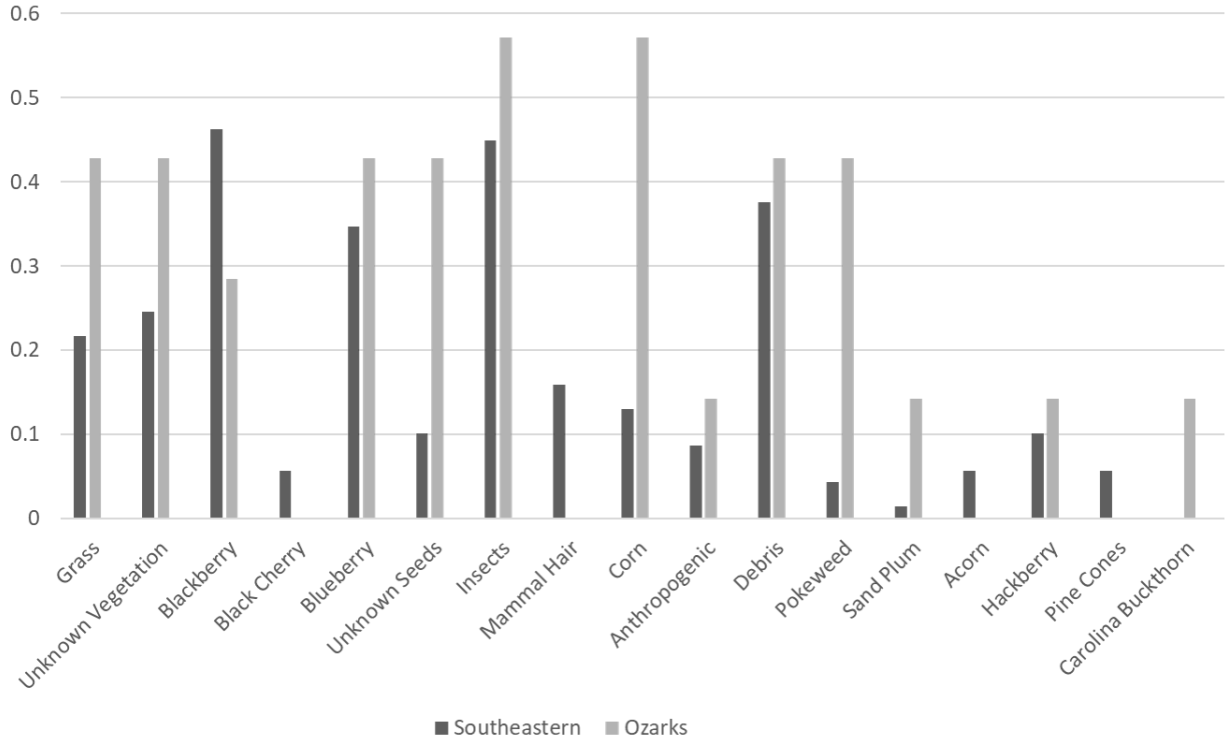

Figure 2: Comparison of weight percentages of different food types at the southeastern and Ozarks sites. There was a total of 69 samples from the southeastern sites and 7 samples from the Ozarks sites.

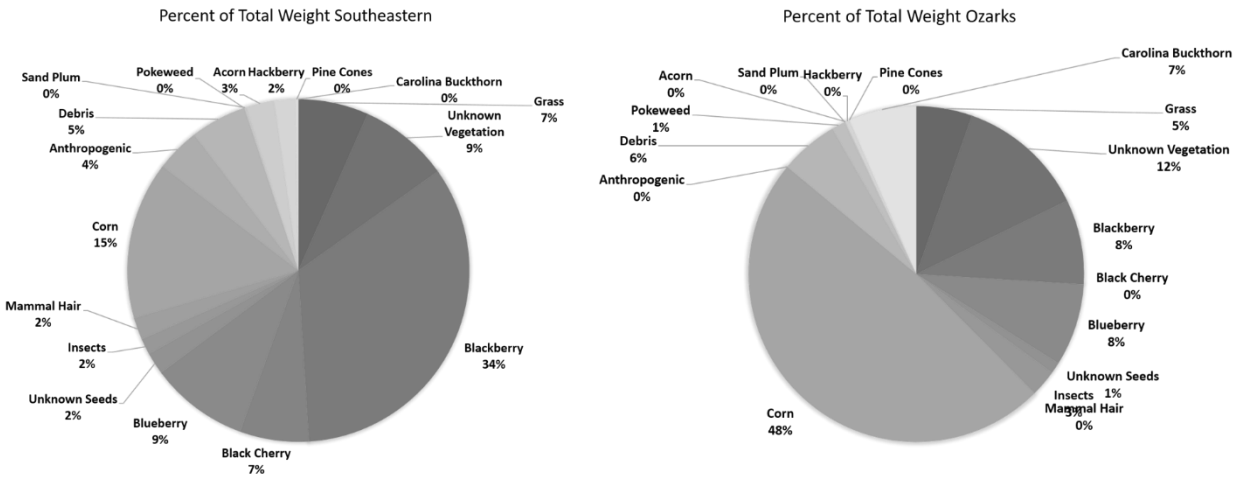

Figure 3: Comparison of frequency of occurrence of each food type during denning season, early summer, and late summer with a total of 65 samples used from the southeastern sites.

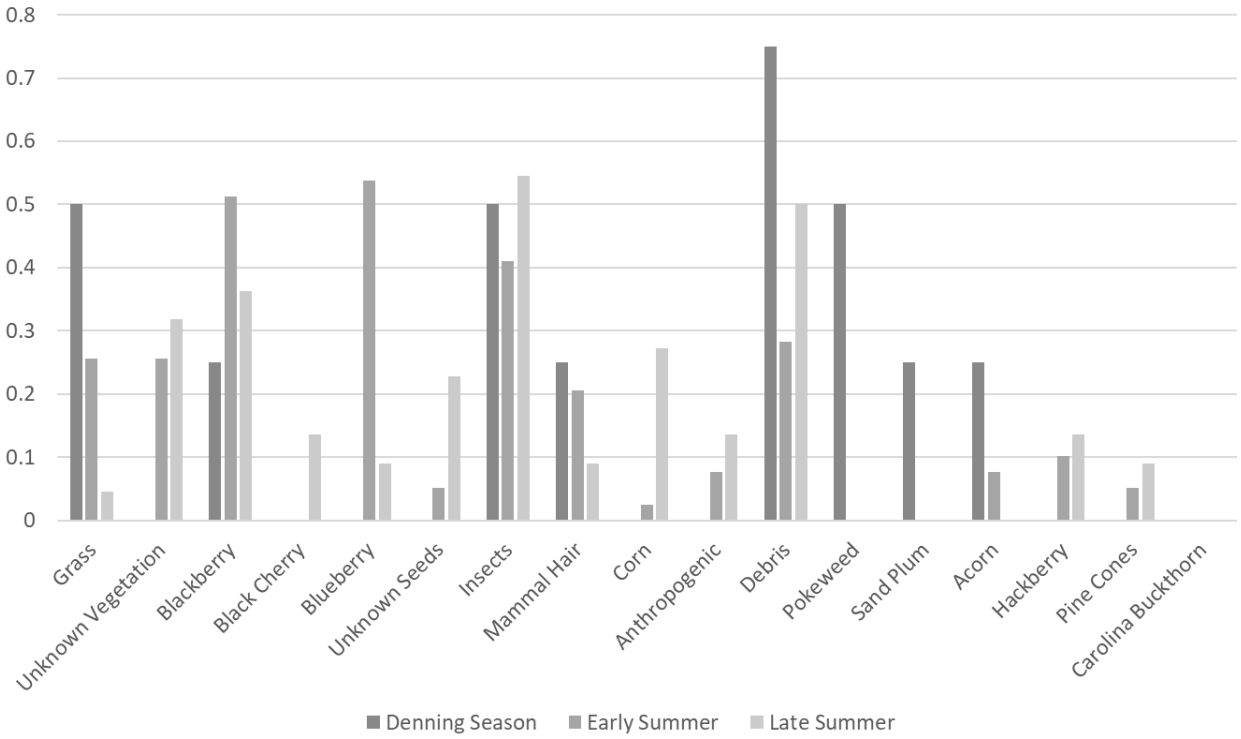

Figure 4: Comparison of weight percentages of different food types in early summer and late summer using 61 samples from the southeastern sites.

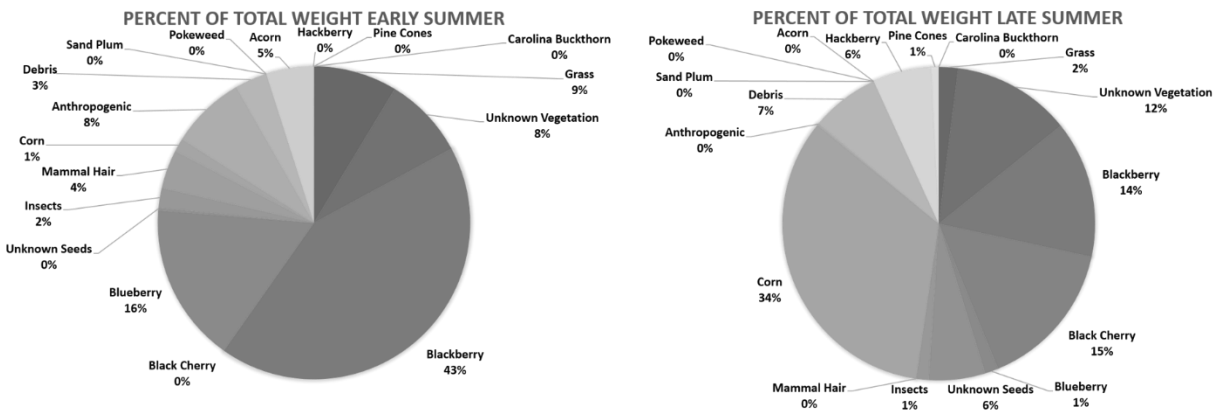

Table 1 displays the overall data from the study, 76 samples, with 2,400.35 grams of food fragments. The most common food types by frequency of occurrence were insects, blackberry, debris, blueberry, and unknown vegetation. The most common food types by weight were blackberry, corn, unknown vegetation, blueberry, and grass.

There was a total of 69 samples from the southeastern site, with 2,100.875 grams of food. The most common food types by frequency of occurrence were blackberry, insects, debris, blueberry, and unknown vegetation. The most common food types by weight were blackberry, corn, blueberry, unknown vegetation, and grass.

There was a total of 7 samples from the Oklahoma Ozarks study site, with 299.47 grams of food. The most common food types by frequency of occurrence were insects, corn, debris, pokeweed, blueberry, unknown seeds, grass, and unknown vegetation. The most common food types by weight were corn, unknown vegetation, blackberry, blueberry, and Carolina buckthorn.

Figure 1 is a comparison between the two sites, using frequency of occurrence data. The Ozarks samples yielded a higher frequency of occurrence than the southeastern samples in every food category except blackberry, black cherry, mammal hair, acorns, and pine cones.

In the February-April denning season, the most common food types by frequency of occurrence were debris, grass, pokeweed, insects, blackberry, and sand plum. The most common food types by weight were debris, corn, grass, blueberry, and sand plum. The scats from this season were collected around dens where black bears were known to be hibernating. It is suspected that the scats were deposited near the den either right before or right after hibernation. These samples were predicted to have high levels of acorns and other hard masts from fall

gorging in preparation for hibernation. Figure 3 confirms that there was an increase in acorns during this season, but it was not as significant as it was originally predicted to be. A possible explanation is that other animals were also competing for that resource, or that the production of acorns is not as high in Oklahoma.

In the May-June early summer season, the most common food types by frequency of occurrence were blueberry, blackberry, insects, debris, grass, and unknown vegetation. The most common food types by weight were blackberry, blueberry, grass, unknown vegetation, and anthropogenic.

In the July-August late summer season, the most common food types by frequency of occurrence were insects, debris, blackberry, unknown vegetation, and corn, The most common food types by weight were corn, black cherry, blackberry, unknown vegetation, and debris.

Consumption of animal parts was not seen in scat from the Ozarks population, although sample size was low. The scat from the southeastern black bear population only contained animal parts/hair in 11 out of 69 samples. Eight of the 11 scats containing evidence of mammals occurred in the early summer (May-June). It is possible that the bears hunted for the meat, but they also commonly scavenge or steal kills from other animals. Deer were the main animal prey of black bears with 9 samples containing deer hair, including one confirmed fawn in which a small hoof was present in the sample. Out of 76 total samples, 26 contained small amounts of bear hair, likely a byproduct of grooming. The only other mammal hair that appeared in scat was from samples taken in July 2014 and June 2015, likely from a feral pig (*Sus scrofa*). The populations of feral pigs and black bears do overlap, although it is more likely that a bear killed a piglet as opposed to attacking an adult pig.

Figure 2 shows a significant difference between the two regions in consumption of corn. As predicted, there was more corn in the diets of bears in the Ozarks, where baiting is legal. Figure 4 illustrates that the increase of corn in the diet did in fact take place in late summer, as hunters and wildlife enthusiasts prepare for the fall deer season.

Discussion

As predicted, black bears in eastern Oklahoma consumed predominantly vegetation. Black bears consumed a larger proportion of green vegetation and blueberries in early summer (May-June) than in late summer (July-August). Blueberries are known to be a preferred food among black bear populations in Oklahoma, but the large consumption of green vegetation was likely due to a decreased availability of other preferred foods. Berries in particular tend to ripen later in the summer, although this data suggests that blackberry consumption rates do not change and blueberry consumption rates actually fall drastically from early to late summer. This was unexpected, as more northern studies on black bear diets find an increase in berry consumption in the late summer and fall (Graber and White, 1983). One explanation for this could be the difference in when wild berries ripen relative to one another in Oklahoma. There was an increase in other seeds during late summer, which is consistent with data collected by researchers in previous studies of more northern populations.

There was an increase in consumption of corn and anthropogenic food types such as trash in the late summer, as predicted. The increase in frequency of corn in the diet is anthropogenic in origin, as humans begin feeding deer corn in anticipation of the fall hunting season. The consumption of bait corn and destruction of deer feeders is the current leading cause of human-black bear conflict in Oklahoma (Artz, 2016). Frequency of consumption of corn was only about 0.33 but when bears were able to find corn they consumed a lot of it at once. It is possible that

corn is overrepresented in those samples that contain it, as it does not digest as well as most other foods. Another possibility is that bears may eat a large amount corn when they are able to find it, enough to deplete the resource. The increase in trash consumption may be due to low availability of natural food, possibly because of the harshness of the season.

Because of the timing of occurrence of deer in the scat and the fact that there is little winter kill of deer at this latitude, the occurrence probably represents deer fawns in the bear diet. In an Oregon study, deer and elk remains made up a quarter of the samples by frequency of occurrence, and an estimated 10% in total volume (Torgersen et al., 2001). In Oklahoma populations, the frequency of occurrence is approximately half that of the Oregon populations. Although frequency of white-tailed deer in scats was low, this might be due to the dates most of the scats were collected because deer fawns would be most susceptible to bear predation when very young. Currently, there does not seem to be a problem with consumption of livestock by black bears in eastern Oklahoma, although they have been known to break into domestic beehives. Consumption of insects increased in the late summer, and could help bears prepare for hibernation when they are unable to consume enough protein or energy through meat or hard masts.

The black bear population on our study areas ate primarily vegetation and fruits. As the bears are still moving into new areas of Oklahoma, keeping a detailed log of any human-bear conflicts that occur could also improve our understanding of their behavior and diet. A future investigation into how the climate affects food availability between years and seasons could provide more detailed information on the feeding habits of black bears in the south.

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