

**Dog owners and their dogs' influence on the blue-green algae blooms at Shubie Off-Leash
Dog Park, Dartmouth, NS**

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Abstract

Lake Micmac by Shubie Off-Leash Dog Park in Dartmouth, Nova Scotia has been experiencing blue-green algae blooms, a cyanobacteria that can be harmful to the environment and the health of animals, including humans. As blue-green algae blooms occur more frequently, recreational areas including Shubie-off Leash Dog Park are at risk of being closed to the public. A study looking at the sources of fecal contamination in Lake Micmac found that there was a high amount of canine fecal markers nearshore of the Shubie Off-Leash beach. Considering fecal matter contains algae-inducing nutrients, it is suspected that unattended dog waste is contributing to the increasing frequency of blue-green algae blooms in Lake Micmac. Through unobtrusive dog observations and an in-person survey, this study investigates how dog owners manage their dog waste at Shubie Off-Leash Dog Park. Findings suggest there are an insufficient number of amenities including trash bins, doggie bags, and signs stating what areas are designated as on or off-leash. Signage that is present is confusing to some. Other results revealed many dog owners disliked other dog owners and their dogs. Therefore, it is recommended that the park management look into more amenities related to facilitating proper dog waste disposal. Signage should be clear to understand, appealing, and located in popular areas such as trails and trailheads. Engaging with dog owners is needed to form collective community norms that comply with park policy. Park management should also explore fencing certain areas that are naturally ill-defined without affecting the park user's experience. Finally, future studies need to seek out how effective educational measures like the "Canine for Clean Water Campaign" are at informing the public.

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Chapter 1: Introduction

1.1 Background

In recent years, waterways near the Shubie Off-Leash Dog Park in Dartmouth, Nova Scotia have been experiencing harmful blue-green algae blooms (Sun *et al.*, 2018). Blue-green algae are a species of cyanobacteria that can be harmful to the environment and the health of animals (Zhang *et al.*, 2023). Across Canada, blue-green algae blooms have been becoming more frequent in the summer months and early fall (Orihel *et al.*, 2012). Several communities throughout the country including Nova Scotia are faced with health risks from cyanobacteria in waterways, especially in recreational areas (Bradley, 2018; Orihel *et al.*, 2012; Ray, 2021; “Springfield”, 2023). As climate change continues to alter weather patterns, algae blooms are expected to occur more frequently and for longer (Zhang *et al.*, 2023).

The Shubie Off-Leash Dog Park by Lake MicMac is a space designed for people and their dogs to enjoy (Shubie Campground, 2021). The Park includes a rocky beach, where dogs have access to the water year-round, as well open fields, and 1.8 km of trails that both dog owners and their dogs can walk through (“Off-Leash Dog Parks,” 2023). In recent years, Lake MicMac has tested positive for canine fecal matter near the shoreline of the Shubie off-leash beach (McGuigan, 2019). Other fecal contaminants found in Lake MicMac come from residents, farms, commercial buildings, and avian species including ducks and geese (McGuigan, 2019). This is alarming for local communities because fecal matter contains phosphorus and nitrogen, two nutrients that can help induce an algae bloom (Lu *et al.*, 2019; Orihel, *et al* 2012). Canine fecal matter specifically carries coliform bacteria, an organism

type that can be pathogenic among dogs and humans (Ebani *et al.*, 2021). Thus, fecal contamination at Shubie park is a health and safety issue for both humans and their dogs. Although coyote feces can also be a factor, they have a relatively small population size in Nova Scotia and sightings seem to be uncommon in the Shubie Park area (Sabean, 1989).

Considering there were high canine feces levels found nearshore of the Shubie Off-Leash Dog Park, it is suspected that canine feces signatures recorded in the lake have been a direct result of feces left unattended by dog owners in the dog park (Cooke, 2019; McGuigan, 2019). To prevent fecal matter contaminating Lake Micmac, the goal of this project is to determine if owners are leaving their dog's waste unattended, and if so, what can be done to mediate this behaviour.

1.2 Blue-Green Algae Blooms

From 2019 to 2022, cases of blue-green algae blooms have continued to increase in the Halifax Regional Municipality (HRM) ("Blue-green algae", 2023). From June to October of 2022, there was a record high of 73 reports of blue-green algae blooms across the HRM, with Lake Micmac being one of them ("Reported Blue-Green Algae", 2022). The most recent blue-green algae bloom reported at Shubie Off-Leash Beach was on July 26th, 2023. ("Shubie Park", 2023). Once a cyanobacteria report is confirmed, the area is typically closed to the public until the water quality is considered safe ("Municipality launches LakeWatchers", 2022).

1.3 Health Effects

The cyanotoxins that are produced from cyanobacteria during blue-green algae blooms can cause severe health effects or worse, be fatal to humans and other animals (Backer *et al.*, 2013; Zhang *et al.*, 2023). Dogs are especially at risk because they are more likely to drink from natural bodies of water (Backer *et al.*, 2013). Once ingested, cyanotoxins can affect the brain, liver, kidneys, skin, and the gastrointestinal tract (Zhang *et al.*, 2023; Zanchett & Oliveria-Filho *et al.*, 2013). The east coast of Canada has had several dogs either become sick or die from blue-green algae cyanotoxins (Bradley, 2018; Crosby, 2023; Fraser, 2018).

1.4 Current Measures

In response to the health risks, Shubie Off-Leash Dog Park has implemented information dissemination measures for dog owners. The Park, in partnership with the Young Naturalists Club and Nature Nova Scotia installed an informative sign indicating what cyanobacteria looks like and what to do if exposed as shown in Figure 1, Appendix F.



Figure 1. Photo of the “Green Space And Water Quality” Sign at Shubie Off-Leash Dog Park. Created by the Young Naturalist Club. Located on the open field area by the off-leash trails.

Other Shubie Park signs specify that dog owners must clean up after their dogs, as detailed in the A-700 municipal bylaw (HRM [Halifax Regional Municipality], n.d.). Additional amenities like dogie bags and bins have been placed throughout the park, in hopes that dog owners find it easy to discard their dog’s waste. There has also been a campaign called “Canines for Clean Water” that was launched in 2019, the same year the canine fecal material was found in the Dartmouth waterways (Ahlstrand, 2019; McGuigan, 2019). The educational campaign emphasizes the importance of dog owners cleaning up after their dog and encourages the public to follow park policies (“Picking up after your dog”, 2023). Despite these measures, fecal matter in the Shubie-Off leash dog park continues to be an ongoing issue (Cooke, 2019; Crosby, 2022).

1.5 Dog and Dog Owner Behaviour

Unattended dog feces are a common problem for dog parks across the country and worldwide (Chen *et al.*, 2022; Mori *et al.*, 2023). This could have several explanations, one of which is the stationary behavior of dog owners at off-leash parks (Rahim *et al.*, 2018). Dog owners are more likely to stand or sit in these types of parks, while dogs are more likely to independently explore the area (Rahim *et al.*, 2018; Lee *et al.*, 2009). In this case, it could be more difficult to have a consistent visual of the dog, ultimately letting dog activities including defecation go unnoticed.

Shubie Dog Park has a mixed policy of both on-leash and off-leash areas. In addition to the beach and open field areas, there are a series of trails that are off-leash as shown in Figure 1 (“Trail Guide”, n.d.). If the stationary owner behaviour holds true at Shubie park, it could at least partly explain the fecal contamination.

1.6 Factors Influencing Dog Owner Behaviour

Dog owners could also be aware of a dog fecal event happening, but other factors such as believing dog feces is natural to the environment could prevent prosocial behaviour (Scruggs *et al.*, 2021; Webley & Siiviter, 2000). Even though Shubie Park has tools to inform the public about blue-green algae blooms, there still might be a misunderstanding on the environmental status of dog feces.

A community’s collective of beliefs, norms, and values can also have an influence on unattended dog waste (Graham & Glover, 2014). When there is community of people that have the same beliefs and practices, they are more likely to influence other people (Rohe *et*

al., 2017). Dog owners may disvalue park guidelines if there are only a few owners picking up after their dog.

The community of dog owners at Shubie Off-Leash Dog Park could lack collective norms and have inaccurate beliefs that go against park policies of picking up after dog waste (Graham & Glover, 2014; Rohe *et al.*, 2017). This may be another reason why there is dog fecal matter in the park.

1.7 Purpose and Objective of the Study

Based on the canine fecal material found in Lake Micmac, it is expected that dog owners at Shubie Off-Leash dog park are not picking up after their dog. Frequent fecal events create an opportunity for cyanobacteria-inducing nutrients to be washed into waterways (Cooke, 2019). Unfortunately, Lake Micmac by the off-leash beach is likely to experience blue-green algae blooms during the summer and fall months due various factors including the presence of dog feces (Cooke, 2019; McGuigan., 2019; Zhang *et al.*, 2023). The consequences of a harmful algae bloom (HAB) event in a recreational area can pose a serious threat to the community (Backer *et al.*, 2013; Zanchett & Oliveria-Filho, 2013; Zhang *et al.*, 2023). To keep the public safe, beach closures will continue to limit accessible natural spaces (Energy & Environment, 2023). Based on the harmful health effects of cyanobacteria and unattended dog feces, there seems to be a disconnect between dog owner's actions and the importance of dog waste disposal (Smith *et al.*, 2022; Yin *et al.*, 2023).

In exploring how dogs and dog owners interact with Shubie Off-Leash Dog Park, the purpose of this study is to investigate how dog feces are being managed by dog owners. The objective of this study is to determine what activities dog owners and their dogs

perform, how often, where these activities are being carried out in the Shubie-Off Leash Dog Park, and the dog owners' perspective on park management. Answering this research question will require quantitative and qualitative analysis of dog owners and their dogs. The qualitative analysis includes a series of in-person survey questions related to the objective of this study. The quantitative analysis will include observing the type of dog activity and dog behaviours taking place. In doing so, this study hopes to help address the disconnect between dog owners and park policy.

Chapter 2: Literature Review

Blue-green algae blooms have been more frequent in recent years, especially in watercourses in the Dartmouth and Halifax regions (“Blue-green algae”, 2023). Public recreational beaches are at risk and the Shubie Off-leash Dog Park located in Dartmouth, Nova Scotia is no exception (Cooke, 2019; Bradley, 2018; Young *et al.*, 2022). The Shubie Off-Leash Dog Park is an all-season public area, open to the public and their dogs, 365 days per year (“Off-Leash Dog Parks”, 2023). The 160,000 m² park has many features including a freshwater beach, open fields, trails, and wooded areas (Shubenacadie Canal, 2022). Dogs can socialize, run, swim, and play with each other and their owners (“Off-Leash Dog Parks”, 2023).

2.1 The Effects and Conditions of Blue-Green Algae Blooms

Blue-green algae is a type of cyanobacteria which releases cyanotoxins, a chemical that can be toxic to humans and other animals (Zhang *et al.*, 2023). Conditions that can create an optimal environment for cyanobacteria to bloom are warm water temperatures,

excessive nutrients, still water, and pH (potential of hydrogen) levels between 8-10 (Energy & Environment, 2023; Sun *et al.*, 2018; Zhang *et al.*, 2023).

Coming into contact or ingesting blue-green algae cyanotoxins can cause serious negative health effects such as itchy skin, digestive issues, changes in behavior, and in severe cases, fatal (Zanchett & Oliveria-Filho, 2013; Zhang *et al.*, 2023). In recent years dog fatalities due to algae blooms have increased in the HRM (Crosby, 2023; Bradley, 2018; Fraser, 2018). A study analyzed cases of HABs affecting the health of dogs across 13 different states in the U.S. and found 67 reports of dog poisoning (Backer *et al.*, 2013). Among the cases, 87% of dogs were exposed to HABs through ingestion or skin contact. Following exposure, more than half of these cases were fatal. Dogs that survived experienced health effects including vomiting, diarrhea, and changes in behavior and mobility (Backer *et al.*, 2013). Similar cases have been confirmed across Canada (Fraser, 2018; McIntyre, 2021; Slugoski, 2020; Wilson, 2016).

Different parts of the Shubie Off-Leash Dog Park are either off-leash or on-leash. Off-leash dog parks can offer many benefits to a community, like social engagement and outdoor recreation, however, they can also create controversy (Lee *et al.*, 2009; Rock, Graham *et al.*, 2016). A meta-analysis looking at dog parks around the world found that unattended dog feces are one of the biggest problems that local off-leash communities face (Chen *et al.*, 2022). To ensure that people are complying with park policies, Halifax animal bylaw A-700 specifies that people must keep their dog on a leash unless there is a sign stating otherwise (HRM, n.d.). Although there is a policy in place for picking up after dogs, it is suspected that dog owners are not complying with park policies at the Shubie-Off Leash Dog Park (Cooke, 2019; McGuigan, 2019). To contextualize the findings of the thesis

research methods, this literature review section explores relevant themes and related studies of fecal contamination at dog parks.

2.2 Dog and Dog Owner behavior

Even though some dog behaviors may not directly be correlated to dog defecation, they could indirectly affect the dog owner's decision-making. In St. John's, Newfoundland, and Labrador, Howse *et al.* (2018) observed dog behaviours relative to their age, sex, and the number of dogs at an off-leash dog park. Over a 6-minute period, several dog behaviours were recorded including time spent with other dogs, humans, and being alone (Howse *et al.*, 2018). The results revealed that immediate dog behaviour when entering the park was socializing with other dogs and humans (Howse *et al.*, 2018). Behaviors like eliminations don't necessarily happen the first minutes that dogs are present in the park, suggesting that it typically takes longer for dogs to defecate when they are in a social setting (Howse *et al.*, 2018). These initial social behaviours could affect the dog owner's level of attention to the dog; if defecation does not happen immediately, the dog owner may stop paying close attention. Howse *et al.* (2018) further highlighted that a dog's time spent alone (being at least one meter away from another dog or human) increases during the duration of 6-minute observations. In fact, dogs were alone 50% of the time at the off-leash dog park (Howse *et al.*, 2018). Other studies have found that dog owners in off-leash areas spent more of their time socializing with other owners in the park than watching their dog (Lee *et al.*, 2009; Rock, Graham *et al.*, 2016). Since there is no leash, dog owners are more likely to be stationary and likely to talk to other people around them instead of observing their dog (Lee *et al.*, 2009; Rahim *et al.*, 2018). The combination of a dog's being

independent and owners being stationary can cause owners to lose sight of their dog, leading to fecal events going unnoticed.

In addition to independent and stationary behavior, dogs are more likely to defecate in areas where there is bush and tall grass such as those found in more naturalized dog park settings like Shubie Park (Holderness-Roddam, 2020). This potentially adds another barrier for dog owners to have a full visual of their dog, especially if owners are distracted by socializing with each other.

2.3 On and Off-Leash Dog Policy

Studies have shown there are higher amounts of dog feces in off-leash dog parks relative to on-leash areas (Mori *et al.*, 2023; Wells *et al.*, 2006; Westgarth *et al.*, 2010). A study by Mori *et al.* (2023) compared the amount of dog feces in dog parks with either an off-leash, on-leash, mixed (both on and off-leash areas), or no dog park policy in Calgary, Alberta. Using point surveys of 16 parks, findings suggested that off-leash dog parks had the highest amount of fecal matter (Mori *et al.*, 2023). Alternatively, an observational study (N=101) in Highcliff and Exeter, England by Webley & Siviter (2000) found there was no difference between dog fouling (fecal contamination) and on or off-leash park policy. Thus, mixed results of whether on-leash park policy is at minimizing dog waste is not certain.

A survey in Calgary, Alberta during 2011 and 2012 by Rock, Graham *et al.* (2016), measured the number of dog fecal matter droppings among two local parks relative to their landscape and community. Martindale Park is characterized by an open grass field with a wooded area between the field and a residential unit. The park was an on-leash area in 2011, changing to an off-leash park in 2012. In support of Mori *et al.* (2023) results, Rock, Graham *et*

al. (2016) found that there was a higher amount of dog feces at Martindale Park in 2012 compared to the year before. Tardale Park located in the same neighborhood however, had an off-leash area in both years. Tardale Park underwent renovations in 2012 including installing a parking lot, mowing lawn areas, and the creation of two fenced enclosures (one for small dogs and another for bigger dogs). Even though the off-leash policy remained the same, Rock, Graham *et al.* (2016) found a decrease in dog fouling in 2012 compared to 2011. The findings of this study suggest that policy alone may not have a large influence on public compliance, but rather the amenities of the park may also influence these behaviours.

2.4 Park Features

Other efforts that can promote prosocial behaviours related to park hygiene are park features. Many studies related to urban planning find that park features such as bins, fences, doggy bags, clear signs, and water stations encourage the public to comply with bylaws while enjoying the site (Chen *et al.*, 2022; Rahim *et al.*, 2018; Rock, Degeling, *et al.*, 2016). Clear signage directing where bins are and what areas are on-leash versus off-leash helps the public engage with park policy, a feature that Shubie Park is lacking (Chen *et al.*, 2022). The Shubie Off-Leash Dog Park has bins and bag stations to address dog fouling throughout the area, but the border between the on and off-leash area is ill-defined and the relatively naturalized, borderless space may contribute to an attitude of ignoring waste (Figure 2). Importantly, the high grass and bushes surrounding the dog park, spaces that dogs use as “off-leash” although they are not meant to be, may prevent owners from collecting dog waste due to fear of ticks or stepping on the waste of other dogs left behind. Thus, the site design itself may contribute to poor stewardship behaviours. Park management may need to upgrade park features like signage or barriers to

make it clear for the public, especially newcomers, about the policies they are expected to follow (Chen *et al.*, 2022).

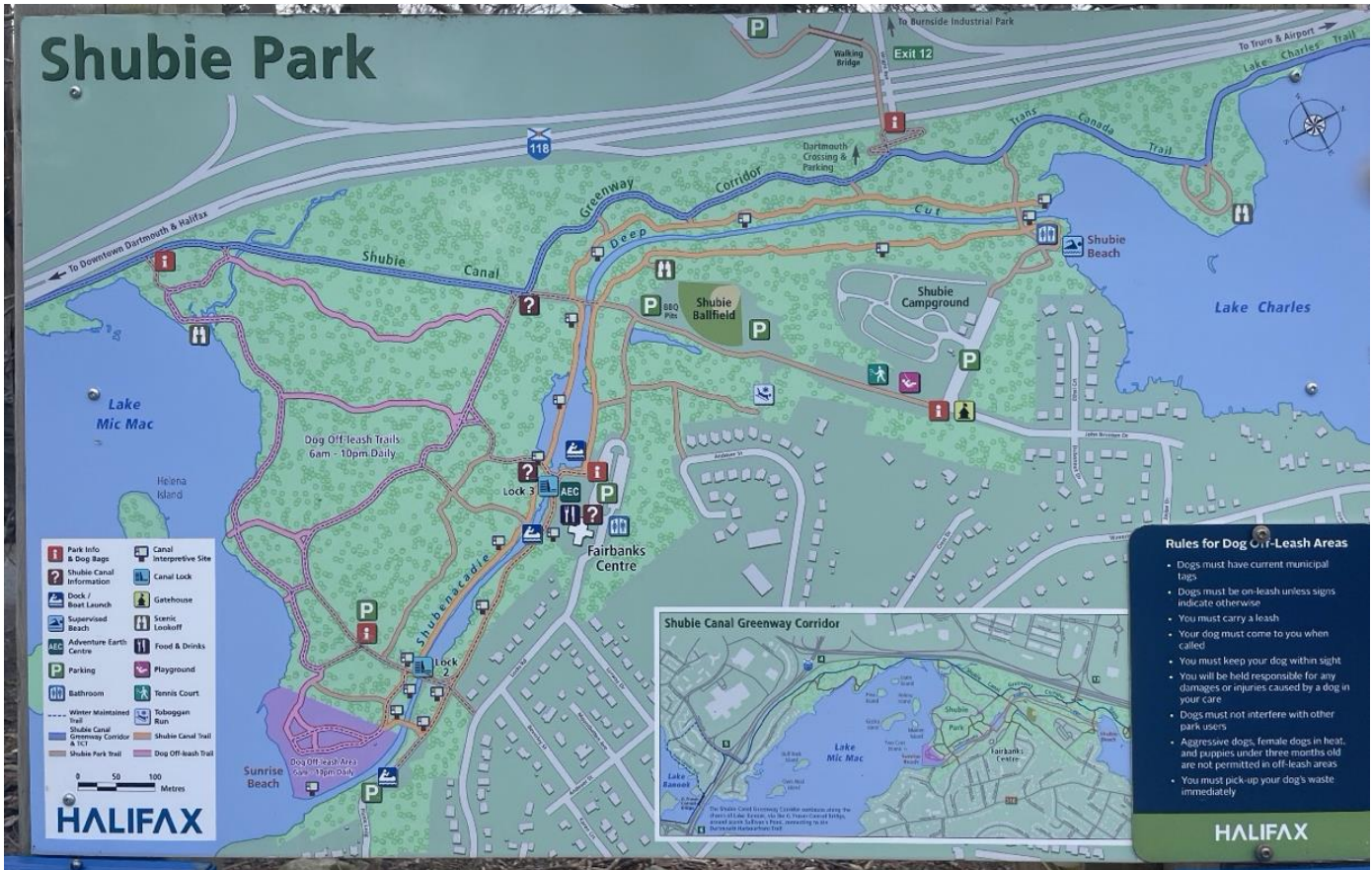


Figure 2. Photo of the map displaying both on and off-leash areas within Shubie Park, Dartmouth, Nova Scotia. Located at the entrance of Shubie Off-Leash Dog Park. The pink trails and pink area represent the off-leash areas and the orange trail represents the on-leash areas.

2.5 Education and Beliefs

Another reason that dog owners don't pick up their dog's waste is because of their beliefs and intentions (Leung *et al.*, 2015; Webley & Siviter, 2000). Webley & Siviter (2000) performed a Likert scale survey, where they asked dog owners in different parks in England the level of agreeability to statements related to picking up after their dog's waste. They found dog owners who failed to clean up after their dogs had a higher tolerance of dog waste being left in parks

relative to dog owners who complied with park policy. Higher tolerance dog owners also believed dog waste was a part of the natural environment (Webley & Siviter, 2000). Even with sufficient amenities and full attention to dog behaviour, dog owners might still disregard park policy because they believe dog waste is innocuous to the environment.

Considering informative tools including signs and the “Canine for Clean Water” Campaign, dog owners at Shubie Off-Leash dog park are suspected to be educated on the harmful effects dog waste has on the environment (Ahlstrand, 2019). Whether these tools are efficient at public outreach remains in question.

2.6 Community

The type of community can display a stronger influence on dog owner activity than park policy (Rock, Graham, *et al.*, 2016). In general, dog owners find dog parks provide an opportunity for them to interact with each other and become familiar with like-minded people (Lee *et al.*, 2009). In fact, a global systematic study looking at 26 papers on the benefits of dog parks found that human socialization and community engagement were one of the most common factors in creating an effective off-leash area (Chen *et al.*, 2022). In the Greater Montreal area, a study investigated the social dynamics among dog owners at local dog parks (Graham & Glover, 2014). The recruiting process involved 35 park users from Montreal Dog Blog Facebook page. Participants were asked to complete a questionnaire related to their experiences at local dog parks. Positive experiences included socializing with other dog owners, with some people forming personal relationships outside the park. The questionnaires further highlighted that dog parks create familiarity between dog owners, thereby creating community (Graham & Glover, 2014). At some parks, community groups have even addressed maintenance issues and

encouraged the public to comply with park policy. Conversely, dog parks are also a space where owners can feel alienated from community groups, creating disparities during social interactions (Graham & Glover, 2014). Based on both outcomes, local community groups seem to have the potential to be either healthy or harmful to the park users' experience depending on the type of social group and their behaviour. Social dynamics could potentially influence the relationship between park policy and behaviours at Shubie Off-Leash Dog Park.

2.7 Conclusion

The Shubie Off-Leash Dog Park has had issues with dog owners not complying with the city's bylaws concerning dog waste. Canine fecal matter encourages blue-green algae blooms and can pose a threat to dogs and human health (Cooke, 2019; Zhang *et al.*, 2023). For this reason, exploring dog owner and dog activity related to park management will hopefully reveal what features of the park encourage amenability to the A-700 bylaw (HRM, n.d).

Dog owners tend to be less mobile in off-leash areas, typically interacting with other dog owners and letting their dogs be active on their own (Lee *et al.*, 2009; Rahim *et al.*, 2018). In doing so, the combination of stationary dog owners and dog exploration behaviours can create a situation where dog owners are unaware of what their dog is doing or where their dog is located.

In other areas of study, policy does not show a significant influence on the park's hygiene but rather the strength of the community and park management (Graham & Glover, 2014; Rock, Graham *et al.*, 2016). Engaging with the public by installing bins, doggie bag posts, clear signs, proper vegetation, and other features could encourage the public to adhere to park policy while enjoying the area (Chen *et al.*, 2022). More importantly, investigating dogs and their owner's behaviour and activity at the park could potentially reveal the state of the community and

effectiveness of park features relative to compliance of park policy. Thus, this literature review provides insight into possible outcomes of what the Shubie Park study may come across and potential solutions to explore in the future.

Chapter 3: Methods

3.1 Study area

Located in Dartmouth, Nova Scotia, the Shubie Off-Leash Dog Park (490,000 m²) is situated between Lake Charles and Lake Micmac, with a series of on and off-leash trails that run through the area (Shubenacadie Canal, 2022). The broader features of Shubie park offer different recreational activities including hiking, biking, camping, kayaking, and canoeing. The off-leash dog park (around 8,850 m²) includes trails, a beach, and open-fields (Figure 3). There are only 9 off-leash park areas in the Halifax Regional Municipality (HRM), with Shubie and the Commons being the only two in the Dartmouth area (“Off-Leash Dog Park”, 2023).

The HRM A-700 bylaw states that dog owners must pick up after their dogs in any area that is not their own property (HRM, n.d). The bylaw further specifies dog owners can let their dogs off-leash by signage confirmation within a municipal (HRM, n.d.). Depending on the specific area, Shubie Park has an on-leash and off-leash park policy that dog owners are expected to comply with.

3.2 Sample Collection

The estimated annual population size of dogs and dog owners at Shubie-Off Leash Dog Park was estimated during the pilot study between June and July of 2023. The pilot study involved visiting the Shubie-Off leash Dog Park 5 different times, with each visit being 1 hour in

duration. The park was visited on different days and times in 2023 (June 20th at 6:00 p.m.; June 24th, at 5:20 p.m.; June 25th at 5:30 p.m.; July 24th at 8:55 p.m.; July 29th at 10:05 a.m.) to compile an estimation of the annual population. To determine population proportion for the sample size, the assumption was made that at least 50% of the estimated population visiting the off-leash area were dog owners (Surveyking, n.d.). Using Google Earth to measure the area (m²), the off-leash dog park makes up less than 2% of the total park. As there are many other areas with the same physical features (E.g. trails, beach) within the park, it is reasonable to expect people visiting the small dog park area specifically are doing so with dogs. Therefore, 50% of people are assumed to be dog owners within the study area.

To avoid miscounting the number of people and their dogs, each recorded visit was assumed to be by a different individual. An average of 21 people per hour was estimated based on the 5 different visits during the pilot period. The average estimate of people per hour (21) for 17 hours (the park's opening hours; 5 a.m. to 10 p.m.) was 357 people per day (“Off-leash dog park”, 2023). To determine the annual estimated population, the estimated average people per day (357) was multiplied by 365 days of the year. Thus, the annual population of this study was 130,305 people. Together with the number of people, there was an average number of 10 dogs per hour across the same 5 site visits. The same protocol for calculating the annual human population was applied, computing an estimated annual dog population of 62,050. A sample size calculator was then set to a 90% confidence interval (CL), and an 8% margin of error (ME), resulting in a target sample size of N=107 for in-person surveys (Surveyking, n.d.).

3.3 Recruitment

Dog owners were asked 9 in-person questions related to what activities they like to do with their dog, how often, where these activities are taking place in the Shubie Off-Leash Dog Park, and their thoughts on park management. For this study, the definition of a “dog owner” is anyone who attends the park with a dog. The anonymous survey included 4 multiple-choice questions, 3 dichotomous questions, and 2 open-ended questions displayed on paper, taking two minutes to complete (Appendix A). Asking directly if dog owners pick up their dog waste was avoided, as people tend to give an inaccurate response when the question is centered around normative behaviour (Brenner & DeLamater, 2016a). Since park policy set a normative behavior of people picking up their dog’s waste, self-reporting studies show respondents tend to have a bias toward a prosocial response even when the response is untrue (Webley & Siviter, 2000; Brenner & DeLamater, 2016b). To minimize inaccurate responses, indirect questions related to waste management was asked as shown in Appendix A.

The recruitment process involved the researcher, Morgan Leon, approaching dog owners at the Shubie Off-Leash Dog Park area. The participant was then asked if they had a dog under their care at the time of the survey to confirm they were a dog owner. To avoid involving a higher risk audience, the participants were also asked if they were 19 years older before proceeding with the survey.

3.4 Observations

In combination with human survey participation, observing and recording dog behaviour required splitting the Off-Leash Dog Park into three different sites as shown in Figure 3; note that the researcher created these sites and do not represent a physical delineation.



Figure 3. Map of Site 1 (purple), Site 2 (yellow), and Site 3 (blue) at Shubie Off-Leash Dog Park, Dartmouth. The white line represents the boundary of the off-leash area. Areas that are not highlighted were not surveyed (Google Earth, n.d.). Map created using Google Earth.

Canines visiting the Off-Leash Park were observed using scan and instantaneous sampling, for 1 hour at each study site within 10-minute time intervals following the method described by Soriano *et al.* (2021). Using a tally sheet found in Appendix B, the number of dogs that perform the following behaviors were recorded, *Defecation* (DF), *Swimming* (SW), *Catch* (CT), *Digging* (DI), *Peeing* (Pe), *Playing* (PY), *Drinking* (DR), and *Eating* (ET).

If the same dog did the same behavior within the same 10-minute interval, the behaviour was not recorded. Alternatively, if the same dog did the same behaviour in a different 10-minute interval, their behaviour was documented. To avoid the mistake of miscounting the number of dogs, documenting the same dog in a different 10-minute interval helped keep track of each individual dog. During the pilot study (between June and July of 2023), 10-minute intervals were determined to be an appropriate time to record behaviours accurately and efficiently due to the sporadic number of dogs within one hour. To minimize error, the observer identified what behaviours were able to be recorded when

there were multiple dogs in the area. Scan sampling is a useful method for observing distinctive behaviours among multiple individuals within the same time frame (Amato *et al.*, 2013). Table 1 shows the behaviours that were distinctive and timely to identify and record during the pilot study. The behaviours in Table 1 were retrieved from former studies focusing on dog and wolf behavior (Bennett, 2020; Callon *et al.*, 2017; Carrier *et al.*, 2013; Grigg *et al.*, 2021; Pal., 2010; Rooney *et al.*, 2019; Schipper., *et al.*, 2008; Howse *et al.*, 2018).

Table 1. Ethogram of defined behaviours for recorded dog observations in Shubie Off-Leash Dog Park.

Observed Behaviour	Definition
<i>Defecation</i> (DF)	<ul style="list-style-type: none"> • still with a rounded back (Howse <i>et al.</i>, 2018)
<i>Swimming</i> (SW)	<ul style="list-style-type: none"> • water level is at least shoulder height, and the dog is either still or moving
<i>Catch</i> (CT)	<ul style="list-style-type: none"> • moves in the same direction as the moving object thrown by the owner (Rooney <i>et al.</i>, 2019)
<i>Peeing</i> (PE)	<ul style="list-style-type: none"> • still, with either their left or right limb lifted, or their back legs are slightly bent (Bennett, 2020; Howse <i>et al.</i>, 2018).
<i>Playing</i> (PY)	<ul style="list-style-type: none"> • playing with other dogs and other owners • rolling over, wrestling, lunging, chasing, and leaping towards another dog or owner (Carrier <i>et al.</i>, 2013; Howse <i>et al.</i>, 2018; Pal, 2010).
<i>Digging</i> (DR)	<ul style="list-style-type: none"> • front forelimbs alternating repeatedly while making contact with the ground (Grigg <i>et al.</i>, 2021)

Observed Behaviour	Definition
<i>Eating</i> (ET)	<ul style="list-style-type: none"> Eating a substance until it is consumed (Callon <i>et al.</i>, 2017)
<i>Drinking</i> (DI)	<ul style="list-style-type: none"> Drinking from the lake (Schipper <i>et al.</i>, 2008).

Swimming (SW) was the only behavioural definition that was created independently during the pilot study. Locomotion of dog's swimming is defined by as a series of strokes from both the fore and hindlimbs (Catavittello *et al.*, 2015; Fish *et al.*, 2021). During observations, the observer's viewpoint was at a distance where strokes could not be visualized. To ensure observations are accurate, swimming is defined within the context of the study. If the dog was submerged in the water at shoulder height, it was classified as swimming.

The number of individual dogs that display a behaviour once in a 10-minute interval was tallied using a printed survey found in Appendix B. While behaviours are being recorded, the number of people that attend each site was documented as well.

3.5 Ethics

The study protocol complied with Dalhousie Research Ethics Board suggestions and conditions and was approved by the Dalhousie Ethics Review Board (2023-6863). Ethics approval is found in Appendix C.

3.6 Data Analysis

The survey found in Appendix A, had a variety of different types of questions. Questions 1 and 3 were dichotomous, 2, 4, 5, 6 were multiple choice, 6 to 8 were open-ended and question 9 was dichotomous with an option to elaborate. Once the surveys were completed, the answers were tallied and recorded on a Microsoft Excel sheet. Descriptive statistics using Microsoft Excel determined the percentage of each answer (N=107) for close ended questions. To interpret open-ended questions, a thematic-based analysis of the survey questions using NVivo coding software was carried out following the steps outlined by Fereday & Cochrane (2006). Using both deductive and inductive coding (also known *a priori* and *a posteriori*), the results were synthesized into common themes. There were a different number of codes and sub codes depending on the question as shown in Appendix D. Descriptive statistics were also used to compare the percentage and calculate the mean frequency (per 10-minutes) of the behaviors in each site as shown in Table 1 (Howse *et al.*, 2018).

3.7 Limitations

The recruitment process of both dog owners and dogs only took place in the off-leash dog area because the location facilitated easier observation of dog behavior than the off-leash trails. However, certain viewpoints were visually restricted, and so certain areas as shown in Figure 3 were not surveyed for dog observations. The researcher did not interact with dogs when possible and attempted to be unobtrusive when performing dog observations.

Question 5 of the survey, describing what dog owners like to do with their dog was seemingly misunderstood as to what activities does your dog like to do by some survey

participants. Thus, reported activities like swimming and running may or may not involve dog owners.

Since the data collection was taking place between October and January, the data does not account for summer activity. Although the participants were asked general questions, their answers may be skewed to what they do at the most recent time of the survey. The survey and observations were also weather permitting.

Chapter 4: Results

4.1 Close Ended Questions

The average number of dog owners who attended the Shubie-Off Leash Dog Park per week is displayed in Table 2. Dog owners (N=107) typically attended the dog park around ‘1-2 times a week’ (n=40, 37%) or ‘3-5 times a week’ (n=34, 32%). Some dog owners went ‘less than once a week’ (n=12, 11%), ‘6-7 times a week’ (n=16, 15%) or ‘more than 7 times a week’ (n=5, 5%).

Table 2. Dog owners responses to Question 2: “How often do you go to Shubie Off-Leash Dog Park a week with your dog(s)?” Responses displayed as a percentage (%) and number (in parentheses).

Less Than 1	1-2 Times	3-5 Times	6-7 Times	More Than 7
11% (12)	37% (40)	32% (34)	15% (16)	5% (5)

Almost all respondents (n=106, 99%) stated that they let their dog off-leash in the Off-Leash area except for one dog owner. Table 3 shows the answers to where in the Shubie Off-Leash Dog Park dog owners like to be active with their dog(s). The two most common locations

were the ‘trails’ (n=95, 89%) and the ‘beach’ area (n=89, 83%). A smaller portion stated the ‘open fields’ (n=41, 38%) and all respondents that elaborated said the ‘lake’ (n=17, 16%).

Table 3. Dog owners responses to Question 4: “Where in the Shubie Off-Leash Dog Park does your dog like to be active. Circle all that apply.” Responses are displayed as a percentage (%) and number (in parentheses).

Beach	Trails	Open Fields	Lake
83%(89)	89%(95)	38%(41)	16%(17)

Table 4 summarizes answers to what activities dog owners like to do with their dog(s) in the Shubie Off-Leash Dog Park (N=107). Most dog owners said ‘walking’ (n=86, 80%), around half said playing ‘fetch’ (n=57, 53%), and a smaller portion said ‘running’ (n=40, 37%). Of the dog owners that circled ‘Other’ (n=34, 32%), most said ‘swimming’ (n=18, 17%). Other answers included ‘socializing’ (n=11, 10%), ‘service training’ (n=2, 2%), ‘hiking’ (n=1, 1%), ‘biking’ (n=1, 1%), and ‘sitting’ (n=1, 1%).

Table 4 Dog owners responses to Question 5: “What activities do you like to do with your dog(s)? Circle all that apply.” Responses are displayed as a percentage (%) and number (in parentheses).

playing fetch	running	walking	other
53%(57)	37%(40)	80%(86)	32%(34)

Table 5 summarizes answers to whether dog owners found it challenging to discard their dog(s) waste in the Shubie Off-Leash Dog Park (N=107). If the dog owners answered ‘yes’, they had the option of choosing one of the multiple-choice answers. Most dog owners (n=84, 79%)

stated that they ‘did not have any difficulties discarding their dog’s waste’. For the dog owners who said ‘yes’ (n=23, 22%), ‘locating waste bins’ seems to be the biggest challenge (n=9, 8%), followed by ‘insufficient doggie bags’ (n=7, 7%) and ‘locating dog waste’ (n=8, 7%).

Table 5. Dog owners responses to Question 6: Do you find it challenging to discard your dog’s waste in the Shubie Dog Park area, and if so, what are those challenges? Circle all that apply.” Responses are displayed as a percentage (%) and number (in parentheses).

No	Locating waste bins	Inaccessible doggie bags	Difficult to locate waste
79%(84)	8%(9)	7%(7)	7%(8)

Out of the dog owners that stated ‘no’ (n=84, 79%), a portion of respondents (n=13, 12%) elaborated as shown in Figure 4. Through qualitative coding, there were 2 primary themes including owners commenting on ‘other poor dog ownership’ (primary theme) and ‘suggested solutions’ (primary theme) as displayed in Appendix D. Majority of people stated ‘suggested solutions’ (n=12, 11%) including ‘more doggie bags’ (n=9, 8%), followed by ‘more bins’ (n=3, 3%). Others commented on ‘poor dog ownership’ (n=2, 2%) including ‘fail to watch their dogs’ (n=1, 1%) or ‘fail to discard their dog’s waste’ (n=1, 1%).

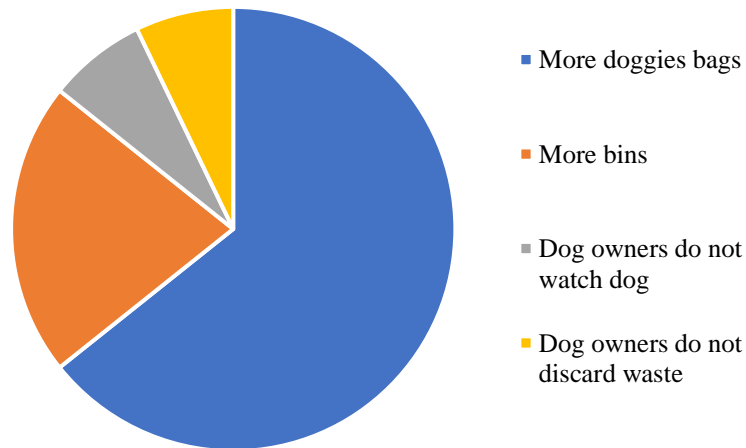


Figure 4. Responses to Question 6: “Do you find it challenging to discard your dog's waste in the Shubie Off-Leash Dog Park area, and if so what are those challenges?” Out of the 79% (84 respondents) that said no, 14 respondents elaborated. 9 dog owners stated that there should be more doggie bags in general and/or on the trails, 3 dog owners stated more bins, 1 dog owner stated that other people do not watch their dog, and 1 dog owner said that other people do not discard their dog’s waste.

4.2 Open Ended Questions

The dog owners were asked what their feature of the Shubie Off-Leash Dog Park was and why (N=107). The answer was broken down into 4 primary themes, 17 secondary themes, and 4 tertiary themes as shown in Appendix D. Figure 5 shows the primary and secondary themes only. Overall, 64% (n=74) of dog owners stated ‘natural features’ (primary theme) were their favourite feature, with a high number of respondents specifying ‘off-leash areas’ (n=68, 64%) (secondary theme). Within the off-leash area responses (secondary theme), dog owners enjoy the ‘beach’ (n=24, 22%), ‘trails’ (n=22, 20%), ‘openness’ (n=5, 5%), and the ‘lake’ (n=24, 22%) (tertiary themes). Other secondary themes of ‘natural features’ included ‘nature’ (n=10, 9%), ‘woods’ (n=3, 3%), and ‘streams’ (n=1, 1%).

Following ‘natural features’, 49% (n=52) of dog owners also stated, ‘physical activity’ (primary theme) including the secondary themes: ‘swim’ (n=17, 16%), ‘run’ (n=9, 8%), ‘roam’ (n=7, 7%), walk (n=4, 4%), and ‘freedom’ (n=4, 4%) as shown in Figure 5.

Aside from ‘natural features’ and ‘physical activity’, 28% (n=30) dog owners said ‘community’ (primary theme) was their favourite dog park feature (parent theme) with respondents specifying ‘socializing among dogs’ (n=20, 19%) (secondary theme) as their favourite feature. Other secondary themes within the ‘community’ (primary theme) are ‘park management’ (n=4, 4%), ‘socializing among people’ (n=4, 4%), and ‘safe’ (n=3, 3%). A low number of respondents stated ‘convenience’ (n=12, 11%) (primary theme), with secondary themes including, ‘close to home’ (n=8, 7%), ‘maintenance’ (n=3, 3%), and ‘parking’ (n=2, 2%).

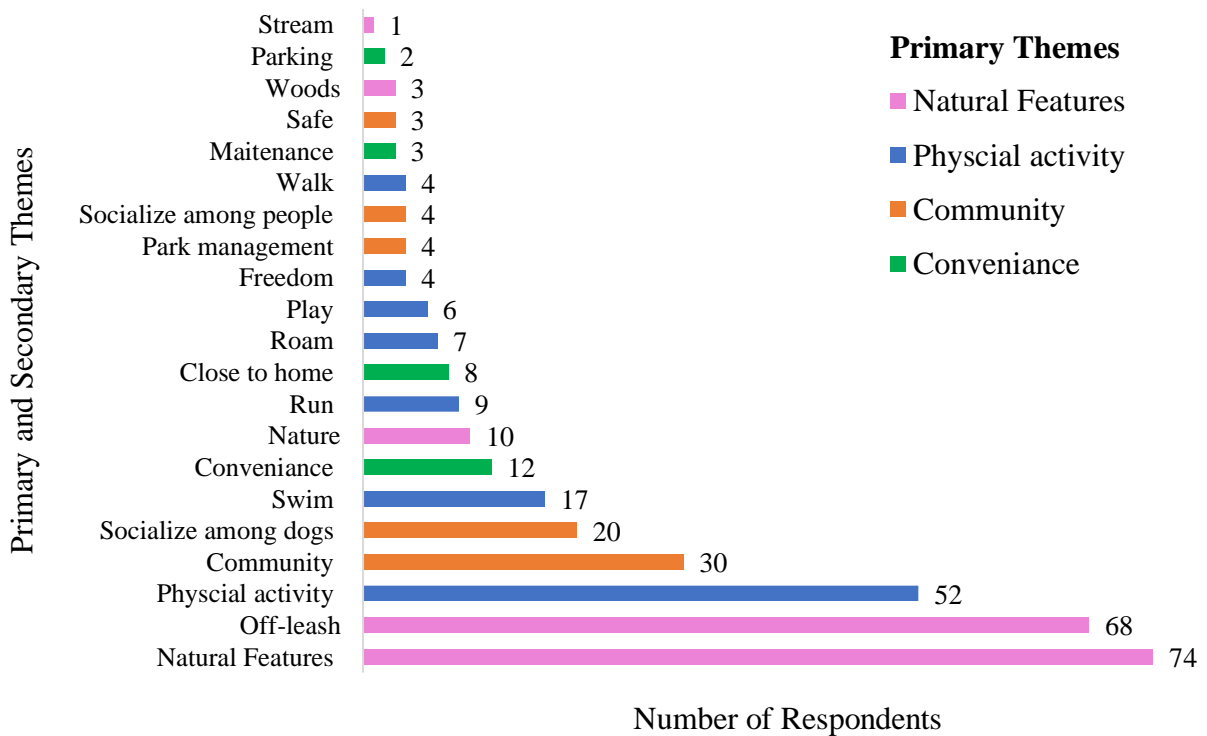


Figure 5. Primary and secondary themes of answers to Question 7: "What is your favourite feature of the Shubie Off-Leash Dog Park and why?" Each colour represents a family of themes correlated to the number of respondents. The parent theme and secondary themes are denoted by the same colour. The pink represents natural features (parent theme), and secondary themes include off-leash, nature, woods, and streams. The blue colour represents physical activity (parent theme) and the secondary themes include swim, run, roam, play, freedom, and walk. The orange represents community (parent themes) and secondary themes include socialize among dogs, socialize among people, park management, and safe. The green represents convenience (parent theme), and secondary themes include close-to-home, maintenance, and parking.

Dog owners were also asked what their least favorite feature of the Shubie off-leash dog park is and why (N=107). The responses fell into 5 primary themes, 14 secondary themes, and 11 tertiary themes as shown in Appendix D. Figure 6 shows the primary and secondary themes. Approximately 20% (n=22) of dog owners did not have a least favourite feature of the off-leash area at Shubie Off-Leash Dog Park. For those that did, 38% (n=41) of dog owners said ‘community’ (primary theme) with respondents stating ‘other dog owners’ (n=27, 25%) and ‘other dogs’ (n=22, 21%) (secondary themes) as their least favourite feature. Respondents that

stated ‘dog owners’ (secondary theme), were because of ‘conflict’ (n=13, 12%), ‘dog poo’ (n=8, 7%), and the ‘lack of owner control over their dogs’ (n=8, 7%) (tertiary themes). Respondents that stated ‘dogs’ (secondary themes) were because of ‘conflict’ (n=16, 15%) and ‘dog aggression’ (n=11, 10%) (tertiary themes). Other secondary themes within the ‘community’ include ‘busy’ (n=3, 3%) and ‘other park users’ (n=8, 7%).

Following community, approximately 21% (n=23) of dog owners responded that ‘park management’ was their least favourite park feature (primary theme), with secondary themes including, ‘confusing signs’ (n=3, 3%), ‘lack of amenities’ (n=9, 8%), ‘leash policy’ (n=9, 8%), and ‘parking’ (n=5, 5%). ‘Lack of amenities’ (secondary theme) has tertiary themes including ‘lack of additional amenities’ (n=6, 6%), ‘signs’ (n=3, 3%), and ‘trash cans’ (n=2, 2%). ‘Leash policy’ (secondary theme) also had tertiary themes including ‘limited off-leash areas’ (n=6, 6%), ‘on-leash trails’ (n=2, 2%), and the ‘size of the off-leash area’ (n=3, 3%). Approximately, 11% (n=12) of answers were related to ‘natural events’ (primary theme) and around 3% stated ‘park location’ (primary theme) as shown in Appendix D. Within ‘natural features and events’ (primary theme), respondents stated ‘algae blooms’ (n=11, 10%) (secondary theme) as their least favourite feature as shown in Figure 6.

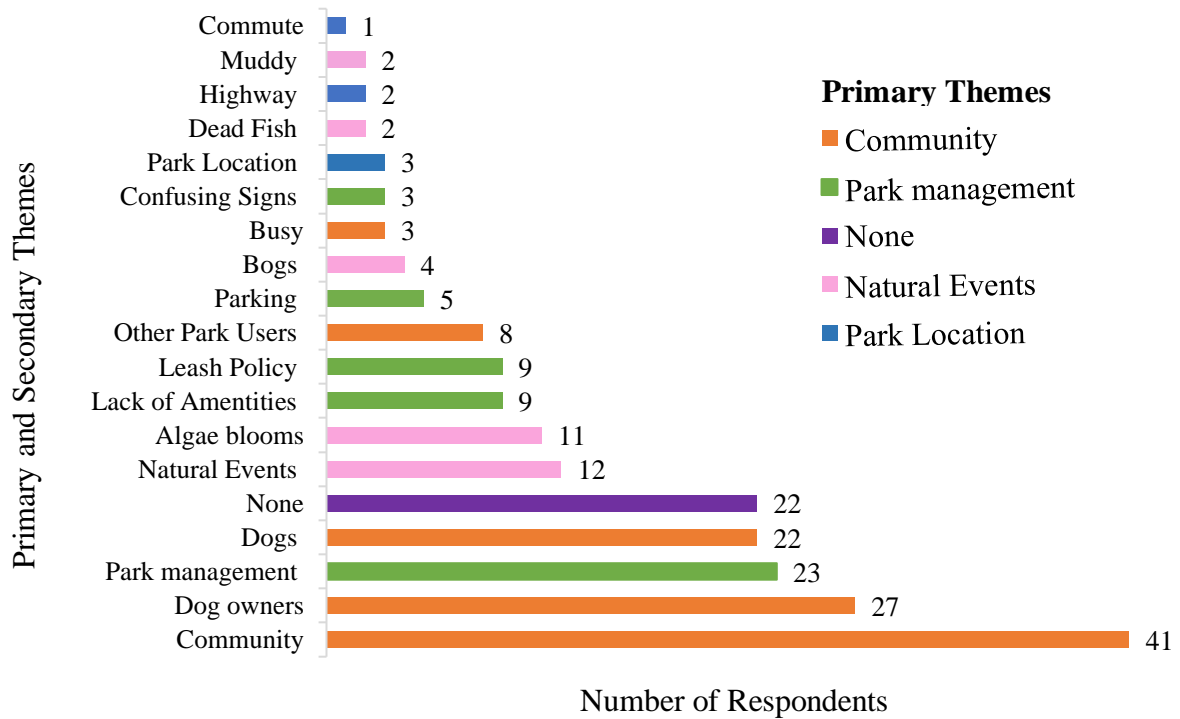


Figure 6. Primary and secondary themes of answers to Question 8: “What is your least favourite feature of the Shubie Off-Leash Dog Park and why?” The primary theme and secondary themes are displayed using the same colour. The orange represents Community (primary theme), and secondary themes include, dog owners, dogs, other park users, and busy. The green colour represents park management (primary theme) and secondary themes include lack of amenities, leash policy, parking, and confusing signs. The purple represents none (primary themes). The pink represents natural events (primary theme) and secondary themes include algae blooms, bogs, dead fish, and muddy. The blue represents park location and secondary themes include highway and commute.

Dog owners were then asked if they found park signs marking on vs off-leash areas of the Shubie Off-Leash Dog Park clear and easy to understand. If they stated ‘no’, they were asked to elaborate. There are 3 primary themes and 8 secondary themes as shown in Appendix D. Figure 7 shows that approximately 88% (n=94) of dog owners said ‘yes’, 8% (n=9) said ‘no’, and 3% (n=3) of dog owners said ‘sometimes’. Across all three primary themes, 7% (n=8) said ‘there needs to be more signs’ (secondary theme). For Dog owners that stated ‘yes’ or ‘sometimes’, 4%

(n=4) stated that ‘there needs to be more detailed signs’ (secondary theme). Finally, among dog owners who stated ‘yes’ or ‘no’, 7% (n=7) said that ‘signs are confusing’ (secondary theme).

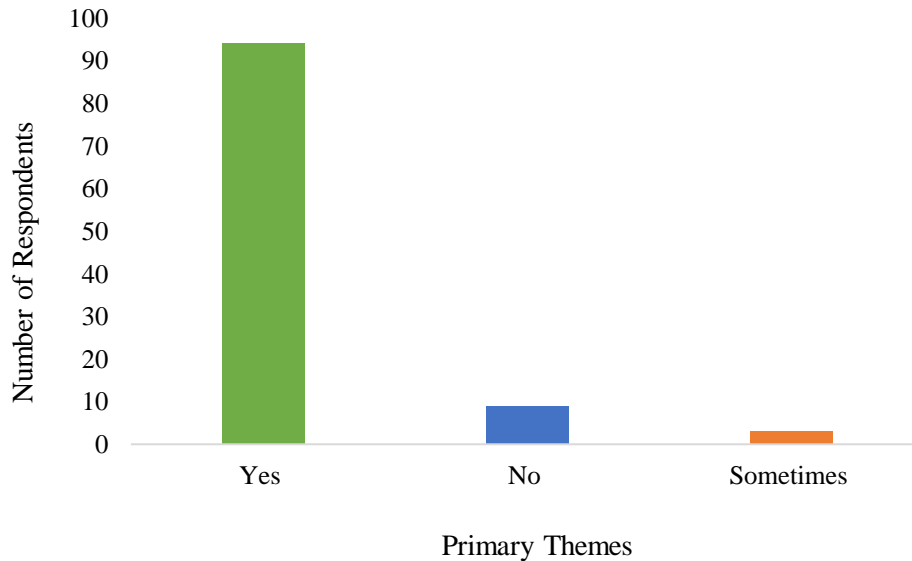


Figure 7. Number of responses based on primary themes of dog owners’ answers to Question 9: “Do you find the park signs marking what part of the Shubie Off-Leash Dog Park is on vs off-leash clear and easy to understand? If no, please elaborate?”

4.3 Dog Behaviour

Dog behaviour at Sites 1, 2, and 3 as shown in Table 6 was observed for an hour using 10-minute intervals and recorded on a tally sheet shown in Appendix E. Behaviours recorded include DF (Defecation), CT (Catch), DI (Digging), PE (Peeing), PY (Playing), DR (Drinking), EA (Eating), and SW (Swimming). Table 5 shows the 10-minute mean frequency of each observed behaviour of Site 1, 2 and 3.

Site 1 (Table 5A) highest mean frequency is ‘playing’ (8.67 times per 10 minutes), followed by ‘catch’ (6 times per 10 minutes). Similar to Site 1, Site 2 (Table 5B) has behaviours with the highest mean frequency of ‘catch’ (7.33 times per 10 minutes) and ‘playing’ (5 times

per 10 minutes). Alternatively, Site 3 (Table 5C) shows that the highest mean frequency was ‘swimming’ (7.33 times per 10 minutes), followed by ‘playing’ (6.67 times per 10 minutes). ‘catch’ (5.67 times per 10 minutes) was also common behaviour along with ‘drinking’ (5 times per 10 minutes) within Site 3.

Table 6. Mean Frequency (per 10 min) of observed behaviours within Site 1, 2, and 3 of Shubie Off-Leash Dog Park.

A.		B.	
Behaviour	Mean (per 10 minutes)	Behaviour	Mean (per 10 minutes)
DF	0.67	DF	0
CT	6	CT	7.33
DI	0.67	DI	0.67
Pe	1	Pe	1
PY	8.67	PY	5
DR	0	DR	0
EA	0	EA	0

C.	
Behaviour	Mean (per 10 minutes)
DF	1
SW	7.33
CT	5.67
DI	0.67
Pe	2.67
PY	6.67
DR	5
EA	0.33

Chapter 5: Discussion

5.1 Dog and Dog Owner Behaviours

One interesting pattern that was observed in the survey responses is that dog owners found it difficult to 'locate their dog's waste'. This could be due to Shubie Park's borderless naturalized features, with no physical separation between the off-leash trails, open fields, and the beach area. In a similar study, Romo *et al.* (2019) found that dog owners were less likely to pick up their dog's waste when it was off trail. Without a leash, dogs are more likely to be farther away from their owner (Leet *et al.*, 2009; Rock, Graham *et al.*, 2016); the naturalized features in combination with the distance between the dog and owner can increase the difficulty of locating dog waste.

The results also highlighted that some dog owners characterized others as 'poor dog owners', citing behaviours including 'not watching what their dog is doing'. As mentioned in the literature review, Rahim *et al.* (2018) highlighted that dog owners are more likely to talk to other people around them in a dog park than always paying close attention to their dog, potentially distracting them from observing what their dog is doing. During my observations of dog behaviour in the Shubie Off-Leash area, few fecal events happened within the observed area, and when these events did occur, they rarely happened within the first 10 minutes. This supports Hose *et al.* (2018) who found that dogs take longer to defecate in social settings. Without the immediate behaviour of defecation, dog owners could stop paying close attention to their dogs. When observing dog behaviour, defecation among the open fields and beach areas, were overall infrequent, possibly suggesting that fecal events are more likely to happen on the trails. Therefore, it is suspected that the combination of off-leash naturalized borders in the Shubie Off-

Leash Dog Park and unwatchful dog owners can interfere with properly picking up and disposing of dog waste.

A potential solution is to create more on-leash areas, which could reduce the number of fecal events that go unnoticed. Several studies have shown that off-leash areas have higher amounts of dog feces contamination relative to on-leash areas (Mori *et al.*, 2023; Wells *et al.*, 2006; Westgarth *et al.*, 2010). However, this finding is contested as Webley & Siviter (2000) reported that there was no relationship between on and off-leash policy relative to picking up dog waste. Considering that dog owners stated that ‘Shubie Park’s Off-Leash areas’ were their favourite feature, cooperative compliance with additional on-leash features or policies is not guaranteed. Future studies could be designed to answer this uncertainty by investigating if the existing on-leash policy does influence hygiene behaviour at Shubie Park Off-Leash trail area. Alternatively, a fence could be established to prevent off-leash dog interaction with ‘peripheral’ areas that are not officially a part of the dog park (Chen *et al.*, 2022). This would potentially constrain the dog fecal events to a more visible area while preserving the off-leash policy. Unfortunately, this intervention would be costly to the city (Brucewark, 2019; Fry, 2016; Stacom & Courant, 2006). Additionally, fencing may not be a favourable solution to mitigating dog waste because of the dog activity that takes place within Shubie Off-Leash Dog Park. Across Site 1, 2, and 3, ‘catch’ and ‘play’ behaviours were relatively common. Within site 3 (beach area) specifically, the most frequent behaviour was ‘swimming’. Fenced areas could limit these activities, and refrain dog owners and their dogs from using the off-leash area including the beach. Many dog owners favourite feature of the Off-Leash Dog Park was their dog being active including ‘playing’, ‘swimming’, ‘roaming’, and ‘running’. Even though fencing may mitigate unattended fecal events, the recreational benefit of the dog park will likely be compromised, and

dog owners would likely take these behaviours to another part of the park that is off-leash and not fenced. Further studies should investigate selective areas for fencing, where it will minimize the limitations of dog activity while reducing the likelihood of fecal events going unnoticed.

5.2 Dog Owners Belief

Most dog owners at Shubie Off-Leash Dog Park stated their dog likes to be active at the ‘beach’ or the ‘lake’. Considering many dog owners enjoy the water related features, it would be suspected that many disfavour algae blooms because bloom events limit park and water access (Energy & Environment, 2023). Only a small portion of dog owners however, said that ‘blue-green algae’ was their least favourite feature. This may suggest that dog owners may not know the severity of algae blooms or that bloom events are associated with dog fouling (Cooke, 2019; Zhang *et al.*, 2023), or that the events are currently infrequent enough that they are not on the top-of-mind.

As previously stated, Webley & Siviter (2000) found that dog owners who had a higher tolerance of dog fouling believed that dog waste was natural to the environment. Beliefs are the underlying foundation that drives human behaviour and action (Ajzen, 1991). Thus, dog owners’ lack of knowledge of dog fecal matter can influence whether they pick up after their dog waste or not. Most dog owners in Shubie Off-Leash Dog Park stated that their favourite features were ‘natural features’ including the ‘trail’, ‘beach’, and ‘open fields’. Based on these results, dog owners could be more inclined to pick up their dog’s waste if they are informed about the environmental effects of dog feces. Knowledge can have an influence on human belief and actions (Griffin & Ohlsson, 2001), but other factors, such as norms can play a role in pro-social behaviours (Ajzen, 1991; Rohe *et al.*, 2017). A campaign called “Canines for Clean Water” in

Albuquerque, New Mexico, studied how many dog owners cleaned up after their dog after seeing educational signs on dog waste. Half of the respondents stated that they picked up their dog's waste more regularly when they learned about the negative impacts dog waste has on the environment (Scruggs *et al.*, 2021). This is promising for the Shubie Off-Leash Dog park, as there has been a sign installed by the Young Naturalist Club and another sign recently installed by the City of Halifax describing the health effects that HABs have on people and their dogs. As stated before, another measure is the "Canines for Clean Water" Campaign, that promotes pro social behaviour of picking up dog waste through public engagement (Ahlstrand, 2019).

Although the Young Naturalist Club sign is informative, the location of the sign is not on a trail or a trailhead. As studies have shown, park users are more likely to read a sign when it is immediately visible (Bradford & McIntyre, 2007; Schwartz *et al.*, 2018). It is therefore recommended that the Young Naturalist Club sign is relocated in a populated area such as a trailhead. During the study, an additional cyanobacteria sign by the City of Halifax was installed on the off-leash trailhead as shown in Appendix F. Although the location was visible to the park user, the information does not include how dog feces can induce an algae bloom. It is recommended that the City of Halifax signage include information containing environmental effects of cyanobacteria and dog feces. Future studies should investigate how effective these signs are, together with the "Canine for Clean Water" campaign relative to informing the public about dog waste and blue-green algae blooms.

5.3 Park features

Dog park users had mixed opinions on the quality and quantity of park amenities in relation to discarding their dog's waste at the Shubie Off-leash Dog Park. Most dog owners did not find it challenging to discard their dogs waste, however, others found that there was either an 'insufficient number of bins', 'doggie bags', or had 'difficulty locating their dog's waste'. This suggests that there is a lack of park amenities throughout the Shubie Off-Leash area including the beach, open fields, and trails. A similar study in the United Kingdom had dog owners do an online questionnaire (N=933). Around 95% of respondents said more trash bins and dog dispensers would make them more likely to properly dispose of their dog's waste (Romo *et al.*, 2019). Several qualitative studies have found that waste bins and doggie bags make it easier for dog owners to clean up after their dog (Cutt *et al.*, 2008; Miller & Howel, 2008; Romo *et al.*, 2019). Based on the results and supportive literature, it is recommended that there should be a higher frequency of dog bag dispensaries and trash bins installed throughout Shubie Off-Leash Dog Park.

In addition to insufficient signs, some dog owners found park signs generally 'confusing' regarding what areas are on or off-leash at Shubie Park and suggested that there needs to be 'more detailed signs'. Although Shubie Park has signs marking on and off-leash areas, as well as a map as shown in Figure 2 (located on the main entrance), these measures seem unsuccessful based on survey responses. Previous research shows that persuasive language and graphic design have a behavioural influence on people (Ham *et al.*, 2009; Rice *et al.*, 2023). The likelihood model of persuasion describes there are two ways to persuade someone (Ham *et al.*, 2009; Petty & Cacioppo, 1986). The central route suggests that the more someone can agree with a target behaviour (the sign), the more likely they are to comply. This type of audience takes more time

and effort to comprehend what a message is saying than a peripheral audience. The peripheral route of persuasion describes taking a brief amount of time to look at a sign, where behavior is temporarily influenced (Petty & Cacioppo, 1986). To support this theory, an unobtrusive study by Rice *et al.* (2023) placed different sign designs in a park located in Montana, USA. They found it was important to have a capturing graphic design (different colours and text) and authoritative information that is suitable for both central and peripheral persuasion (Rice *et al.*, 2023). Thus, Shubie Park trail signs may not be captivating enough or lack relatable messaging to influence behavioural change; this is likely reinforced by the ill-defined boundaries on the site itself, where there is no delineation between the off-leash area and the broader park to reinforce the sign graphics. A study measuring the effect of sign location at St. Lawrence Island National Park, Ontario found that park users were more likely to comply with policy when signage was on the trailheads (Bradford & McIntyre, 2007). Placing the signs in the same place where the requested behaviour is inquired is important for effective behavioural persuasion (Bradford & McIntyre, 2007; Schwartz *et al.*, 2018). To determine if a better sign design and placement could change behaviour, future research will need to focus on the effect of signage in relation to behavioural change at Shubie Park. Based on dog owners' responses, more signs on trails and trailheads between on and off-leash areas should be considered.

5.4 Community

Dog owners' dislike toward the sense of community at the Shubie Off-Leash Dog Park was partly credited to 'conflict with other dog owners' and 'other dogs'. Dog owners were disliked because they 'lacked control over their dogs' and 'did not pick up their dog's waste'. This supports the results of previous studies (Chen *et al.*, 2022; Lowe *et al.*, 2014), showing that

hygiene and irresponsible dog ownership are a common issue in dog parks. Another reason provided for why the community was a least favourite feature was due to dog aggression. Dog aggression has been shown to happen in off-leash dog parks, but studies suggest that aggressive encounters between dogs happen infrequently (Shyan *et al.*, 2003; Roll & Unshelm, 1997).

Based on the survey results, Shubie Off-Leash Dog Park seems to lack a positive sense of community. As previously stated, community has shown to encourage park users to comply with park policy (Batch *et al.*, 2001; Graham & Glover, 2014; Robins *et al.*, 1991). Ajzen (1991) describes that social norm plays a role in influencing one's attitude and behaviour. This supports Rohe *et al.* (2017) case study, where a collective of people complying with the same policy influences other people to develop the same compliance behaviour. Dog owner's dislike of other dog owners and dogs at Shubie Off-Leash Dog Park likely indicate that the area lacks a similar set of shared norms and values. As a result, compliance with park policy could be harder to achieve.

To encourage a sense of community, several issues including poor dog ownership and inappropriate dog behaviour need to be addressed. In addition to signage, doggie bags, fencing, and education, the formation of community groups has shown to be successful in addressing conflict (Batch *et al.*, 2001; Chen *et al.*, 2022; Graham & Glover, 2014; Rock, Graham *et al.*, 2016). In Calgary, Alberta, an off-leash ambassador program created in 2014 entails a group of volunteers that educate dog owners on the importance of park policy (Park and Roads Services *et al.*, 2014). After a year of operation, the animal and bylaw services saw a drop in complaints related to dog aggression and human conflict (MacGregor, 2014). This suggests that the park management of Shubie Park should work closely with different stakeholders including the public

to create a cohesive group of dog owners that can encourage norms and values aligning with park policy.

Chapter 6: Conclusion and Future Studies

Dog owners and their dogs enjoy the off-leash naturalized features of Shubie Off-Leash Dog Park, specifically the trail and the beach area. Many dog owners found discarding their dog's waste difficult due to 'lack of park amenities' and 'confusing leash signage'. Dog owners specified that other owners' 'practice poor ownership' including 'not picking up after their dog'. The presence of dog's waste could be justified for several reasons, including owners not being able to see their dog defecating and the belief that dog waste is natural (Webley & Siiviter, 2000). These acts of poor ownership along with dogs displaying aggressive behaviour have shown to be disfavoured by many respondents, suggesting that Shubie-Off Leash Dog Park lacks collective norms and values (Rohe *et al.*, 2017).

From these findings, it is suggested that Shubie Off-Leash Dog Park should put more signs on trails and trailheads that are clear and detailed (Ham *et al.*, 2009). It is also recommended that more doggie bags and trash bins be installed throughout the off-leash area including the beach and trails (Cutt *et al.*, 2008; Romo *et al.*, 2019; Miller & Howel., 2008). To instill similar norms and value that align with park policy, planned program of like-minded dog owners can be created to encourage others to comply as well (Parks and Road Services *et al.*, 2014).

Future studies should assess how effective additional on-leash policies would be at minimizing dog waste. Additional studies should be designed to determine how effective current measures including “Canine for Clean Water” campaign and signage are at informing the public about the impact that fecal material has on the environment

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Appendix A

Survey

Date_____

1. Are you 19 years old or older? (Y/N)
2. How often do you and your dog(s) go to the Shubie Off-Leash Dog Park a week?
 - a. 1-2 times a week
 - b. 3-5 times a week
 - c. 6-7 times a week
 - d. More than 7 times a week
3. Do you let your dog(s) off-leash? (Y/N)
4. Where in the Shubie off-leash Dog Park does your dog like to be active? Circle all that apply.
 - a. Beach
 - b. Trails
 - c. Open fields
 - d. Other (if so please specify)
5. What activities do you like to do with your dog(s)? Circle all that apply.
 - a. Playing fetch
 - b. Running
 - c. Walking
 - d. Other (if so please specify)

6. Do you find it challenging to discard your dog's waste in the Shubie Dog Park area, and if so, what are those challenges? (i.e., locating or disposing of dog waste). Circle all that apply.
 - a. Locating waste bins
 - b. Don't have doggie bags accessible
 - c. Difficult to locate where your dog's waste is
 - d. Other (please specify)

7. What is your favourite feature of the Shubie Off-Leash Dog Park and why?

8. What is your least favourite feature of the Shubie Off-Leash Dog Park and why?

9. Do you find the park signs marking what part of the Shubie Off-Leash Dog Park is on vs off-leash clear and easy to understand? (Y/N) If No, please elaborate.

Appendix B

Field Notes for Site 1, 2, and 3

Date:

Time:

Weather:

Behavior

Defecation (DF)

Swimming (SW)

Catch (CT)

Digging (DI)

Peeing (PE)

Playing (PY)

Drinking (DR)

Time	DF	SW	CT	DI	PE	PY	DR
10							
20							
30							
40							
50							
60							

Instructions

Tally the number of dogs that do the behavior listed above within a 10-minute time frame. Within the 10-minutes, if the same dog does the behavior more than once do not record it however if the same dog does the same behavior in a different 10-minute interval record that proceed with one tally (I). In summary, I am counting the number of individual dogs that do a behavior once in a 10-minute interval.

Appendix C

Social Sciences & Humanities Research Ethics Board Letter of Approval

October 16, 2023

Morgan Leon
College of Sustainability\College of Sustainability

Dear Morgan,

REB #: 2023-6863
Project Title: Water Quality and Use of the Shubie Off-leash Dog Park Area

Effective Date: October 16, 2023
Expiry Date: October 16, 2024

The Social Sciences & Humanities Research Ethics Board has reviewed your application for research involving humans and found the proposed research to be in accordance with the Tri-Council Policy Statement on *Ethical Conduct for Research Involving Humans*. This approval will be in effect for 12 months as indicated above. This approval is subject to the conditions listed below which constitute your on-going responsibilities with respect to the ethical conduct of this research.

Sincerely,



Dr. John Cameron
Chair, Social Sciences and Humanities Research Ethics Board
Dalhousie University

ethics@dal.ca

Post REB Approval: On-going Responsibilities of Researchers

After receiving ethical approval for the conduct of research involving humans, there are several ongoing responsibilities that researchers must meet to remain in compliance with University and Tri-Council policies.

1. Additional Research Ethics approval

Prior to conducting any research, researchers must ensure that all required research ethics approvals are secured (in addition to Dalhousie approval). This includes, but is not limited to, securing appropriate research ethics approvals from: other institutions with whom the PI is affiliated; the institutions of research team members; the institution at which participants may be recruited or from which data may be collected; organizations or groups (e.g. school boards, Indigenous communities, correctional services, long-term care facilities, service agencies and community groups) and from any other responsible review body or bodies at the research site.

2. Reporting adverse events

Any significant adverse events experienced by research participants must be reported **in writing** to Research Ethics **within 24 hours** of their occurrence. Examples of what might be considered “significant” include: a negative physical reaction by a participant (e.g. fainting, nausea, unexpected pain, allergic reaction), an emotional breakdown of a participant during an interview, report by a participant of some sort of negative repercussion from their participation (e.g. reaction of spouse or employer) or complaint by a participant with respect to their participation, report of neglect or abuse of a child or adult in need of protection, or a privacy breach. The above list is indicative but not all-inclusive. The written report must include details of the situation and actions taken (or proposed) by the researcher in response to the incident.

3. Seeking approval for changes to research

Prior to implementing any changes to your research plan, whether to the risk assessment, methods, analysis, study instruments or recruitment/consent material, researchers must submit them to the Research Ethics Board for review and approval. This is done by completing the amendment request process (described on the website) and submitting an updated ethics submission that includes and explains the proposed changes. Please note that reviews are not conducted in August.

4. Continuing ethical review - annual reports

Research involving humans is subject to continuing REB review and oversight. REB approvals are valid for up to 12 months at a time (per the Tri-Council Policy Statement (TCPS) article 6.14). Prior to the REB approval expiry date, researchers may apply to extend REB approval by completing an Annual Report (available on the website). The report should be submitted 3 weeks in advance of the REB approval expiry date to allow time for REB review and to prevent a lapse of ethics approval for the research. Researchers should note that no research involving humans may be conducted in the absence of a valid ethical approval and that allowing REB approval to lapse is a violation of the University Scholarly Misconduct Policy, inconsistent with the TCPS and may result in the suspension of research and research funding, as required by the funding agency.

5. Final review - final reports

When the researcher is confident that all research-related interventions or interactions with participants have been completed (for prospective research) and/or that all data acquisition is complete, there will be no further access to participant records or collection of biological materials (for secondary use of information research), a Final Report (available on the website) must be submitted to Research Ethics. After review and acknowledgement of the Final Report, the Research Ethics file will be closed.

6. Retaining records in a secure manner

Researchers must ensure that records and data associated with their research are managed consistent with their approved research plans both during and after the project. Research information must be confidentially and securely retained and/or disposed of in such a manner as to comply with confidentiality provisions specified in the protocol and consent forms. This may involve destruction of the records, or continued arrangements for secure storage.

It is the researcher’s responsibility to keep a copy of the REB approval letters. This can be important to demonstrate that research was undertaken with Board approval. Please note that the University will securely store your REB project file for 5 years after the REB approval end date at which point the file records may be permanently destroyed.

7. Current contact information and university affiliation

The lead researchers must inform the Research Ethics office of any changes to contact information for the PI (and supervisor, if appropriate), especially the electronic mail address, for the duration of the REB approval. The PI must inform Research Ethics if there is a termination or interruption of their affiliation with Dalhousie University.

8. Legal Counsel

The Principal Investigator agrees to comply with all legislative and regulatory requirements that apply to the project. The Principal Investigator agrees to notify the University Legal Counsel office in the event that they receive a notice of non-compliance, complaint or other proceeding relating to such requirements.

9. Supervision of students

Faculty must ensure that students conducting research under their supervision are aware of their responsibilities as described above and have adequate support to conduct their research in a safe and ethical manner.

Appendix D

Coding Hierarchy

Questions 6-9

Table D-1: Question 6. Do you find it challenging to discard your dog's waste in the Shubie Dog Park area, and if so what are those challenges? Number of survey answers(parentheses) related to each code.

Primary Theme	Secondary Theme	Notes
Dog ownership (2)	<ul style="list-style-type: none">• Does not watch dog(1)• Does not discard waste (1)	
Suggested Solutions (11)	<ul style="list-style-type: none">• More doggie bags (9)• More bins (3)	<ul style="list-style-type: none">• Providing solutions that can help making discarding dog waste easier for dog owners

Table D-2: Question 7. What is your favourite feature of the Shubie Off-Leash Dog Park and why? Number of survey answers(parentheses) related to each code.

Primary Themes	Secondary and Tertiary Themes	Notes
Community (30)	<ul style="list-style-type: none"> • Park Management(4) • Safe_(3) • Socialize among dogs_(20) • Socialize among people_(4) 	<ul style="list-style-type: none"> • the influence of other people and other dogs
Convenience (12)	<ul style="list-style-type: none"> • Close to home (8) • Maintenance (3) • Parking (2) 	<ul style="list-style-type: none"> • convenient and easy for dog owners to interact with the Shubie Off-Leash Dog Park
Natural Features (74)	<ul style="list-style-type: none"> • Nature (10) • Off-leash (68) <ul style="list-style-type: none"> -beach (24) -lake (24) -open (5) -trail (22) • Stream (1) • Woods (3) 	
Physical Activity (52)	<ul style="list-style-type: none"> • Freedom (4) • Play (6) • Roam (7) • Run (9) • Swim (17) • Walk (4) 	

Table D-3: Question 8. What is your least favourite feature of the Shubie Off-Leash Dog Park and why? Number of survey answers(parentheses) related to each code.

Primary Themes	Secondary and Tertiary Themes	Definition
Community (41)	<ul style="list-style-type: none"> • Busy (3) • Dog owners (27) <ul style="list-style-type: none"> - conflict (8) - dog poo (8) - lack of control (8) • Dogs (22) <ul style="list-style-type: none"> - conflict (3) • Dog aggression (7) • Other Park Users (8) 	<ul style="list-style-type: none"> • the influence of other people and other dogs
Natural Features & Events	<ul style="list-style-type: none"> • Algae blooms (11) • Bogs (4) • Dead fish (2) • Muddy (2) 	
Park Location	<ul style="list-style-type: none"> • Commute (1) • Highway (2) 	
Park Management	<ul style="list-style-type: none"> • Confusing Signs (3) • Lack of Amenities (9) <ul style="list-style-type: none"> -additional amenities (6) -signs (3) -trash cans (2) • Leash Policy (9) <ul style="list-style-type: none"> -not enough off-leash trails (6) -on-leash trails (2) - small off-leash area (3) • Parking (5) 	<ul style="list-style-type: none"> • Park amenities • Rules and regulations

Table D-4: Question 9. Do you find the park signs marking what part of the Shubie Off-Leash Dog Park is on vs Off-leash clear and easy to understand? (Y/N) If not, please elaborate. Number of survey answers(parentheses) related to each code.

Primary Themes	Secondary and Tertiary Themes	Notes
No (9)	<ul style="list-style-type: none"> • Confusing signs (4) • More Signs (5) • Too Many Signs (1) 	
Sometimes (3)	<ul style="list-style-type: none"> • More detailed signs (1) • More Signs(1) 	<ul style="list-style-type: none"> • Inconsistent understanding of what parts of Shubie park are on or off-leash
Yes (94)	<ul style="list-style-type: none"> • Confusing signs (3) • More detailed signs (3) • More signs (2) 	

Appendix E

Behaviour tally sheet for each site

Dog Behavior: Site 1

Defecation (DF)
Swimming (SW)
Catch (CT)
Digging (DI)
Peeing (PE)
Playing (PY)
Drinking (DR)

Table E-1: The number of dogs that were observed doing one of the following behaviors per 10 minutes, for an hour of Site 1, on November 9, 2023, at 1:00 p.m. 22 people and 18 dogs attended Site 1.

Date: November 9th, 2023

Time: 1:00

Weather: Sunny 6C, little cloudy

Time (per 10 minutes)	DF	SW	CT	DI	PE	PY	DR	EA
10			1					
20			1					
30			2					
40			2					
50						2		
60	1		1		2			
sum	1	0	7	0	2	2	0	0

Table E-2 :The number of dogs that were observed doing one of the following behaviors per 10 minutes, for an hour of Site 1, on November 16, 2023 at 3:15 p.m. 24 people and 29 dogs attended Site 1.

Date: November 16th, 2023

Time: 3:15

Weather: Sunny 10C

Time (per 10 minutes)	DF	SW	CT	DI	PE	PY	DR	EA
10			1					
20			1			3		
30			2			4		
40			2			2		
50			3					
60					1			
sum	1	0	9	0	1	9	0	0

Table E-3: The number of dogs that would do one of the following behaviors per 10 minutes, for an hour of Site 1, on January 11th, 2024 at 3:18 p.m. 30 people and 20 dogs attended Site 1.

Date: January 11th, 2024

Time: 3:18 pm

Weather: Sunny, 4C

Time (per 10 minutes)	DF	SW	CT	DI	PE	PY	DR	EA
10			1					
20								
30								
40	1					3		
50				2		6		
60			1			6		
sum	1	0	2	2	0	15	0	0

Dog Behavior: Site 2

Table E-4: The number of dogs that would do one of the following behaviors per 10 minutes, for an hour of Site 2, on October 25th, 2023 at 9:11 a.m. 6 people and 6 dogs attended Site 2.

Date: October 25th, 2023

Time: 9:11 a.m.

Weather: Sunny with a slight breeze, 13C

Time (per 10 minutes)	DF	SW	CT	DI	PE	PY	DR	EA
10			1			1		
20			1	2		1		
30			2					
40								
50						3		
60								
sum	0	0	4	2	0	5	0	0

Table E-5: The number of dogs that would do one of the following behaviors per 10 minutes, for an hour of Site 2, on November 5th, 2023 at 3:40 p.m. 12 people and 15 dogs attended Site 2.

Date: November 5th, 2023

Time: 3:40 p.m.

Weather: Cloudy and Sunny, 11C

Time (per 10 minutes)	DF	SW	CT	DI	PE	PY	DR	EA
10			3			3		
20			1			2		
30					1			
40			1		1			
50								
60								
sum	0	0	5	0	2	5	0	0

Table E-6: The number of dogs that would do one of the following behaviors per 10 minutes, for an hour of Site 2, on November 13th, 2024 at 1:08 p.m. 19 people and 18 dogs attended Site 2.

Date: January 13th, 2024

Time: 1:08 p.m.

Weather: Cloudy, 1C

Time (per 10 minutes)	DF	SW	CT	DI	PE	PY	DR	EA
10			4					
20			3			3		
30								
40			4			2		
50					1			
60			2					
sum	0	0	13	0	1	5	0	0

Dog Behavior: Site 3

Table E-7: The number of dogs that would do one of the following behaviors per 10 minutes, for an hour of Site 3, on November 5th, 2023 at 4:00 p.m. 20 people and 28 dogs attended Site 3.

Date: November 5th, 2023

Time: 4:00 p.m.

Weather: Sunny, 4C

Time (per 10 minutes)	DF	SW	CT	DI	PE	PY	DR	EA
10	1	2			2	1		
20		3	2		1	2		
30		6	4			5		
40		2				2		
50	1	3	3	1	2		5	
60				1	1	2	1	1
sum	2	16	9	2	6	12	6	1

Table E-8: The number of dogs that would do one of the following behaviors per 10 minutes, for an hour of Site 3, on November 9th, 2023 at 1:00 p.m. 22 people and 18 dogs attended Site 3.

Date: November 9th, 2023

Time: 1:00 p.m.

Weather: Sunny, 6C

Time (per 10 minutes)	DF	SW	CT	DI	PE	PY	DR	EA
10			1					
20			1					
30			2					
40			2					
50						2		
60	1		1		2			
sum	1		7	0	2	2	0	0

Table E-9: The number of dogs that would do one of the following behaviors per 10 minutes, for an hour of Site 3, on January 17th, 2024 at 1:38 p.m. 6 people and 12 dogs attended Site 3.

Date: January 17th, 2024

Time: 1:38 p.m.

Weather: Partly sunny, -1C

Time (per 10 minutes)	DF	SW	CT	DI	PE	PY	DR	EA
10								
20		2	1			3	3	
30		3				3	6	
40		1						
50								
60	0							
sum	0	6	1	0	0	6	9	0

Appendix F

Current Cyanobacteria Signage



Figure F-1 “Green Space And Water Quality” Sign at Shubie Off-Leash Dog park. Created by the Young Naturalist Club. Located on the open field area by the off-leash trail area.



Figure F-2 “What Should You Know About Cyanobacteria?” Sign created by the City of Halifax. Located on the Off-Leash trail head, in front of the beach area.