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### Authors

Kurniawan, Stephanie

Daum, Kim

Wannamaker, Macy

et al.

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# Tracking Wildlife Seasonality of Mesocarnivores in Alameda County, California

Stephanie Kurniawan, Kim Daum, Macy Wannamaker, Bridget Mooney, and Bea Tiburcio  
Alameda County Vector Control Services District, Alameda, California

**ABSTRACT:** Alameda County Vector Control Services District (ACVCSD) responds to requests for service regarding mesocarnivores due to their proximity to humans and potential as a rabies vector. Mesocarnivore related calls are the most common wildlife related calls with striped skunks, raccoons, and Virginia opossums being the most common species. They are adapted to suburban and urban environments and readily exploit human resources. We investigated these requests for services and categorized them by call type. We looked at the frequency of call types related to potentially seasonal behaviors and created a histogram to determine if certain types of calls are seasonal and if they are seasonal, to determine the temporal range and peak frequencies. We then compared the frequency and temporal range of these call types with information from academic institutions. We used this information to create an estimated timeline when these behaviors occur in Alameda County.

**KEY WORDS:** *Didephis virginiana*, *Mephitis mephitis*, mesocarnivores, *Procyon lotor*, raccoon, striped skunk, vector control, Virginia opossum, wildlife damage management

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## INTRODUCTION

Alameda County Vector Control Services District (ACVCSD) responds to Requests for Service (RFS) from the residents of Alameda County, California. Roughly one third of all requests involve wildlife, the most common being striped skunks (*Mephitis mephitis*), raccoons (*Procyon lotor*), and Virginia opossums (*Didephis virginiana*). These three species can be classified as mesocarnivores, which we define as small to mid-sized mammals with a diet that is roughly 50-70% meat. In suburban and urban environments, mesocarnivores have adapted to exploit human resources for food, water, and shelter. This results in increased encounters with humans that often result in human-animal conflicts.

Skunks, raccoons, and opossums are rabies vectors, with skunks being the second most important rabies vector in California after bats (CDPH 2024). They are also a common source of nuisance fleas that potentially spread pathogens from the animal to humans.

When residents of Alameda County request assistance from ACVCSD, a biologist performs an inspection at the location and gives recommendations on how to resolve or mitigate the conflict. Biologists use IPM principles during the inspection and give recommendations specific to the situation. These Requests for Service may involve reproductive behaviors, nesting behaviors, or other behaviors that cause conflict with humans. These behaviors are assumed to have a seasonal pattern that appear to occur outside the ranges published by extension programs and institutions. For example, studies done in northwestern Illinois showed that the breeding season was restricted to a short period between late February and early March, and that this period was consistent from year to year. Skunks in Oregon were also shown to be synchronized although skunks in New York had much wider ranges (Vert 1967). Many of these studies are done in areas with climates different from California. Breeding dates may have been influenced by climate in some areas, as male skunks may be immobile due to deep snow covering winter dens (Vert

1967). However, this concept has only been supported by anecdotes from ACVCSD staff and has not been investigated further. If these behaviors have seasonality specific to Alameda County and that seasonality can be predicted, a timeline can be created to help tailor IPM recommendations.

We investigated Requests for Service (RFS) from Alameda County residents that involved mesocarnivores and categorized them by type of call. We then plotted the frequency and range of these behaviors and traits of these call types and compared them to published sources. We wanted to investigate if Alameda County mesocarnivores have seasonal behaviors that can be tracked and whether this seasonality is different from what is reported in other parts of the United States. By systematically examining these Requests for Service and categorizing them by seasonal behaviors, we can create a timeline specific to Alameda County. This will allow for better decision-making regarding wildlife conflict resolution and better predict when such behaviors may begin or end. It can also give some insight on whether Alameda County significantly differs from other locations, regarding wildlife seasonality.

## Hypothesis:

- Alameda County mesocarnivores have behaviors that can be tracked via Request for Service data and they have a seasonal pattern.
- Alameda County mesocarnivores have a seasonal pattern of behavior that differs from what has been reported from academic sources.

## METHODS

### Data Collection

We collected all Requests for Service from Alameda County Vector Control's database from 2021-2022 involving skunks, raccoons and/or opossums. We read the narrative

for each call and selected calls that belonged to these two categories:

- **Confirmed:** biologist saw the reported animal (in person/on camera) or observed identifiable animal hair/feces, pawprint etc. indicating recent activity.
- **Suspected:** biologist investigated, and the situation/evidence observed is consistent with the reported animal, but the biologist could not observe enough concrete evidence to confirm if the activity was recent or confirm the identity of the suspected animal.

We investigated each RFS further and labeled them with a tag if they contained any of the following traits/behaviors:

**Kits/Joey:** RFS involves a lactating female animal and/or dependent (likely unweaned) young. It is important to verify if there are potential kits or joeys before using a one-way door. One-way doors are common devices used to allow an animal to exit a den while preventing re-entry. Use of a one-way door when there are dependent young present may lead to separation of mother and litter, potentially resulting in death of the litter or extreme distress for the mother. The mother animal may show increased aggression and destruction of residents' property as she attempts to retrieve her young. To prevent this from happening, ACVCSD staff employ remote monitoring cameras during the months when young may be present in a den. Camera footage can be used to identify lactating mother animals and/or dependent young.

**Presence:** Animal is seen on property but is not living on the property. It includes animals accidentally trapped in structures. Presence of an animal reported by residents may be due to increased travel or individuals looking for resources.

**Harboring:** Animal is living on the property, and a den is confirmed. The three mesocarnivores in this study often use human structures for shelter including decks, foundations, sheds, and in house crawlspaces. If there are no young present, one-way doors may be utilized. Residents hear noises in their homes or report animals repeatedly going in and out of a location. Is this behavior associated with reproductive status? Does this happen primarily during mating and kit/joey season? According to Vert (1967), female skunks in captivity began preparing for birth by removing nesting material in their nest boxes. This may make it more obvious that a skunk is residing in a den and is close to or have given birth recently.

**Smell:** Skunk spray smell was reported by the resident. Skunks are not odorous until they spray, usually out of defense or surprise, or if they are recently deceased. The increase of skunk smell in an area or the occurrence of a pet or person being sprayed by a skunk is commonly associated with the mating season in mainstream media (Carmichael 2024). Male skunks increase their range during mating season in search of female skunks and may be more likely to get into conflict with cars, pets, and/or

humans (Pierce and McNeely 2022). Additionally, males spray each other as they compete for mates. Female skunks that have already mated fought males attempting to mount as early as 1 week after mating. This was used as a sign of successful mating prior to detectable uterine swelling (Vert 1967).

**Latrine:** Raccoon latrine is found on the property. Raccoons use communal sites to defecate. Raccoon latrines are the communal toilet of raccoons, usually multiple raccoons using the same site. Locations are typically at the base of what they are climbing, or on roofs, and often near an area of convenience. Latrines are a public health concern because they may contain infectious raccoon roundworm eggs that can be harmful to humans and pets if ingested. Is the presence of latrines close to human habitation associated with time of year?

**Digging:** Animal damage to lawn or decorative vegetation that is the result of an animal searching for protein food sources, such as turf grubs and worms. A common type of turf grub that mesocarnivores search for is the white grub, which are Scarab larvae (Flint and Sutherland 2016). During the fall in California, larvae of this species are large and close to the surface of the turf. Determining when mesocarnivores start digging and scavenging for these grubs can better direct residents to act proactively, thereby reducing conflict.

**Sick/Dead:** Sick or dead animal on property. Is the presence of sick or dead animals near human habitation related to time of year? For example, it could be due to increased travel during mating season or dispersal of young after they are weaned. (Or changes in temperature could affect disease transmission).

Frequency of each type of call was calculated per week and was plotted on a histogram using R and RStudio (R Core Team 2023, RStudio Team 2023).

### Comparison with Other Sources

We looked for academic sources, preferably peer reviewed, whenever they were available and recorded the reported "seasons". In our figures (see below) the range of each season is presented as a box and displayed on top of the histogram.

#### University Extension Programs

- University of California IPM (Baldwin 2014, Baldwin 2015a, Baldwin 2015b)
- PennState Extension (Birmingham 2006)
- University of Nebraska-Lincoln NebGuide (Ferraro et al 2006)
- University of Missouri Extension (Pierce and McNeely 2022)

#### Government Agencies

- Washington Department of Fish and Wildlife (WDFW 2024)
- Massachusetts Division of Fisheries and Wildlife (MDFW 2024)

*Other*

- Raccoons in the Attic Nationwide Service (RIANS 2024): The only non-institutional or government agency used on the list. It is an organization of wildlife removal technicians. They had interesting anecdotal information from their technician regarding raccoon behavior that was more in-depth than many other websites.

**RESULTS**

**Kits/Joey**

**Skunks**

We used lactation in an adult skunk as a proxy for soon-to-be and current mothers because newborn skunk kits are often difficult to see without accessing the den. Weaning is complete when skunks are about two months old. At this age, young begin to accompany the mother on hunting trips and families are maintained until autumn (Vert 1967). At this stage, one-way doors can be used if the door is large enough to fit the animal, but small enough where the door is not too heavy for the animal to push open. We used the last confirmed sighting of mother skunks with their young outside the den to mark the end of the “litter season”. The earliest instance of a confirmed lactating mother skunk in Alameda County was in early March for both 2021 and 2022 (Figure 1). The latest confirmed sighting of kits outside of their den before leaving was June 25.

Skunk gestation lasts for approximately 9 weeks (Baldwin 2015), and a minimum of 4 months is required

between conception and weaning of young (Vert 1967). If we assume a lactating skunk is close to giving birth, we can estimate roughly when the skunk was mated. The skunks that were confirmed lactating in early March could have mated as early as December. December is earlier than the February to March “mating seasons” stated in other sources (Figure 1). Several sources had “birthing” seasons that occur later than several of the confirmed kit/joey RFS.

**Raccoons**

We also used lactating mothers as proxy to determine if there were new mothers or soon-to-be mothers. The first lactating female raccoons confirmed on camera were March 25 in 2021 and March 15 in 2022 (Figure 2). Raccoon families are easier to detect by residents because they prefer to live in attics and crawlspaces. Mother raccoons creating dens often cause obvious destruction, and raccoon kits can be loud with their distinct chattering calls and movements. Like skunks, raccoon kits stay with their mother. The latest confirmed raccoon kits in den with their mothers (before they were confirmed to have left) was on November 22 in 2021, however; it appears to be an outlier because it is the only confirmed call in the fall season. There are suspected raccoon kit calls in fall for 2022, but the biologists only noted hearing “chattering” noises that are commonly associated with young raccoons, and there was no confirmation by camera that it belonged to a raccoon kit.

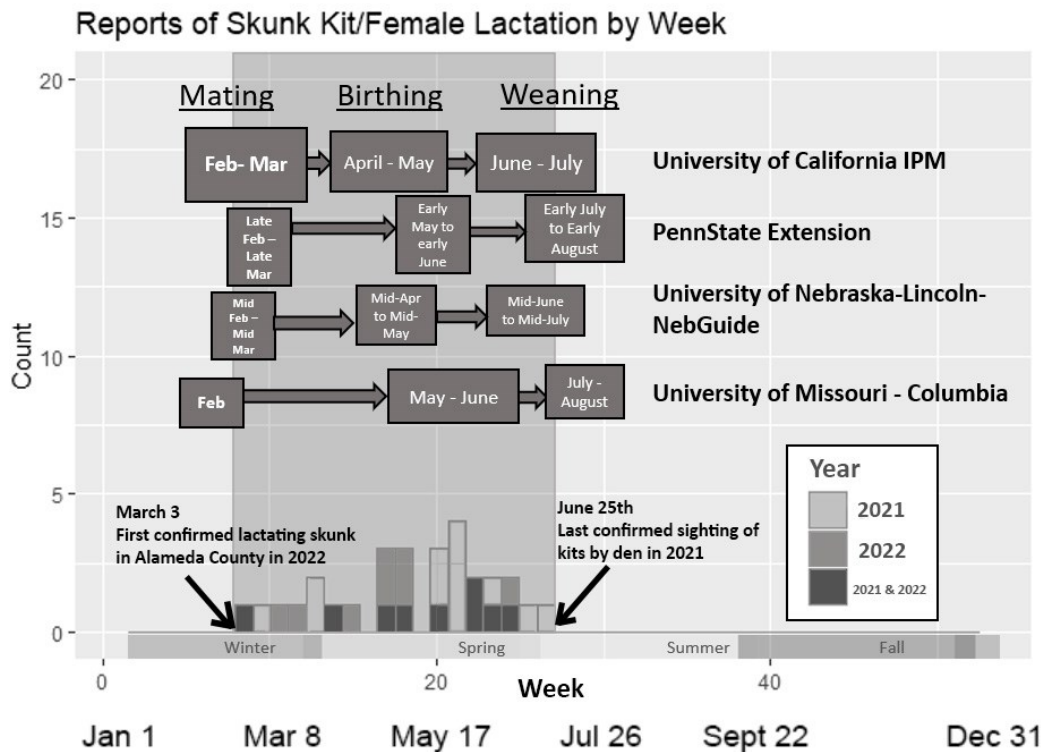
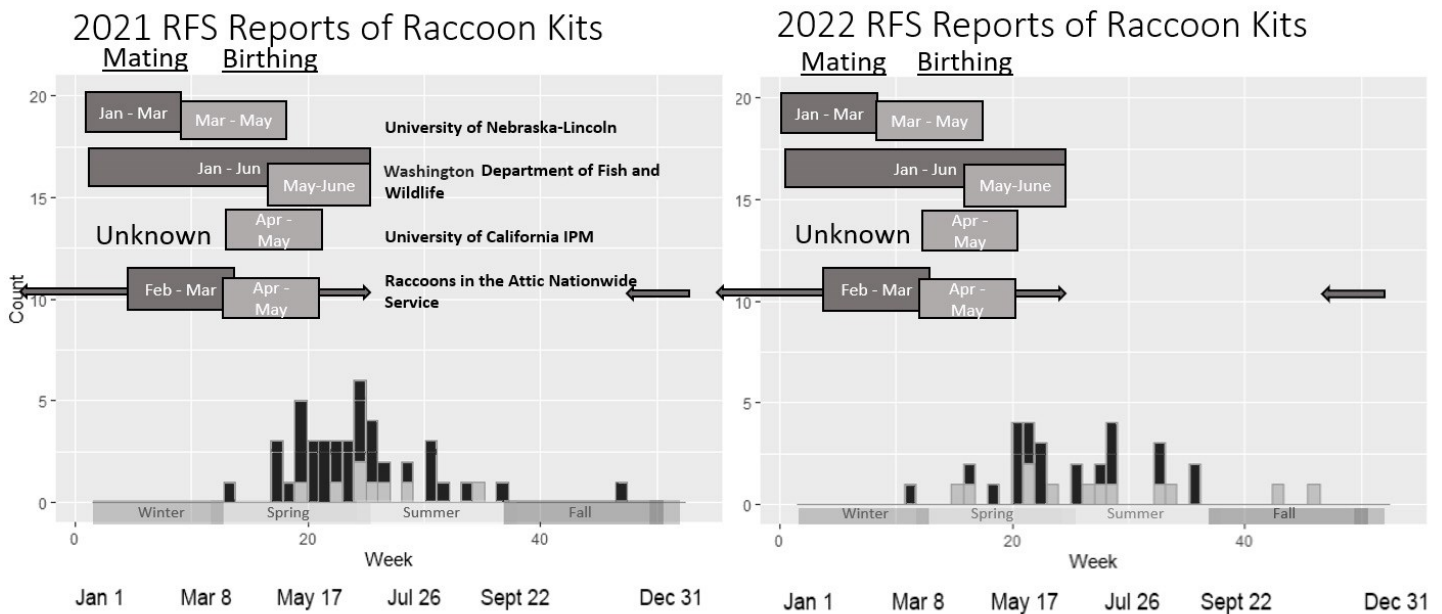
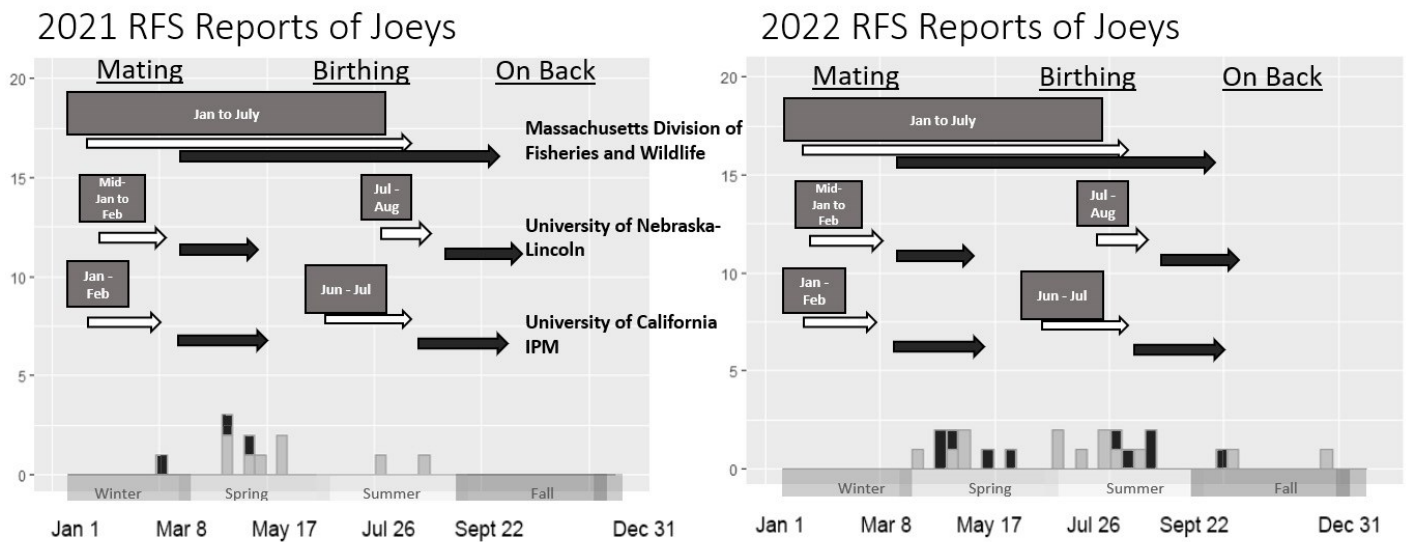


Figure 1. Frequency of skunk kit related RFS from 2021 and 2022 by week. Visualization of the “mating”, “birthing” and “weaning” seasons from institutions was overlaid on the diagram. The beginning and end of the boxes indicate the range of the seasons.



**Figure 2. Frequency of raccoon kit related RFS from 2021 and 2022 by week overlaid with a visualization of the “mating” and “birthing” from institutions. Arrows indicate range of the breeding season for RiANS. Black bars are confirmed kit activity and grey bars indicate suspected kit activity.**

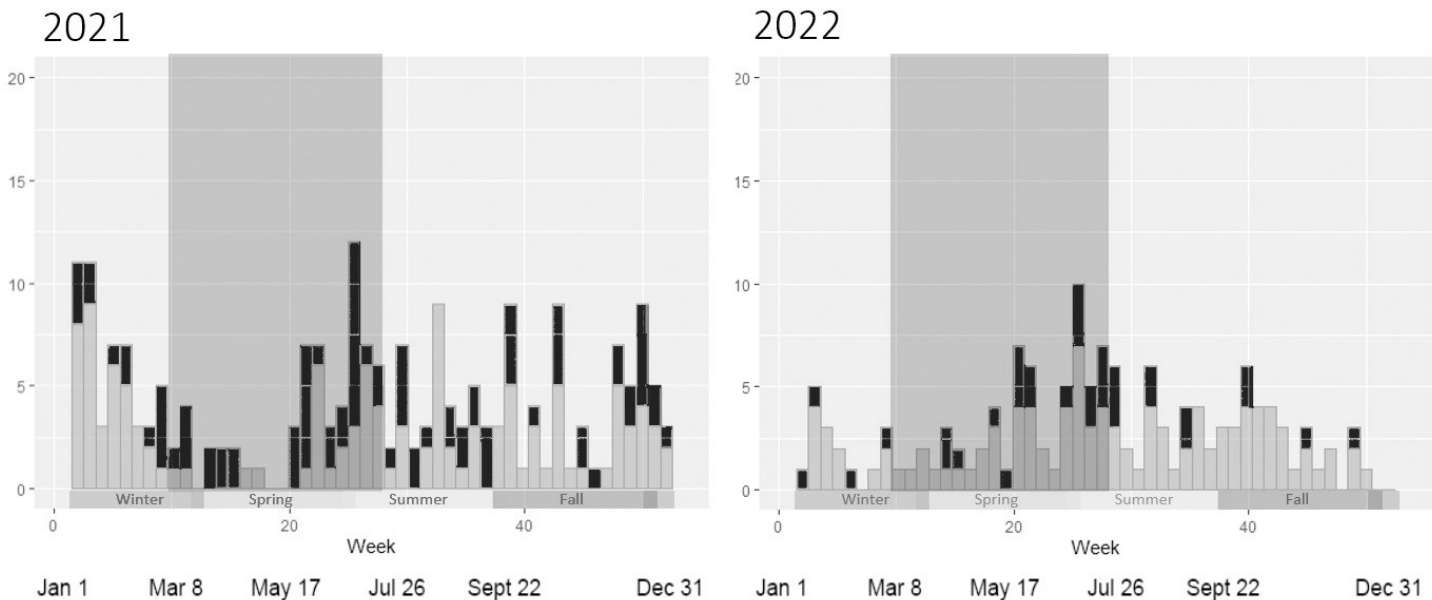


**Figure 3. Frequency of opossum joey related RFS from 2021 and 2022 by week overlaid with a visualization of the “mating”, “birthing” seasons from institutions. Black bars are confirmed kit activity and grey bars indicate suspected kit activity. White arrows are the estimated range of when an opossum joey could be born assuming a gestation of 13 days and black arrows are the estimated range when an opossum joey is likely to be sighted on mother’s back assuming it takes 8 weeks from birth for an opossum joey to move from the pouch to its mother’s back.**

Raccoons were harder to categorize, and their reported mating season and reproductive habits varied from source to source (Figure 2). Female raccoons are only fertile for 3-4 days per mating season. Females who do not become pregnant or lose an early litter, go back into heat within 2-4 months (RIANS 2024). This explains why adult male raccoons may kill raccoon kits. Losing a litter early in the season can induce the female to go back into heat (RIANS 2024) and serve as a potential mating opportunity for the aggressive male. This is the reasoning behind the design of

“eviction fluid”, a type of raccoon repellent that utilizes the male’s scent by targeting the instinctive protective measures of raccoon mothers (Wildlife Control Supplies 2024). It is likely that the late-season cases of raccoon kits are the result of the second heat cycle.

Unlike skunks, published information on raccoon “mating” and “birthing” season were varied and with a larger range. One source, Raccoons in the Attic Nationwide Service (RIANS 2024), reported that “mating” season occurs from late fall to early summer, unlike the University of Nebraska-



**Figure 4. Frequency of skunks reported near human habitation but not confirmed or suspected to be residing on the property. Black is confirmed cases and light grey is suspect cases. The dark grey box shows the range of reported sightings of lactating skunks and their kits denning as shown in Figure 1.**

Lincoln and Washington Department of Fish and Wildlife that have mating season beginning in January (Figure 2). Despite the wide range for the mating seasons, the frequency of lactating raccoons/ raccoon kits shown in Figure 2 gives an idea of when to avoid using one-way doors. They should not be applied until the absence of raccoon kits is confirmed by wildlife cameras. In Alameda County, it is best to monitor the presence of young kits from late winter to the end of summer, with some caution in the fall. When kits are confirmed by camera to follow their mother out of the den, one-way doors can be installed. Raccoon exclusion should be done in the winter and fall, making sure raccoons cannot den before kit season. Once kits are born, if harassment techniques are not working, residents are forced to wait until the kits are weaned between two and four months after birth.

### ***Opossums***

Opossum reproduction is more difficult to track as both newborn joeys and lactation is obscured in the mother's pouch. Confirmed RFS with opossum joeys involved joeys that were spotted on their mother's back and were assumed to be close to weaned (Figure 3). It is important to not use one-way doors when joeys are on their mother's back, as mother opossums may be separated from the joeys and the mother may not return to retrieve them (in contrast to raccoons and skunks). The black arrows on Figure 3 show the range of when to expect joeys on their mother's back and is consistent with ACVCSD RFS data.

### **Presence**

We expected to see more reports of skunks roaming near human habitation but not residing on the property during the "mating season". Only the 2021 RFS were consistent with that assumption (Figure 4). In both the 2021 and 2022 data, there was a reduction of reports of skunk presence when lactating mothers and kits were

reported, likely due to the skunks reducing roaming and settling into a den. No visible pattern of reports of raccoon and opossum presence were noted. More data is needed to draw any conclusions.

### **Harboring Skunks**

Skunk dens are easy to recognize. They are unable to climb walls and generally den in areas that provide a solid roof over their heads. They also dig much more persistently compared to raccoons and opossums. However, compared to the range of reports of lactating skunks/skunk kits, there are fewer reports of skunk harboring during the assumed "birthing" and "weaning" seasons. It is possible mother skunks are less conspicuous during this time because there are fewer incidents of spraying and travel while the mother skunks are raising their young. Reports increase around the "weaning" seasons, likely because weaned or close to weaned skunks will often play outside their dens during the daytime and skunk families are becoming more mobile (Figure 5).

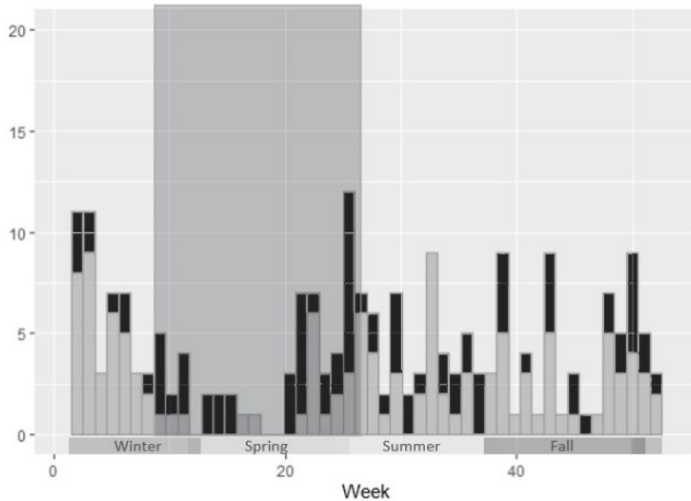
### **Raccoons**

Unlike skunks, raccoons prefer to den in attics and are more easily detected by residents due to the loud noises made from denning and from chittering of the kits. Because of this, we expected to see more reports of raccoon harboring to occur during "kit season", from the birth of the kits until they are weaned up to the time they leave the den with their mother. The RFS data, from 2021 is consistent with this hypothesis, but the data from 2022 looks more varied (Figure 6).

### **Skunk Smell**

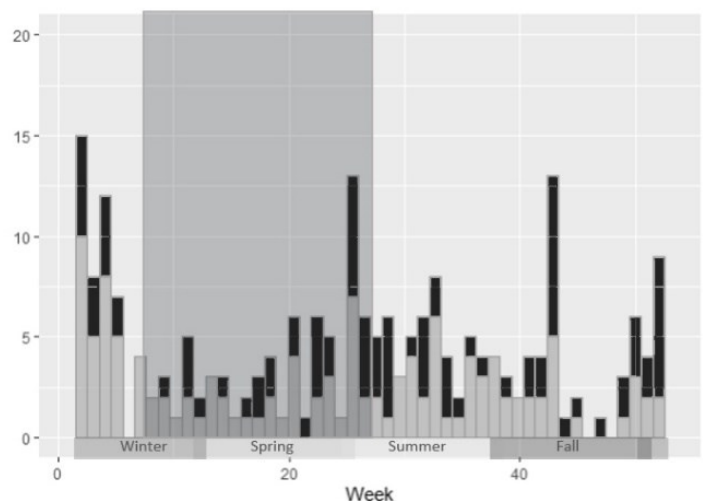
Most reports of skunk spraying events in 2021 occurred in early Jan and early August. 2022 is more scattered, but the weeks with most activity were in mid-January and

2021



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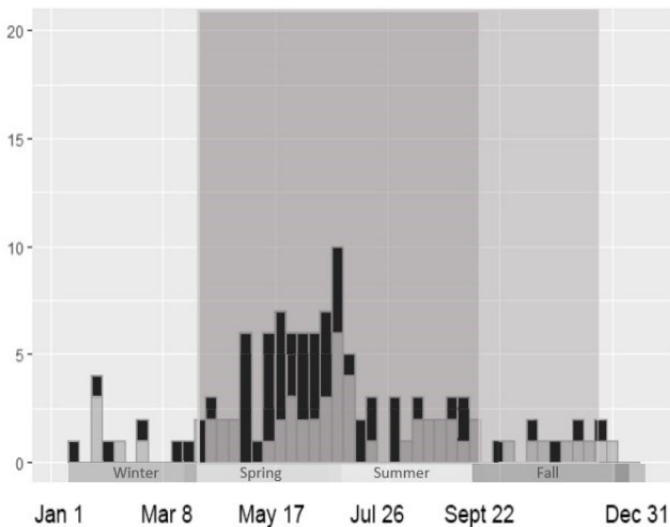
2022



Jan 1 Mar 8 May 17 Jul 26 Sept 22 Dec 31

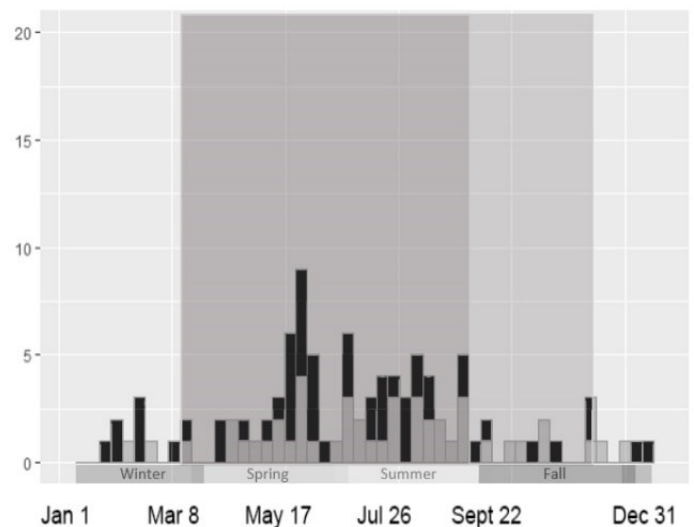
**Figure 5. Frequency of skunks residing on resident’s property. Black is confirmed cases and light grey is suspect cases. The dark grey box shows the range of lactating skunks and sightings of kits at den as shown in Figure 1.**

2021



Jan 1 Mar 8 May 17 Jul 26 Sept 22 Dec 31

2022



Jan 1 Mar 8 May 17 Jul 26 Sept 22 Dec 31

**Figure 6. Frequency of raccoons residing on resident’s property. Black is confirmed cases and light grey is suspect cases. The dark grey box shows the range of reported sightings of lactating raccoon and kits at den as shown in Figure 2.**

middle of the fall (Figure 7). In comparison with the mating season information from other sources, ACVCSD data show there is a spike of activity that occurs earlier than the proposed start of mating season of February to March.

**Raccoon Latrines**

The histogram showed no apparent pattern and latrines were rarely reported in RFS. Additionally, reports of a latrine did not indicate if the latrine was currently in use and when the latrine was formed.

**Digging**

Examining damage patterns and employing wildlife cameras, it’s possible to determine which animal is responsible for the damage. However, in most cases damage was rarely reported unless it was severe. Thus, the reports are heavily skewed towards raccoon damage (Figure 8). According to UC IPM, white grubs are mostly scavenged by mesocarnivores from September to November (Flint and Sutherland 2016). Reports outside of this range are assumed to be from animals foraging for other food items other than white grubs, such as earthworms and other arthropods. There was an increase in digging activity in the fall, especially in raccoons (Figure 8). There were no confirmed instances of opossums digging into turf, but this is likely due to the low level of damage they create.

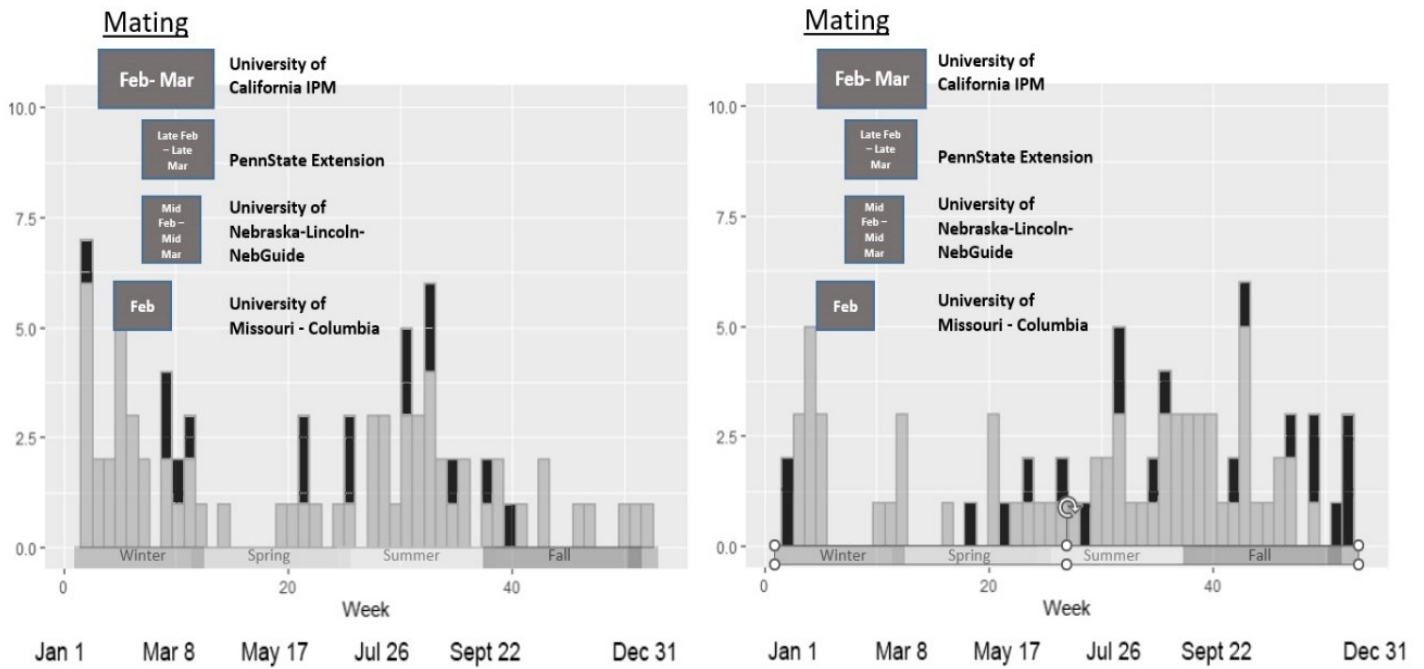


Figure 7. Frequency of skunk smell reported by Alameda County residents. Black is confirmed cases and light grey is suspect cases. Dark grey boxes are the “mating season” as described by institutions.

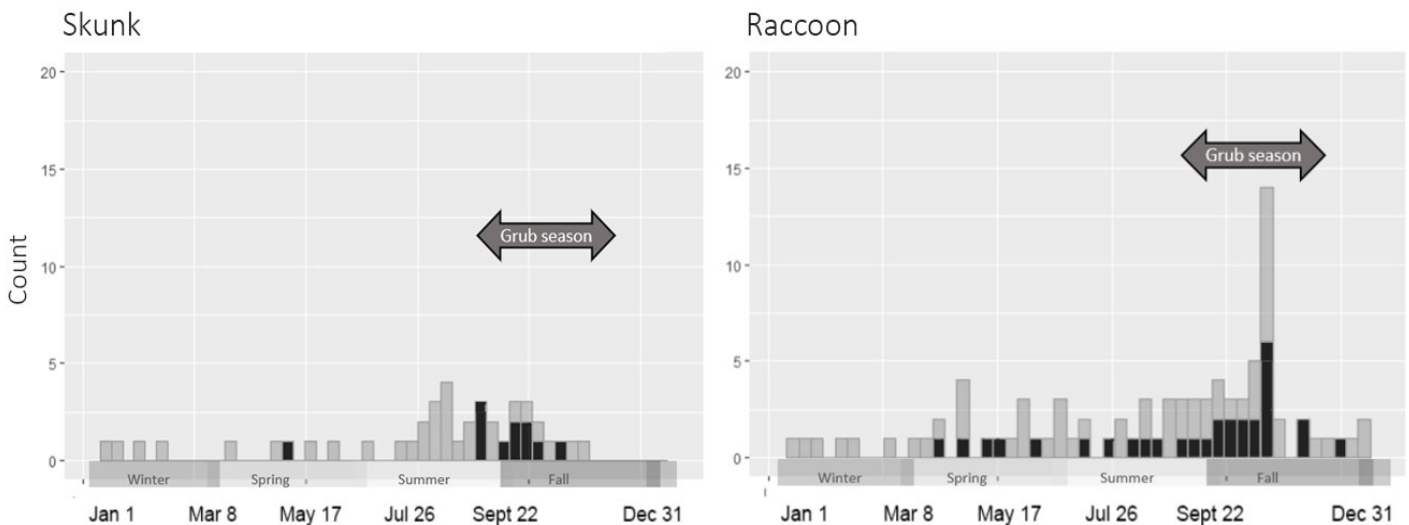


Figure 8. Reports of skunk and raccoon digging into turf and ornamental vegetation in 2021 and 2022. Black bars indicate reports that happened in both 2021 and 2022. Gray bars are singular reports in 2021 or 2022.

### Sick/Dead

A cluster of sick and dead animal reports may be useful in identifying disease outbreaks or may help determine which age groups are more susceptible to death and disease. There was no clear pattern for raccoons or opossums. For skunks, we had hypothesized that there would be more dead skunks during the mating season due to increased travel of adult skunks. However, our results found an increase in dead skunks in the summer and fall (Figure 9). These reports maybe be related to higher mortality in juvenile skunks.

### DISCUSSION

Because no statistical analysis was done, only visual comparisons could be made. More data and statistical tests are needed to see if the frequencies and range are statistically significant and consistent for every year.

The most consistent data is the skunk and raccoon kit RFS data. The range of when skunk and raccoon kits may occur is particularly useful when considering usage of a one-way door. The skunk and kit data also suggested that the “mating” and “kit” seasons of skunks are earlier in Alameda County than other sources. This may be due to



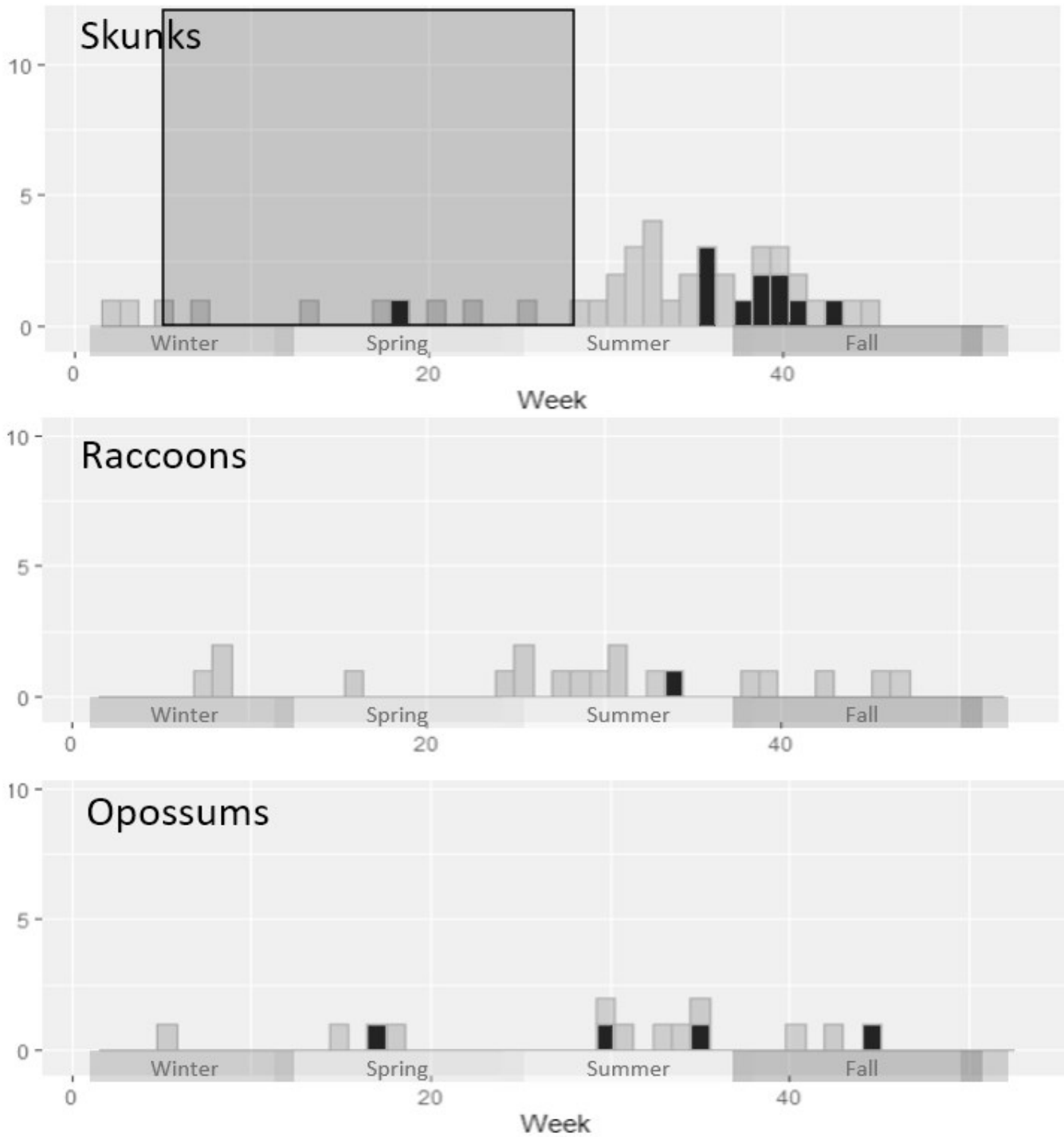


Figure 9. Reports of sick and dead mesocarnivores in 2021-2022 by week. Black bars are reports that occurred in both 2021 and 2022. The large grey box marks the skunk kit season range from Figure 1.

the milder climate of Alameda County and bias towards suburban over rural populations of skunks. Opossum reproduction and behaviors were difficult to determine and track due to their marsupial pouches and mobile life-style. This information can help determine when to implement preventative measures such as exclusion and trapping.

## LITERATURE CITED

- Baldwin, R. A. 2014. Raccoons integrated pest management in and around the home. University of California Agriculture and Natural Resources (UCANR) State Integrated Pest Management Program. Pest Note 74116. <<https://ipm.ucanr.edu/home-and-landscape/raccoons/pest-notes/#gsc.tab=0>>. Accessed 24 April 2024.
- Baldwin, R. A. 2015a. Opossum integrated pest management for homes, gardens, and landscapes. University of California Agriculture and Natural Resources (UCANR) State Integrated Pest Management Program. Pest Note 74123. <<https://ipm.ucanr.edu/home-and-landscape/opossum/pest-notes/#gsc.tab=0>>. Accessed 24 April 2024.
- Baldwin, R. A. 2015b. Skunks integrated pest management for home gardeners and landscape professionals. University of California Agriculture and Natural Resources (UCANR) State Integrated Pest Management Program. Pest Note 74118. <<https://ipm.ucanr.edu/home-and-landscape/skunks/pest-notes/#gsc.tab=0>>. Accessed 24 April 2024.
- Behrens, J., C. Lossler, D. Drake, J. Suckow, and B. Koele. 2013. Skunk ecology and damage management. University of Wisconsin-Extension, Cooperative Extension. <<https://wildlifedamage.cals.wisc.edu/wp-content/uploads/sites/289/2020/10/Skunk.pdf>>. Accessed 24 April 2024.
- Brittingham, M. C. 2006. Skunks: solutions to common problems. Penn State Extension. <<https://extension.psu.edu/skunks-solutions-to-common-problems>>. Accessed 24 April 2024.
- CDPH (California Department of Public Health). 2024. Veterinary public health section. Reported animal rabies data. <<https://www.cdph.ca.gov/Programs/CID/DCDC/Pages/ReportedAnimalRabies.aspx>>. Accessed 24 April 2024.
- Carmichael, J. 2024. Springtime skunk invasion stinky but short-lived in Edmonton. Edmonton Journal. <<https://edmontonjournal.com/news/local-news/springtime-skunk-invasion-stinky-but-short-lived-in-edmonton>>. Accessed 24 April 2024.
- Cranshaw, W. S. 2019. Billbugs and white grubs: control in home lawns. Colorado State University Extension Fact Sheet 5.516. <<https://extension.colostate.edu/topic-areas/insects/billbugs-and-white-grubs-5-516/>>. Accessed 24 April 2024.
- Ferraro, D. M., S. E. Hygnstrom, S. M. Vantassel, and S. Wilson. 2006. Controlling raccoon and opossum damage. University of Nebraska-Lincoln, Institute of Agriculture and Natural Resources. NebGuide G1688. <<https://extensionpubs.unl.edu/publication/621>> Accessed 24 April 2024.
- Flint, M. L., M. A. Harivandi, and A. M. Sutherland. 2016. Agriculture turfgrass pest management guidelines: masked chafers (white grubs). University of California Agriculture and Natural Resources. UC ANR Publication 3365-T <<https://ipm.ucanr.edu/agriculture/turfgrass/masked-chafers-white-grubs/#gsc.tab=0>>. Accessed 24 April 2024.
- MDFW (Massachusetts Division of Fisheries and Wildlife). 2024. Learn about Opossums. Wild Massachusetts. <<https://www.mass.gov/info-details/learn-about-opossums>>. Accessed 24 April 2024.
- Pierce, R. A., and R. McNeely. 2022. Managing skunk problems in Missouri. University of Missouri Extension. <<https://extension.missouri.edu/publications/g9454>>. Accessed 24 April 2024.
- R Core Team. 2023. R: A language and environment for statistical computing. R Foundation for Statistical Computing, Vienna, Austria. <https://www.R-project.org/>.
- RStudio Team. 2023. RStudio: Integrated Development for R. RStudio, PBC, Boston, MA.
- RIANS (Raccoons in Attic Nationwide Service). 2024. Raccoons in the attic: guide to safe removal. <<https://www.raccoonatticguide.com/index.html>>. Accessed 24 April 2024.
- Vantassel, S. M., S. E. Hygnstrom, D. M. Ferraro, and L. Pennisi. 2014. Dealing with skunks. University of Nebraska-Lincoln, Institute of Agriculture and Natural Resources. NebGuide G1769. <<https://extensionpubs.unl.edu/publication/g1769/na/html/view>>. Accessed 24 April 2024.
- Vert, B. J. 1967. The biology of the striped skunk. First Edition. University of Illinois Press, Champaign, IL.
- WCS (Wildlife Control Supplies). 2024. Wildlife control supplies. <<https://www.wildlifecontrolsupplies.com/animal/NWS1115.html>> Accessed 24 April 2024.
- WDFW (Washington Department of Fish & Wildlife). 2024. Species in Washington raccoons. <<https://wdfw.wa.gov/species-habitats/species/procyon-lotor#desc-range>>.