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Raccoons and Refuse: The Impacts of Food Waste Management Practices at UC Santa Barbara on Raccoon Foraging Behavior

By

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ABSTRACT

Raccoons and Refuse: Evaluating Food Waste Management Practices at UCSB and Their Implications for Raccoon Behavior, Ecology, and Health

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Improperly managed food waste can significantly alter the behavior, health, and ecological roles of wildlife, particularly opportunistic foragers such as raccoons (*Procyon lotor*). This thesis investigates the impact of different food waste management strategies at the University of California, Santa Barbara (UCSB) on raccoon foraging behavior, aiming to identify which methods most effectively reduce raccoon interactions with human food waste. While previous studies have examined wildlife access to anthropogenic food, few have focused on how trash cans with varying levels of accessibility influence foraging behavior, especially in high-density university settings where food waste production, human activity and resulting wildlife behavior may differ from residential or park settings. This leaves a gap in understanding how these dynamics play out specifically on UCSB's campus and in other similar institutional environments. To address this, the research is guided by the question: What methods of food waste management at UCSB present the least amount of interactions between raccoons and waste? UCSB presents a particularly relevant case due to its proximity to biodiverse coastal habitats and the densely populated student community of Isla Vista, where high levels of waste and human presence create frequent opportunities for wildlife interactions with food waste. Over an 18 night period, SpyPoint Flex-M trail cameras were deployed at three campus sites representing open, semi-open, and fully closed trash can designs. Observational data, analyzed in RStudio, documented 35 total raccoon interactions: 31 at the open site, 3 at the semi-open, and 1 at the closed site. These findings support the hypothesis that closed waste systems are most effective at reducing wildlife access, suggesting that trash can design plays a critical role in shaping raccoon behavior with broader health and ecological implications. They contribute to a deeper understanding of how human infrastructure influences wildlife and inform practical recommendations including secure receptacle design, adjusted collection times, and educational signage to promote more wildlife-conscious waste management practices at UCSB and other urban campuses.

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Chapter 1: Introduction

1.1 Introduction

The problem of food waste is becoming an increasingly pressing global issue, with the amount of wasted food growing each year (Melikoglu et al., 2013). Inefficient and improper management of this food waste provides increased opportunities for wildlife to access human foods, and research has shown that such access can significantly alter wildlife behavior, health, and overall ecology (Newsome & Van Eeden, 2017). As such, understanding the extent to which food waste management practices contribute to these interactions is a critical step in developing more wildlife-conscious practices. Opportunistic feeders, such as raccoons, are among the most vulnerable to improper food waste management because they tend to exploit any available and accessible food sources, particularly in urban areas (Duhem et al., 2003). UC Santa Barbara, with its substantial waste production and proximity to open natural areas, provides a critical setting for this research. Therefore, this research focuses on evaluating the effectiveness of different food waste management types at UCSB and their respective impacts on raccoons, to promote practices that minimize harmful interactions and foster coexistence.

Beyond its effects on wildlife, food waste presents well-documented humanitarian and environmental costs. Socially, it reflects and exacerbates deep inequalities, contributing to food insecurity while straining household and municipal budgets (Geetha et al., 2020; Roy et al., 2023). Environmentally, it generates significant greenhouse gas emissions and wastes water, land, and energy resources, accelerating habitat loss and biodiversity decline (Scherhaufer et al., 2018).

Although both the anthropogenic and environmental impacts of food waste are significant, this study will focus specifically on its effects on wildlife. As highlighted above, managing food waste has profound implications for wildlife, particularly in environments where human and animal populations frequently intersect. In light of these considerations, this research aims to explore the following question to address these challenges.

1.2 Research Question

This research investigates the interactions between raccoons and various food waste management practices at the University of California, Santa Barbara (UCSB). Specifically, it seeks to answer the question: What method(s) of food waste management at UCSB present the least amount of interactions between raccoons and waste?

The importance of this question is grounded in a well-documented body of literature showing that access to anthropogenic food sources can significantly alter wildlife behavior, health, and ecological roles. Opportunistic foragers like raccoons may experience shifts in diet quality, increased disease risk, and changes in spatial behavior when they routinely access human waste. These consequences not only affect raccoon populations but also have broader ecological and public health implications (Prange et al., 2004; Murray et al., 2016; Bateman & Fleming, 2012).

Given UCSB's substantial food waste generation, its proximity to biodiverse coastal habitats, and its location adjacent to the densely populated community of Isla Vista, the campus provides an informative setting to evaluate how waste infrastructure influences raccoon access to food waste. Understanding which food waste management methods most effectively reduce wildlife interactions can inform sustainable campus practices and contribute to broader conversations about human-wildlife coexistence in urbanized environments.

1.3 Scholarly Contribution

Although previous studies have explored how wildlife species such as raccoons and black bears interact with human waste, relatively few have focused specifically on how different trash can designs shape wildlife foraging behavior across varying levels of waste accessibility. Of those that have, most have been conducted in residential neighborhoods, campgrounds, or parks. Even fewer have examined these interactions within high-density institutional settings like university campuses, where food waste volume and human activity may cause wildlife behavior to differ significantly. These environments are important to study because campuses can act as hotspots for food waste generation and are often

embedded within or adjacent to ecologically sensitive areas, making them key sites for both wildlife exposure and potential conflict.

The UC Santa Barbara campus provides a particularly insightful context for this research, as it is bordered by expansive, biodiverse coastal habitats and situated directly next to Isla Vista (IV), a densely populated community characterized by high levels of human presence, activity, and waste. These conditions may contribute to frequent raccoon foraging near human infrastructure and increase opportunities for interactions with various trash receptacle designs.

This study builds on existing research while addressing a specific gap: the lack of empirical, site-level data on how varying accessibility of trash within trash cans influences raccoon behavior in institutional environments that have high densities of food waste, humans, and wildlife. This data is valuable not only for informing UCSB's waste management policies but also, by examining wildlife-food waste interactions in a novel space, contributing to a broader understanding of how patterns of wildlife-trash interactions generalize across ecological and social contexts.

1.4 Policy Contribution

This research aims to inform and contribute to policy development by providing a foundational understanding that can guide future food waste management practices at UCSB. By offering evidence-based insights into how different types of trash can designs influence raccoon interactions, this study can inform UC Santa Barbara as to which types of waste disposal bins to invest in to reduce wildlife access to food waste. In doing so, it supports efforts to promote ecosystem health, minimize human-wildlife conflicts, and increase the health and safety of students, staff, and surrounding wildlife communities. These findings may also assist campus sustainability programs in meeting waste diversion goals while aligning infrastructure decisions with broader environmental and public health objectives.

1.5 Hypothesis

This study hypothesizes that trash cans with latches that fully close will present the least amount of interactions between raccoons and food waste. In contrast, trash cans without lids are hypothesized to lead to the highest frequency of raccoon interactions compared to other waste management systems on the

UC Santa Barbara campus. This prediction is based on the accessibility and ease of entry that open trash cans provide, making them more attractive to opportunistic feeders like raccoons. Previous research has shown that wildlife, particularly species adapted to urban environments, are more likely to exploit food sources that require minimal effort to access (Prange et al., 2003; Bateman & Fleming, 2012).

The logic behind this hypothesis stems from raccoons' highly adaptable foraging behavior and their tendency to exploit readily available resources. Open trash cans reduce the physical barriers between raccoons and food waste, making them a more consistent and predictable source of food. In contrast, lidded or secured trash cans increase the level of effort required to access waste, potentially discouraging wildlife interactions. This hypothesis will be tested by examining data collected from camera traps deployed at different trash and recycling can sites, and categorizing and comparing frequencies of raccoon interactions at these locations. This study seeks to identify waste management strategies that minimize harmful interactions and support coexistence by evaluating the relationship between trash can design and wildlife interactions.

1.6 Research Design

To evaluate how different food waste management systems affect raccoon interactions on the UCSB campus, I deployed three SpyPoint Flex-M camera traps at three different sites, each with a distinct type of trash can: open, semi-open, and closed. At each site, I recorded raccoon interactions with the trash cans over 18 consecutive nights. I only recorded interactions during nighttime hours because that is when raccoons are most active and I wanted to reduce interference from daytime human activity and ensure consistency in observation.

I selected sites based on specific criteria to isolate the impact of waste management systems on raccoons and to ensure consistent environmental conditions across all three locations. I avoided areas with potentially-confounding ecological characteristics such as dense vegetation, water sources, or heavily landscaped zones, which could influence raccoon foraging behavior (Beasley et al., 2007). I also chose sites that were approximately equidistant from one another and from the UCSB Library, a central hub of human activity, to standardize exposure to people across treatments.

Ideally, I would have included multiple sites for each trash can type to allow for replication and to better control for small-scale habitat variation. However, limited access to camera traps and time constraints associated with the nature of the study (a senior thesis) prevented this. Given these constraints, I strategically selected locations that were closely matched in vegetation cover, landscape features, and human traffic. Therefore, although the uneven distribution of trash can types on campus posed challenges, I attempted to minimize bias and maintain internal consistency as much as possible. I discuss these limitations in greater detail in Chapter 6.

I defined an interaction as any instance in which a raccoon showed clear interest in or made contact with a trash can. Each unique interaction was recorded using time-stamped footage, though it was not always possible to distinguish between individual raccoons. After data collection, I logged interactions in tables and analyzed them using RStudio to visualize patterns and differences across the different trash can types.

1.7 Thesis Roadmap

The remainder of this thesis is organized into six chapters. Chapter 2 presents the literature review, which establishes the academic foundation for this study by exploring the behavioral, ecological and health implications of raccoon and other wildlife interactions with human food waste. It also examines previous research on trash can design and wildlife foraging behavior. Chapter 3 provides critical background information on the study site, UCSB, by examining the historical and current food waste management practices implemented on campus. This context frames the research within the university's environmental conditions, emphasizing its relevance to the campus and surrounding ecosystems.

Chapters 4 through 7 present the core research process and findings. Chapter 4 outlines the methods and data collection process, including camera trap deployment, site selection, and the criteria used to define and record raccoon interactions. Chapter 5 presents the results, summarizing the number and timing of interactions at each trash can type and highlighting key behavioral patterns observed. Chapter 6 serves to analyze and discuss the behavioral, ecological and health implications of the findings by connecting them to broader themes in the literature. It also considers how UCSB's waste management

practices may be influencing wildlife behavior and offers practical recommendations for more wildlife-conscious infrastructure. Finally, Chapter 7 concludes the thesis by synthesizing the study's contributions, reflecting on its limitations, and proposing directions for future research.

Chapter 2: Literature Review

2.1 Introduction

Food waste is an important and growing global ecological problem. It contributes significantly to greenhouse gas emissions, depletes valuable resources like water and energy, and disrupts ecological processes (Scherhaufer et al., 2018). Specifically in urban environments, one pressing issue rests in the way improperly managed food waste influences wildlife behavior. Opportunistic foragers such as raccoons are particularly vulnerable, as easy access to anthropogenic food sources can lead to behavioral adaptations, ecological imbalance, wildlife health issues and increased human-wildlife conflict (Newsome & Van Eeden, 2017).

Researchers have thoroughly documented the environmental and public health implications of food waste, but have studied less how infrastructure, specifically trash can design, shapes wildlife interactions. In this literature review, I examine current knowledge on the response of wildlife to food waste, with a focus on raccoon behavior and waste management strategies in an urban and institutional setting. I draw upon ecological, behavioral, and infrastructural research to identify the gap this study addresses and to frame its broader significance.

I selected sources for this chapter based on several criteria, prioritizing peer-reviewed studies that directly investigate the impacts of anthropogenic food waste on the behavior, ecology, and health of surrounding wildlife. I also included studies employing observational or experimental methods, particularly those involving raccoons or similar mesocarnivores in urban or institutional environments. Finally, I emphasized research that offers insight into trash can design and accessibility, as these themes are central to this study's focus on infrastructure-based management strategies.

2.2 Behavioral Impacts of Food Waste Access

Individual animals can adapt their behavior in response to food waste availability. These behavioral changes, including learning, memory, and routine foraging, form the mechanisms that often drive broader ecological shifts. Behaviorally, wildlife species exhibit high levels of adaptability when foraging in human-modified environments. Specifically, studies have shown that raccoons are capable of

distinguishing between different trash receptacle types and modifying their behavior accordingly (Stanton et al., 2024). Raccoons are known for their cognitive flexibility and ability to manipulate containers and latches through trial-and-error learning (Zeveloff, 2002; Stanton et al., 2024). Repeated access to unsecured trash fosters site fidelity and routine visitation, as observed in college campuses and urban neighborhoods (Barone & Leichman, 2017; Prange et al., 2004). In Yosemite National Park, black bears were documented teaching their cubs how to break into trash receptacles, evidence of socially learned foraging behavior that perpetuates risky habits across generations (Mazur & Seher, 2008). Similarly, gulls in coastal cities have adapted their feeding strategies to capitalize on human food waste, altering their social behavior and foraging zones in response to urban stimuli (Oro et al., 2013). These examples illustrate how urban wildlife not only learn to exploit anthropogenic food sources but may also pass down these behaviors, intensifying their long-term presence in human spaces.

Such behaviors can lead to increased contact between humans and wildlife, heightened competition among scavengers, and a growing dependency on anthropogenic food sources. The persistence of these behaviors across settings suggests that infrastructure alone may not be sufficient. Contextual factors like community density, habituation, and species-specific cognition also play a role in shaping outcomes, emphasizing the importance of studying these interactions in specific locations to inform local management strategies.

2.3 Health and Physiological Impacts

In addition to behavioral adaptations, access to human food waste can have significant consequences for wildlife health. Raccoons and other species that rely heavily on anthropogenic food sources often suffer from obesity, metabolic issues, and compromised gut microbiomes (Murray et al., 2015; Berger, 2020). Additionally, the ingestion of plastics, wrappers, and chemical contaminants poses risks of gastrointestinal blockage and organ damage. Townsend and Barker (2014) observed crows using synthetic materials from trash in nest construction, leading to entanglement and nest failure, demonstrating that trash impacts can extend beyond consumption.

These health impacts have broader implications for wildlife populations and the ecosystems they inhabit. Nutritionally poor, human-derived diets may reduce survival and reproductive success, contributing to long-term shifts in population dynamics. Moreover, increased wildlife presence at waste sites elevates the risk of zoonotic disease transmission, as raccoons and other scavengers may carry pathogens that threaten both human and animal communities.

2.4 Population-Level and Ecological Effects

At broader scales, the behavioral and health impacts of food waste can ripple outward to affect wildlife populations and ecosystems. Consistent access to anthropogenic food sources can increase population densities, reduce fear of humans, and compress home ranges in species such as black bears and coyotes (Beckmann & Berger, 2003; Gehrt et al., 2011). In Yellowstone National Park, bears with regular access to garbage experienced increased reproduction rates and population growth—but also higher rates of human conflict (Craighead et al., 1995).

Newsome et al. (2015) highlight how food subsidies can shift predator diets and affect ecosystem dynamics. In contrast, other studies have shown that the absence of reliable food subsidies may lead to wider ranging behavior and more energy-intensive foraging (Parsons et al., 2022). For instance, in a study by Bozek et al. (2007), raccoons were found to selectively inhabit areas of high food waste availability, even when these were not ideal habitats otherwise. This behavior suggests that food subsidies can override natural habitat preferences, leading to artificial concentrations of wildlife in human-dominated areas.

Ecologically, subsidized urban wildlife may reduce their engagement in natural ecosystem roles such as seed dispersal and scavenging, leading to altered trophic dynamics, reduced biodiversity, and greater stress on species that perform similar ecosystem services. Beckmann and Berger (2003) found that black bears with consistent access to trash stopped performing typical foraging behaviors that help regulate insect and rodent populations, disrupting those communities. A case study of urban coyotes in Chicago demonstrated that access to anthropogenic food waste led to reduced reliance on natural prey and a rise in small mammal populations, highlighting how altered predator foraging can cascade through

ecosystems (Gehrt et al., 2011). Although coyotes differ from raccoons ecologically, the pattern underscores a broader trend: when urban opportunists shift their diets, the cascading effects can destabilize local food webs.

2.5 Human-Wildlife Conflict and Institutional Significance

As raccoons and other species become habituated to human environments, the likelihood of conflict increases. These conflicts can take the form of property damage, aggressive encounters, and growing public support for lethal control methods (Decker et al., 2010). In Santa Barbara, a notable incident occurred near a childcare facility where raccoon feces were found to contain raccoon roundworm (Baylisascaris procyonis) eggs, leading to concerns about parasite exposure to humans (Daily Nexus, 2002). Similar public health risks have been noted in urban areas across North America, where raccoons notoriously serve as reservoirs for zoonotic pathogens, including rabies and leptospirosis.

University campuses, with their high foot traffic, abundant food waste, and nearby natural spaces, are increasingly important sites for managing such interactions. Studies have shown that campuses serve as ecological hotspots for generalist species due to the overlap of predictable food waste and minimal deterrents (Bozek et al., 2007), making them more prone to human-wildlife conflict related to food waste.

2.6 Trash Can Design as Management Strategy

Wildlife-resistant receptacles have proven to be effective tools for reducing human-wildlife conflict in several contexts. For instance, bear-proof containers have significantly lowered conflict rates in residential areas and parks (Johnson et al., 2018). In Yosemite, compliance with bear-proof trash infrastructure has led to measurable reductions in bear sightings within campgrounds (Mazur & Seher, 2008).

Yet, despite these successes, relatively few studies have evaluated how different types of trash cans influence wildlife behavior across a range of accessibility levels. Barone and Leichman (2017) documented raccoon behavior at dumpsters on a college campus, but their study did not compare different trash can designs.

Measuring wildlife interactions with trash across various levels of accessibility, however, can reveal how different types of trash cans, including semi-opened trash cans that might not be prohibitively expensive in certain contexts, affects wildlife behavior. Further, Kirby et al. (2017) and others note that local wildlife behavior can vary substantially, suggesting that the effectiveness of a deterrent may depend on setting-specific factors such as the density of human populations and food waste, prevailing waste habits, and community compliance. This motivates a study of wildlife interactions with different types of trash cans in institutional settings like UCSB, places that often prioritize sustainability, possess resources to address food waste–wildlife conflicts (though these resources may be limited), and generate high volumes of waste alongside consistent human activity, conditions that can foster more frequent and bolder wildlife encounters.

2.7 Raccoons as a Focal Species

Because of their opportunistic nature and prevalence on UCSB's campus, raccoons are the target species of this study. Raccoons (*Procyon lotor*) are medium-sized mammals who belong to the family Procyonidae. Native to North America, they range from southern Canada to Panama, making them one of the continent's most recognizable and adaptable species (Goldman, 1950). In the wild, raccoons inhabit forests, marshes, and prairies, where their omnivorous diet includes fruits, vegetation, insects, and small vertebrates. Increasingly, raccoons have also been found in rural and urban environments, largely due to the availability of anthropogenic food sources (Bozek et al., 2007).

Raccoons are highly adaptable and opportunistic feeders, which allows them to thrive in diverse habitats. They are easily recognized by their black facial "mask," ringed tail, and dexterous front paws. As nocturnal animals, they forage at night and rest during the day (Zeveloff, 2002). Within their ecosystems, raccoons play crucial ecological roles: they disperse seeds by consuming fruits and excreting the seeds, thus promoting plant diversity and forest regeneration; they help regulate populations of insects and small mammals, supporting ecological balance; and they contribute to nutrient cycling by feeding on decomposing matter (Zeveloff, 2002).

At UCSB, raccoons are commonly observed foraging in both open and semi-open trash cans. The campus's proximity to expansive open spaces and Isla Vista, a densely populated student community, creates an environment with high food waste availability and minimal deterrents. Understanding how raccoons interact with different receptacle types in this context offers valuable insight into behavioral ecology and management effectiveness. It also provides a case study for questions about broader generalization of deterrent strategies.

2.8 Research Gap and Justification

Despite growing interest in studying urban wildlife, little research has directly compared how raccoons interact with different trash can designs in high-density institutional settings. Most research focuses on single environments (such as suburban homes and campgrounds) or general foraging patterns without isolating the role of receptacle type.

This study addresses that gap by systematically evaluating raccoon interactions with open, semi-open, and closed trash cans at UCSB, offering site-specific data that can inform general waste management strategies. By doing so, it contributes to a broader understanding of how wildlife behavior varies across infrastructure types and urban contexts, information that can be used to determine how other institutions manage their waste infrastructure, and its implications for altering wildlife behavior.

2.9 Conclusion

The literature shows that access to food waste alters wildlife behavior, ecology, and health, and that trash can design is a key factor in moderating these effects. While raccoons and other urban wildlife have demonstrated remarkable adaptability, the consequences of these adaptations pose risks both to ecosystems and to human communities. Institutional environments like UCSB present unique challenges and opportunities for managing these interactions effectively. By synthesizing insights from ecology, behavior, and infrastructure, this review lays the groundwork for evaluating the impacts of food waste management strategies in campus settings.

Chapter 3: Background

3.1 Importance of Study Site

The University of California, Santa Barbara (UCSB) is located along the southern coast of California, nestled between the Pacific Ocean and the foothills of the Santa Ynez Mountain range. The campus sits near several open spaces, including Coal Oil Point Reserve, part of the UC's larger reserve system, and the expansive North Campus Open Space, which serve as critical habitats for a variety of wildlife. This proximity to natural areas enhances the campus's ecological value but also facilitates the movement of local wildlife, including raccoons, into the more urbanized areas of campus.

As a major university with a high population of students and staff, UCSB generates significant amounts of food waste through its dining services, events, and campus eateries. This makes the university an ideal setting for exploring improvements in food waste management practices. The combination of large food waste production and the campus's proximity to natural areas creates a unique environment to study the intersections of human behavior, waste management, and wildlife conservation. Understanding these dynamics is essential for developing strategies that support both the campus community and local wildlife populations.

3.2 Food Waste Management at UCSB

The history of waste management at UCSB has evolved over time, from simple waste collection practices to more complex systems aimed at reducing environmental impact. Like many other institutions in the past, the university focused primarily on basic trash disposal with little emphasis on recycling or composting. However, as sustainability became a greater priority, UCSB implemented a series of measures designed to reduce waste and promote environmental stewardship. Today, the campus supports an ambitious sustainability program with goals of achieving zero waste by diverting the majority of its waste from landfills through recycling, composting, and sustainable sourcing initiatives (UC Santa Barbara, 2024). UCSB has also introduced a range of initiatives that focus on reducing food waste, a significant contributor to overall waste on campus. Dining services have introduced trayless dining to minimize excess food waste and have implemented a comprehensive composting program that diverts

100% of pre- and post-consumer food waste from landfills. Additionally, UCSB participates in food recovery programs, redirecting surplus meals to community organizations to combat food insecurity. These initiatives position UCSB as a leader in campus sustainability practices and contribute meaningfully to reducing its environmental footprint (Campus Dining, 2024).

Despite these advancements, challenges related to waste management on campus still remain, particularly with regard to the physical infrastructure of waste management. While UCSB has installed some solar-powered, compacting trash cans, many campus trash receptacles remain outdated and ineffective at containing waste securely. Poorly designed trash cans that are easily accessed by wildlife contribute to littering, especially during periods of increased campus activity, such as finals week. Overflowing or accessible trash not only undermines UCSB's sustainability goals but also exacerbates human-wildlife conflicts, encouraging raccoons and other species to forage in human spaces. Thus, despite the success of downstream initiatives like composting and food recovery, there is a critical need to address "first-line" waste management practices that prevent wildlife from accessing waste at its source.

Although UCSB has made substantial progress toward reducing food waste through diversion programs, the management of waste at the point of disposal, particularly through improved trash can design, remains a less developed aspect of campus sustainability. Current strategies focus primarily on diverting waste after it has been generated, with less emphasis on preventing initial wildlife access. By examining how different trash can designs influence raccoon interactions, this study addresses a critical but underexplored component of UCSB’s food waste management system, offering insights that can strengthen both campus sustainability efforts and wildlife conservation initiatives.

Chapter 4: Methods and Data Collection

This chapter outlines the methodology used to investigate the study's research question: What methods of food waste management at UCSB present the least amount of interactions between raccoons and waste? To address this question, SpyPoint Flex-M camera traps were deployed at three selected sites on the UCSB campus over an 18-night period. Each site contained a different type of trash can—closed, semi-open, and open—to allow for a comparison of raccoon activity.

The sections that follow describe the criteria for site selection, camera deployment procedures, the timeframe and environmental considerations for data collection, and the specific metrics used to define and quantify raccoon interactions.

4.1 Camera Deployment and Site Selection

To systematically investigate raccoon interactions with different types of trash cans, three sites were selected across UCSB's campus for camera trap deployment. SpyPoint Flex-M camera traps were chosen for their high-resolution nighttime imaging and rapid motion-sensing capabilities, ideal for detecting raccoons during their peak nocturnal activity.

4.1.1 Site Selection Criteria

Specific criteria were established to ensure consistency across camera trap locations:

- **Proximity to distinct landmarks:** Locations immediately adjacent to dense vegetation, open grassy areas, or relatively large water sources were avoided to prevent skewing results through external environmental influences.
- **Human activity level:** Sites were selected to represent moderate human traffic areas. Excessively busy or completely isolated areas could alter raccoon foraging behavior, thus introducing confounding variables (Prange et al., 2004). The three sites chosen were centered around the library to help standardize the influence of human presence across locations.

Despite these criteria, practical limitations arose. Semi-open trash cans were significantly more prevalent across campus, while closed and fully open trash cans were rare, narrowing available site options. These limitations are acknowledged and discussed further in section 6.6.

4.1.2 Camera Trap Sites

Following campus surveys, the following locations were selected:

Figure 1: Closed, Semi-Open and Open Trash Can Sites

Left: *Closed Trash Can Site*—Located near Storke Tower, this site experienced low human traffic and had comparable vegetation density to the other sites. However, its close proximity to the campus lagoon, a natural attractant for raccoons, may have influenced animal presence.

Center: *Semi-Open Trash Can Site*—Situated near the Life Sciences Building, this site was relatively secluded with moderate human activity and slightly denser vegetation. It was also closer to the coastline, potentially affecting wildlife presence.

Right: *Open Trash Can Site*—Located near Buchanan Hall, this site had similar vegetation but the highest human traffic of all three, which may have impacted raccoon behavior.

Figure 2 below provides a campus map with the three camera trap locations marked, corresponding to each trash can type. Each site is approximately equidistant from each other and the library, which is labeled and just upper and left of the center of the map.

Figure 2: Map of UCSB Campus Indicating Camera Trap Locations

4.2 Time Frame for Analysis

Camera trap deployment was scheduled to accommodate time constraints while minimizing the likelihood of poor weather or seasonal inactivity that could reduce raccoon activity. In particular, I aimed to avoid periods when raccoons might enter torpor—a temporary stage of reduced physiological activity—which can result in decreased foraging (Zeveloff, 2002). Although February and March are typically among the rainiest months in Santa Barbara, I identified a forecasted stretch of favorable

weather and aligned data collection with this window. As a result, I deployed camera traps over 18 consecutive rain-free nights, from February 15th to March 4th, 2025.

To ensure data consistency, I analyzed only nighttime footage recorded between 11:00 p.m. and 6:00 a.m. This window was chosen to capture peak raccoon activity hours while minimizing overlap with residual human activity on campus. Using a consistent seven-hour observation period each night allowed for standardized comparisons across sites, ensuring a clearer understanding of raccoon foraging behavior in relation to only waste management practices.

4.3 Criteria for Analysis

Clear and consistent criteria for what qualified as a raccoon "interaction" were established to maintain consistency across all camera footage evaluations. For the purpose of this study, an interaction was defined as any instance in which an individual raccoon physically engaged with or showed explicit interest in a trash can. Examples of qualifying interactions include a raccoon jumping onto or actively inspecting a trash can. Conversely, raccoons simply passing by without showing direct interest or investigative behavior were not counted as interactions. This distinction was made to ensure that only meaningful encounters related to food waste access were recorded.

When multiple raccoons appeared simultaneously in a single frame, the event was counted as one interaction, not multiple, to avoid inflating interaction counts based on group size. Similarly, if the same raccoon remained in the vicinity for an extended period without exiting and re-entering the frame, it was counted as a single continuous interaction rather than multiple events. This approach reduces uncertainty about the magnitude of each interaction and offers a more conservative measure of raccoon activity, especially given the difficulty of distinguishing individual animals in night footage.

Other species, including squirrels, skunks, and crows, were occasionally documented engaging with the trash cans. Although their interactions were recorded for observational purposes, only raccoon data were included in the primary analysis of waste management effectiveness. Interactions involving other wildlife species are discussed separately in Section 5.6.

Time stamps from camera footage provided essential context to help differentiate individual interactions. These timestamps were particularly helpful in determining interaction durations and evaluating whether closely timed interactions might represent separate individuals or repeat visits by the same raccoon. However, due to the inherent limitations of camera footage and monitoring raccoon behavior patterns, it was impossible to definitively identify whether closely timed interactions involved the same raccoon or different individuals. Consequently, each separate instance of raccoon activity was counted as an individual interaction, a methodological limitation that will be explored further in the discussion chapter. Together, these criteria helped ensure a consistent and conservative approach to counting raccoon interactions, improving the reliability of the results and supporting meaningful comparisons between trash can types.

Chapter 5: Results

5.1 Overall Results

This chapter presents the results of the 18-night camera trap study examining raccoon interactions with three types of trash cans—open, semi-open, and closed—across UCSB's campus. A total of 35 raccoon interactions were documented, with substantial variation in activity depending on the level of trash can accessibility. Specifically, the open trash can accounted for 31 interactions across 14 of the 18 nights of observation, while the semi-open can recorded 3 interactions across 2 nights, and the closed can recorded only 1 interaction on a single night. These findings highlight significant differences in raccoon access and behavior across trash can designs. In addition to raccoon visits, incidental observations of other wildlife species, such as skunks, squirrels, and crows, were also noted.

The data presented in this chapter directly address the study's research question: What methods of waste management at UCSB present the least amount of interactions between raccoons and waste? By comparing raccoon activity across trash can types, these results offer a foundation for identifying more wildlife-resistant waste management strategies. The following sections provide a breakdown of interactions by trash can type, differences in interactions by site and unexpected findings.

5.2 Open Trash Can Interactions

Over the 18-night observation period, the open trash can site consistently attracted raccoons, with a total of 31 recorded interactions. Activity was highest during early mornings, typically between midnight and 5:00 a.m., which aligns with raccoons' known foraging patterns.

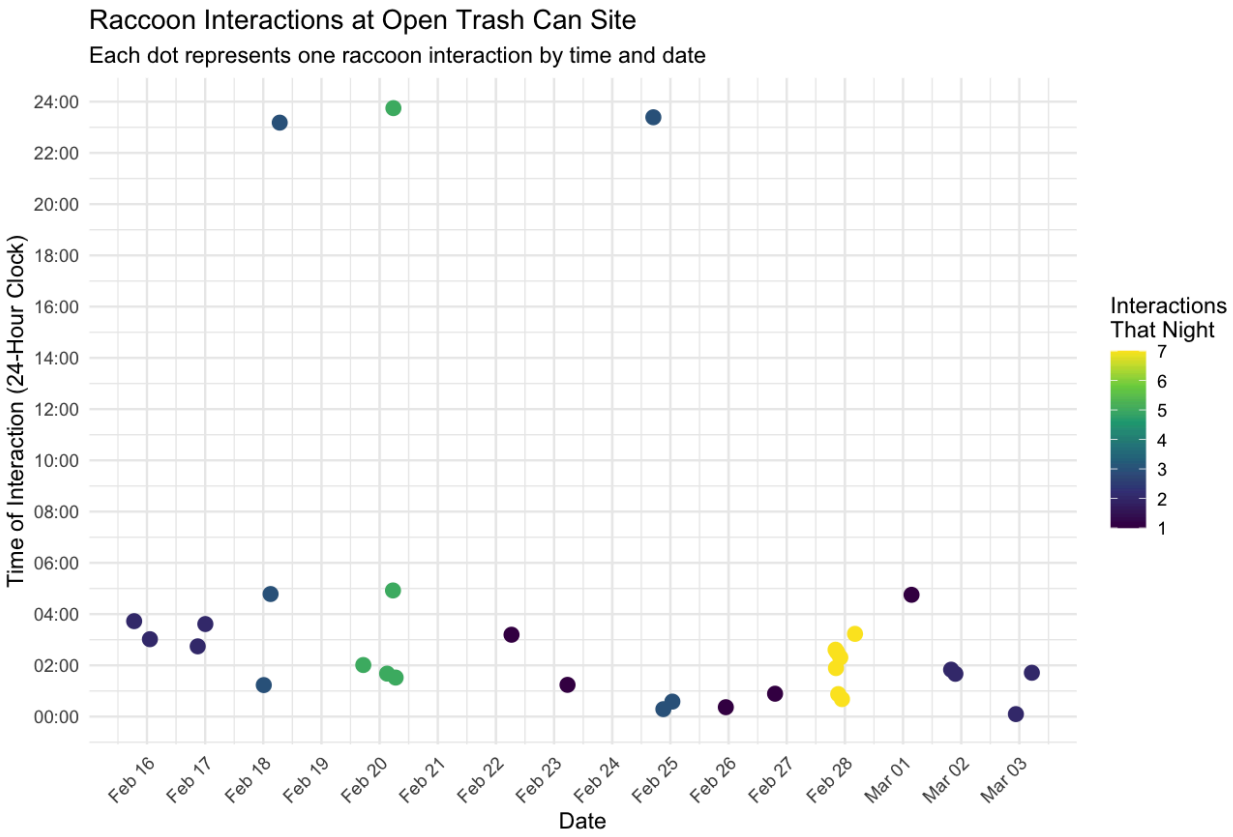

Figure 3: Timing and Frequency of Raccoon Interactions at the Open Trash Can Site

The figure above visually represents the time and frequency of raccoon visits at the open trash can site across the research period. Each dot represents a raccoon interaction plotted by time of night and date. Color indicates the total number of raccoon interactions recorded on each night, highlighting the frequency of foraging activity.

Several visits involved multiple raccoons, and occasional observations of other species were also documented, including 3 squirrel visits, 2 skunk sightings, and 1 crow visit. Raccoons were only absent on four nights—February 15, February 21, February 24, and March 4—demonstrating their frequent presence at this site. A detailed breakdown of raccoon and other wildlife activity at the open trash can site is provided in Table 1 of Appendix A.

A particularly notable event occurred on February 20, when three raccoons were simultaneously observed foraging at the open trash can.

Figure 4: Three Raccoons Foraging at the Open Trash Can Site

5.3 Semi-Open Trash Can Interactions

The semi-open trash can experienced significantly fewer raccoon interactions, with three visits recorded over the course of the study.

- On February 26, two raccoons attempted, but failed, to access the trash at 1:05 a.m.
- On March 2, two separate visits occurred at 1:36 a.m. and 1:46 a.m.
- No other raccoon activity was recorded at this site.

Additionally, a squirrel was observed foraging near the semi-open trash can on March 2 at 7:31 a.m., although this was outside of the nocturnal time period of the study and squirrel interactions were not included in the primary analysis.

Figure 5: Two Raccoons Attempting to Access Half-Closed Trash Can

5.4 Closed Trash Can Interactions

The closed trash can proved highly effective at deterring raccoon interactions. Only one interaction was recorded during the entire monitoring period:

- On February 23, two raccoons accessed the trash can at approximately 2:00 a.m. due to an improperly latched lid left partially open by human error.

No additional raccoon or other wildlife activity was recorded at this site during the study.

Figure 6: Two Raccoons Foraging at Closed Trash Can Site

5.5 Differences in Raccoon Interactions by Trash Can Type

In summary, across the 18-night monitoring period, raccoon interactions varied substantially by trash can type. The open trash can experienced the highest number of interactions, with a total of 31 visits. In contrast, the semi-open trash can was visited only 3 times, and the closed trash can had just 1 recorded interaction. These findings suggest a notable relationship between trash can design and raccoon activity, with open cans being significantly more accessible and appealing to raccoons.

To statistically evaluate whether these differences were meaningful, a Chi-Square Goodness-of-Fit test was conducted. The test compared the observed distribution of raccoon interactions to the expected distribution if raccoons had interacted equally with all three trash can types. Under this null hypothesis, each can type would be expected to have approximately 11.67 interactions (35 total interactions divided evenly across three categories). The chi-square analysis yielded a test statistic of $\chi^2(2, N = 35) = 48.22$, with a p-value < 0.0001. This result indicates a highly significant difference between observed and expected values, providing strong evidence that raccoon interactions at each site are not evenly distributed.

Taken together, these results underscore that raccoons strongly prefer trash cans with easier access to food waste, reinforcing the conclusion that receptacle design plays a central role in shaping wildlife foraging behavior in urban environments. While the graph comparing observed and expected raccoon interactions is not included here, it can be found in Appendix B for reference.

5.6 Unexpected Findings

In addition to the primary observations regarding raccoon interactions with different trash can types, several unexpected findings emerged during the study period. These observations provide additional insight into raccoon foraging behavior and broader wildlife interactions with waste on campus.

5.6.1 Repeated and Persistent Visits

One of the most notable unexpected findings was the persistence of raccoon visits, particularly at the open trash can site. On the night of February 28, raccoons made approximately seven separate visits to the open trash can, with some interactions occurring only minutes apart. This repeated activity appeared to be linked to the trash can being overflowing with waste.

Figure 8: Raccoon Foraging at Overflowing Trash Can

5.6.2 Interactions From Other Species

While raccoons were the primary focus of this study and accounted for the most interactions, multiple other species were observed interacting with trash at the monitored sites.

Notable observations:

- **Skunks** were frequently observed during nighttime hours, often foraging alongside or shortly after raccoon visits.
- **Squirrels** were commonly seen interacting with waste during the early morning and daylight hours.
- **Crows** were occasionally observed inspecting trash cans during the day, particularly at the open trash can site.

On March 1st, a raccoon, two skunks, and a squirrel were all observed interacting with waste at the open trash can on the same day. Additionally, on March 2, a squirrel was documented foraging through litter from the semi-open trash can that a raccoon had left scattered on the ground hours earlier.

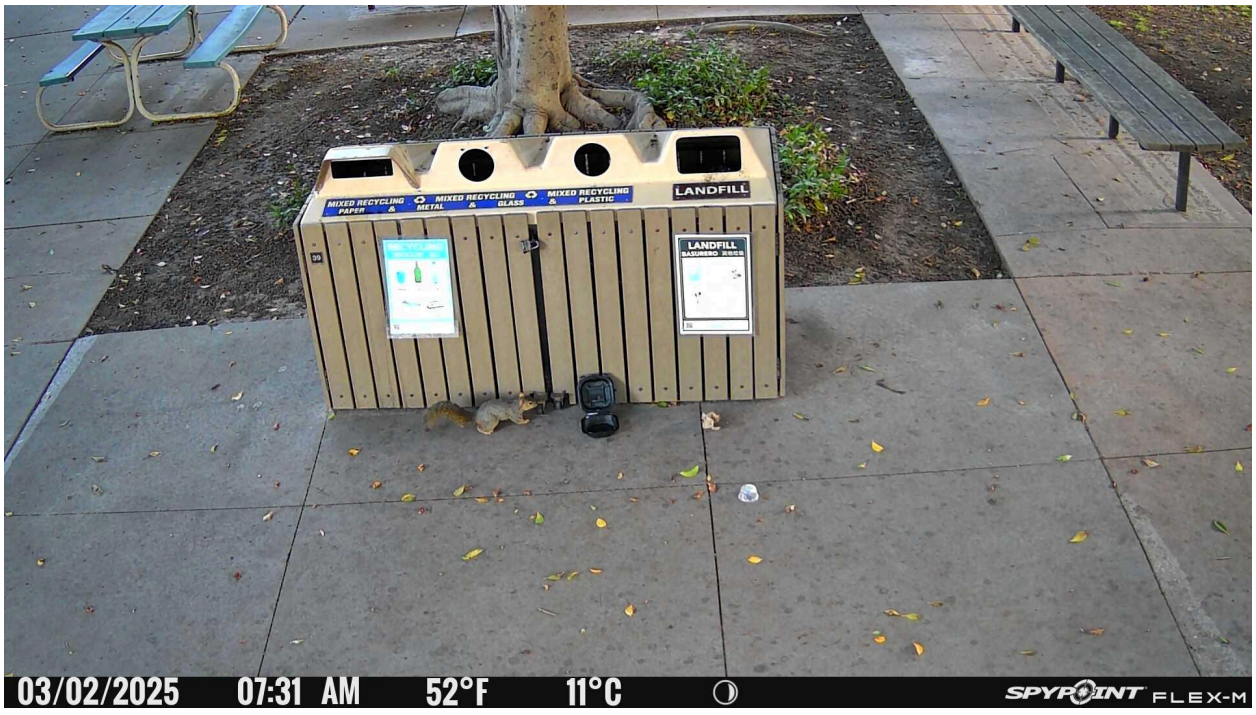

Figure 9: Squirrel Interacting with Trash Left Behind by a Raccoon

5.7 Conclusion

In summary, the results demonstrate a strong relationship between trash can design and raccoon foraging behavior. Open trash cans received the vast majority of raccoon visits, while semi-open and closed designs were far less accessible and therefore less frequently visited. Statistical analysis confirmed that these differences were significant. Additional findings—such as repeated visits in a single night, foraging persistence, and interactions from other wildlife species—offer further insight into how food waste management influences animal behavior on campus. These results provide a critical foundation for the discussion and interpretation in the following chapter, where the ecological, health, behavioral and management implications of these findings will be examined.

Chapter 6: Discussion

6.1 Introduction

The purpose of this chapter is to analyze the data collected during the 18-night camera trap deployment and explore the behavioral, ecological, health and managerial implications of reduced raccoon access to human food waste on UCSB's campus. In doing so, this chapter draws from both statistical analysis and observational patterns to interpret the significance of the findings.

By interpreting the empirical data in light of previous studies discussed in Chapter 2, this chapter aims to provide a deeper understanding of how waste infrastructure can shape wildlife behavior and inform more sustainable management practices at UCSB and in similar urban environments.

6.2 Behavioral Implications

The behavioral patterns observed in this study provide strong evidence that raccoons adapt their foraging strategies based on the accessibility of waste receptacles. The vast majority of interactions occurred at the open trash can site (31 of 35 total), indicating a clear preference for easily accessible food sources, an outcome consistent with raccoons' cognitive flexibility and ability to learn from environmental cues (Zeveloff, 2002; Prange et al., 2004; Stanton et al., 2024).

Referencing figure 3, raccoons visited this site regularly throughout the 18-night study period, typically between midnight and 5:00 a.m., suggesting both site fidelity and temporal consistency. These patterns mirror those documented in other urban foraging studies, where raccoons repeatedly return to reliable food sources and develop routine foraging behaviors based on prior success (Stanton et al., 2024). While individual raccoons could not be identified, the clustering of interactions across certain nights, such as February 20 and 28, supports the likelihood of repeat visits by the same individuals.

In contrast, raccoons largely avoided the closed trash can, with only a single interaction recorded, attributable to an improperly latched lid. This strongly implies that secure trash receptacles can effectively deter even highly adaptable foragers. Similarly, semi-open trash cans, although the most common receptacle type on campus, received only three visits. Their low interaction rate, despite being more

widespread and presumably more frequently encountered, underscores the importance of can design over availability in driving raccoon behavior.

Taken together, these findings show that trash can accessibility, not just presence, shapes wildlife behavior. Open receptacles invite exploitation and repeated visitation, while secure designs disrupt these learned patterns. The implications extend beyond raccoons: sustained access to human food waste can reinforce dependency and elevate conflict potential, whereas design-based interventions offer a powerful means of shaping wildlife behavior and supporting coexistence.

6.3 Ecological and Health Implications

The data from this study strongly suggest that restricting wildlife access to human food waste through improved trash can design has the potential to restore more natural foraging behaviors among raccoons and other urban wildlife. When animals rely less on anthropogenic food sources, they are more likely to re-engage in ecologically beneficial roles such as seed dispersal, scavenging, and small mammal predation. This is particularly important in campus environments like UCSB, where wildlife interact with both urban and natural landscapes, and where their ecological functions may influence broader ecosystem health.

For raccoons, shifting away from human food waste may encourage more natural foraging behaviors, such as hunting insects, amphibians, or seeking out wild fruits, rather than scavenging from trash receptacles. Similar dynamics have been observed in other urban carnivores. As previously discussed, a study on coyotes in Chicago found that reliance on anthropogenic food led to dietary shifts and resulting trophic disruptions, such as unchecked small mammal population growth, that destabilized local ecosystems (Gehrt et al., 2011). While raccoons occupy a different ecological niche, the core mechanism is similar: when predators alter their foraging strategies in response to human-provided food, it can trigger cascading effects that undermine ecological balance.

Beyond raccoons, camera traps in this study recorded other wildlife species visiting trash cans, including skunks (*Mephitis mephitis*), squirrels (*Sciurus carolinensis*), and crows (*Corvus brachyrhynchos*). Although these species were not the primary focus of the study, their presence

underscores the broader ecological footprint of unsecured food waste. Opportunistic species such as skunks and crows are well-known for their ability to exploit urban resources. For example, increasing crow populations in urban areas, driven in part by access to food waste, have been linked to the decline of smaller, more vulnerable bird species due to nest predation and competition (Marzluff & Neatherlin, 2006). These dynamics exemplify mesopredator release, a phenomenon in which generalist predators thrive in human-altered environments at the expense of more sensitive species, leading to community-level shifts in biodiversity and trophic function. Securing trash can access is therefore essential not just for reducing raccoon impacts, but also for curbing broader ecological imbalances. As such, limiting wildlife dependence on waste can help maintain a healthier, more functionally diverse wildlife community.

In addition to ecological concerns, the health impacts of human food waste on wildlife are significant. Diets consisting primarily of processed foods, rich in sugars, fats, and artificial additives, are nutritionally poor and linked to obesity, metabolic dysfunction, and altered gut microbiomes in urban raccoons (Murray et al., 2015). Exposure to non-food contaminants such as plastic, foil, and chemically treated items can result in gastrointestinal blockage, toxicity, or even death. These risks were especially acute at the open trash can site, where 31 raccoon interactions were recorded, which was far more than at the semi-open (3) and closed (1) sites. Notably, on the night of February 28th, 7 separate interactions were recorded at the open trash can site. Camera footage revealed discarded items such as soda containers and pizza boxes, providing raccoons with access to highly processed foods that may expose them to the nutritional and physiological risks discussed above.

Reducing access to waste not only helps raccoons maintain more balanced diets and healthier physiologies but also minimizes the likelihood of zoonotic disease transmission. Raccoons are known carriers of pathogens such as Baylisascaris procyonis (raccoon roundworm), which can be harmful to humans. Concentrated foraging at unsecured trash sites increases the chances of fecal contamination and parasite spread, posing a threat to both wildlife and the campus community.

Taken together, these ecological and health implications reinforce the critical importance of securing food waste. Improved trash infrastructure is not merely a logistical or aesthetic improvement. It is a necessary step toward promoting healthier wildlife populations, reducing disease risk, and maintaining ecological balance in campus environments and beyond.

6.4 Role of Human Behavior

While infrastructure plays a critical role in shaping wildlife access to food waste, this study also underscores the influence of human behavior in determining the success of waste management strategies. On February 23, two raccoons accessed the closed trash can site, an unexpected interaction given the design's effectiveness throughout the study. Upon reviewing the footage, it became clear that the lid had been left partially open due to human error, not mechanical failure or animal persistence. This moment of negligence enabled raccoons to exploit a container that had otherwise served as a strong deterrent.

This incident highlights a broader issue: even well-designed infrastructure can be undermined by inconsistent human use. Trash cans with latching mechanisms, for example, are only effective if lids are securely closed after each use. When users fail to follow proper disposal practices, intentionally or unintentionally, they create openings that raccoons can quickly exploit. As the February 23 interaction shows, raccoons are highly attuned to changes in receptacle accessibility and respond rapidly to new opportunities.

To fully realize the benefits of improved infrastructure, behavioral interventions must accompany physical upgrades. Signage that encourages users to properly close lids, dispose of food waste responsibly, and understand the ecological consequences of unsecured trash can foster greater community accountability. Educational campaigns, whether through posters, social media, or orientation programs, can reinforce these expectations, particularly in high-traffic areas frequented by students and staff.

In short, trash can design alone cannot resolve the problem of wildlife-waste interactions. Human behavior remains a critical factor, and successful waste management requires a dual approach: effective infrastructure supported by consistent, informed use.

6.5 Institutional and Management Implications

The data collected in this study, combined with well-established research on the ecological and health effects of food waste on raccoons and other animals, provide compelling evidence that the way UCSB manages its waste infrastructure has direct effects on wildlife behavior, with broader ecological and health implications, particularly among raccoons and possibly other wildlife species as well. The near elimination of interactions at the closed trash can site compared to the 31 interactions at the open site suggests that access to food waste is actively shaping raccoon foraging ecology and site selection behavior.

Given what is known from prior studies about the impacts of consuming human food waste on wildlife health, including dietary shifts, obesity, and disease risk (Murray et al., 2015; Newsome et al., 2015), it is reasonable to infer that raccoons at UCSB are likely experiencing these effects where waste access is not well controlled. Additionally, other species observed interacting with trash suggest that this issue may extend beyond raccoons alone. Although this study focused on raccoons, the presence of skunks and other species at trash sites indicates that UCSB's waste infrastructure could be shaping foraging behaviors across a range of urban-adapted animals.

These findings underscore the need for UCSB to re-evaluate its approach to waste infrastructure. Currently, the campus heavily relies on semi-open trash cans. While somewhat effective, these trash cans still allow wildlife access. Eliminating all open trash cans and transitioning to fully enclosed, raccoon-resistant bins would be a crucial first step toward reducing wildlife-waste interactions. Such infrastructure upgrades would not only promote healthier, more ecologically appropriate behavior in raccoons and other species, but also help UCSB align with its broader environmental values and commitments to sustainability.

Of course, replacing infrastructure presents logistical and financial challenges. Better-designed receptacles often cost more and may initially be met with resistance from users or departments managing waste. However, strategies exist to overcome these barriers. UCSB could pilot the use of raccoon-proof

bins in a few high-traffic areas, monitor effectiveness (building on this study), and use those data to acquire funding through sustainability grants or campus green initiatives.

One practical and easily implementable improvement to the current waste management system is adjusting the timing of trash collection. Camera footage from this study revealed that trash cans are typically emptied in the early morning hours, around 5 to 6 a.m. Shifting this to the early evening would reduce the overnight availability of food waste to raccoons and other wildlife, thereby minimizing the health, behavior and ecological risks previously discussed. While this measure alone would not eliminate all access, since individuals may continue to dispose of waste after collection, it represents a low-cost, complementary strategy that could enhance the effectiveness of broader waste management interventions.

6.6 Study Limitations

Like all field-based studies, this research was shaped by practical and logistical limitations. However, these constraints do not diminish the significance of the findings. Instead, they highlight opportunities for further investigation and underscore the value of this study as an important first step in understanding the relationship between waste accessibility and wildlife behavior on UCSB's campus.

One limitation was the uneven distribution of trash can types across campus. Fully closed trash cans were less common and often located in areas not suitable for standardized comparison, which limited site selection. While efforts were made to match vegetation levels and human activity across sites, it was not possible to control for all environmental variables. Despite this, the consistent pattern observed, where open trash cans received 31 raccoon interactions compared to only 1 at the closed site, strongly supports the conclusion that trash can design is a key driver of wildlife access.

The 18-night observation period provides a short-term snapshot of raccoon behavior but does not capture potential seasonal variations, reproductive cycles, or longer-term trends. Still, the clarity of the observed activity differences across trash can types suggests that the effect of waste accessibility is immediate enough to detect even within a brief timeframe.

Additionally, the use of motion-activated camera traps meant that individual raccoons could not be identified, making it impossible to determine whether some interactions were made by repeat visitors.

However, this limitation is common in urban wildlife research, and the consistent presence and timing of raccoon activity at the open trash can site (as shown in Figure 3) very likely point to behaviorally meaningful patterns, including site fidelity and learned foraging routines.

Finally, although non-target species such as skunks, squirrels, and crows were observed interacting with trash, they were not the focus of systematic analysis in this study. Their presence, however, reinforces the broader ecological relevance of wildlife access to food waste and supports the argument for expanding research to address multi species impacts on campus.

Taken together, these limitations offer valuable insights into the kinds of questions that future research could explore more deeply while also affirming the strength of this study's core contribution: that trash can accessibility has a measurable, immediate impact on raccoon behavior, with broader implications for wildlife health, ecology and campus waste policy.

6.7 Conclusion

The findings of this study demonstrate that raccoon access to human food waste is not merely a matter of nuisance behavior. It is a behavioral, ecological, and health issue. The raccoons' repeated interactions with accessible receptacles reflect learned foraging strategies that reinforce dependence on human resources. This shift in behavior not only alters raccoon health and physiology through poor-quality diets and contaminant exposure but also has cascading ecological consequences, including disrupted foraging patterns and altered species dynamics. These interconnected impacts underscore the urgency of implementing integrated waste management solutions that pair effective infrastructure with human behavioral interventions. In doing so, institutions like UCSB can promote healthier urban ecosystems, safeguard public health, and support more sustainable coexistence between humans and wildlife.

Chapter 7: Conclusion

7.1 Restating Research Questions

This study investigates how food waste management practices influence raccoon interactions with trash on the University of California, Santa Barbara (UCSB) campus. Specifically, it investigated the question: *What methods of food waste management at UCSB present the least amount of interactions between raccoons and waste?* This question was driven by the broader goal of understanding the behavior impacts of such interactions, and the wider implications that has for raccoon ecology and health. By examining raccoon activity across open, semi-open, and closed trash can types, the study aimed to identify which designs are most effective at minimizing wildlife interactions and to inform more sustainable, wildlife-conscious waste management strategies on UCSB's campus.

7.2 Summary of Key Findings

Camera trap data collected over an 18-night period revealed that raccoon interactions were strongly influenced by trash can design. The open trash can site recorded 31 raccoon interactions and was visited on 14 out of 18 nights. In contrast, the semi-open site was visited on just 2 nights, with 3 interactions total, and the closed site was visited only once, with a single recorded interaction. These findings support the study's hypothesis that more secure trash cans result in fewer raccoon-waste interactions, demonstrating that fully closed receptacles are effective in limiting wildlife access to anthropogenic food sources on campus.

Repeated visits at the open trash can site, often at similar times of night, indicate strong site fidelity and learned behavior. These findings align with known behavioral traits of raccoons, including adaptability and memory. Non-target species such as skunks, squirrels, and crows were also observed interacting with the waste, suggesting that the effects of unsecured trash cans extend beyond raccoons and may influence a broader range of urban wildlife.

7.3 Significance of the Findings

7.3.1 Implications for UCSB

This study demonstrates that UCSB's current waste management infrastructure is likely influencing the behavior of raccoons, with broader ecological and health implications for raccoons. The stark difference in raccoon activity between open and closed trash can sites suggests that the current design and placement of waste receptacles are creating foraging opportunities for wildlife.

By consistently providing access to food waste, open and semi-open trash cans may be contributing to increased wildlife habituation, altered movement patterns, and potential overreliance on anthropogenic food sources. These shifts can negatively impact wildlife health, increase disease transmission risk, and reduce the functional roles these animals play in their natural ecosystems. For UCSB, this is not only an environmental concern but a public health issue as well.

The findings provide concrete, actionable guidance for UCSB. Transitioning to fully enclosed, raccoon-resistant trash cans, especially in areas of moderate to high human activity, would significantly reduce wildlife interactions with waste. Education and signs promoting proper waste disposal behaviors could further reinforce these infrastructure changes. Additionally, shifting trash collection times to the early evenings could limit the availability of food waste to raccoons and other opportunistic feeders.

7.3.2 Broader Implications for Theory and Practice

This study contributes to a growing body of research on the behavioral effects of anthropogenic food subsidies. It reinforces theories of behavioral changes among urban mesocarnivores and supports the argument that even small-scale infrastructure decisions, such as trash can design, have measurable impacts on wildlife behavior, health and ecology.

Practically, these findings have relevance for other universities, municipalities, and public land managers seeking to reduce human-wildlife conflict. By showing how specific types of waste receptacles can mitigate or exacerbate wildlife access, the study offers a framework for evaluating and improving urban waste systems. In terms of broader sustainability and coexistence goals, this study affirms that

wildlife-conscious management must be integrated into urban planning, especially where campuses and open spaces intersect.

7.4 Study Limitations

This study faced several logistical and methodological constraints typical of field-based wildlife research. Site selection was limited by the uneven distribution of trash can types across UCSB, and while sites were matched for vegetation and human activity, not all environmental variables could be controlled. The 18-night data collection period offered only a short-term view of raccoon behavior, and motion-activated cameras could not identify individual animals, preventing analysis of repeat visits. Still, the clustering of activity at the open trash can site suggests strong site fidelity. Non-target species like skunks, squirrels, and crows were observed but not systematically analyzed, highlighting the broader ecological relevance of food waste access. Despite these limitations, the findings clearly show that trash can design strongly influences raccoon foraging behavior and offer actionable insights for reducing wildlife access to waste and associated conflicts.

7.5 Future Research Directions

Building on the results of this study, future research could expand both in scope and scale. Longer-term studies across multiple seasons would provide a clearer picture of temporal variation in raccoon behavior. Identifying individual raccoons through tagging or facial recognition would allow for more precise analysis of site fidelity and foraging routines.

Additionally, future studies could incorporate dietary analysis, such as scat sampling, to determine the extent of anthropogenic food consumption. Expanding the analysis to include other species could shed light on community level impacts of waste access. Behavioral intervention studies, such as testing the effectiveness of educational signs or enforcement policies, would also be valuable in assessing how human behavior affects wildlife access to waste.

Finally, there is strong potential for interdisciplinary work connecting environmental science, public health, and campus operations. This thesis provides a foundation upon which UCSB and other

institutions can build more effective, data-informed strategies for sustainable human-wildlife coexistence surrounding food waste.

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Appendix A: Open Trash Can Data Table

Table 1: Summarized Visits to Open Trash Can Site

Date	Raccoon Interactions (Time)	Other Species	Notes
02/16/2025	3:01 a.m., 3:39 a.m.		
02/17/2025	2:45 a.m., 3:36 a.m.		
02/18/2025	1:14 a.m., 4:52 a.m., 11:13 p.m.		
02/19/2025		One crow at 2:11 p.m.	
02/20/2025	1:33 a.m., 1:37 a.m., 2 a.m., 4:54 a.m., 11:41 p.m.		Three raccoons were seen during the 1:37 a.m. visit
02/22/2025	3:09 a.m.	One squirrel at 10:31 a.m.	
02/23/2025	1:18 a.m.		Two raccoons during the visit
02/25/2025	12:18 a.m., 12:33 a.m., 11:22 p.m.		
02/26/2025	12:25 a.m.		
02/27/2025	12:51 a.m.		
02/28/2025	12:37 a.m., 12:52 a.m., 1:55 a.m., 2:18 a.m., 2:33 a.m., 2:40 a.m., 3:09 a.m.		
03/01/2025	4:50 a.m.	One skunk at 12:00 a.m., one skunk at 1:15 a.m., one squirrel at 6:12 a.m.	
03/02/2025	1:36 a.m., 1:46 a.m.	One squirrel at 7:31 a.m.	
03/03/2025	12:02 a.m., 1:43 a.m.		

Note: No raccoon activity was documented on February 15, February 21, February 24 or March 4.

Appendix B: Observed vs. Expected Raccoon Interactions by Trash Can Type

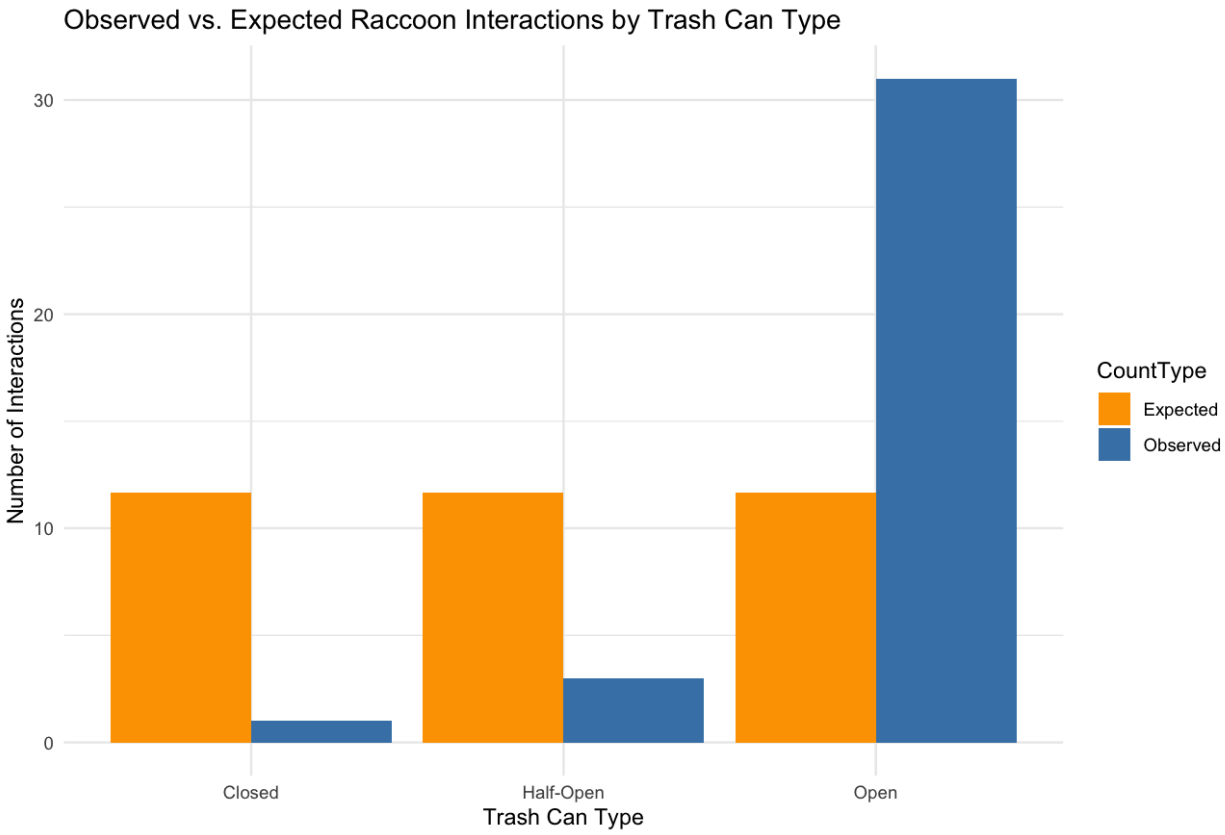

Figure 7: Bar Graph Comparing Observed and Expected Raccoon Interactions By Trash Can Type