Human–Wildlife Interactions 17(1):86–98, Spring 2023 • digitalcommons.usu.edu/hwi

Case Study

Human–black bear interactions and public attitudinal changes in an urban ordinance zone

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Abstract: Human–bear (*Ursus* spp.) interactions (HBI) commonly occur in residential areas throughout North America. Negative HBI can be alleviated by using bear-resistant garbage cans (BRC) and by securing other bear attractants (e.g., bird feeders). Since the early 2000s, human and Florida black bear (*U. americanus floridanus*) densities have increased substantially throughout Florida, USA, concurrently producing an increase in HBI. In central Florida, an area with high densities of humans and black bears, we surveyed 2 neighborhoods that occurred in an urban ordinance zone established in 2016 that required residents to secure anthropogenic food sources. Residents were supplied with BRC in 2017, and our surveys in 2017 and 2018 assessed the changes in HBI in the year before and after receiving BRC as well as the attitudes of residents toward ordinance measures and the perceived effectiveness of BRC. We found that a combination of preventive measures practiced by residents along with use of BRC effectively reduced HBI by 54%, especially bears eating garbage (reduced to 0%). Consequently, residents spent more time outdoors in their neighborhoods and experienced an elevated quality of life because fear of HBI lessened. We also analyzed public calls to the Florida Fish and Wildlife Conservation Commission concerning HBI. Public calls declined during the 5 years after the ordinance was established compared to 5 years prior. A reduction in HBI (especially conflicts) and public acceptance of using BRC is a long-term goal for management of black bears in Florida.

Key words: bear-resistant garbage cans, black bear, Florida, human–bear interactions, ordinance, urban, *Ursus americanus*

Human–bear (*Ursus* spp.) interactions (HBI) have become common in recent decades throughout North America, especially with American black bears (*U. americanus*; Gore 2004, Spencer et al. 2007, Beckmann and Lackey 2018, Lackey et al. 2018, Westrich et al. 2018). Public perception of bears can be positive, but conflicts tend to ensue when bears enter areas of substantial human activity, such as suburban neighborhoods (Gore 2004). In some locations, bear densities can be higher in urban areas than in surrounding wildlands (Beckmann and Berger 2003, Fusaro et al. 2017). Bear abundance and distribution influence HBI (Peine 2001, Wilton et al. 2014, Fusaro et al. 2017), and concurrent growth of bear and human populations can amplify the potential for HBI (Beckmann and Lackey 2018).

From 2002 to 2016, Florida black bears (*U. a. floridanus*) increased in population from an estimated 2,600 to 4,050 (Simek et al. 2005, Humm et al. 2017, Murphy et al. 2017*a*). During this period, the human population in Florida, USA, increased from 16.7 million to 20.6 million (U.S. Census Bureau 2021).

Black bear populations are divided into 7 genetically distinct subpopulations in Florida (Dixon et al. 2007), occur in 60 of Florida's 67 counties, and commonly range across approximately 49% (72,127 km^2) of the state's land area (Florida Fish and Wildlife Conservation Commission [FWC] 2019). Florida black bears opportunistically use a wide range of natural habitats (Maehr and

Brady 1982, Poor et al. 2020) but have expanded into anthropocentric areas to forage because of a combination of abundant anthropocentric foods (e.g., unsecured garbage, bird feeders), natural habitat loss, and/or low availability of natural foods (Maehr et al. 1988, Moyer et al. 2007, Murphy et al. 2017*b*). Bears have been found to forage in urban areas regardless of availability of natural foods (Merkle et al. 2013), especially when high-caloric resources such as garbage are accessible (Beckmann and Berger 2003, Lackey et al. 2018). Others found an inverse relationship between natural food availability and the amount of HBI (Howe et al. 2010, Obbard et al. 2014) or that individual bears switched foraging patterns between wildland areas and urban areas based on natural food availability (Baruch-Mordo et al. 2014).

The FWC manages the black bear population in Florida and is responsible for tracking and responding to public calls regarding many wildlife species, including bears. The number of public calls concerning bears received by the FWC each year has increased from 1,364 in 2002 to 5,126 in 2016 (FWC 2019). Content of public calls ranged from relatively benign observations of bears to more adverse encounters, such as property damage, injuries to pets, or livestock depredation (FWC 2019).

The complaint filed most often with the FWC is bears accessing garbage (Pienaar et al. 2015, FWC 2019), a behavior that has led to conflicts with bears across Florida (Lowery et al. 2012, Barrett et al. 2014, Pienaar et al. 2015, Noel and Pienaar 2017). Bears that have learned to forage in developed areas may become food-conditioned and human-habituated (Mazur and Seher 2008). Food-conditioned bears that have acclimated to the presence of people can compromise the safety of the public and that of bears (Elfström et al. 2014). Generally, the only management option for these bears is to be humanely killed by wildlife managers (Lackey et al. 2018).

Balancing the benefits and risks bears present to the public is challenging, as is preventing bears from inhabiting anthropocentric environments (Gore 2004). Less-lethal conflict management techniques (e.g., hazing, capture and relocation) help to discourage bears from approaching humans and using residential areas (Lackey et al. 2018); however, these methods do not perpetually exclude bears from human environments (Baruch-Mordo et al. 2013). The most beneficial approach to reduce HBI is to eliminate access to anthropogenic food sources (Spencer et al. 2007, Baruch-Mordo et al. 2013, Lackey et al. 2018). Because black bears generally forage within urban areas at night when humans are less active (Beckmann and Berger 2003, Miller et al. 2016, Zeller et al. 2019), storing attractants (e.g., garbage cans) overnight in secured buildings can be helpful.

An alternative option is to use bear-resistant garbage cans (BRC) in residential areas (Baruch-Mordo et al. 2013, Barrett et al. 2014, Beckmann and Lackey 2018, Johnson et al. 2018). Bears can be drawn into neighborhoods by other anthropogenic attractants (e.g., bird feeders, pet food, livestock feed, fruit trees), which occasionally can be more enticing than garbage (Merkle et al. 2013). Consequently, successful urban bear management requires a comprehensive approach to secure all bear attractants. One method is to establish ordinance zones that require residents to safeguard bear attractants in areas near high-density bear populations (Peine 2001, Johnson et al. 2018). Although ordinances require residents to perform tasks beyond their normal activities, this presumed inconvenience should be offset by the potential reduction in HBI.

The objective of our study was to describe HBI in central Florida within an ordinance zone containing high densities of humans and black bears. We surveyed residents within suburban neighborhoods to determine the effectiveness of ordinance measures and specifically the use of BRC in reducing HBI. We were also interested in assessing the comfort levels of residents in spending time outdoors in their neighborhoods and their quality of life before and after receiving the BRC. We analyzed independent datasets regarding HBI (e.g., public calls to FWC) as well to determine the effectiveness of using bear deterrents. Identifying how residents respond to HBI and the effect of preventive measures on their comfort living near bears is key in determining optimal solutions for long-term coexistence between bears and people.

Study area

We conducted our study in central Florida within Seminole County's Urban Bear Management Area, a zone established on February 7, 2016, that requires residents to secure all bear

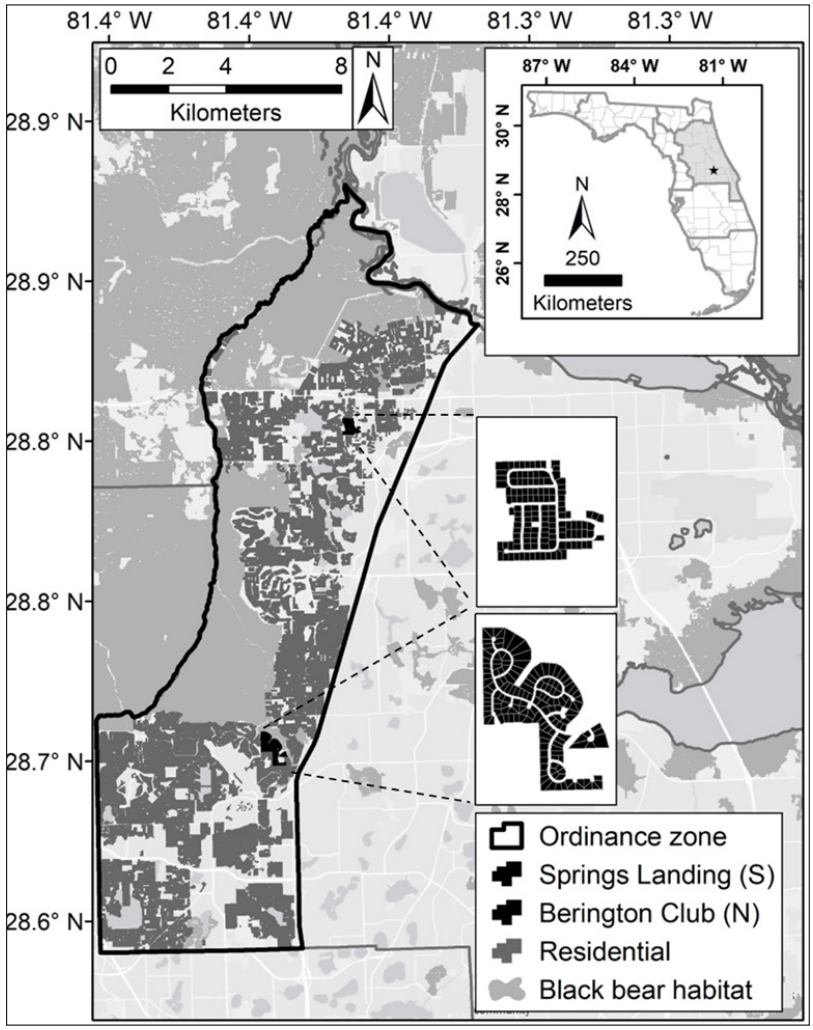

Figure 1. An urban bear (*Ursus americanus floridanus*) ordinance zone in Seminole County, Florida, USA, in 2018 and 2 treatment sites (residential homeowner's associations [HOAs]) near bear habitat. Grayscale base map is from World Light Gray Canvas (Environmental Systems Research Institute, Inc., HERE Technologies, Garmin©), and the inset map shows the study location (star), county lines (light gray lines), 7 Bear Management Units (BMU; dark gray lines), and the Central BMU (shaded area).

attractants (e.g., garbage, food products, bird feeders) on their property within 30 days of adopting the ordinance or else penalties are enforced (Seminole County Board of County Commissioners 2015). The ordinance zone is 148 km^2 encompassing 18% of the county's land area and intersects a large tract of potential bear habitat where bears frequently occur (FWC 2019; Figure 1). Nearby bear habitat, identified using a contemporary statewide land cover classification, included hydric hammock, mesic flatwoods, freshwater forested wetlands, floodplain swamp, cypress swamp, bay gall, scrubby flatwoods, and mixed hardwood-coniferous forest (FWC and Florida Natural Areas Inventory 2018). The mean annual temperature in Seminole County is 22.5°C and mean annual rainfall is 129.5 cm.

In 2018, the human population density was 584.1/km^2 within Seminole County. Seminole County is located within the Central Bear Management Unit (BMU; Figure 1), which is an area bounded by county lines that contains 1 of the 7 identified subpopulations of the Florida black

bear (Humm et al. 2017, FWC 2019). Within the Central BMU, the most recent estimated density of bears was 0.13 bears/km^2 in 2016. Most complaint calls to the FWC concerning bears occurred in northeastern Florida counties, including Seminole, where 5 incidents involving bears injuring people have occurred since 2006 (Pienaar et al. 2015, FWC 2019).

Methods

Experimental design

Initially, we planned to use a before-after-control-impact design (Johnson et al. 2018). We selected 4 neighborhoods, each under the purview of a homeowners' association (HOA), with historically high HBI. Neighborhoods included 2 treatment sites where residents were provided BRC and 2 paired control sites. However, we encountered difficulties at control sites because of a lack of survey participation and low response rates, and furthermore, over half of the surveyed residents purchased BRC during the study period, thereby negating their inclusion in the control group. Consequently, we analyzed only the 2 treatment sites, including a northern location at Berington Club HOA (n = 131 homes) and a southern location at Springs Landing HOA (n = 160 homes; Figure 1).

The FWC canvassed treatment sites over 2 days in 2015, providing residents informational material on black bears and BRC and conducted latch demonstrations for the BRC as needed. The FWC partnered with Seminole County and their waste service provider, Waste Pro, to conduct a media campaign while delivering the BRC. Sixty-four-gallon capacity Toter® BearTight BRC (Statesville, North Carolina, USA) were supplied to every resident in the treatment sites; prior to our study, <5% of residents owned some form of BRC. The FWC provided Seminole County state-appropriated funding ($565,953 USD), matched by county funds and in-kind services ($423,071 USD), to purchase 3,622 BRC. The county sold 131 BRC to Berington Club HOA for $42.14 USD each, which were delivered in August 2017. The FWC provided grant funds ($16,000 USD) to the Springs Landing HOA using proceeds from the Conserve Wildlife specialty license plate managed by the Fish & Wildlife Foundation of Florida. The HOA matched funds ($21,400 USD) with in-kind services to purchase 160 BRC, which were delivered in April 2017. All BRC deliveries were scheduled and implemented by Seminole County staff.

Site characteristics

To determine if bear use of treatment sites during the data collection period was influenced by landscape and climate factors, we analyzed the amount of available bear habitat and levels of precipitation and temperature in our study area. We compared the amount of bear habitat surrounding each neighborhood by creating a circular buffer using a 7-km radius that represented the mean home range size (155 km^2) of male Florida black bears around the central Florida area (FWC 2019). Within each buffer area, we computed the percentage of bear habitat, which was estimated from a species distribution model (SDM) developed by Poor et al. (2020), who used a threshold rule to convert the SDM to a binary output of potential habitat and non-habitat.

We examined climate variables within our study area using data collected at a weather station (USC00087982) located in Sanford, Florida (within 14 km of the treatment neighborhoods) that we downloaded from the National Oceanic and Atmospheric Administration (NOAA) website (NOAA 2022). Climate data included precipitation (cm) and temperature (°C) that we compiled from January 1, 2011, to December 31, 2020. For each climate variable per neighborhood, we computed the mean and standard error (SE) across months for the periods of 1 year before and 1 year after BRC treatment. We also computed the mean and SE for climate variables across years for the periods of 5 years before and 5 years after the ordinance zone was established.

Treatment effects on HBI

We mailed questionnaires to all residents in each neighborhood via the U.S. Postal Service. Respondents were required to be at least 18 years of age and could reply with hard copies by mail or by submitting an online survey form. Pretreatment surveys were initiated on December 21, 2017, for Berington Club and on January 17, 2018, for Springs Landing; residents were allowed 3 months to respond. We structured questions in pretreatment surveys retroactively so that experiences and responses of residents covered a 1-year period prior to receiving BRC.

We conducted posttreatment surveys on July 13, 2018, approximately 1 year after neighborhoods received BRC; again, residents were allowed 3 months to respond. In effect, pretreatment and posttreatment responses each covered a 1-year period.

We asked residents if they knew they were in the Urban Bear Management Area ordinance zone (yes or no), what actions they took to deter HBI before and after treatment (open-ended responses), and if they thought their actions were effective in preventing HBI (yes, no, or not applicable if no measures were taken). To determine a treatment effect, we asked residents if they experienced any HBI in their neighborhood before and after receiving BRC (yes or no). Residents could then select multiple responses from 8 categories of HBI: (1) ate garbage, (2) in yard, (3) in area, (4) in building/structure, (5) damaged property, (6) ate pet food, (7) ate wildfeed (e.g., from bird feeder), or (8) injured a pet. Most HBI categories were self-explanatory, but the "in area" category was defined as the bear being observed within sight of the resident's home but not occurring on their property. Based on FWC (2019) protocols, we also categorized HBI into core and non-core classes, where the core class included HBI considered to be direct conflicts (e.g., eating garbage, property damage, threatened human or pet) and the non-core class included HBI considered to be observational (e.g., bears seen in the yard or in the area). To determine the frequency of HBI before and after treatment, we scored responses of residents as: (1) none, (2) every 6 months, (3) every few months, (4) once a month, (5) once a week, (6) every few days, or (7) daily.

Using chi-squared tests (combining classes when appropriate so frequencies were >5) in a preliminary analysis, we determined that responses from the 2 treatment sites were similar for HBI types ($\chi^2 = 5.85$, df = 4, $P = 0.21$) and HBI frequency ($\chi^2 = 4.24$, df = 3, $P = 0.24$). Therefore, all results were pooled across sites. We qualitatively analyzed percentages of responses to questions that concerned living in an ordinance zone and actions used to prevent interactions with black bears. To determine effectiveness of BRC on total HBI, we computed mean effect sizes (pretreatment minus posttreatment responses) and 95% confidence intervals (CI) using 1,000 bootstrapped samples in the program R version 3.5.1 (R Development Core Team 2021). For frequency of HBI, we computed median effect sizes and 95% CI using 1,000 bootstrapped samples using the R packages "boot" (Canty and Ripley 2021) and "simpleboot" (Peng 2019); residents did not select daily frequency, so only 6 scores were analyzed.

Responses of residents

To determine treatment impacts on public attitudes and behaviors, we asked if residents spent any time outdoors in their yard or neighborhood before and after treatment (yes or no). As a follow up, we asked about the comfort level residents felt spending time outdoors before and after treatment and scored responses as: (1) not comfortable, (2) barely, (3) somewhat, or (4) very. Residents were asked to explain their reasons for selecting their outdoor comfort level (open-ended responses). We also asked residents posttreatment only whether the amount of time they spent outdoors changed (e.g., increased, decreased, or stayed the same), and if their quality of life changed (e.g., improved, declined, or stayed the same).

To determine if residents spending any time outdoors differed before and after treatment, we computed mean effect sizes and 95% CI using 1,000 bootstrapped samples. To determine if comfort levels of spending time outdoors differed before and after treatment, we computed median effect sizes and 95% CI using 1,000 bootstrapped samples; the categories "barely comfortable" and "not comfortable" were combined because of sparse responses, resulting in 3 categories overall. We qualitatively analyzed percentages of responses to questions that concerned the amount of time spent outdoors and quality of life.

Independent datasets

To determine how other sources of HBI data (independent from our surveys) were affected by the ordinance, we compiled information from 2 datasets collected statewide by the FWC, including public calls concerning HBI and bears humanely killed due to conflicts with humans. We categorized public calls into core and non-core HBI but removed calls that did not fit into either class (e.g., sightings of dead or sick/injured bears). We filtered data of humanely killed bears to only include entries that

Table 1. Mean and standard error (SE) of precipitation (cm) and temperature (°C) summarized monthly over 1-year periods before and after deliveries of bear-resistant garbage cans in 2017 to 2 neighborhoods (north and south) within an urban bear (*Ursus americanus floridanus*) ordinance zone located in Seminole County, Florida, USA. Means and SEs were summarized annually for 5-year periods before and after the ordinance zone was established in 2016.

	Precipitation (cm)				Temperature (°C)			
	Before		After		Before		After	
Site	Mean	SE	Mean	SE	Mean	SE	Mean	SE
North	9.1	2.5	10.6	3.4	19.5	1.3	18.9	1.3
South	9.4	2.2	13.1	3.3	19.5	1.3	19.3	1.4
Ordinance zone	132.6	6.6	136.1	3.9	19.0	0.3	18.8	0.6

resulted from a conflict with humans; bears humanely killed for ailments were removed from analysis because the injury might not have been human-caused, or if it were (e.g., vehicle strike), it might not have originated within the ordinance zone. Because the sample sizes of these 2 datasets were small ($n < 25$ each) within the treatment neighborhoods during our 2-year survey period, we analyzed these data at the ordinance zone level for the periods of 5 years before (2011–2015) and 5 years after (2016–2020) the ordinance was established.

We compared the annual mean and SE of public calls and bears humanely killed between the 2 5-year periods. Because BRC deliveries were staggered over time and all planned BRC deliveries had not yet occurred (4,407 delivered out of 5,803) within the ordinance zone by 2020, our analyses conveyed an incomplete comparison of BRC effects but still addressed effects due to the ordinance. We also pooled the public call data over the 10-year period to illustrate the mean ± SE amount of HBI calls (core and non-core) for each of the 12 months.

Results

Survey and site summaries

At treatment sites, 100% of residents received BRC. All respondents used the online form. We obtained pretreatment survey responses from 94 residents (north = 35, south = 59), accounting for 32% of all available residents, and we received posttreatment responses from 64 residents (north = 20, south = 44), accounting for 22% of all available residents.

The Euclidean distance between the 2 surveyed neighborhoods was 11 km. Percentage of bear habitat within buffer areas was similar between the northern (32%) and southern (28%) neighborhoods. The monthly means for precipitation and temperature were each similar for the 1-year periods before and after treatment for the 2 neighborhoods (Table 1). The annual means for precipitation and temperature were each similar for the 5-year periods before and after the ordinance zone was established (Table 1).

Treatment effects on HBI

The pooled mean HBI declined after treatment (effect size = 54%, CI = 41–66%) from 82% to 28% (Table 2). The pooled percentage of bears observed eating garbage dropped to 0% posttreatment from 42% pretreatment (Table 2). Both core and non-core HBI declined, though core HBI declined considerably more (Table 2). The mean number of HBI types (out of 8 possible categories) selected per resident decreased from 2.2 pretreatment to 0.5 posttreatment. The median scores of HBI frequency decreased (effect size = 3, CI = 2–3) from 4 (once a month) pretreatment to 1 (none) posttreatment (Figure 2).

Most respondents (90%) practiced preventive measures to deter HBI before treatment even though only 80% knew they were in the ordinance zone. The most reported preventive measures were storing garbage cans in the garage, storing pet food indoors, removing bird feeders, and remaining bear aware when going outdoors. Before treatment, 61% of respondents thought their preventive actions were effective, and 82% of respondents kept their garbage cans stored in the garage until the night before or day of garbage pickup. This practice continued among 54% of respondents after treatment, although 54% of residents considered the BRC by themselves sufficient deterrents.

Table 2. Percentages of human–bear (*Ursus americanus floridanus*) interactions (HBI) from surveyed residents for 1 year before (pretreatment) and 1 year after (posttreatment) receiving bear-resistant garbage cans in 2017 in 2 neighborhoods (north and south) located in an urban bear ordinance zone in Seminole County, Florida, USA. Because each respondent could choose multiple interactions, the percentage for individual interaction types is out of 100% per treatment period, which was computed by summing the count of respondents who selected the interaction type divided by total respondents per treatment period. "Non-core" were the combined types of "in yard" and "in area," and "core" were the combined remainder of HBI types.

	Pooled %		North %		South %	
Variable	Pretreatment	Posttreatment	Pretreatment	Posttreatment	Pretreatment	Posttreatment
≥1 Interaction	82	28	80	15	83	34
None	18	72	20	85	17	66
Core	52	7	57	0	49	9
Non-core	79	27	77	15	80	32
In yard	76	23	71	10	78	30
In area	54	20	54	10	54	25
Ate garbage	42	0	46	0	39	0
Property damage	21	2	31	0	15	2
In building	13	3	20	0	9	5
Ate wild feed	5	0	9	0	3	0
Ate pet feed	4	2	6	0	3	2
Injured animal	1	0	3	0	0	0

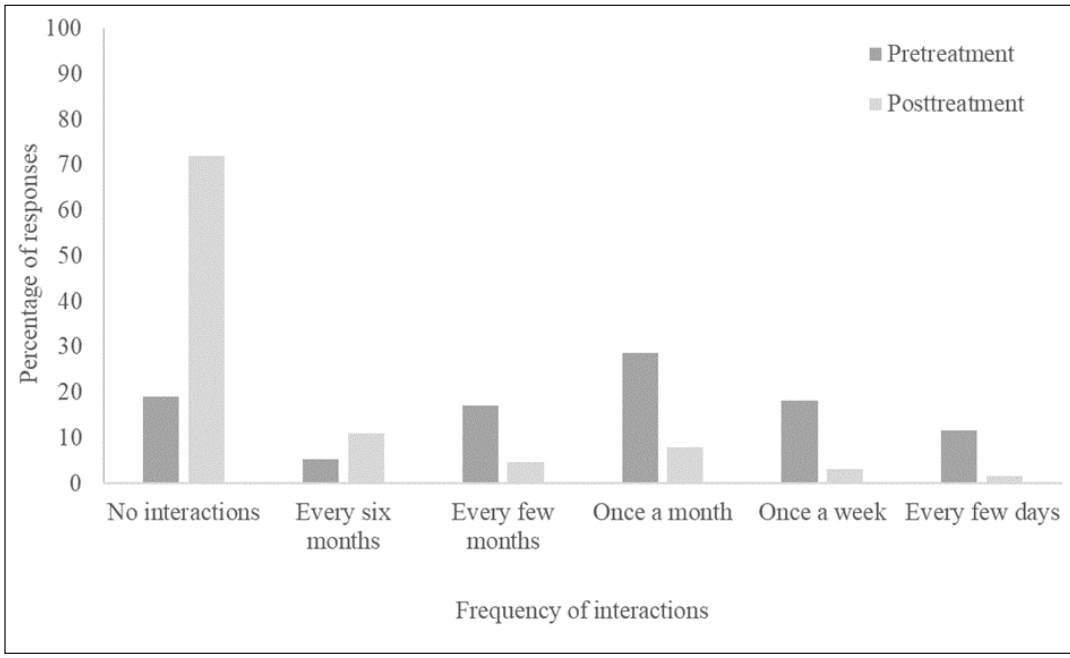

Figure 2. Percent frequency of human–bear (*Ursus americanus floridanus*) interactions from combined surveys in 2 residential neighborhoods within an urban bear ordinance zone in Seminole County, Florida, USA, for 1 year before (pretreatment) and 1 year after (posttreatment) receiving bear-resistant garbage cans in 2017.

Treatment effects on residents

The mean percentage of residents spending any time outdoors in their neighborhood was similar before (92%) and after (93%) treatment (effect size = 0.9%, CI = -10–8%). After treatment, 17% of residents who spent time outdoors stated the amount of time they spent outdoors increased, whereas the amount of time spent outdoors stayed the same for the remainder (83%). The median score was 4 (very comfortable) for the comfort level of residents spending time outdoors before and after treatment (effect size = 0, CI = -1–1). Most residents felt somewhat (pretreatment = 34%; posttreatment 38%) or very (pretreatment = 52%; posttreatment 60%) comfortable outdoors regardless of treatment. It is worth noting that only 1 resident (2%) remained not/barely comfortable posttreatment, decreasing from 12 (13%) pretreatment. After pooling explanations by residents that were somewhat and very comfortable spending time outdoors, 58% stated they were aware of and adjusted to living within bear range. Explanations by residents that were not/barely comfortable pretreatment because of HBI included being concerned for the safety of their children or pets (57%), and they were fearful going outside when it was dark (14%). Reduced fear of HBI after treatment dissipated much of this apprehension, although some residents stated they remained cautious when it was dark outside. The resident that remained in the barely comfortable category did not provide a detailed reason for continued discomfort.

After treatment, quality of life improved for 57% of respondents but remained the same for the remaining 43%. When cross-referencing respondents whose quality of life improved after treatment with frequency of bear interactions, 73% of these residents experienced no interactions; the remaining 27% still felt that quality of life had improved even when HBI occurred once per month. Quality of life improved after treatment because 71% of residents felt more secure with fewer bear encounters or sightings, whereas 12% simply appreciated no longer cleaning up scattered garbage.

Analyses of independent data

Most HBI calls to the FWC from 2011 to 2020 occurred between July and December in the ordinance zone (Figure 3). The mean number of non-core HBI remained the same before and after the ordinance was established, whereas the mean number of core HBI declined considerably (40%), as did those concerning bears eating garbage (46%; Figure 4). The mean ± SE number of bears humanely killed by the FWC per year declined from 5.8 ± 2.5 bears to 2.4 ± 0.9 bears after the ordinance was established.

Discussion

We found that providing BRC to all residents simultaneously in HOA communities located within an ordinance zone significantly reduced HBI. Even though 20% of our surveyed residents were unaware that they were in an ordinance zone, the ordinance was somewhat effective by itself because 61% of respondents stated their pretreatment preventive measures (e.g., storing garbage in the garage) were working, and core HBI calls to the FWC declined after the ordinance was established. In other Florida neighborhoods without an ordinance, BRC worked reasonably well to deter bear encounters in that bears attempting to eat garbage dropped from 60–75% pretreatment to <20% posttreatment (Barrett et al. 2014). Yet, the combined effects of BRC and ordinance requirements in our treatment areas helped to substantially lower posttreatment levels of core HBI (especially bears eating garbage), though bears still remained in the area based on non-core HBI results.

For many residents, decreased HBI led to improved quality of life psychologically (e.g., less fear of bear encounters) and tangibly (e.g., less property damage or cleanup), and some residents spent more time outdoors in their neighborhood. Outdoor recreation in urban and surrounding natural environments has been associated with increased support for environmental and conservation issues (Schuttler et al. 2018) and improved human health (Abraham et al. 2010, Nordh et al. 2017). In addition, the well-being of bears can be improved by deterring their use of urban areas and human foods, both of which can increase mortality (e.g., vehicle collisions, lethal removals; Laufenberg et al. 2018), decrease fitness (Johnson et al. 2020), and even influence hibernation periods and aging (Kirby et al. 2019). We found that the number of bears humanely killed by the FWC decreased after the ordinance zone was established. Successful coexistence of humans and bears is possible if behaviors (by both parties) fa-

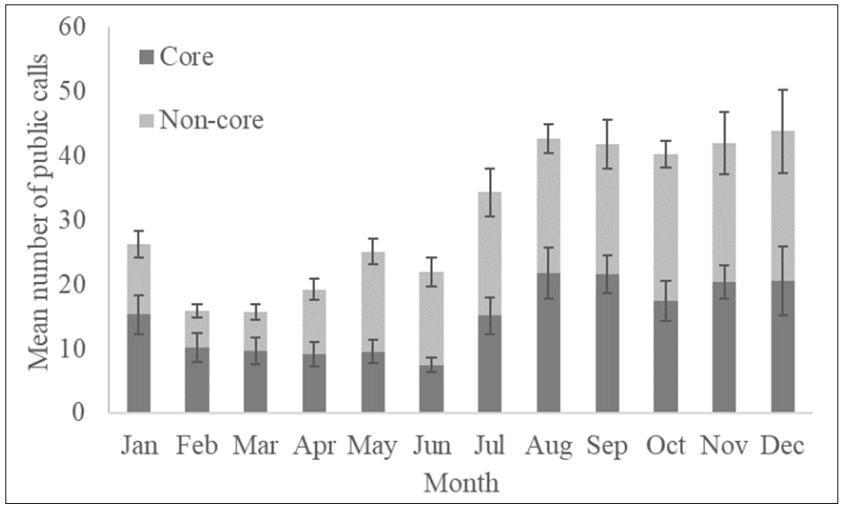

Figure 3. Mean (± standard error) number of human–bear (*Ursus americanus floridanus*) interactions (HBI) categorized as core HBI (determined to be conflicts with bears) and non-core HBI (general observations of bears in the area) that were summarized from public calls to the Florida Fish and Wildlife Conservation Commission from 2011 to 2020 within an urban bear ordinance zone in Seminole County, Florida, USA.

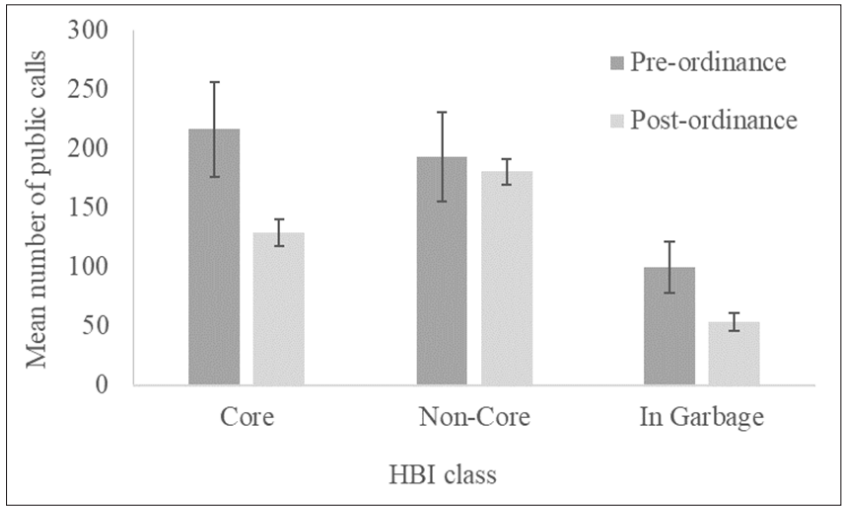

Figure 4. Mean (± standard error) number of human–bear (Ursus americanus floridanus) interactions (HBI) categorized as core HBI (determined to be conflicts with bears) and non-core HBI (general observations of bears in the area) that were summarized from public calls to the Florida Fish and Wildlife Conservation Commission for 5 years before (pre-ordinance) and 5 years after (post-ordinance) an urban bear ordinance zone was established in 2016 within Seminole County, Florida, USA. In garbage (a core HBI) was also shown separately being a primary management concern.

cilitate conflict avoidance.

The public's cooperation with wildlife management agencies is influenced by their perception of competence in the agencies (Rudolph and Riley 2014, Wilbur et al. 2018). We experienced a lack of participation at control sites in our study, perhaps caused by miscommunication among the FWC, the county, and HOA leadership. Although Seminole County scheduled these neighborhoods to receive BRC in the future, many res-

idents independently purchased BRC, and every survey respondent who did not receive a BRC stated they wanted one issued to them. Perhaps this confusion led to a negative perception of the FWC and produced low survey response rates. These were problems not only for our study but also for future bear management needs in the area. A possible solution is to conduct presurveys or canvassing directly before the questionnaires are offered, an effective method implemented by Johnson et al. (2018). Additionally, only 80% of residents in treatment areas knew they were in an ordinance zone, indicating a need for further communication to ensure messaging is quickly and accurately conveyed. Furthermore, the low number of public calls to the FWC regarding HBI in the 2 treatment neighborhoods, even though the percentage of HBI was high in survey results, indicates residents might distrust the FWC or were under the misconception that the FWC always kills bears in response to reports of HBI. Although the FWC has seen some success with their outreach messaging about living with black bears (Pienaar et al. 2015), educational approaches are not always uniformly accepted, so different tactics might be needed based on the audience receiving the information (Dietsch et al. 2017). Although education on bear awareness alone will not reduce HBI (Dietsch et al. 2017), increasing public knowledge of bears and the potential adverse impacts of living near them can help with public acceptance of management strategies implemented by wildlife officials (Heneghan and Morse 2017).

The viewpoints of humans toward bears are ambiguous, variable, and likely based on individual experiences or perceived notions (Gore 2004). People who have been questioned about living alongside black bears in other studies have reported their quality of life is either reduced (Campbell 2013), improved (Lischka et al. 2020), or on average relatively unaffected (Palmer 2009). Lowery et al. (2012) observed ambivalence in public attitudes toward black bears in northern Florida; we encountered similar findings in our study area in central Florida. Some individuals are not tolerant of bears at any level in their neighborhood; a resident in our treatment site stated, "Get rid of all the bears" and was not satisfied even after HBI were reduced posttreatment. Other residents are tolerant of bears in their neighborhood even if HBI rates are high. This could be a result of the personal experience concept that non-negative HBI are associated with decreased concern about health and safety threats posed by bears (Siemer et al. 2009). Many residents in our study appreciated the reduction of HBI produced by using BRC as exemplified by a long-time resident who wrote: "Since the bears no longer have the trash to eat from, they are not as noticeable. I have lived in the neighborhood since 1987. Bears had become much more prevalent in the past 5–10 years. Though I still see a bear occasionally, my comfort has returned to that of years past." An encouraging statement by another resident posttreatment was: "My level of stress is much less… I appreciate all the help from the FWC of Florida. It has made our neighborhood a little safer for ourselves and our children."

Management implications

A reduction of HBI and public acceptance of using BRC is a long-term goal of the FWC's Florida Black Bear Management Plan. Public messaging could help realize this goal by ensuring that residents know when they are in an ordinance zone and the benefits of securing garbage and other attractants from bears. If non-garbage attractants cause bears to remain in a neighborhood that properly uses BRC, it could result in a misplaced devaluation of the BRC. Cost sharing with counties or other organizations to help purchase BRC could expand their distribution to areas with high HBI. When conducting follow-up studies to determine longer-term efficacy of measures to reduce bear access to attractants and to track public attitudes and behaviors over time, we recommend using >1 data source (e.g., surveys, public calls, telemetry) when available to analyze HBI and their impacts on bears and humans.

Acknowledgments

We sincerely thank Fish & Wildlife Foundation of Florida, Seminole County, Berington Club HOA, and Springs Landing HOA for contributing funding toward the purchase of BRC. We thank Seminole County for organizing BRC sales and Waste Pro for distribution, for media messaging, and for modifying their service procedures to handle the BRC. We appreciate the cooperation of HOA representatives and the participation of residents in the treatment and

control neighborhoods. Comments and feedback provided by D. Doran-Myers, M. Cleary, R. Baumstark, and B. Hyde greatly improved earlier versions of the manuscript. Finally, we thank C. Lackey, the associate editor, and 2 anonymous reviewers for their thoughtful insights and helpful edits to the manuscript.

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