Seattle Urban Carnivore Project

Carnivore Spotter Annual Report
July 21, 2020 - December 3, 2021

Originally Prepared by
Brittany Amaral and Jackelyn Garcia (2019-2020 Annual Report)

Updated and Revised by
Celeste Mari Williams (Current 2021-2021 Report)

for Woodland Park Zoo

Abstract

Woodland Park Zoo and Seattle University collaboratively launched Carnivore Spotter, a web-based carnivore reporting tool, on August 12, 2019. From its launch to December 3, 2021 we collected over 7,000 reports thanks to community members in the greater Seattle area who have submitted mammalian carnivore sightings through the online website. This current annual report from July 21, 2020 to December 3, 2021 includes a total of 3,030 submitted reports. We analyzed these data and found that all eight of our focal species were reported within greater Seattle. Coyotes were the most reported species (~50% of all reports) throughout the year, at various times of day, and with the greatest geographic distribution. Raccoons were the second most reported, followed by river otters, bobcats, and black bears. Of the top ten neighborhoods, the highest number of carnivore reports were in Magnolia, followed by Olympic View and Wallingford. The most common carnivore behaviors observed were movement and foraging for food. Of 3,030 reports, approximately 4% described a carnivore interacting with a human-made object or place, ~2% described a direct interaction between a carnivore and a domestic animal/pet, and 0.03% involved direct carnivore-human interactions. Of the latter, 30% occurred with the presence of a pet dog. Predation of a domestic animal/pet was also a rare occurrence (0.05% of all reports). These 2020-2021 reports have given us additional awareness of the types of interactions that occur while sharing space with urban carnivores. Data collection of carnivore sightings from community members will continue to increase our understanding of urban carnivores and our work to support coexistence with these species.

Table of Contents

Introduction

The Pacific Northwest is home to a diversity of carnivores, including coyotes, bobcats, bears and more. With the growth of suburban and urban areas worldwide, interactions and conflicts between carnivores and humans are becoming more common. The Seattle Urban Carnivore Project is working to support coexistence between people and carnivores in urban ecosystems across the greater Seattle area.

The Seattle Urban Carnivore Project (SUCP) is a collaborative partnership between Woodland Park Zoo, Seattle University, and community members like you. SUCP aims to increase our human understanding of urban carnivores by studying how these species live and interact with people across urban and suburban areas in the greater Seattle region. This project ensures that we also listen to both community excitement and concerns about these interactions. SUCP focuses on studying and supporting coexistence with the following species: coyotes, black bears, bobcats, cougars/mountain lions, Virginia opossums, raccoons, river otters, and red foxes. These terrestrial mammals tend to be present in developed regions. Most of them are in the taxonomic order Carnivora, with the exception of opossums, which are marsupials. Some, such as cougars and bobcats, eat a primarily carnivorous diet. Others, such as coyotes, opossums, red foxes, raccoons, and black bears are more omnivorous, eating vegetation and meat.

Two major approaches are employed to accomplish this work. The first is a successful camera monitoring program, where we collect data from camera traps installed in green spaces by Seattle-area residents, university students, and Woodland Park Zoo volunteers. The second approach is through Carnivore Spotter, a public online platform launched on August 12, 2019 (Carnivore Spotter; www.carnivorespotter.org). This tool allows community members to report sightings of these carnivore species and interactions that may occur. Through this work, we hope to foster connection, empathy, and coexistence with our local carnivores.

Your efforts and enthusiasm as participants with the Seattle Urban Carnivore Project have contributed to our understanding of carnivores in the greater Seattle area and improving our coexistence as a community. From Carnivore Spotter's launch on August 12, 2019 to July 20, 2020, 4,217 reports were collected and were included in the first annual report. Since then, an additional 3,030 reports were collected from July 21, 2020 to December 3, 2021, totaling 7,247. This research would have never come to

fruition without community members like you. Over 7,000 reports demonstrate a strong community commitment to our efforts. We are sincerely grateful for your active engagement and willingness to learn and coexist.

In this second annual report, we analyzed sightings reported through Carnivore Spotter from July 21, 2020 to December 3, 2021. Like the first annual report, we focused on specific types of interactions carnivores had with people, with human-made objects, and with domestic or wild animals. We also summarized where these interactions occurred geographically, as well as categorized the types of comments people submitted with their reports. This report summarizes our findings of the data you contributed and is meant to inform how we can better serve the community. Reports that included photos, video, or audio were reviewed by project staff and were verified for the correct animal identification. While reports without media could not be verified, they were included with the data. ***Please note that the observations of local carnivores were based on reports made and did not necessarily reflect all the places where animals occurred, how many there were, or most importantly where they did not occur.*** While the number of reports for specific carnivores may seem high or low in certain locations, this only indicates that these species were present in the area as noted by reported sightings through Carnivore Spotter. This does not necessarily represent species abundance within those areas.

Methods

Study Area of Carnivore Spotter

Carnivore Spotter serves the Seattle-Tacoma metropolitan area. While there were no restrictions on where reports can be submitted from, for the purpose of this analysis, we only included sightings within Washington state and incorporated neighborhoods located in all Washington State counties.

Methods of Analysis

Staff Review of Reported Sightings

Before we analyzed the reports observers submitted to Carnivore Spotter from July 21, 2020 to December 3, 2021, the reports were reviewed by project staff. Reported observations that included media (i.e., photo, video, or audio) were reviewed and the animal identification corrected, if necessary. The only other edits project staff may have made to observations were if the following applied:

1. The observer did not select a location
    a. If the observer did not select a location, the observation was logged at a default latitude and longitude (the default location). For every observation

at the default location, if contact information is available, project staff attempted to obtain the correct location from the observer and updated the observation to this location. If no contact information was provided or a correct location could not be obtained from the observer, observations at the default location were deleted.

2. The observation was not of a live carnivore (e.g., dead)
    a. If the observation was not of a live carnivore, such as dead animals, tracks, or scat (feces) not accompanied by a direct observation of the carnivore were deleted.
3. The media was not appropriate for the observation or was not a focal species for SUCP
    a. If the media was not appropriate for the observation or not a species included in the project (e.g., a photo of a domestic cat marked “Bobcat”), the observation was deleted.

Data Analysis for Carnivore Spotter Reported Sightings

After the reported sightings submitted to Carnivore Spotter underwent this review process, the remaining reports were analyzed relative to the types of interactions that occurred. These included direct carnivore interactions with humans, human-related objects, domestic animals/pets, other species of wild animals, as well as the geographic locations of the sightings. Additional comments were analyzed for themes related to concerns and general feelings about urban carnivores and were categorized as either positive or negative. We analyzed the following themes in further detail:

1. The frequency of reports made for each carnivore species, and where these reports were occurring geographically, to better understand the regions of Washington that are utilizing Carnivore Spotter and which regions are not.
2. The types of interactions observed between carnivores and humans or human-related objects, such as fencing, gardens, trash bins, and birdfeeders.
    a. These interactions were categorized based on the type of interaction and/or conflict that occurred. Therefore, they were categorized as either a neutral or a potentially negative interaction from a human perspective. For example, a carnivore’s interaction with trash bins could be seen as a negative interaction for a human.
3. The types of interactions observed between carnivores and domestic animals.
    a. These interactions were categorized based on the type of interaction and/or conflict that occurred as well, and included any carnivore’s display of playful behavior, a carnivore physically attacking other animals, and the

act of predation/feeding, which was included when it was reported that the carnivore killed and consumed an animal, or was witnessed feeding on an animal.

4. We manually coded the types of feelings the reporter expressed towards the carnivore(s) in any comments included with observations.
    a. Positive feelings such as curiosity, excitement, etc.
    b. Negative feelings such as concern related to the carnivore, feeling unsafe with their presence, or feeling their presence is problematic.

These themes were assigned a distinct code (Appendix I) to allow descriptive statistical summaries to be made.

Results

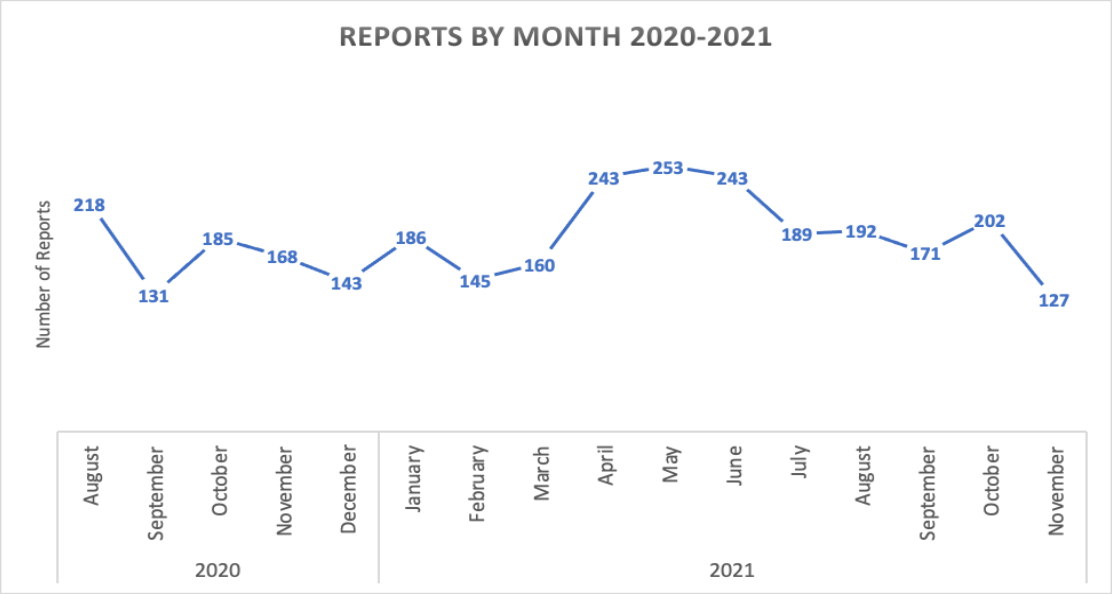
Introduction

In the first year from Carnivore Spotter's launch to July 20, 2020, a total of 4,217 reports were submitted. The current annual report from July 21, 2020 to December 3, 2021 had a total of 3,030 submitted reports, which included 4,156 individual animals. The number of individual animals observed was higher, since two or more animals are often observed in a single report.

Reports by Month

Although this second annual report investigated data from July 21, 2020 to December 3, 2021, the following Reports by Month are from August 2020 to November 2021 (Figure 1). Due to the limited days in July 2020 and December 2021 included in the data range, these months were removed to show a more accurate number of reports per month. August 2020 had 218 reports, then dipped below 200 from September 2020 to March 2021. There was another increase above 200 in April, May, and June 2021, then dipped below 200 from July 2021 to September 2021. There was a slight increase to 202 in October 2021, then dipped to 127 in November 2021. The average number of carnivore reports per month was 187.5.

Figure 1. Reports by Month August 2020- November 2021

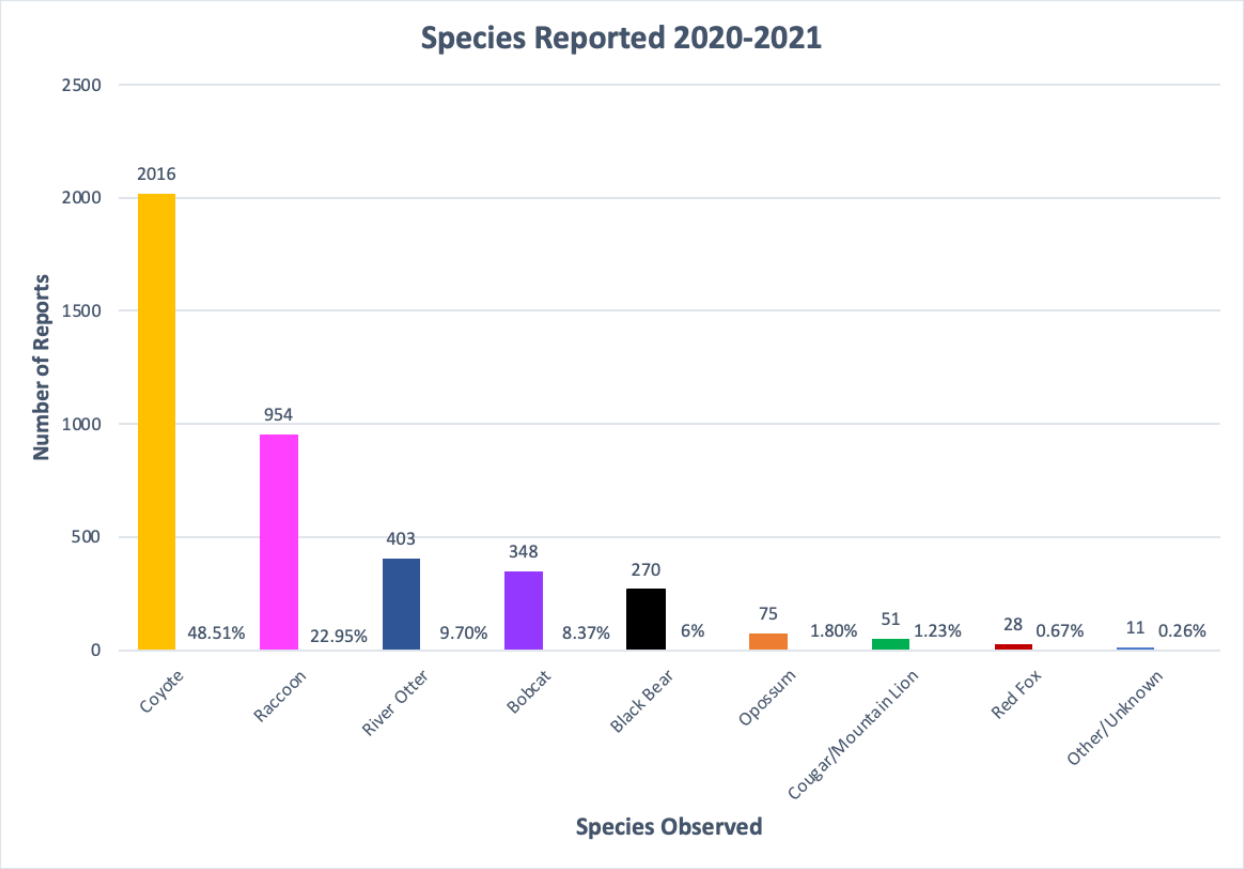


Species Reports

Coyotes were the most reported species, making up almost 50% of all reports. Raccoons were also frequently reported, making up 23% of all reports, followed by river otters at 9.7%, bobcats at 8.4%, and black bears at 6% (Figure 2). Cougars/Mountain lions and opossums were both below 2%. Red foxes were the least reported species at 0.7% of all reports.

These results do not represent the number of these carnivores within Seattle, but do illustrate that these carnivores are present within the greater Seattle area and are observed by people who have then taken the step to report them to Carnivore Spotter.

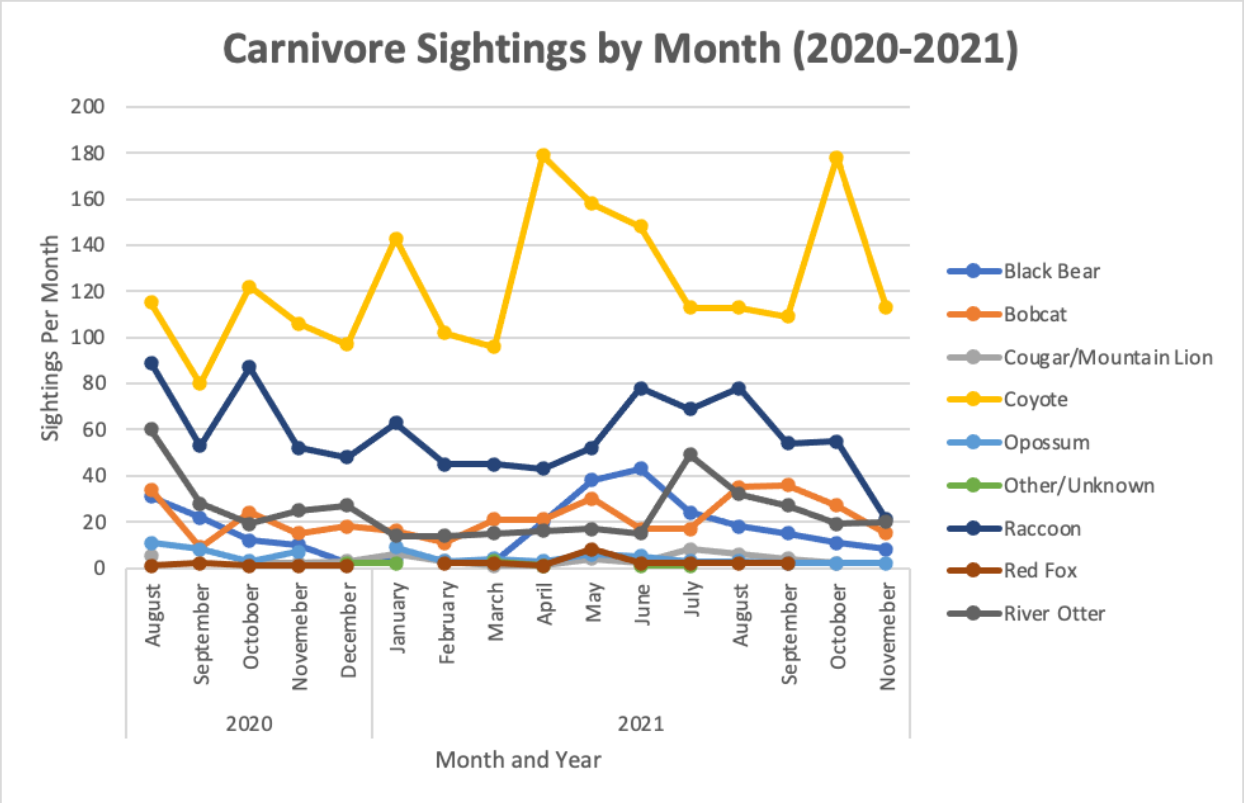
Figure 2. Species Reported 2020-2021

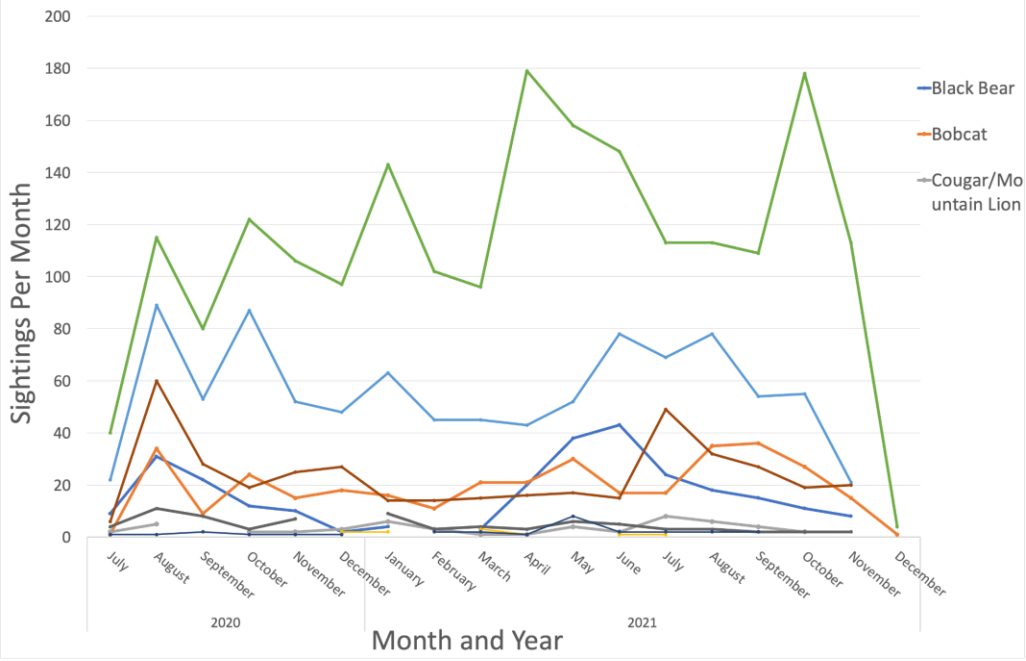


Carnivore Sightings by Month

The number of carnivore sightings varied from month to month (Figure 3). Coyotes continued to be the most reported species with peaks in April and October. Future years of Carnivore Spotter reports will help us to further analyze these trends. The following Carnivore Sightings by Month are from August 2020 to November 2021. July 2020 and December 2021 are not included, as these months had fewer reporting days included in the data range of this report.

Figure 3. Carnivore Sightings By Month 2020-2021

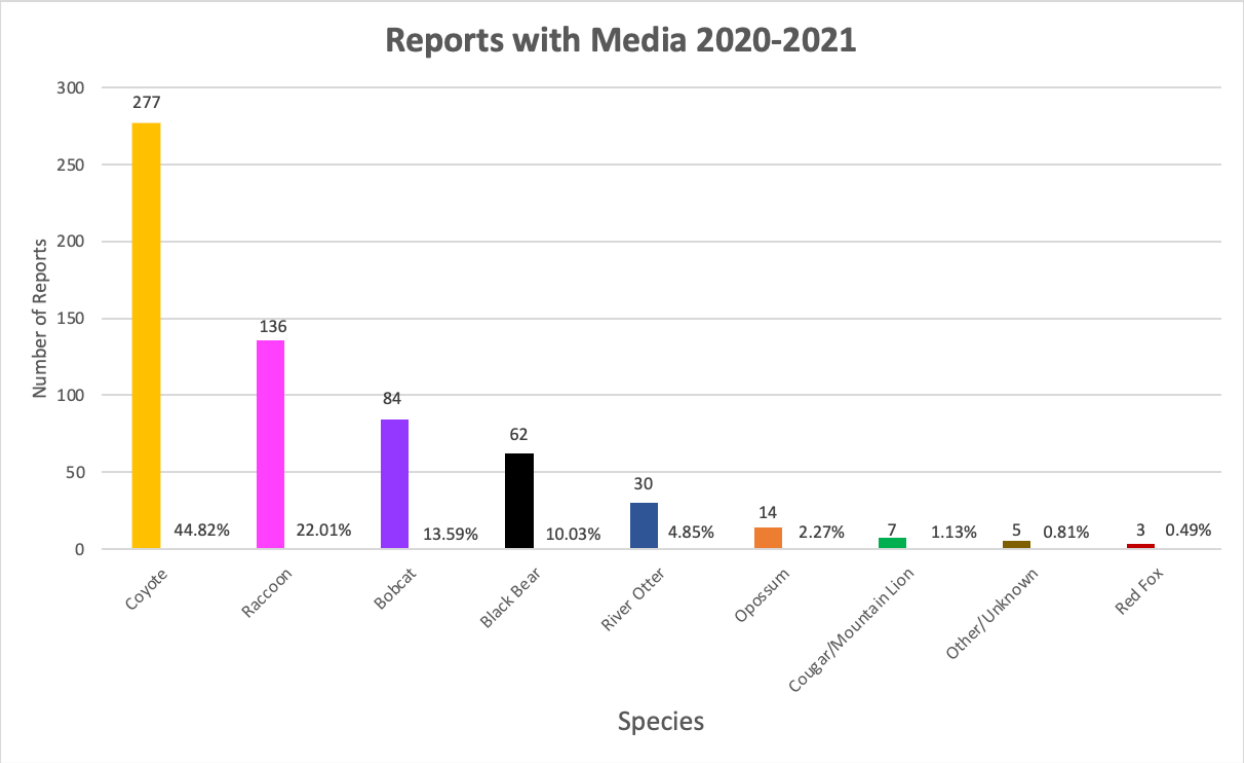




Reports with Media

Of the 3,030 total submitted reports, 618 (20%) included media (i.e., photo, video, or audio) (Figure 4). These reports allowed a staff member to review and confirm the species identification. Of the 618 reports with media attached, the majority were confirmed to be coyotes with 277 reports (44.8%), followed by raccoons with 136 (22%), bobcats with 84 (13.6%), and black bears with 62 (10%). The remaining species reports with media were below 5% with red foxes the lowest at 3 (0.49%).

Figure 4. Reports with Media 2020-2021.

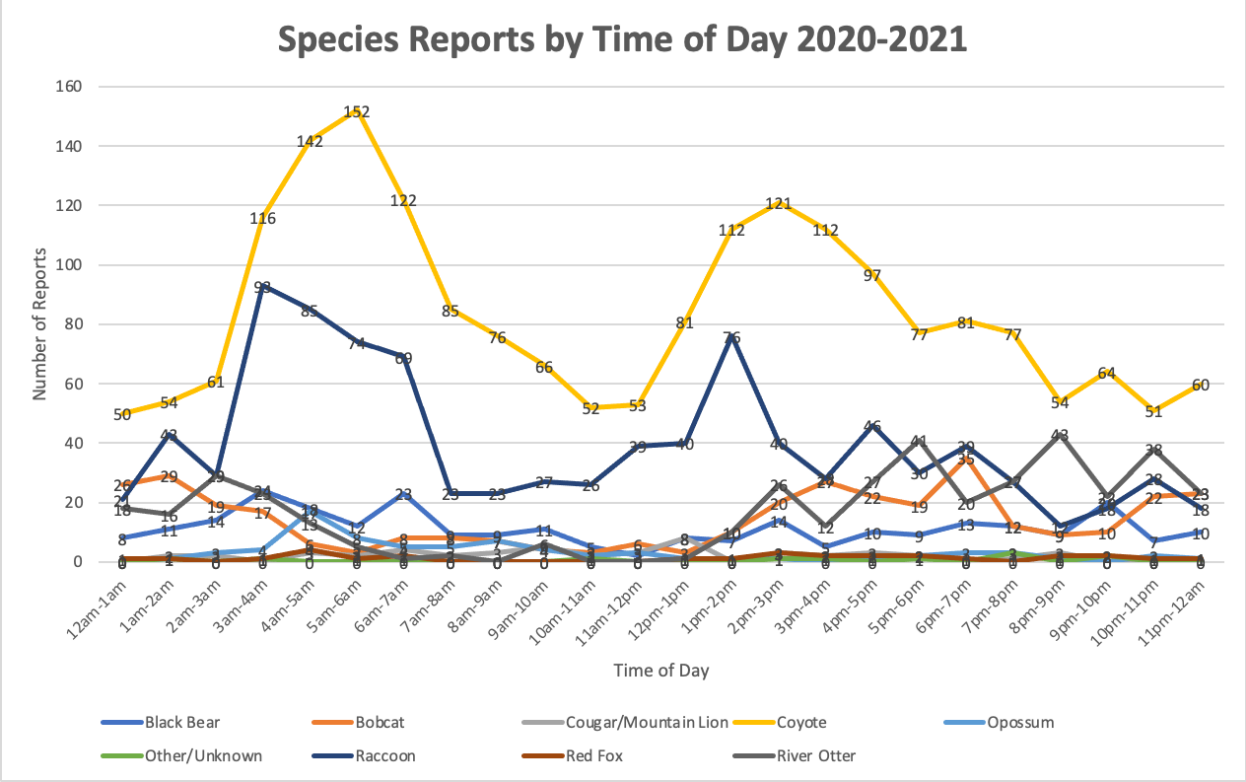


Species Reports by Time of Day

Out of 3,030 total reports, 4,156 individual animals were sighted at various times of day from July 21, 2020 to December 3, 2021. The number of individuals is higher since two or more animals are often sighted in a single report. The following time data of individual animal observations was analyzed in one-hour increments from 12:00 a.m. to 11:00 p.m. (Figure 5). Most reported observations occurred between 3:00 a.m. and 7:00 a.m. (more than 230). The number of observations dropped between 7:00 a.m. to 1:00 p.m. (less than 150), then increased between 1:00 p.m. to 7:00 p.m. (between 183 to 217), then decreased between 7:00 p.m. to 3:00 a.m. (between 162 to 124). The fewest observations were made from 10:00 a.m. - 11:00 a.m. (91). Coyotes were the highest reported species at all times of day with a peak of 152 between 5:00 a.m. and 6:00 a.m.

and a low of 50 between 12:00 a.m. and 1:00 a.m. Raccoons were the second highest with a peak of 93 between 3:00 a.m. and 4:00 a.m. and a low of 12 between 8 pm and 9 pm. The lowest reported species at all time increments were red foxes, which peaked at four between 4:00 a.m. and 5:00 a.m. It is important to note that these are the times that people observed carnivores and do not indicate that carnivores are more or less present at these times of day.

Figure 5. Species Reports by Time of Day 2020 - 2021



Geographic Distribution of Carnivore Reports

Instead of the spatial analysis data used in the first annual report, this report includes general geographic distribution of species through Carnivore Spotter. Reports of carnivores came from various regions across Washington state. Of all reported species, coyotes showed the greatest geographic distribution, particularly in King County (Appendix II). Coyote reports with media were predominantly in the North, Northwest, and Northeast Seattle regions (City of Seattle, 2022). Several coyote reports were from the Pioneer Square to Magnolia region, the Central and South regions, with additional reports from other areas within and outside of Seattle. In regions outside of Seattle, there were coyote reports from regions east of Lake Washington, as well as areas south of Seattle including Burien and Tacoma. Raccoons were the second most reported carnivore with the greatest distribution in the Northern and Central Seattle

regions, and some in West Seattle and east of Lake Washington (Appendix III). Several raccoon reports were also submitted from areas within and outside of Seattle. Bobcats had greater distribution in regions east of Lake Washington including Bothell, Sammamish, Maple Valley, and Issaquah (Appendix IV). The few bobcat reports in Seattle areas were in the northern region. Black bears were principally reported east of Lake Washington in areas north and south of I-90 with greater distribution in Union Hill and Issaquah (Appendix V). Within the Seattle area, there was only one verified black bear report in the northern region. Cougars were more sparsely distributed with a few reports from Northwest and Central Seattle, with greater numbers east of Lake Washington (Appendix VI). River otters were typically reported near water bodies including Elliot Bay, Lake Union, Lake Washington, Puget Sound, and connecting canals (Appendix VII). There were also some reports from water bodies beyond the greater Seattle area such as Lake Sammamish. Virginia opossums were primarily reported in the northern region of Seattle and were sparsely distributed across different areas within and outside of Seattle (Appendix VIII). The distribution of red fox reports were infrequent and came from various locations within and outside of Seattle (Appendix IX); the only red fox observation with media posted during the date range of this report came from the San Juan Islands area.

Carnivore Reports from Washington Neighborhoods

From the 3,030 total reported sightings of carnivores, we analyzed the ten neighborhoods with the most reports (Appendix X). The neighborhood with the highest reports was Magnolia with 193, followed by Olympic View, Wallingford, Renton, North Queen Anne, Phinney Ridge, Redmond, Greenwood, Broadview, and Fremont with 59. There were 136 reports from “Washington,” which is a default setting when Carnivore Spotter cannot identify a Seattle neighborhood or county. This will sometimes occur when species, such as river otters, are spotted in water. These reports were not included with the neighborhood data analysis. During the first year of Carnivore Spotter, reports submitted from certain suburban or rural areas that the platform could not recognize were designated as “unknown.” This issue has since been addressed and resolved.

Factors that Affect Reporting

The number of Carnivore Spotter reports within a particular census tract was positively correlated with the income of that census block. Zooming in to North Seattle, we see a high concentration of reports in the neighborhoods around Woodland Park Zoo.

Figure 6. Distribution of reports by census tract in King County, with larger circles representing more reports.

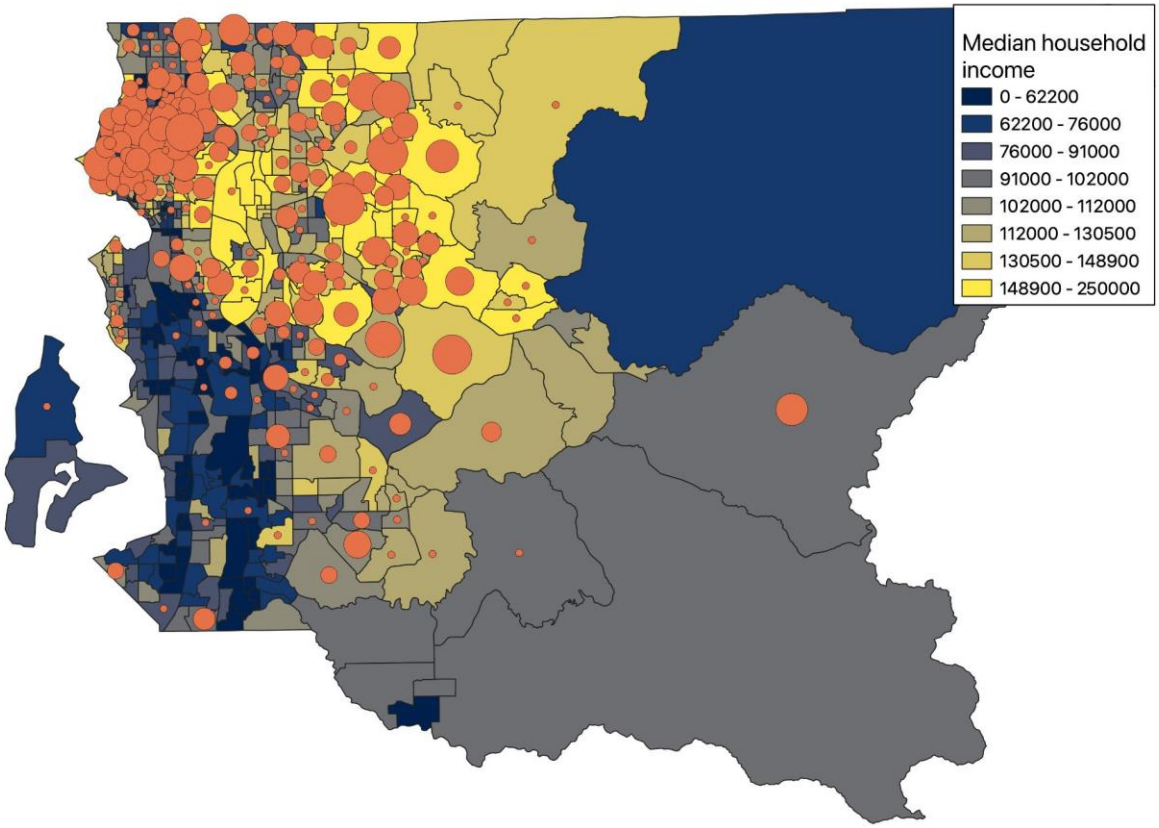
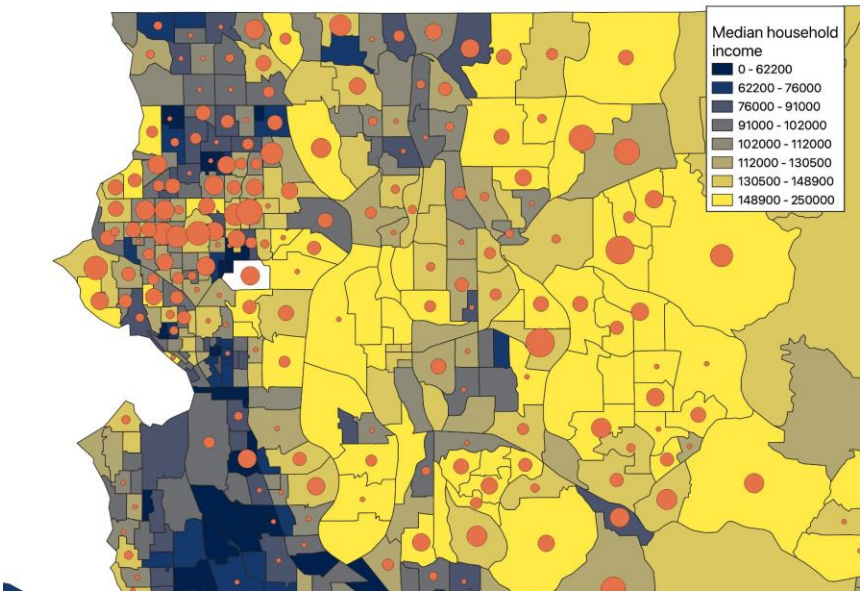


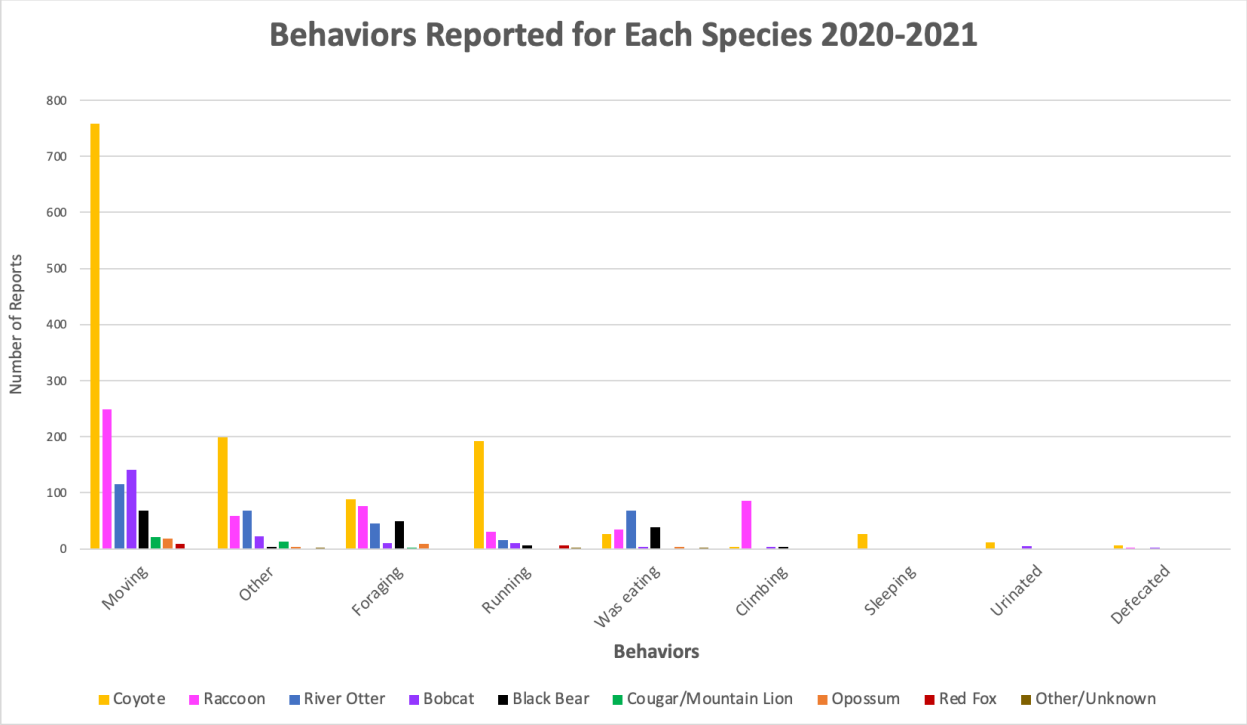
Figure 7. Distribution of reports by census tract, detail of North Seattle. Larger circles represent more reports.



Behavioral Results

When submitting a report in Carnivore Spotter, observers have the option to select the behavior of the animal(s) they encountered from a dropdown list with the options: moving, foraging, eating, running, sleeping, urinating, defecating, and other. However, observers may also provide written comments about the behaviors observed. Out of 3,030 total reports, 2,628 listed the carnivore's behavior when encountered (Figure 8). Of those 2,628 reports over 1,381 (50%) species were "Moving" with coyotes at 758. "Other" was the second most reported behavior at 371 for unidentified animals, followed by foraging (280), running (265), eating (176), and climbing (97). Urinating and defecating were the least reported behaviors at 16 and 12 respectively. 89% of the climbing reports were raccoons at 86 out of 97, along with single digit reports of bobcat, black bear, coyote, and opossum. Only bobcats and coyotes were reported as urinating.

Figure 8. Behaviors Reported for Each Species 2020 - 2021



Interactions with Urban Carnivores

Reports of Actions and Interactions

Of the 3,030 reports, a total of 478 (16%) showed actions and interactions with carnivores (Table 1). The categories of the interactions were identified through the observer's optional selection from a dropdown list of interactions that could have occurred. These include the following: 1) Animal made physical contact with pet or livestock, 2) Animal made physical contact with human(s), 3) Animal interacted with

human-related item or place (e.g., trash can, bird feeder, fence/yard, attic), and/or a written description of the interaction through the comments option. Other categories included interactions with a wild animal (9.6%), actions of predation/feeding (16.3%), and actions displaying playful behavior.

Carnivore Interactions with Human-made Objects or Places

Of the 478 reports of actions and interactions, 118 (24.7%) or ~4% out of the total 3,030 reports, described a carnivore interacting with a human-made object or place with 69 (4.4%) categorized as positive and 49 (10.3%) categorized as negative. Reporter comments revealed observations of coyotes, raccoons, and bobcats in backyards, gardens, and along fences. Other comments indicated opossums eating pet food left outside and raccoons interacting with water features like bird baths. Black bears and raccoons were reported as interacting with garbage/compost bins, as well as bird feeders. A single red fox was also observed interacting with a bird feeder. Some comments indicated cougars, bobcats, and black bears along fences trying to get into chicken coops. A few comments described raccoon mothers utilizing areas under decks as dens for raising young.

Carnivore Interactions with Animals: Domestic and Wild

Of the 478 reports of actions and interactions, 66 (~14%) or ~2% of the total 3,030 reports, described a direct interaction between a carnivore and a domestic animal (pet or livestock). There were 33 (6.9%) instances of a carnivore observed physically attacking the pet or livestock. Of the latter, coyotes represented the majority at 27, followed by two black bears, two raccoons, one cougar, and one bobcat. Most coyote direct interactions were considered ‘attacks’ on cats and dogs. The black bear and bobcat incidents involved chickens and the raccoon incidents involved chickens and one unspecified pet. The comments in many of the reports of carnivores making physical contact with pets or livestock included chasing, eating, or carrying dead cats in their mouths; attacking, chasing, or killing dogs of various sizes; and attacking or eating chickens. Some examples of these comments included, *“2 coyotes attacked our beagle while in our yard. Life threatening injuries, but she survived attack after hospitalization”, “Human smacked raccoon with a large rain boot to keep it away from pet.", "Black bear broke through my wood fence and broke into my chicken coops and ate 10 of my pet chickens", and "[Coyote] dug under my fence and attacked my dog in my front yard. Had to put my dog down."* Although the previous incidents were challenging and sometimes tragic for pet and domestic animal owners, they only comprise 1.09% of the 3,030 total reports.

Carnivore Interactions with Humans

Of the 478 themed reports of actions and interactions, ten (2.1%) reported direct interactions between a human and carnivore (0.03% of the total 3,030 reports) with eight (1.7%) categorized as negative. The ten direct human-carnivore interactions reported were with coyotes (6 reports), opossums (2 reports), and raccoons (2 reports). Of those ten direct human-carnivore interactions, three reports indicated the presence of pet dogs with one instance of a small leashed dog (up to 20 lbs), one instance of large unleashed dog (60 lbs+), and two instances of medium dogs (20-60 lbs) that were not marked as leashed or unleashed. In the direct interactions between humans and carnivores, people's responses included walking away (5 instances), staying quiet (2 instances), shouting or making noise (2 instances), and one instance in which the comment describes three men chasing a coyote away with a baseball bat.

Out of the 478 reports of actions and interactions with carnivores there were 78 (16.3%) instances of predation/feeding behaviors, 46 (9.6%) interactions with wild animals, and 11 (2.3%) playful behaviors reported.

Table 1. Categories related to interactions between carnivores and human-made objects, humans, domestic animals/pets, and wild animals; Also observed actions of carnivore predation/feeding and playfulness; n = 478 (2020-2021)

Categories of CS Reports (Actions)	Number reported
All interactions with human-made objects/places	118 (24.7%)
Interaction with a domestic animal/pet	67 (14.0%)
Interaction with other wild animal	46 (9.6%)
Predation / feeding	78 (16.3%)
Carnivore was playful	11 (2.3%)
Negative Interactions with human-made objects/places	49 (10.3%)
All interactions with humans	10 (2.1%)
Carnivore physically attacks domestic animal/pet	33 (6.9%)
Negative Interactions with humans	8 (1.7%)

Analysis of Human Sentiment Towards Carnivores

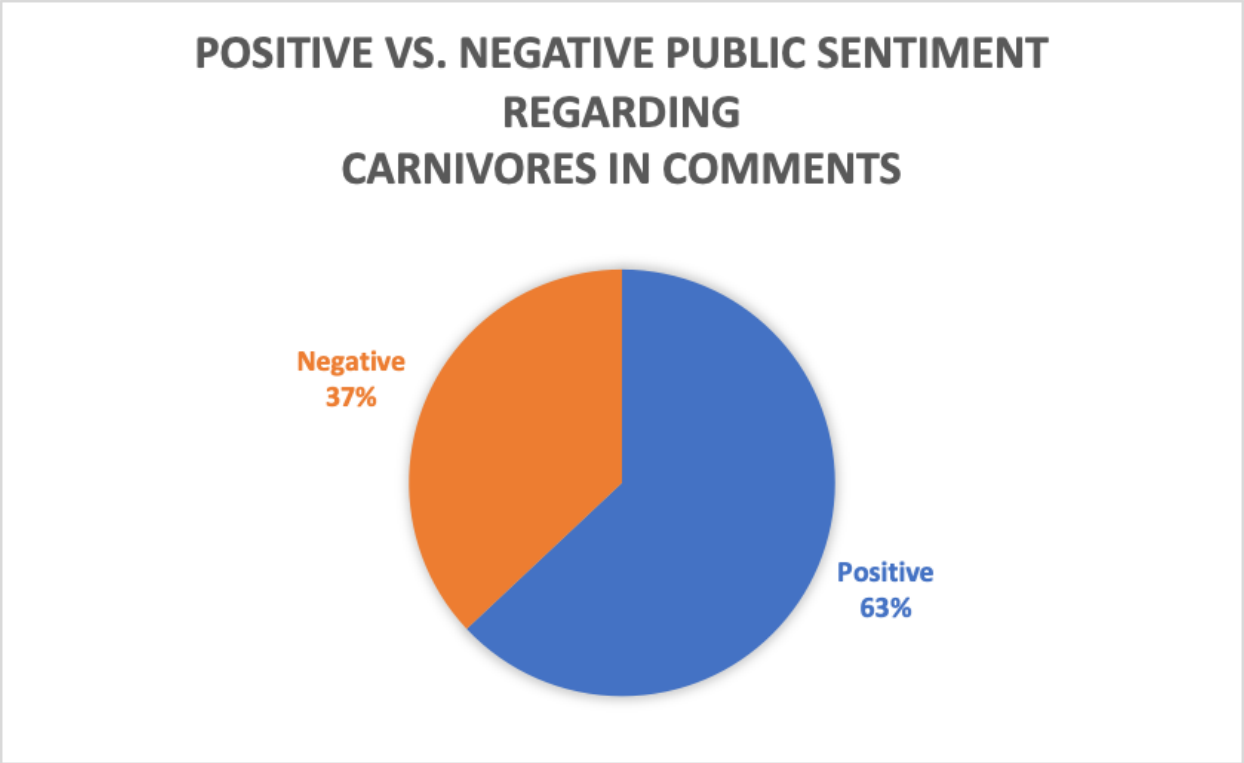
Any comments that expressed positive or negative feelings towards a carnivore were coded into themes so that we could analyze those sentiments (Table 2). Positive themes were assigned to comments that expressed empathy, thankfulness, curiosity, and wonder from encounters with carnivores. Negative themes were assigned to comments that expressed concern for safety or desire to get rid of carnivores within urban spaces. We included a table of common words used in comments that express positive or negative sentiment towards carnivores (Appendix XII).

Table 2. Themes related to human sentiment towards carnivores 2020-2021

Categories of CS Reports (Feelings)	Number reported
Positive feelings of reporter towards carnivore	39 (63%)
Negative feelings of reporter towards carnivore	23 (37%)
User explicitly expressed empathy for the carnivore	15 (24.2%)
User explicitly expresses feeling unsafe about urban carnivore presence	10 (16.1%)
User explicitly expressed thankfulness for the application	12 (19.4%)
User explicitly expresses they want to get rid of urban carnivore presence	13 (21%)
User explicitly expressed curiosity and wonder about carnivore	12 (19.4%)

Of those that expressed either a negative or positive sentiment within the comments in Carnivore Spotter, 63% of reports showed positive sentiments regarding their carnivore encounters and 37% showed a negative response (Figure 9).

Figure 9. Positive vs. Negative Public Sentiment Regarding Carnivores in Comments.



Discussion

Through the contributions of Carnivore Spotter reports by community members we have gained a better understanding of human interactions with carnivores in urban spaces in the greater Seattle area, and how people feel about sharing space with urban carnivores including coyotes, bobcats, black bears, raccoons, cougars/mountain lions, red foxes, river otters, and Virginia opossums.

Carnivore Species Reports by Month, Time of Day, and Media

Overall, coyotes were the most reported species making up ~50% of reported observations and/or interactions throughout the year, at various times of day, and with the greatest geographic distribution. Raccoons were the second most reported species, followed by bobcats, river otters, bobcats, and black bears. Cougars/mountain lions, Virginia opossums, and red foxes. The number of carnivore reports per month showed little variability with an average of 187.5. The number of carnivore sightings of all species showed higher numbers in April, May, and June 2021, closely followed by August 2020 and October 2021. September 2021 had 40 more reports than September 2020, and November 2021 had 41 fewer reports than November 2020. Coyote reports were highest in April and October 2021 and lowest in September 2020.

Carnivores were sighted at various times of day with most reports made between 3:00 a.m. and 7:00 a.m. and the lowest between 10:00 a.m. - 11:00 a.m. Unsurprisingly, coyotes were the highest reported species at all times of day with peak observations between 5:00 a.m. and 6:00 a.m. and the lowest between 12:00 a.m. and 1:00 a.m. Even though daytime sightings of coyotes might indicate increased coyote habituation to humans, this does not necessarily correlate to increased aggression since coyotes tend to avoid people (Drake, Dubay, and Allen, 2021). Raccoon observations were the second highest with peaks between 3:00 a.m. and 4:00 a.m. and lows between 8:00 p.m. and 9:00 p.m. It is important to note that the time of day that people observed carnivores does not represent actual daily and nightly activity patterns of carnivores, but only indicates when people were more likely to observe them.

Of the 3,030 total submitted reports, 20% included media (i.e., photo or video) (Figure 4). Of the reports with media, the majority were confirmed to be coyotes, followed by raccoons, bobcats, and black bears. The remaining species reports including river otters, Virginia opossums, cougars, and red foxes were below 5%. Although only reports with media were used to verify species sightings by Carnivore Spotter staff members, the remaining 80% were still included in this annual report. Perhaps future education and outreach could include encouraging observers to take photos and video for more accurately reported sightings.

Geographic Distribution

Reports of carnivores came from various regions across Washington state. Coyotes showed the greatest geographic distribution throughout Seattle areas, followed by raccoons. The varied distribution of coyotes and raccoons suggests these species have responded to landscape factors such as habitat fragmentation from urban density, and the resulting lack of greenspace by altering their natural dispersal patterns (Magle et al., 2021). Bobcats, cougars, and black bears were mostly spotted east of Lake Washington. Despite the few reports of the bobcats, black bears, and cougars in Seattle regions, it is clear that these animals occasionally venture into densely populated urban areas. This could lead to potential conflicts with humans. On the rare occasions when cougars venture into residential areas, they generally avoid encounters with humans by changing their movements and behaviors (Kertson and Keren, 2021). Red fox reports were only outside of Seattle with only one report with a photo from Anacortes located in the San Juan Islands area, which has a known population of red foxes (Wilde, 2018).

Since Seattle had a majority of overall carnivore reports submitted from northern regions and a lower number of reports from central and southern regions, further outreach towards the latter communities could be considered. Since Woodland Park Zoo (WPZ) is located in northeast Seattle, we have engaged in community outreach and education about Carnivore Spotter with WPZ audiences including members, staff,

and volunteers. It is likely that residents of northern Seattle neighborhoods who are connected with WPZ have greater awareness of Carnivore Spotter. By promoting Carnivore Spotter in other regions of Seattle we may develop a clearer understanding of the geographic distribution of reports across the greater Seattle area. Current users of Carnivore Spotter can aid with promoting awareness of Carnivore Spotter by sharing about it with family, friends, colleagues, neighbors and other contacts.

Most of the top ten Seattle neighborhoods with reported carnivore sightings were from higher median income areas. While Carnivore Spotter does not collect socioeconomic data of reporters, some studies have shown a positive correlation to higher income neighborhoods and greater species biodiversity that could attract more local carnivores (Magle et al., 2021). Further investigation of social and economic factors, such as the greater Seattle area's history of redlining is vital.

Actions and Interactions with Urban Carnivores

According to observer selections from Carnivore Spotter's dropdown menu, carnivores interacted the most with human-related objects or places such as trash cans, bird feeders, and fences/yards, or attics. Additional observer comments indicated carnivore interactions with specific objects and places near human dwellings including backyards, fences, decks, garbage/compost bins, chicken coops, bird feeders, bird baths, and pet food bowls. These observations are reminders that we share space with these carnivores. It is important to consider ways we can foster coexistence by encouraging people to take extra care by securing trash bins, chicken coops, and preventing carnivore access to human or pet food as potential food sources.

Observed behaviors of predation/feeding were only ~2.5% of all reported sightings. Accurately identifying a carnivore attempting to eat another animal can be challenging. While behaviors such as hunting, stalking, and aggression can indicate an attempt to eat another animal, those behaviors may not lead to an act of predation that includes consumption. Observers describing a carnivore trying to eat another animal in their comments may have inferred predation based on behaviors of hunting or stalking. It is important to distinguish animal behaviors from human interpretations of those behaviors (Rychyk & Alexander, 2019). We considered reports of carnivore predation on other animals only when observer comments indicated that a domestic animal/pet was being targeted by a carnivore or that the carnivore had the animal in their mouths and/or was carrying them away.

Of the 3,030 total reports, only ~2% included a direct interaction between a carnivore and a domestic animal/pet. There were 33 instances of a carnivore observed physically attacking the pet or livestock. Reported comments of carnivores making physical contact with pets, included chasing, eating, or carrying dead cats in their mouths, attacking, chasing, or killing dogs of various sizes, and attacking or eating

chickens. Although uncommon, coyotes represented the majority of reported encounters with cats and dogs. These findings correspond with other studies that demonstrate that coyote interactions are generally infrequent or benign despite negative media attention of coyote attacks on pets (Drake, Dubay, & Allen, 2021; Mowry et al., 2021).

Direct interaction between a human and carnivore was rare, making up only ~0.03% of all reports. Reports that included aggressive interactions with coyotes tended to involve the presence of cats or dogs or anthropogenic food sources such as pet food, which corresponds with other research (Draheim et al., 2013; Drake et al., 2021). Although these incidents were infrequent, we recommend taking precautions when leaving pets or livestock outside unattended. In interactions between humans and carnivores, the majority of people stayed quiet, while others shouted/made noise or walked away. In reports where people shouted or made noise, some indicated the carnivore responding by running or walking away. This suggests that when encountering a carnivore, yelling or making noise may mitigate potential conflict with the carnivore.

Human Sentiment Towards Carnivores

The comments related to concerns and general feelings towards urban carnivores were analyzed for various themes and categorized as either positive or negative. Reports showed a majority of positive themes that expressed empathy, thankfulness, curiosity, and wonder from encounters with carnivores. The remaining reports with negative themes expressed concern for safety or desire to get rid of carnivores within urban spaces. Studies have shown that perception can have a stronger influence on human attitudes towards carnivores than knowledge (Kellert, Black, & Rush, 1996). Some reporter comments expressed outrage and demanded to have carnivores, particularly coyotes, removed or eradicated. Negative attitudes can incite intolerance by labeling some species as undesirable “pests", which can impact how species are controlled and managed (Draheim et al., 2013; Klees van Bommel et al., 2020). People with intolerant attitudes towards a species are also more likely to approve of lethal control methods (Lute & Carter, 2020).

Although our analysis showed a low percentage of negative experiences between humans and carnivores, and carnivores and pets/livestock, we feel empathy for our fellow community members who have faced the loss of a beloved pet from a local carnivore. The powerful feelings and bonds humans have with their animal family members should be considered for future education and outreach.

Coexistence through Community Education and Outreach

Understanding public attitudes and perceptions of coyotes and other carnivores is important for education or outreach campaigns (Draheim et al., 2013; Gehrt & McGraw, 2007; Santana & Armstrong, 2017). Wildlife managers might consider tailoring messages to specific demographics and social groups to ease public concerns and clarify misunderstandings (Draheim et al., 2013; Lu, Siemer., Baumer, & Gulde, 2016). Public education that focuses on human behavior modifications can promote coexistence with carnivores and prevent conflicts, especially concerning proactive solutions around anthropogenic food sources that invite these species into human occupied areas (Gehrt & McGraw, 2007). Proactive mitigation measures are recommended to reduce food attractants and protect livestock. These methods included wildlife-resistant bins, compost containment, electric fences, and guardian dogs (Klees van Bommel et al., 2020).

The Seattle Urban Carnivore Project promotes coexistence through community science, public education, and outreach. This is encouraged through garbage, compost, and recycling management, and suggestions for staying safe if encountering a carnivore (Woodland Park Zoo, 2021b). Given human connections between people and their pets, reaching out to pet owners to encourage human behavior changes could help protect pets and reduce conflict with carnivores (Draheim et al., 2013; Kertson & Keren, 2021). This includes owners keeping pets and pet food indoors, as well as keeping dogs leashed when taken on walks. In addition, further investigation of socioeconomic factors, such as the greater Seattle area's history of redlining, is vital for greater understanding of species distribution (Magle et al., 2021). This could promote equity, leadership, and collaboration that allow historically underrepresented communities to be seen and heard.

The data collected over the course of this past year has provided us with deeper insight on urban carnivores within Seattle and will help us increase our understanding of these species to contribute to cultivating coexistence between wildlife and human communities. We hope to continue to learn more about the carnivores within these urban spaces by comparing the data from Carnivore Spotter with our wildlife camera data for the Seattle Urban Carnivore Project. We are very grateful to those who submitted comments in their reports. Reading your comments is vital in understanding how we can more efficiently provide recommendations and resources to our community members as they encounter carnivores. Thank you for using Carnivore Spotter and sharing your carnivore encounters! We could not have had such a successful second year without your support. We look forward to hearing about your further sightings of urban carnivores!

Relevant Links:

- Carnivore Spotter: https://carnivorespotter.org/urban-carnivore-spotter/
- Carnivore Spotter and Seattle Urban Carnivore Project Description Webpage: https://www.zoo.org/carnivorespotter
- Frequently Asked Questions About Coyotes: https://www.zoo.org/seattlecarnivores/faq
- PAWS Wildlife Center for helping sick, injured and orphaned wildlife: https://www.paws.org/wildlife/
- Washington Department of Fish and Wildlife's Article on Living with Wildlife: https://wdfw.wa.gov/species-habitats/living
- Seattle Urban Carnivore Project: https://www.zoo.org/seattlecarnivores
- Seattle Urban Carnivore Project - Coexisting with carnivores information: https://www.zoo.org/coexisting

References Cited

Carnivore Spotter. (2022). Retrieved March 23, 2022 from https://carnivorespotter.org/

City of Seattle (2022). *Neighborhoods & Council Districts.* Retrieved May 14, 2022, from https://www.seattle.gov/neighborhoods/neighborhoods-and-districts

Draheim, M., Patterson, K., Rockwood, L., Guagnano, G., & Parsons, E. (2013). Attitudes of College Undergraduates Towards Coyotes (*Canis latrans*) in an Urban Landscape: Management and Public Outreach Implications. *Animals*, *3*(1), 1–18. https://doi.org/10.3390/ani3010001

Drake, D., Dubay, S., & Allen, M. L. (2021). Evaluating human–coyote encounters in an urban landscape using citizen science. *Journal of Urban Ecology, 7*(1), 1-7. https://doi.org/10.1093/jue/juaa032

Gehrt, S. D., & McGraw, M. (2007). *Ecology of Coyotes in Urban Landscapes*. [Conference session]. Proceedings of the 12th Wildlife Damage Management Conference, Omni Corpus Christi Hotel, Corpus Christi, TX, United States.

Kellert, S. R.; Black, M.; Rush, C. R.; & Bath, A.J. (1996). Human culture and large carnivore conservation in North America. *Conservation Biology, 10*(4), 977–990. doi:10.1046/J.1523-1739.1996.10040977.X

Kertson, B. N., & Keren, I. N. (2021). Cougar use of residential areas and interactions with people in periods of population stability and growth. *Journal of Mammalogy*. *103*(2), 347-360. https://doi.org/10.1093/jmammal/gyab145

Klees van Bommel, J., Badry, M., Ford, A. T., Golumbia, T., & Burton, A. C. (2020). Predicting human-carnivore conflict at the urban-wildland interface. *Global Ecology and Conservation*, *24,* . https://doi.org/10.1016/j.gecco.2020.e01322

Lu, H., Siemer, W. F., Baumer, M. S., Decker, D. J., & Gulde, A. (2016). Effects of message framing and past experience on intentions to prevent human–coyote conflicts. *Human Dimensions of Wildlife*, *21*(6), 506–521. https://doi.org/10.1080/10871209.2016.1198852

Lute, M. L., & Carter, N. H. (2020). Are we coexisting with carnivores in the American west? *Frontiers in Ecology and Evolution*, *8*, 48. https://doi.org/10.3389/fevo.2020.00048

Magle, S. B., Fidino, M., Sander, H. A., Rohnke, A. T., Larson, K. L., Gallo, T., Kay, C. A. M., Lehrer, E. W., Murray, M. H., Adalsteinsson, S. A., Ahlers, A. A., Anthonysamy, W. J. B., Gramza, A. R., Green, A. M., Jordan, M. J., Lewis, J. S., Long, R. A., MacDougall, B., Pendergast, M. E., Remine, K., Simon, K. C., St. Clair, C. C., Shier, C. J., Stankowich, T., Stevenson, C. J., Zellmer, A. J., Schell, C. J. (2021). Wealth and urbanization shape medium and large terrestrial mammal

communities. *Global Change Biology*, *27*(21), 5446–5459. https://doi.org/10.1111/gcb.15800

Mowry, C. B., Lee, A., Taylor, Z. P., Hamid, N., Whitney, S., Heneghen, M., Russell, J., & Wilson, L. A. (2021). Using community science data to investigate urban Coyotes (*Canis latrans*) in Atlanta, Georgia, USA. *Human Dimensions of Wildlife*, *26*(2), 163–178. https://doi.org/10.1080/10871209.2020.1806415

Rychyk, M. & Alexander, S. (2019). Web-GIS, Citizen Science and Human-Coyote Encounters in Calgary, AB. *Canadian Wildlife Biology & Management. Foothills coyote initiative, 8*(1). Retrieved from https://www.researchgate.net/publication/350235868

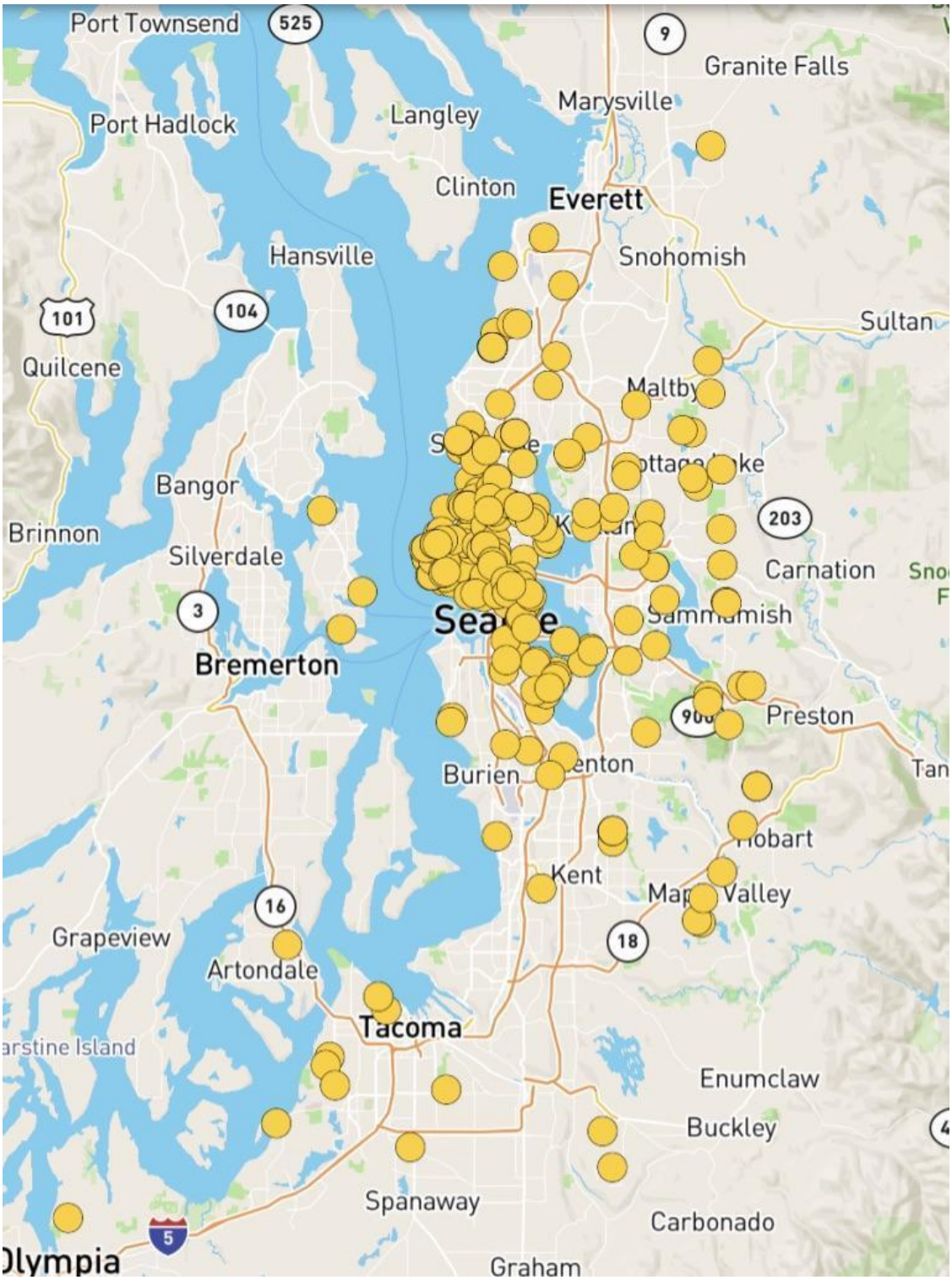
Santana, E. M., & Armstrong, J. B. (2017). Food habits and anthropogenic supplementation in the diet of coyotes *(canis latrans)* along an urban-rural gradient. *Human-Wildlife Interactions*, *11*(2), 156–166. https://doi.org/10.5070/v427110634

Wilde, L. (2018, April 8). *The foxes of san juan island*. AdventuresNW. Retrieved June 5, 2022, from https://www.adventuresnw.com/the-foxes-of-san-juan-island/

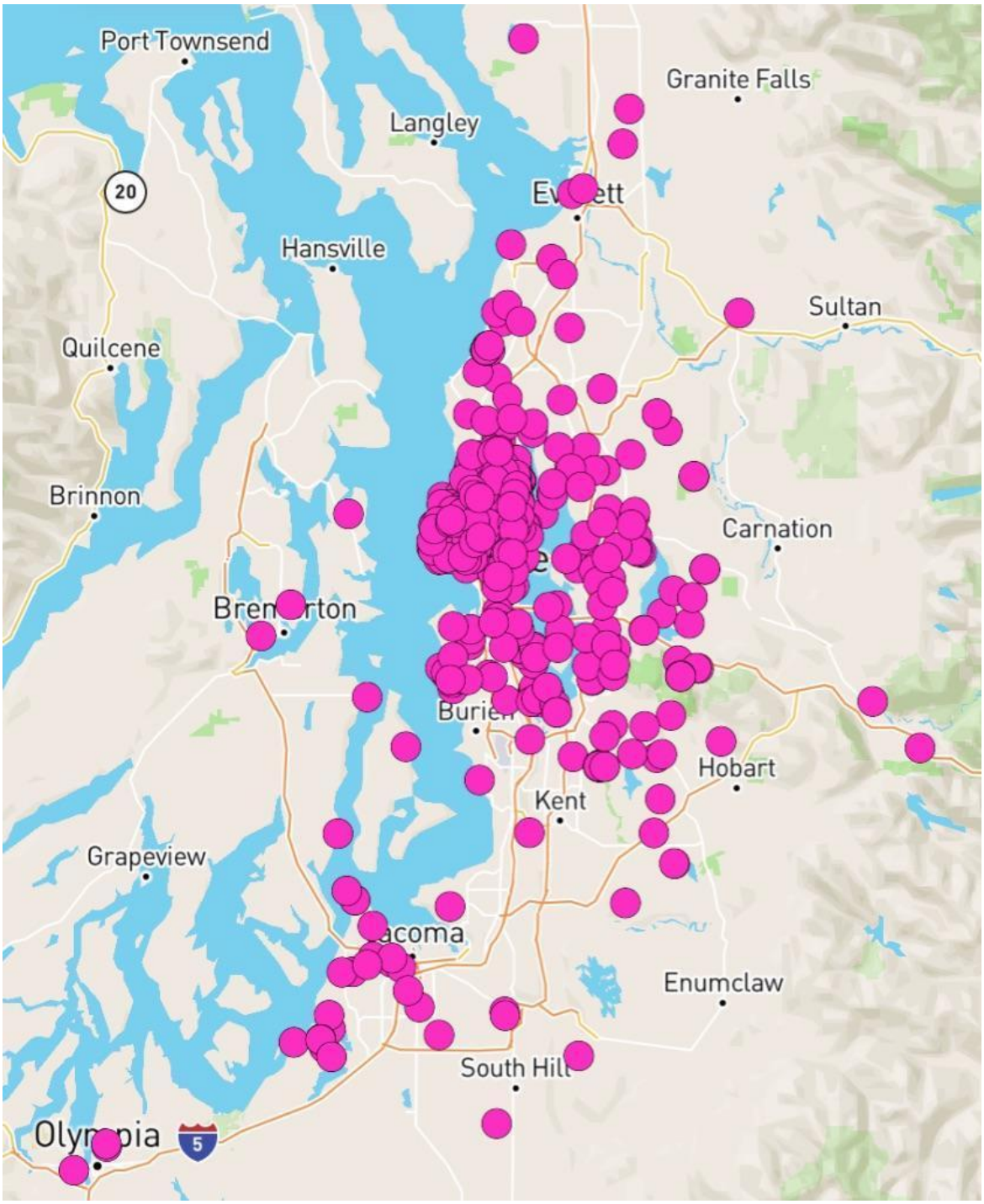
Appendix I: Table showing the different themes coded for within the data

Categories of CS Reports	Code
Feelings of reporter towards carnivore (Neutral)	F
Interactions with human-made objects (Negative)	ON
Interaction with a domestic animal (Neutral)	D
Feelings of reporter towards carnivore (Positive)	FP
Interaction with other wild animal (Neutral)	W
Predation / feeding (Neutral)	P
Carnivore was playful (Neutral)	PL
Interactions with human-made objects (Neutral)	O
Feelings of reporter towards carnivore (Negative)	FN
User explicitly expressed empathy for the carnivore (Neutral)	E
User explicitly expresses feeling unsafe about urban carnivore presence (Negative)	Unsafe
Carnivore physically attacks domestic animal or pet (Neutral)	A
Interactions with humans (Negative)	HN
Interactions with humans (Neutral)	H
User explicitly expressed thankfulness for the application (Positive)	T
User explicitly expresses they want to get rid of urban carnivore presence (Negative)	Problem
User explicitly expressed curiosity and wonder about carnivore (Neutral)	C

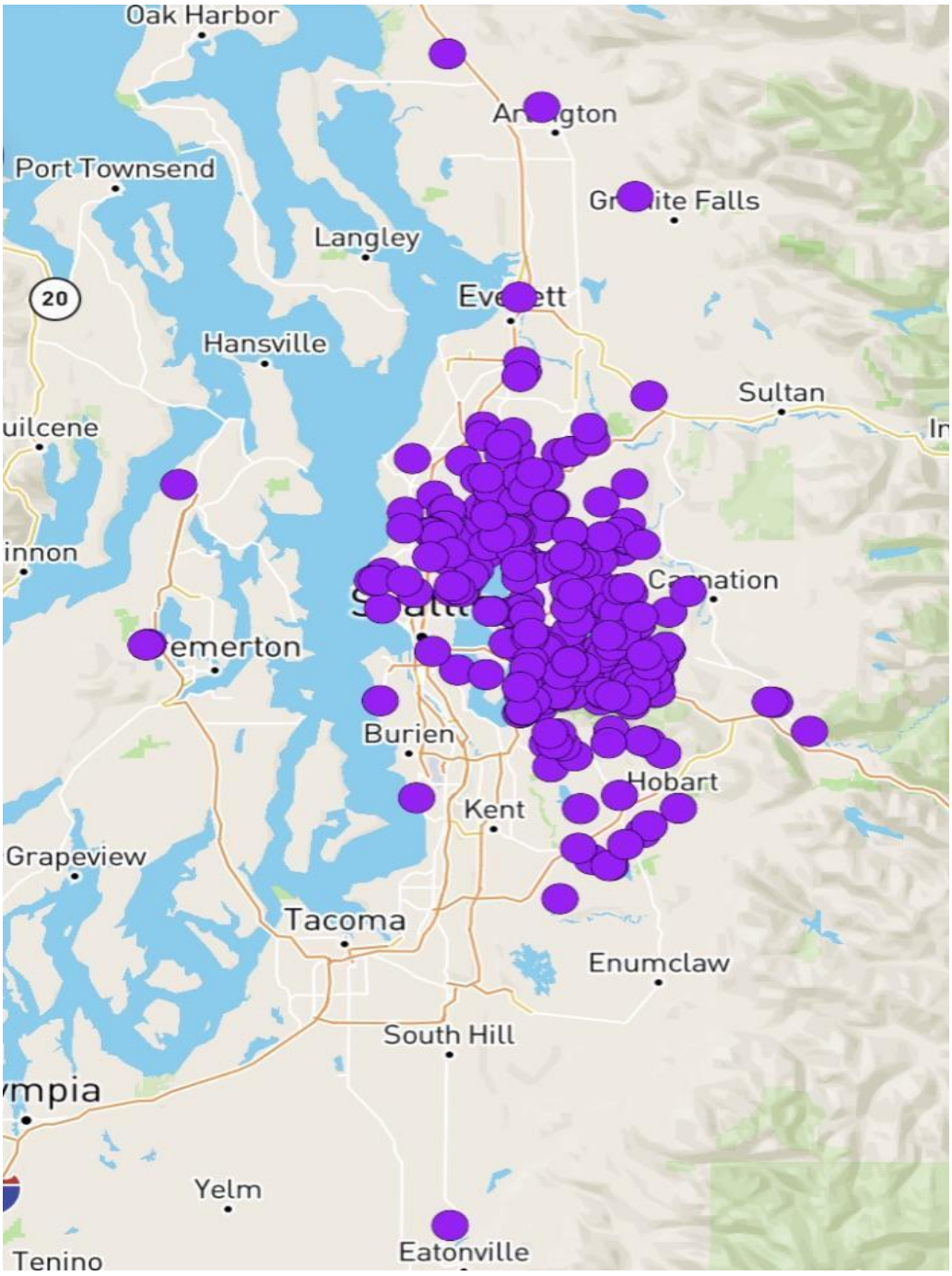
Appendix II: Geographic distribution of reports indicating sightings of coyotes (with media only due to greater overall numbers)



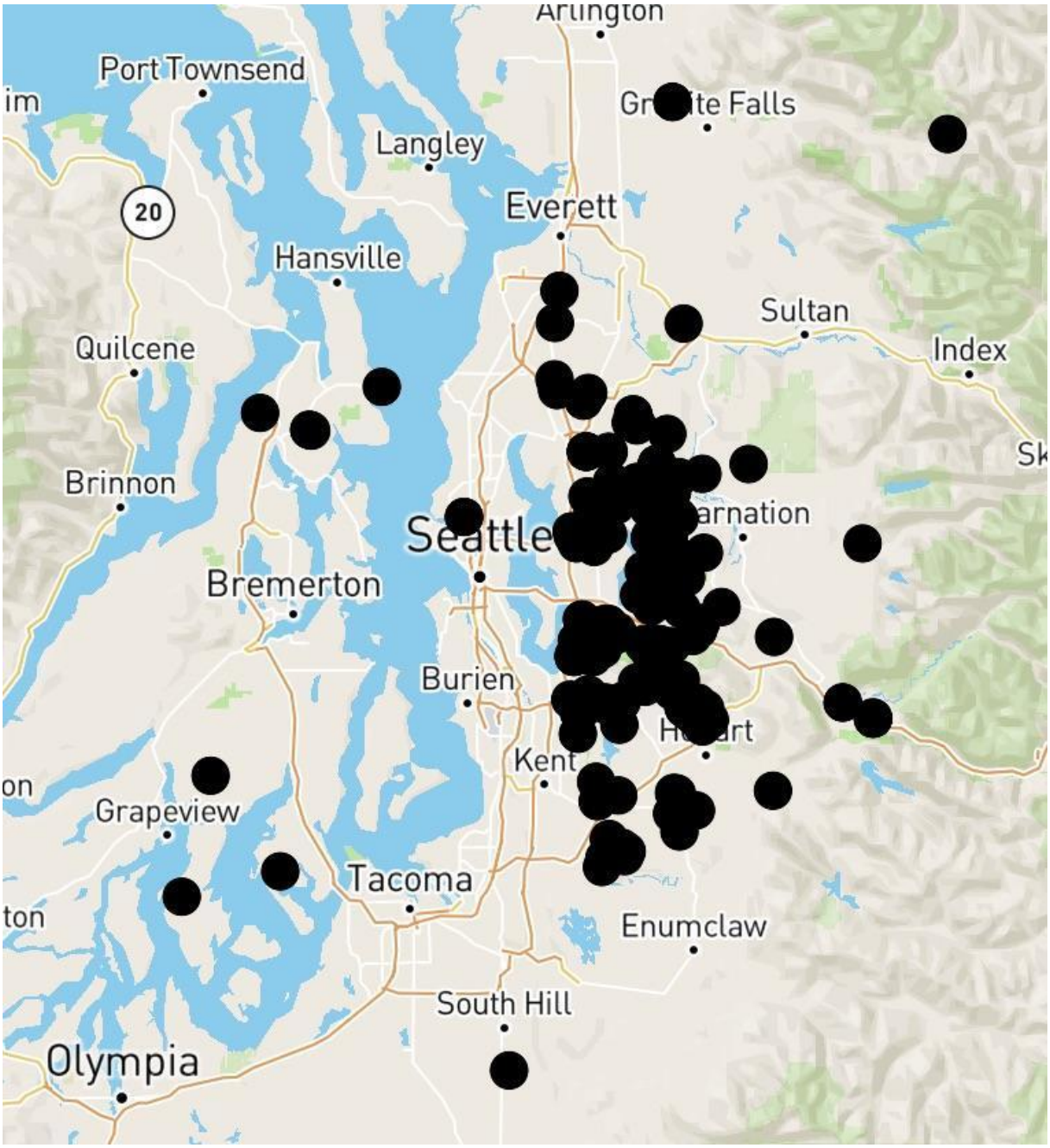
Appendix III: Geographic distribution of reports indicating sightings of raccoons (With and without media).



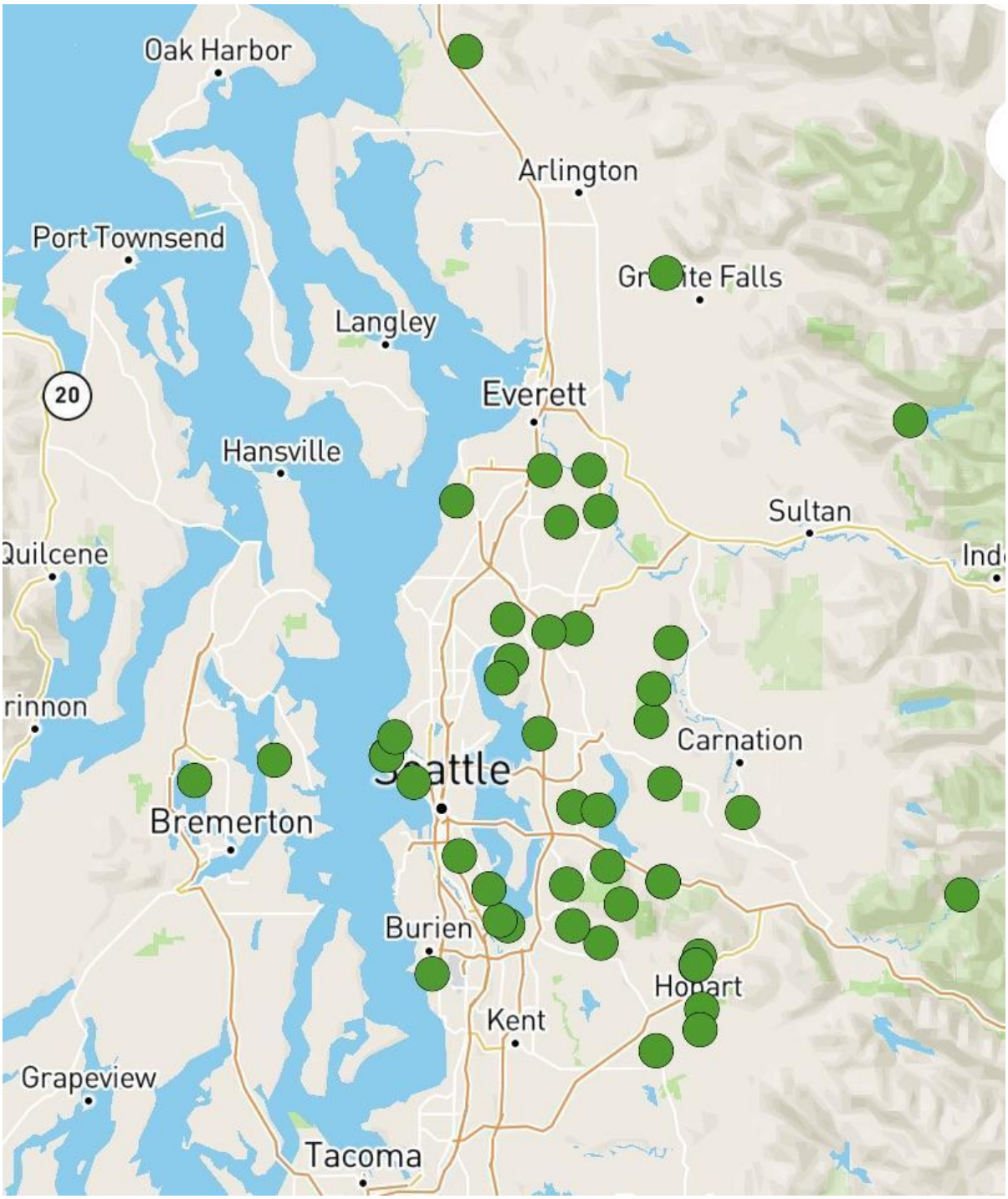
Appendix IV: Geographic distribution of reports indicating sightings of bobcats (With and without media).



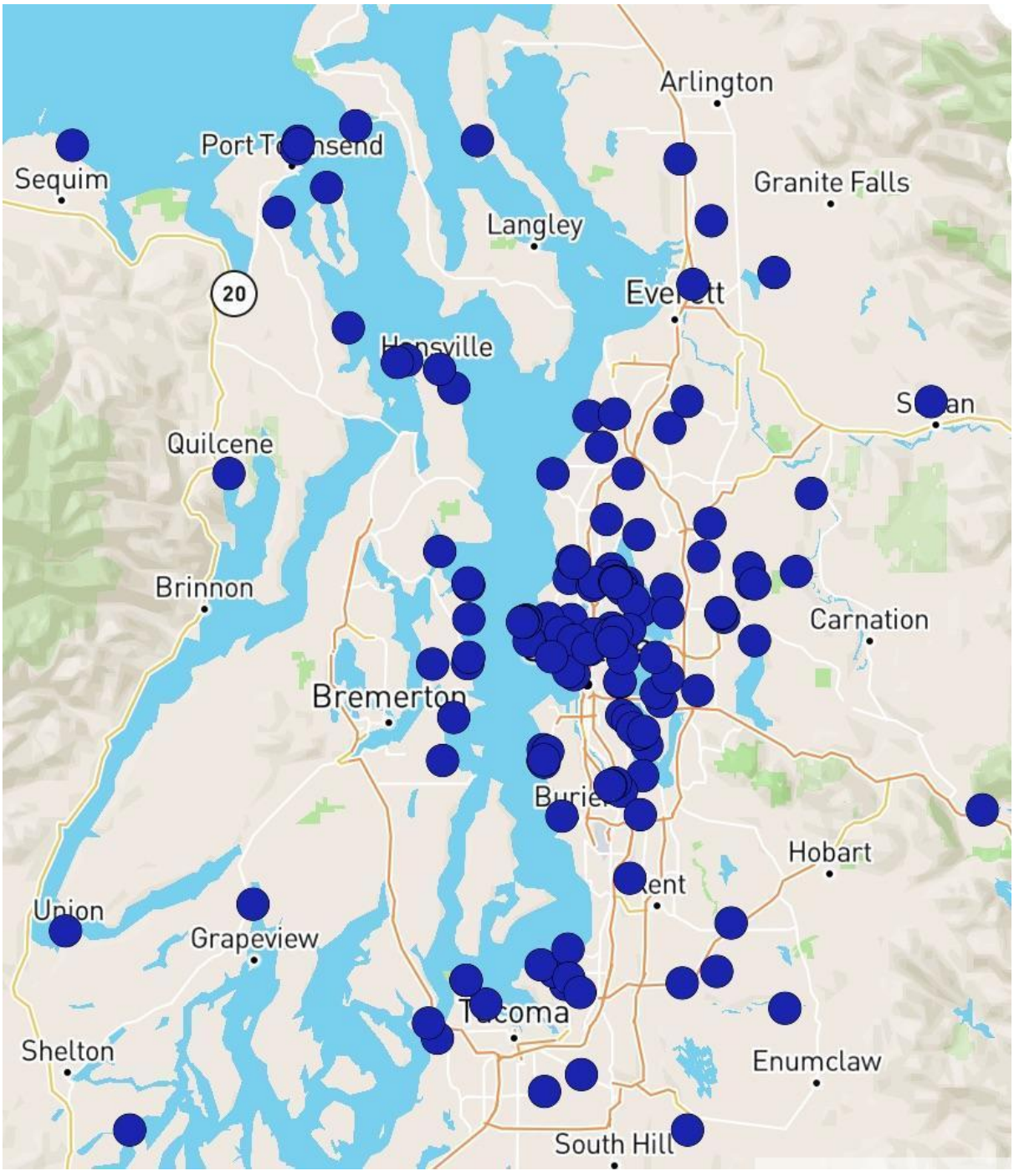
Appendix V: Geographic distribution of reports indicating sightings of black bears (With and without media).



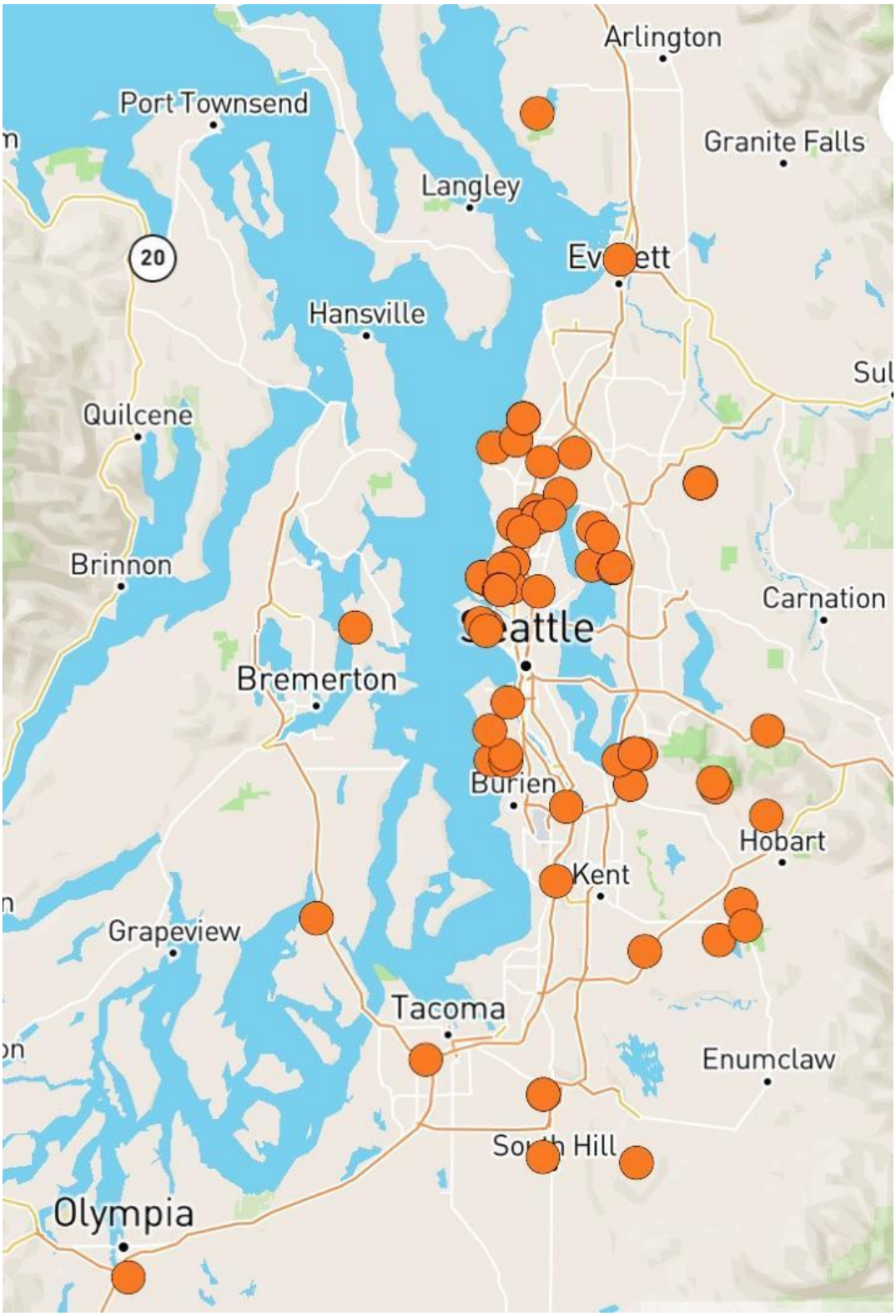
Appendix VI: Geographic distribution of reports indicating sightings of cougars/mountain lions (With and without media).



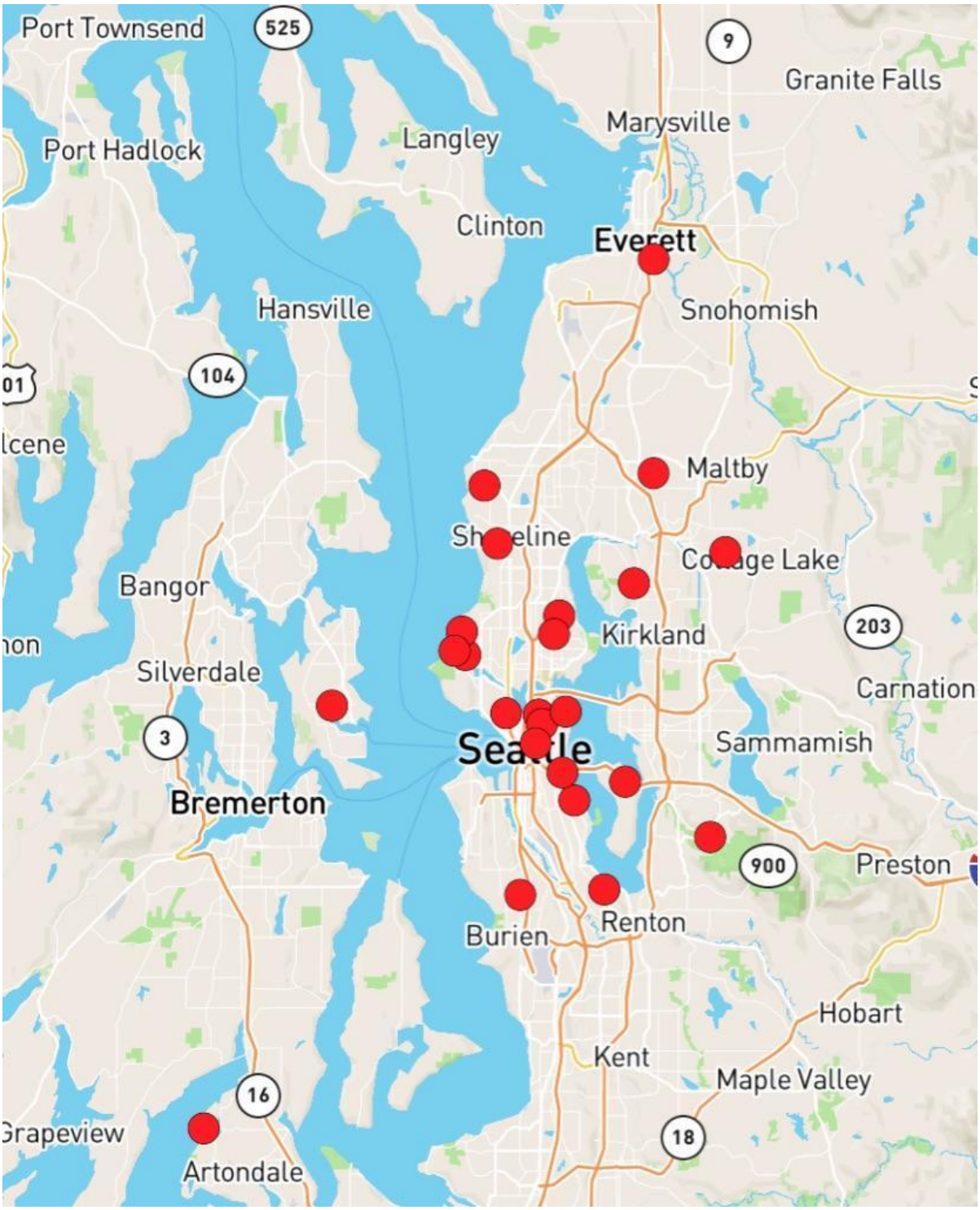
Appendix VII: Geographic distribution of reports indicating sightings of river otters (With and without media).



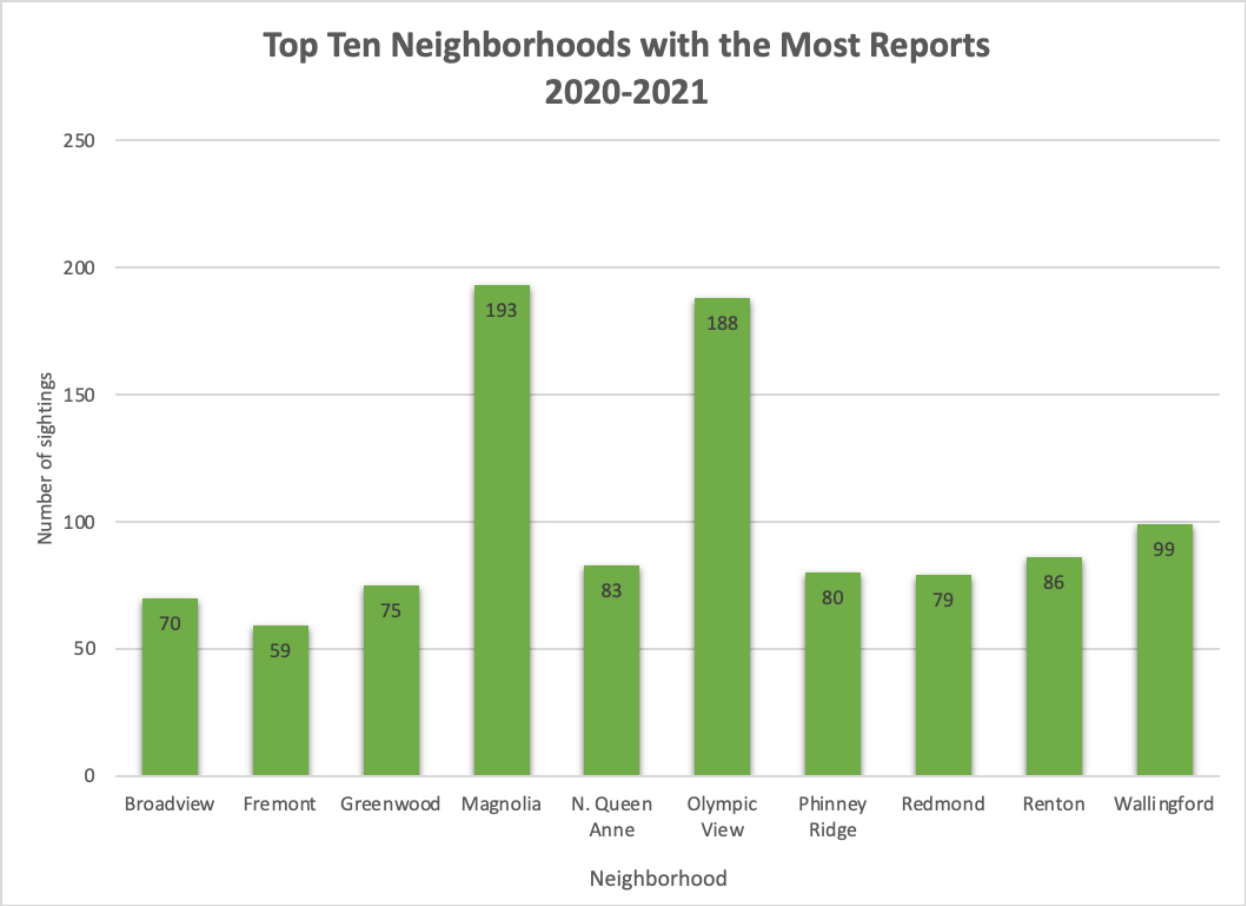
Appendix VIII: Geographic distribution of reports indicating sightings of Virginia opossums (With and without media).



Appendix IX: Geographic distribution of reports indicating sightings of red foxes (all without media). The only report with photos during the date range of this report was posted from the San Juan Islands area (off this map).



Appendix X: Top 10 Neighborhoods with the most reports 2020-2021



Appendix XI: Examples of language used in comments that expressed either a positive or negative sentiment toward the carnivore.

Negative	**Positive**
fear	coexist
afraid	hope
worried	cool
nervous	beautiful
concerned	good
aggressive	excited
animal control	great
danger	enjoy
hate	adorable
uncomfortable	cute
deter	okay
get rid	:)
pest	magical
issue	wonderful
:(	
unsafe	
911	