Thrown Away: Litter and Littering Behavior in Outdoor Public Recreational Areas in Idaho

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Abstract

Littering is an environmental issue of significant concern worldwide, including campgrounds. Litter can be anything ranging from small items, such as cigarette butts or plastic food wrappers, to larger items, such as electrical appliances, to discarded furniture or vehicles. Campgrounds in public spaces are fascinating places with a mix of artificial environments nestled in natural settings. This makes them an interface between human and wild ecosystems and therefore, interesting places to study how humans interact with such ecosystems regarding litter (especially plastic) and the associated habits. This research conducted in four State Parks and one National Forest in Idaho aimed to a) quantify the amount and type of macro litter that remains behind in the campgrounds, and b) identify campground users' perception of litter and their management preferences. The macro litter was collected through camp hosts and by the research team in person, and the on-paper survey was distributed to the campers by the hosts. 78.6% of the macro litter collected was plastics, followed by metal (14.2%), glass (2.1%), rubber (2.9%), and misc. Plastic flux per camper in a campground was significantly higher than the flux of other types of litter. Thus, in sites with higher visitor usage, having more designated trash receptacles decreases the amount of plastic litter. For the survey, the Revised New Ecological Paradigm (NEP) was used as a measure of the camper's environmental worldview. The results indicated that campers with higher NEP scores showed more pro-environmental behavior in their waste disposal methods. The campers also indicated that the waste disposal options available currently are inadequate. This study provides some unique insights into the litter and littering situation in Idaho, which could benefit and guide park services to design appropriate awareness strategies/campaigns to reduce littering.

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Dedication

To my mom and dad, Deepak and Manju, and my brother Manish.

To my “remote” friends: Lydia, Becca, and Nithya.

To my “in-person” friends: Galen, Maryam, Heather, Marwa, and Kameron

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Chapter 1: Introduction

Public lands (both state and federal) are a massive draw for recreational purposes, but mismanaged waste, both illegal dumping, and littering, is a constant management concern for officials trying to maintain the services that public lands have to offer. Litter negatively impacts communities and public lands regarding aesthetic, environmental, and financial costs (Bator et al., 2011; Ojedokun & Balogun, 2011). Beaches, hiking trails, campgrounds, and harbors across the country have seen a considerable increase in visitor numbers since the pandemic began, and with increasing crowds, there has been an increase in litter accumulation along trails and overflow in garbage collection sites (Chow, 2020). Public use and access to these areas for recreation are economically crucial for states, and the demand for outdoor recreational opportunities will continue to grow (Straubinger, 2018). Given the scope of the problem, there needs to be more scientific attention paid to this issue.

With this thesis, I hope to gain a better understanding of the quantity and composition of litter in campgrounds located in Idaho public lands, what the recreational users have to say about litter, and how this information can be used to keep our public lands free of litter. Chapter 1, this chapter, provides an overview of the critical literature relevant to the topics of litter, littering habits, and littering in Idaho recreational areas. Chapter 2 analyses the litter accumulation in Idaho state parks, national forest campgrounds, and day-use areas using field litter collection data from the summer of 2021. Specifically, the chapter looks at the cleanup efforts by the camp hosts after the campers leave and how, despite active management, there is still a substantial amount of litter that remains behind in those environments. Connecting this collected litter data to the available visitor data helps us understand the litter flux in the recreational environment. Chapter 3 focuses on littering habits and aims to evaluate the environmental worldview of the campers, understand their perception of waste management systems in place, and their effectiveness. This information will help design and implement litter management and reduction strategies within the campgrounds.

1.1 Litter

Litter is defined as “solid waste that is intentionally or unintentionally disposed of into the environment despite the availability of waste management infrastructure” and has been estimated at 2% of all waste generated (Law et al., 2020, p. 3). Active littering is purposeful, with the litterer knowingly leaving litter behind when leaving the space, while in passive littering, litter gets left behind despite taking active precautions to prevent that outcome (Liu & Shibley, 2004). Litter can be anything ranging from small items, such as cigarette butts or plastic food wrappers, to larger items, such as electrical appliances, to discarded furniture or vehicles (Schultz et al., 2013). In short,

anything in an “unacceptable location, regardless of its origin” can be considered litter (Schultz et al., 2013, p.2).

The non-profit Keep America Beautiful (KAB) began investigating litter and littering behavior in the 1960s, which led to widespread media campaigns and a growing awareness of litter. According to the 2020 KAB litter study, litter is a growing environmental concern. There are approximately 50 billion pieces of litter in US roads and waterways, or almost 152 pieces of litter per US resident (KAB, 2021). While the latest KAB report shows marked reductions in litter and littering a (decrease of 61% between 1969-2009 and a further 54% since 2009), there was still a slight uptick in litter from 2019 to 2020 owing to COVID-19 pandemic effects as several communities reported an increase in littering and illegal dumping during this period (KAB, 2021).

While tracking litter by type, it is evident that the most frequently littered item is cigarette butts (9.7 billion cigarette butts in 2020), followed by plastic food package film (2.5 billion) and broken glass and ceramic (2.4 billion) (KAB, 2021). With the COVID pandemic impacting the world starting in 2020, PPE gloves and masks have formed a new category. At the time of KAB’s 2020 survey, it was estimated that there were approximately 207 million pieces of PPE gloves and masks on America’s roads and waterways (KAB, 2021). Though this category was only a tiny proportion (0.4%) of total litter, the introduction of a new litter type can provide insights into the flow and transport of litter in our surroundings.

Of all the litter compositions, plastic litter is especially problematic due to its engineered longevity. During and or/after the manufacturing process of plastics, the material properties of the raw materials, i.e., the petrochemicals, are adjusted by adding synthetic chemical materials to achieve desired strength, color, malleability, versatility, longevity, and relative inexpensiveness (Chamas et al., 2020) which means that when they end up in our terrestrial, freshwater, and marine environments, they remain there for an extended without degrading. While they do not undergo biodegradation, larger plastic particles will break down through physical, chemical, or biological processes to form plastic particles smaller than 5 mm, called microplastics (NOAA, 2016). Even for plastics that claim to be biodegradable, studies have shown that they are more likely to disintegrate into secondary microplastic than biodegradable (Qin, 2021).

Out of the 400+ million tons of plastic produced every year, 29 million tons of it enter the environment each year, with ~20 million of it going into terrestrial and freshwater environments (Law et al., 2020). The 2021 report by the United Nations Environmental Program (UNEP) further estimates that plastic accounts for 85% of all marine litter, with 8-10 million metric tons of plastic waste ending up in the oceans each year, of which 80% is estimated to be a direct result of littering (UNEP, 2021). Breaking down the littering aspect in the US more, the KAB 2020 litter survey found

that plastics, including cigarette butts, form 58.2% of the total litter recovered (KAB, 2021). The report also showed that cigarette butts alone contribute 19.6% of the total litter recovered (2021). As there is high variability in the fragmentation of plastics, it is hard to estimate the weight of total plastic litter compared to other litter categories such as metal, glass, rubber, and more. Additionally, weight is not a common measurement in litter studies. However, the results of the 2021 litter study on ten Scottish beaches showed that the average weight of plastic litter was 15.6 grams compared to non-plastic litter types (wood, glass, and rubber), with the average weight ranging from 76.8 g to 154.7 g (Smith & Turrell, 2021). The lightweight quality of plastics means that often, the weight of plastic litter, on average, will be lower than other categories, which might include metal, glass, or rubber.

1.2. Litter in Recreational Areas

Maintaining environmental quality in recreation areas while continuing recreational opportunities is becoming a challenge for public land managers. Pierno (2017) estimates that each year, over 100 million pounds of waste are generated in national parks through a variety of means, including park operations, visitors, and more. This is an estimate of managed waste collected through proper garbage disposal channels and excludes mismanaged waste like litter. There have been few studies that tried to quantify litter in public recreational areas like parks. A biweekly litter survey over four weeks done in 37 different sites in New Jersey by Cutter et al. (1991) contained two state parks, and the litter from those two parks contributed 5.1% of the total litter collected (608 pieces out of 9989 pieces). Additionally, the state parks had the highest weekly fresh/new litter accumulation of any of their sites, with thirty-nine new pieces of litter found in the survey area each week (Cutter et al., 1991). By actual item count, cigarette butts (2321) were the most littered items, followed by paper (2892), plastic (1414), glass pieces (1025), and metal (732). Despite the study happening in 1991, the trends are like the KAB 2020 results. In another report by Rodríguez-Rodríguez (2012), within protected areas of the autonomous region of Madrid, paper, and cardboard (44.48%) was the most common littered item, followed by plastic (31.16%). This shows that plastics form a large portion of litter found in green areas. Considering the impact of plastics on the environment, it is imperative to work on preventative measures.

Recently, there has been an increased focus on quantifying litter in recreational areas because people are starting to understand the need behind it. In 2021, Arches National Park in Utah reported hauling out 150 pounds of trash from an illegally made camp within the park (Will, 2021). In 2022, 558 volunteers participated in 44 cleanup sites around the country in national parks and federal lands (urban parks, national forests, and monuments) and collected 14,237 pieces of litter, with 81% of it being plastic and cigarette butt as the highest individual category (Trashblitz, 2022). While there is a variability focus of different litter surveys (number of litter pieces vs. total weight of litter collected

vs. area covered by litter) in public protected areas, what is clear is that protected natural areas are hotspots for litter despite managed waste disposal channels.

Furthermore, especially in campgrounds within protected areas, which are uniquely designed ecosystems in themselves to provide a good visitor experience while also ensuring the protection of ecological resources, littering is an increasingly prevalent issue. As campgrounds are actively being developed as safe spaces for outdoor enthusiasts to enjoy natural landscapes while enjoying modern amenities, they are also being heavily used. When an issue like littering starts dominating these areas, it might lead to reduced recreational experience for campers and might also lead to conflict among visitors (Brown et al., 2010). Thus, understanding the quantity and types of litter left behind by campers can provide insights for park management to develop systems that effectively promote anti-littering habits and, at the same time, promote positive waste management and disposal behaviors.

1.3. Impacts of Litter

Littering, intentional or unintentional, is a human behavioral issue with major aesthetic, health, social, economic, and environmental pollution dimensions (Ojedokun & Balogun, 2011). Aesthetically, littered places are visually less appealing and depreciate the economic value of the surrounding environments, impacting property values and tourism prospects. Wilson et al. (1995) carried out an experiment where they digitally altered pictures of natural areas to either be pristinely clean or have obvious cues of being dirty (visible litter and water sources with algal blooms and surface foam), and they found that the later scenes were less likely to be picked by visitors for hypothetical future visits. Thus, even though litter found in natural areas might be lower in amount compared to other environments, the aesthetic objection is much more significant and more likely to impact recreation decisions with economic consequences.

Litter is also associated with significant health concerns for humans and animals alike. In recreational areas, litter, such as glass fragments or other sharp objects, can be an injury hazard to humans and wildlife (Al-Khatib et al., 2009). A study done on Lorne Beach in Victoria, Australia, found that of the 211 recorded beach injuries that year, 19% were from beach litter (Grenfell et al., 1992). Even on beaches that are considered clean, 21.6% of beach visitors have sustained injuries because of the litter (Campbell et al., 2016). Litter pieces, both biodegradable and non-biodegradable, can serve as a place for diseases to breed and spread (Thompson et al., 2009). For animals, the smell of biodegradable litter can attract them to areas close to human settlement, endangering both humans and animals, increasing dependency on human food, increasing risks of animals ingesting non-edible materials that cause health issues, and more (Thompson et al., 2009). Additionally, cigarette butts, 76% of which end up as litter (Green et al., 2014), have the potential to start fires and contaminate drinking water systems (Al-Khatib et al., 2009).

People are very susceptible to the littering behavior of other people, which means that seeing people actively littering or seeing an already littered area prompts people to litter more and sends the message that littering is an accepted norm (Kallgren et al., 2000). Many other studies show a similar trend in varying surroundings like in grocery stores (Geller et al., 1977), picnic areas (Crump et al., 1977), parking garages (Cialdini et al., 1991), and an alley in the city center (Keizer et al., 2011). While the presence of litter in surrounding areas is not shown to impact crime rates directly, the prevalence of a high amount of visible litter in any area does impact people's perception and anticipation of crime happening there (Medway et al., 2016; Stafford & Pettersson, 2009). A Dutch experiment showed that in littered areas, twice as many people steal envelopes protruding from letterboxes compared to clean neighborhoods (Keizer et al., 2008). Thus, socially, litter and littering promote negative behavioral patterns.

Financially, litter cleanup is expensive. A rough 2009 estimate shows that $11.5 billion is spent annually on litter cleanup costs in public areas (KAB, 2009). A five-year study (2014-2018) conducted by Keep Pennsylvania Clean in nine Pennsylvanian cities representing 18% of Pennsylvania's population showed that these nine cities alone spend more than $68.5 million annually to prevent and clean up litter and illegal dumping (KPB, 2020). Philadelphia alone spends more than $48 million annually on cleanup, education, enforcement, and prevention efforts to address litter and illegal dumping, with 89% of the money going directly into the cleanup efforts (Krummer, 2020). While there is no financial data on littering in Idaho, neighboring Washington state spends over $9 million annually to pick up litter, and in the first seven months in 2022 alone, 816 tons of litter was collected across state highways of Washington (DOE, 2022). The Department of Ecology of Washington clarifies that despite the efforts, millions of pounds of litter get left behind as litter pick-up efforts cannot keep up with the littering rates (DOE, 2022). These are directly reported costs, and this number is lower than the actual costs as so many litter cleanup costs are distributed across various governmental entities as well as community-based organizations and volunteer groups.
Some cleanup costs are reduced by volunteer hours by businesses and organizations cleaning up litter in public spaces. However, even volunteer efforts have associated costs.

In a study by Stein (2005), the cost of litter cleanup was estimated to be $1.29 per piece of litter when work was done by paid employees and 18 cents per item when using voluntary labor under Adopt-a-Highway litter cleanup programs. Another study in Michigan estimated that the per road mile cost of litter cleanups by public employees was $1666.67, and it was $365.92 when relying on voluntary programs (CRI, 2015). So, while volunteer efforts are essential in limiting cleanup costs to landowners, they cannot eliminate litter cleanup costs.

While all types of litter have negative impacts on the environment, the impacts of plastic litter are incredibly persistent and long-lasting. Larger plastic pieces can be carried into freshwater systems (rivers, lakes, and streams) with rain and flood events and contaminate those sources (Thompson et al., 2009). Aquatic animals can also ingest them in a fresh and marine environment and when terrestrial scavengers eat the aquatic animals, plastic enters the food web (Thompson et al., 2009). When the larger plastic particles disintegrate in the environment, they release the additive chemicals that leach into the surroundings, and depending on their weight, microplastic particles can be airborne, get into the aquatic systems (e.g., drinking water facilities), and ultimately impact terrestrial organisms (Enyoh et al., 2020). Once microplastic particles are in the soil, they undergo vertical and horizontal distribution (Guo et al., 2020). Plant processes like root growth and harvesting, movement of soil microbes, animals, and their gut metabolism, and breaking of soil aggregates function as pathways for microplastic movement (Rillig et al., 2017). As the terrestrial food web depends on the transport and distribution of nutrients between the soil, the plants, these microarthropods, and animals, including humans, this intricate relationship also includes the distribution of microplastics within the food web. In a way, the soil not only acts as a sink for microplastics but also as a source for surrounding environments.

More studies are being carried out to examine the impacts of microplastics on components of terrestrial ecosystems, such as soil fertility and function, nutrient cycle, microbes' movement, and, more importantly, the ecological and health risks posed by microplastics. Recent studies have confirmed that microplastics are vectors of biological and chemical contaminants such as PCBs, PAHs, pesticides, and heavy metals and can pose significant health risks to humans and animals alike (Wagner et al., 2014). Some studies have shown that accidental ingestion of microplastics could potentially lead to energy depletion, damage to internal organs, decreased biochemical responses, and various metabolic disorders (Wang et al., 2019). Mohamed Nor et al. (2021), using surveys of microplastics in the air, water, salt, and seafood, suggest that children and adults might ingest anywhere from dozens to more than 100,000 microplastic specks daily.

1.4. Littering Habits

While studies of litter distribution are few, there is a sizable body of work looking at littering habits among different groups. Though many studies fail to find significant demographic predictors behind littering groups, some conclude that males, younger adults, and individuals living in rural communities are more inclined to litter (Schultz et al., 2013; Beck, 2007; Finnie, 1973). Additionally, in another littering study in Bintulu, Malaysia, Abdul Aziz et al. (2019) found that littering behavior in Malaysia is commonly influenced by gender, family income, education level, and age. The influence of gender and age in littering also aligns with the study by Shultz et al. (2011). However,

the variability in results makes it harder to attach specific demographic characteristics to littering behavior.

Understanding why people litter was the goal of KAB's 2009 public attitude survey, which asked questions about public opinion on the presence and effect of litter and littering behavior through interviews and telephone surveys (KAB, 2009). Through the survey and additional observations by KAB, two broad themes emerged: a) personal behavior and b) physical context.

Factors influencing personal littering habits can be personal, social, or habitual. In a behavioral observation study by KAB, the researchers noticed that almost 17% of all the waste disposal observed was littering. When the individuals littered, 81% of them did so intentionally (i.e., dropping the trash and not picking it up again, flicking or shooting it towards the receptacle and not picking it up again when missed, sweeping the trash away with their feet rather than adequately disposing of it) (Schultz et al., 2013). This tells us that littering can be an intentional habit, and the finding also showed that 85% of littering behaviors result directly from individual-level behavior, such as lack of concern or motivation (KAB, 2009).

If an individual perceives litter as their responsibility rather than that of local authorities, they are more likely to dispose of their waste properly (Curnow et al., 1997). A survey in England suggested that despite personal feelings of responsibility if people are in spaces where someone else is paid to clean up, they feel justified in littering or, in some instances, do not even consider their action as littering (Lewis, 2009). The 2009 KAB survey pointed out that the type of litter produced can sometimes be a driving force behind littering habits. When individuals are uncertain about what counts as litter, they are more likely to leave those items behind, such as biodegradable and small items, as these are not necessarily considered 'litter' (Lyndhurst, 2013). Items that are biodegradable or considered to be biodegradable are more likely to be left behind during cleanup processes than other non-biodegradable items (Khawaja & Shah, 2013).

As for habitual factors, Ojedokun & Balogun's (2011) study in Nigeria shows that littering can become a habit over time, no matter which surroundings you may be in. Lewis (2009) suggested trash/litter be dirty, and the desire of an individual to push that unwanted and dirty item out of their space regardless of where it ends up could be a significant factor behind littering. All of these are examples that when an individual does not consider proper waste disposal as their responsibility or part of their beliefs, it leads to litter and a persistent littering habit. The 2009 KAB survey did point out that 85% of littering occurs from personal qualities.

Robinson (1976), Krauss et al. (1978), and Cialdini, Kallgren, and Reno (1991) all show that the presence of litter in a public area increases the likelihood of additional littering. Additionally, Schultz et al. (2013) and KAB (2009) showed that physical context, such as site characteristics,

overall cleanliness of sites, and existing waste disposal infrastructure, determines the frequency of littering in any surrounding about 15% of the time. However, Campbell (2007) found distance to a trash receptacle or disposal site to be a more critical measure. As distance increases, people find it more challenging and inconvenient to dispose of their trash properly, resulting in more littering, as confirmed by KAB (2009), which found that the distance from the trash receptacle was one of the strongest predictors of littering. Conversely, more than the availability of multiple waste disposal options might be needed to change littering habits (Lyndhurst, 2013). For example, a recent study by Philadelphia's Zero Waste and Litter Cabinet found that adding more recycling bins did increase the recycling volume (KPB, 2017).

Most of the littering behavior studies are focused on smaller areas like public urban parks or beaches. Fewer studies have been done on littering habits in campgrounds. A 1972 study by M. Dodge found that campers with a negative attitude towards littering were more willing to clean up the campsites even if other campers left litter behind. The same study also reported that local campers were less concerned about litter in the campsites than visitors from a distance (Dodge, 1972). This might be because the locals are already familiar with and used to the littering situation, while the visitors often hold new places to a higher level of expectation. Thus, littering behaviors are often place and activity-specific and need to be studied based on the context to understand their cause fully and to create possible interventions.

For recreational areas, surveying campers to understand how they perceive litter in natural areas, what they consider to be litter, their waste management habits, and what measures they think may help reduce litter may be a practical starting point for park management to frame their future litter reduction strategies.

1.5. Litter Management Strategies

With the growing litter problem in every part of the world, intervention and management strategies are slowly being recognized as great value. Approaches to reduce littering include the use of public policy (Ong & Sovacool, 2012), educational and awareness programs (Hartley et al., 2015; de Kort, McCalley, & Midden, 2008), infrastructure development (Hoppe et al., 2013), and community development projects (Liu & Sibley, 2004).

Littering is illegal in the entire United States, and each state has penalties for those caught openly littering, depending on the weight or volume of litter. The penalties might include monetary fines, mandatory litter cleanups, and more. Unfortunately, the visible success of these strategies is hard to measure, given the difficulty of catching any perpetrator while they are littering.

There are community programs and anti-litter campaigns all around the world, as in Australia; they have 'Do the Right Thing' (Keep Australia Beautiful, 2016), International Coastal

Cleanup by UNEP, and Keep America Beautiful, and even citizen science projects like the one in Bravo et al. (2009) where the main goal is to quantify litter in surrounding while also encouraging the public to improve their waste disposal behavior and getting them involved in the intervention strategies. Focusing on education and communication is a prominent area in litter reduction strategies. Signs, messages printed on packaging, personal messages, and presentations have some impact on littering. Oliver, Roggenbuck, and Watson (1985) showed that if camping groups received educational messages regarding waste disposal and vandalism, they damaged fewer trees and littered less than groups who received no message. Additionally, personal contacts and face-to-face communication fared even better when reducing litter with simple brochure distribution, reducing litter by almost 50% (Oliver et al., 1985). In a study done among 176 school children (8-13 years) in England, Hartley, Thompson, and Pahl (2015) utilized multiple techniques such as posters, artworks, and demonstrations combined with activities like tours of the aquarium, kayaking, and beach visit to make them aware of litter and its impacts. After the intervention, the children showed higher levels of appropriate litter disposal behavior and encouraged their family and friends to do the same (Hartley et al., 2015). A similar behavior was observed amongst German children 7-9 years old during forest tours, where a combination of verbal instructions and demonstrations showed higher correct waste disposal behavior (Lindemann-Matthies et al., 2012).

Infrastructure changes like increasing the availability of trash receptacles (Schultz et al., 2013; Finnie, 1973; Zane, 1974), the design of trash receptacles (Finnie, 1973; Bitgood, 1988; Geller et al., 1980), and even their placement and accessibility of those trash receptacles (Sibley & Liu, 2003; Bator et al., 2011) has a significant impact on litter and littering. Another important litter reduction strategy is to mix infrastructural changes and behavioral messaging. For example, Brown, Ham, and Hughes (2010) carried out an experiment where they placed a crushed aluminum can (litter) along with a sign nearby, which showed the location of the garbage containers and contained a relevant and provocative method about proper disposal behavior. They found a 20% increase in the aluminum can pick-up and correct disposal when the sign was present versus when it was not. This shows that besides the physical infrastructure, carefully worded language in signs can make a significant impact. In another study, Van Doesum et al. (2021) tested a mix of physical measures and persuasive communication methods to decrease littering in urban parks by relocating waste receptacles and the presence of animal eyes. Moving the waste receptacles near the exits proved that littering did increase when the distance to trash receptacles from the point of trash origin increased. However, placing images of watching animal eyes on the trees resulted in slightly less litter, irrespective of the location of the waste receptacles (Van Doesum et al., 2021). While the difference in litter found between the presence or absence of watching eyes was not statistically significant, the

watching eyes were meant to suggest how having feelings of being watched can have behavioral impacts, and other studies show that watching eyes can trigger reputational concern among people, prompting them to act accordingly (Conty et al., 2016; Oda et al., 2011). This study shows that while simply moving the receptacles might not be an effective intervention, their placement still matters, and if other behavioral interventions accompany the placement, it can be successful.

With cigarette butts being one of the most littered items (KAB, 2009; KAB, 2021), there are quite a few education programs focused on littering interventions targeting cigarettes specifically. The tobacco industry even worked with KAB to create anti-litter campaigns where they try to disseminate information about the proper ways of cigarette butt disposal. When KAB was carrying out its cigarette butt reduction approach in partnership with the tobacco industry, they focused on providing consumers with portable ashtrays and communities with permanent ashtray, and almost 1,000,000 Vantage branded pocket ashtrays were distributed (Smith & McDaniel, 2010). KAB claimed that those strategies did mitigate the litter problem. A similar result was also found in the interventional experiment carried out by Liu and Sibley (2004) in New Zealand's Victoria University's quad area, where structural interventions like adding ashtrays and garbage bins reduced cigarette butt littering by 64% and when the positive results were given back to the students, it further reduced cigarette butt littering by an additional 16.9%.

As the problem of littering is situation-specific, there is no fix-all reduction strategy. Littering requires multiple approaches to get the change in behavior and mindset and must include different disciplines working together, and the developed strategies need to be adapted to fit the demographics and the physical context to achieve the desired outcome.

1.6. Litter in Idaho

Mismanaged waste is a significant issue in Idaho. The 'Don't Dump Idaho' campaign started in 2016, and the common highway sign, 'Idaho is too great to litter,' aims to curb illegal dumping and littering problems in Idaho. These are backed up by robust regulatory authority. Idaho statute 18-7031 specifies that fines of up to $1,000 and/or up to 12 months imprisonment for dumping trash and debris on public land and that littering on public or private property within the State of Idaho can lead to a fine of up to $1000, 30 days imprisonment with the possibility of eight to 40 hours of litter cleanup (Idaho Statute 18-7031). Despite this, variability in enforcement often causes states to spend millions of dollars to clean up public lands. There is no exact figure on how much Idaho spends cleaning up litter. However, in 2021, volunteers in North Idaho picked up 4,171 bags of litter, or about 72.8 tons of litter, on I-90 between Coeur d'Alene and Washington State line, and soon after, the Idaho Transportation Department announced that it was investing in a machine to speed up litter collection process (Jahns, 2022). The machine with two people working for 5 hours could cover a

one-mile roadside distance, which would otherwise take five people working for 8 hours without the machine (Jahns, 2022). This gives us an idea of the litter situation in Idaho and the financial and human effort behind it.

Despite these efforts, dumping and littering remain a problem. For example, in 2019, illegal dumping increased throughout the state (Pearson, 2019). Similarly, The Bureau of Land Management said that over 1700 cases of illegal trash dumping have been documented, investigated, or ticketed on Idaho public lands since 2000 (KTVB, 2016). Popular campground areas around Boise Country in Idaho are experiencing an uptick in visitors along with an increase in the amount of trash left behind to the extent that some of the campgrounds had to be temporarily closed (Jahns, 2022). Mann Creek Campground in Payette National Forest was closed in May of 2021 due to vandalism and other damages within the campground; part of the Grimes Creek area in Boise County was closed due to excessive trash left behind by recreational visitors and in other parts of Boise National Forest (Parris, 2020).

In Idaho, increased recreational visitation to wilderness areas has brought the problem of litter to wilderness settings. Public lands comprise ~69% of land in Idaho, and 25% of the total land area in Idaho is considered forested (Straubinger, 2018). Of that public land, nearly 40% of its total land area is national forests that offer numerous recreational uses, including camping (developed and dispersed campsites). There are 27 state parks in Idaho managed by the Idaho Department of Parks and Recreation, and 3 additional state parks managed by other entities. The 2020 visitation numbers for Idaho state parks show that the parks are most heavily used for day visits (7 million) but also host many campers (647,743) (DIPR, 2021). The camper numbers in 2020 were 3.5% lower than that accounting for the two-month campground closure at the beginning of the pandemic (DIPR, 2021). The breakdown of visitor data for 2021 has yet to be made public.

In Idaho state parks, waste management is generally a combination of recreational user compliance and volunteer/staff labor. Within recreation areas generally, and this is undoubtedly true in Idaho, mismanaged waste typically falls into two categories: point source (related to the location of camping facilities, boat launches, etc.) and linear sources, which are related to communication routes (trails, roads, boating areas, etc.) (Przydatak, 2019). While all the Idaho recreationists are suggested to pack it and pack it out, there are trash receptacles in various places within the parks, especially at the beginning or end of popular trailheads, campgrounds, and other day-use areas. The placement of the trash receptacles is based on access convenience and visitor usage and is different based on the parks. In campgrounds, the volunteer camp hosts clean up a site after campers check out and pick up visible litter left behind. Staff and volunteers also clean up the day-use sites depending on their availability and pick up episodic trash that overflows from receptacles found in trails or other areas.

All the waste collected is typically placed into the receptacles, which are removed by a waste management company to be trucked offsite to landfills. The pick-up by the company varies depending on how frequently they fill up. Many other Idaho campgrounds, especially in national forests, do not even have centralized waste receptacles on-site, and ‘pack it in, pack it out’ is encouraged for campers. The volunteer hosts clean up after the campers, collect the litter, and bring it to the trash receptacles to the nearest park office.

While litter might look simple and unassuming, the behavior behind it is complex, and many more factors influence the act of littering. Litter, especially in recreational areas, comes with enormous ramifications for the visitors and the management. Through this study, we want to understand litter in recreational areas and use that information to target strategies to reduce it.

References

Abdul Aziz, A. N., Lukhman, A. A., Chubo, K. J., & Daud, D. (2019). Public Perception to Littering in Greenspaces: A Case Study in Bintulu, Sarawak, Malaysia. *Journal of Physics. Conference Series, 1358*(1), 12031. https://doi.org/10.1088/1742-6596/1358/1/012031.

Al-Khatib, I.A., Arafat, H.A., Daoud, R., Shwahneh,H. (2009). Enhanced solid waste management by understanding the effects of gender, income, marital status, and religious convictions on attitudes and practices related to street littering in Nablus –Palestinian territory. *Waste Management,* 29: 449 -455.

Bator, R. J., Bryan, A. D., & Wesley Schultz, P. (2011). Who Gives a Hoot? Intercept Surveys of Litterers and Disposers. *Environment and Behavior, 43*(3), 295–315. https://doi.org/10.1177/0013916509356884.

Beck, R. W. (2007). A Review of Litter Studies, Attitude Surveys and Other Litter-Related Literature. *Keep America Beautiful.* Retrieved from: http://www.kab.org/site/DocServer/Litter_Literature_Review.pdf?docID=481.

Bitgood, S., Patterson, D., & Benefield, A. (1988). Exhibit design and visitor behavior: Empirical relationships. *Environment and Behavior, 20*(4), 474 491. https://doi.org/10.1177/0013916588204006.

Bravo, M., de los Ángeles Gallardo, M., Luna-Jorquera, G., Núñez, P., Vásquez, N., & Thiel, M. (2009). Anthropogenic debris on beaches in the SE Pacific (Chile): Results from a national survey supported by volunteers. *Marine Pollution Bulletin, 58*(11), 1718–1726. https://doi.org/10.1016/j.marpolbul.2009.06.017.

Bressers, H., Hoppe, T., Bruijn, T. D., & Garcia, L. F. (2013). Street litter reduction programs in the Netherlands: Reflections on the implementation of the Dutch litter reduction program for 2007 - 2009. Lessons from a public private partnership in environmental policy. *Environmental Engineering and Management Journal*, *12*(8), 1657–1668. https://doi.org/10.30638/eemj.2013.201.

Brown, T. J., Ham, S. H., & Hughes, M. (2010). Picking up litter: an application of theory-based communication to influence tourist behaviour in protected areas. *Journal of Sustainable Tourism, 18*(7), 879–900. https://doi.org/10.1080/09669581003721281.

Campbell, D. F. (2007) People Who Litter. *Environmental Campaigns Limited (ENCAMS)*.

Chamas, A., Moon, H., Zheng, J., Qiu, Y., Tabassum, T., Jang, J. H., Abu-Omar, M., Scott, S. L., & Suh, S. (2020). Degradation rates of plastics in the environment. *Acs Sustainable Chemistry & Engineering*, *8*(9),3494–3511. https://doi.org/10.1021/acssuschemeng.9b06635.

Chow, A. (2020). National parks are getting trashed during COVID-19, Endangering Surrounding Communities. *TIME.* Retrieved from: https://time.com/5869788/national-parks-covid-19/

Cialdini, R. B., Kallgren, C. A., & Reno, R. R. (1991). Advances in experimental social psychology. In *A focus theory of normative conduct: a theoretical refinement and reevaluation of the role of norms in human behavior* (pp. 201–234). Essay, Elsevier Science & Technology. https://doi.org/10.1016/S0065-2601(08)60330-5.

Conty, L., George, N., & Hietanen, J. K. (2016). Watching Eyes effects: When others meet the self. *Consciousness and Cognition*, *45*, 184–197.https://doi.org/10.1016/j.concog.2016.08.016.

Crime and Punishment, Ann. § 18-7031. (1972). Retrieved from https://legislature.idaho.gov/statutesrules/idstat/Title18/T18CH70/SECT18-7031/.

Crump, S. L., Nunes, D. L., & Crossman, E. K. (1977). The Effects of Litter on Littering Behavior in a Forest Environment. *Environment and Behavior*, *9*(1), 137–146. https://doi.org/10.1177/001391657791009.

Curnow, R., Strecker, P., & Williams, E. (1997). Understanding Littering Behavior; a Review of Literature. *Beverage Industry Environmental Council*, Pyrmont, Australia.

Cutter, S. L., Tiefenbacher, J., Birnbaum, S., Wiley, J., & Solecki, W. D. (1991). Throwaway societies: a field survey of the quantity, nature, and distribution of litter in new jersey. *Applied Geography*, *11*(2), 125–141. https://doi.org/10.1016/0143-6228(91)90039-C

de Kort, Y. A. W., McCalley, L. T., & Midden, C. J. H. (2008). Persuasive trash cans: Activation of littering norms by design. *Environment and Behavior, 40*(6), 870-891. https://doi.org/10.1177/0013916507311035.

Department of parks and Recreation. (2021). Idaho State parks Enact Non-resident Fee Increases at Popular Parks. *IDPR*. Retrieved from: https://parksandrecreation.idaho. gov/pressrelease/ idaho -state-parks-enact-non-resident- fee-increases-at-popular-parks/.

Dep. of Ecology (2022). Not Littering-Simple as that. *Department of Ecology, State of Washington.* Retrieved from:ecology.wa.gov/blog/september-2022/not-littering-simple-asthat.

Dodge, M. (1972). Modification of littering behaviour. M.A. thesis, Utah State University

Enyoh, C., Shafea, L., Verla, A., Verla, E., Qingyue, W., Chowdhury, T., & Paredes, M. (2020). Microplastics Exposure Routes and Toxicity Studies to Ecosystems: An Overview. *Environmental Analysis, Health and Toxicology*, *35*(1), 28-37.

Finnie, W. C. (1973). Field Experiments in Litter Control. *Environment and Behavior*, *5*(2), 123–144. https://doi.org/10.1177/001391657300500201.

Geller, E.S., Brasted, W.W. and Mann, M. (1980). Waste Receptacle Designs and Interventions for Litter Control. *Journal of Environmental Systems, 9,* 145-160. http://dx.doi.org/10.2190/5P46-8H2N-41JR-C2EJ

Geller, E. S., Witmer, J. F., & Tuso, M. A. (1977). Environmental interventions for litter control. *Journal of Applied Psychology, 62*(3), 344–351. https://doi.org/10.1037/0021-9010.62.3.344.

Green, A.L.R., Putschew, A., Nehls, T. (2014). Littered cigarette butts as a source of nicotine in urban waters. *Journal of Hydrology, 519*: 3466-3474.

Grenfell R.D. & Ross K.N. (1992). How dangerous is that visit to the beach? A pilot study of beach injuries. *Australian Family Physician, 21*:1145-1148.

Guo, J., Huang, X., Xiang, L., Wang, Y., Li, Y., Li, H., . . . Wong, M. (2020). Source, migration, and toxicology of microplastics in soil. *Environment International*, *137*, 105263.

Hartley, B. L., Thompson, R. C., & Pahl, S. (2015, January). Marine litter education boosts children's understanding and self-reported actions. *Marine Pollution Bulletin*, *90*(1–2), 209–217. https://doi.org/10.1016/j.marpolbul.2014.10.049.

Jahns, M. (2022). A new machine will be used for picking the trash along I-90 this spring. *Idaho Transportation Department.* Retrieved from: https://itd.idaho.gov/news/new-machine-to-pick-up-trash-on-i-90-this-spring/

KAB. (2009). 2009 National Visible Litter Survey and Litter Cost Study. *Keep America Beautiful, Inc*. www.kab.org/site/DocServer/Final_KAB_Report_9-18-09.pdf

KAB 2020. (2021). 2020 National Litter Study. Summary Report. *Keep America Beautiful, Inc.* https://kab.org/wp-content/uploads/2021/05/Litter-Study-Summary-Report-May-2021_final_05172021.pdf

Kallgren, C. A., Reno, R. R., & Cialdini, R. B. (2000). A Focus Theory of Normative Conduct: When Norms Do and Do not Affect Behavior. *Personality & Social Psychology Bulletin*, *26*(8), 1002–1012. https://doi.org/10.1177/01461672002610009.

Keizer, K., Lindenberg, S., & Steg, L. (2008). The Spreading of Disorder. *Science (American Association for the Advancement of Science), 322*(5908), 1681-1685.

Khawaja, F., & Shah, A. (2013). Determinants of Littering: An Experimental Analysis. *Pakistan Development Review*, *52*(2), 157-168.

KPB (2020). The cost of litter & illegal dumping in Pennsylvania. *Keep Pennsylvania Beautiful.* https://www.keeppabeautiful.org/wp-content/uploads/2021/07/KPB-Litter-Cost-Study-013120.pdf.

Krauss, R. M., et al. (1978) Field and Laboratory Studies of Littering. *Journal of Experimental Social Psychology*, 109-122.

Krummer, F. (2020). Philly spends $48 million a year to clean up litter, P.A. report finds. *Inquirer.* Retrieved from: https://www.inquirer.com/science/climate/philadelphia-pennsylvania-litter-recycling-20200206.html.

KTVB. (2016). Don't Dump Idaho campaign discourage illegal dumping on public lands. *9NEWS* Retrieved from: https://www.9news.com/article/news/local/dont-dump-idaho-. campaign-discourages-illegal-dumping-on-public-lands/277-310784942

Law, K., Starr, N., Siegler, T., Jambeck, J., Mallos, N., & Leonard, G. (2020). The United States' contribution of plastic waste to land and ocean. *Science Advances, 6*(44), https://doi.org/10.1126/sciadv.abd0288

Lewis, A. (2009). *Litterbugs: how to deal with the problem of littering*. Policy Exchange.

Lyndhurst, B. (2013). Rapid Evidence Review of Littering Behavior and Anti-Litter Policies. A Brook Lyndhurst Report to Zero Waste. *Zero Waste Scotland. Scotland*, Stirling.

Lindemann-Matthies, P., Bönigk, I., & Benkowitz, D. (2012). Can't See the Wood for the Litter: Evaluation of Litter Behavior Modification in a Forest. *Applied Environmental Education & Communication, 11*(2), 108–116. https://doi.org/10.1080/1533015x.2012.751294.

Liu, J. H., & Sibley, C. G. (2004). Attitudes and behavior in social space: Public good interventions based on shared representations and environmental influences. *Journal of Environmental Psychology, 24*, 373-384.

Medway D, Parker C and Roper S (2016) Litter, gender and brand: The anticipation of incivilities and perceptions of crime prevalence. Journal of Environmental Psychology, 45:135–144. http://dx.doi.org/10.1016/j.jenvp.2015.12.002.

Mohamed Nor, N., Kooi, M., Diepens, N., & Koelmans, A. (2021). Lifetime Accumulation of Microplastic in Children and Adults. *Environmental Science & Technology, 55*(8), 5084-5096.

NOAA (National Oceanic and Atmospheric Administration). (2016). What are microplastics? Retrieved October 05, 2020, from https://oceanservice.noaa.gov/facts/microplastics.html

Ojedokun, O., & Balogun, S. K. (2011). Psycho-sociocultural analysis of attitude towards littering in a Nigerian urban city. *Ethiopian Journal of Environmental Studies and Management, 4*(1)

Oliver, S.S., Roggenbuck, J.W. and Watson, A.E. (1985). Education to Reduce Impacts in Forest Campgrounds. *Journal of Forestry, 83*(4):234-236.

Ong, I. B. L., & Sovacool, B. K. (2012). A comparative study of littering and waste in Singapore and Japan. *Resources, Conservation and Recycling, 61*, 35–42. https://doi.org/10.1016/j.resconrec.2011.12.008.

Parris, J. (2020). Boise County camping areas trashed, forcing locals to clean up after visitors. *KTVB.* Retrieved from: https://www.ktvb.com/article/news/local/208/boise-county-camping-areas-trashed-forcing-locals-to-cleanup-after-visitors/277-9d588217-7486-4b15-a5c3-19acfe72b7f4.

Pearson, B. (2019). F&G asks for public's help to combat illegal dumping at access sites. *Idaho Department of Fish and Game.* https://idfg.idaho.gov/press/fg-asks-publics-help-combat-illegal-dumping-access-sites

Pierno, T. (2017). President's outlook: Trash talk. National Parks Magazine.

Przydatek, G. (2019). Waste Management in Selected National Parks–A Review. *Journal of Ecological Engineering*, 20(4).

Qin, M., Chen, C., Song, B., Shen, M., Cao, W., Yang, H., Zeng, G., & Gong, J. (2021). A review of biodegradable plastics to biodegradable microplastics: Another ecological threat to soil environments? *Journal of Cleaner Production, 312*, 127816–. https://doi.org/10.1016/j.jclepro.2021.127816.

Rillig, M., Ingraffia, R., & De Souza Machado, A. (2017). Microplastic Incorporation into Soil in Agroecosystems. *Frontiers in Plant Science, 8*, 1805.

Robinson, S. N. (1976) Littering Behavior in Public Places. *Environment and Behaviour 8*:3, 363-384.

Rodríguez-Rodríguez, D. (2012). Littering in protected areas: a conservation and management challenge - a case study from the Autonomous Region of Madrid, Spain. *Journal of Sustainable Tourism*, *20*(7), 1011–1024. https://doi.org/10.1080/09669582.2011.651221.

Schultz, P. W., Bator, R. J., Large, L. B., Bruni, C. M., & Tabanico, J. J. (2013). Littering in context: personal and environmental predictors of littering behavior. *Environment and Behavior*, *45*(1), 35–59. https://doi.org/10.1177/0013916511412179.

Smith, E. A., & McDaniel, P. A. (2011). Covering their butts: responses to the cigarette litter problem. *Tobacco Control*, *20*(2), 100–106. https://doi.org/10.1136/tc.2010.036491.

Smith, L., & Turrell, W. R. (2021). Monitoring Plastic Beach Litter by Number or by Weight: The Implications of Fragmentation. *Frontiers in Marine Science*, *8*. https://doi.org/10.3389/fmars.2021.702570.

Stafford, J., and Pettersson, G. (2009). Vandalism, graffiti and environmental nuisance on public transport-Literature review. *Department for Transport.* Retrieved from: https://webarchive.nationalarchives.gov.uk/ukgwa/+/http://www.dft.gov.uk/pgr/crime/reducinggraffiti/literaturereviewgraffitireport?page=1.

Stein, S.R., 2005. Sweating the litter things. Resour. Recycl. 24 (5), 25–30.

Straubinger, A. (2018) Idaho Statewide Comprehensive Outdoor Recreation Plan. *Idaho Department of Parks & Recreation.*

Thompson, R. C., Moore, C. J., vom Saal, F. S., & Swan, S. H. (2009). Plastics, the environment and human health:current consensus and future trends. *Philosophical Transactions of the Royal Society B:Biological Sciences*, *364*(1526), 2153–2166. https://doi.org/10.1098/rstb.2009.0053

Trashblitz. (2022). Plastic-Free Parks. *Trashblitz.* Retrieved from: *https://static1.squarespace.com/static/5522e85be4b0b65a7c78ac96/t/635ff5d2f634f81b7143c4eb/1667233443661/Plastic-Free+Parks+TrashBlitz+Report+2022.pdf.*

UNEP (2018). Single-use plastics: A roadmap for Sustainability (Rev. ed., pp. vi; 6). *UNEP*

Van Doesum, N. J., van der Wal, A. J., Boomsma, C., & Staats, H. (2021). Aesthetics and logistics in urban parks: can moving waste receptacles to park exits decrease littering*? Journal of Environmental Psychology*, *77*, 101669–. https://doi.org/10.1016/j.jenvp.2021.101669

Wagner, M., Scherer, C., Alvarez-Muñoz, D., Brennholt, N., Bourrain, X., Buchinger, S., ... & Rodriguez-Mozaz, S. (2014). Microplastics in freshwater ecosystems: what we know and what we need to know. *Environmental Sciences Europe*, 26(1), 1-9.

Wang, J., Liu, X., Li, Y., Powell, T., Wang, X., Wang, G., & Zhang, P. (2019). Microplastics as contaminants in the soil environment: A mini review. *The Science of the Total Environment*, *691*, 848-857.

Will, K. S. (2021). *Park Remarks: Illegal campsite with 150 lbs. of trash found at Arches National Park*. The Spectrum. Retrieved September 7, 2023, from https://www.thespectrum.com/story/news/2021/12/02/park-remarks-utah-national-parks-transition-seasonal-operations/8825823002/

Wilson, M.I., Robertson, L.D., Daly, M., Walton, S.A. (1995). Effects of visual cues on assessment of water quality. *Journal of Environmental Psychology, 15,* 53-63.doi: 10.1016/0272-4944(95)90014-4

Zane, Lee, T. (1974). The Effects of Different Litter Control Procedures on Movie Audiences. *Western Michigan University. Masters Theses*. Retrieved from: https://scholarworks.wmich.edu/masters_theses/2625

Chapter 2: Macro Litter in Idaho Recreational Areas

2.1. Introduction

Campgrounds are a hub for people to escape their busy, often urban, life and find solace in natural environments (Morse et al., 2020; Grima et al., 2020). With COVID-19 shutting much of the country down in 2020, outdoor recreation became hugely popular and even encouraged activity. This has led to an unprecedented increase in the use of public recreation areas such as national parks, state parks, and national forests (Shartaj et al., 2022; Kupfer et al., 2021; Volenec et al., 2021). Idaho Department of Parks and Recreation (2021) reported that state park visits increased by a margin of more than 1.2 million compared to 2019, and this has been confirmed by conversations with individual Idaho public land managers (Liz Palfini, pers comms, May 28, 2021) as well. Conversations with the park managers also revealed a similar trajectory of increased visitation, especially with the onset of COVID-19 (pers comms, 2019).

One thing that has yet to get much attention with increased public land visitation, both during COVID and more generally, is the issue of waste management. Pierno (2017) estimates that every year in the US, over 100 million pounds of waste are generated in national parks through various means, including park operations, visitors, and more. However, this estimate of waste collected through managed disposal channels does not include mismanaged waste. Jambeck et al. (2015) estimate that mismanaged waste, which can be defined in the US as waste that is either littered or inadequately disposed of (Jambeck et al., 2015), is 2% of waste that is generated, so the national parks alone may be producing 20,000 pounds or more of mismanaged waste each year. Management of this issue represents a significant challenge for public land managers.

Preliminary reports indicate an increase in visitor usage to the point that some parks have had to restrict certain areas or even close for short periods due to an increase in littering and vandalism incidents in federal lands around the country, including Rocky Mountain National Park, Big Bend National Park, Glen Canyon National Recreation Area, Great Falls Park in Maryland, Glacier National Park, Grand Canyon National Park and more (Chow, 2020). In Idaho, increasing visitation has resulted in incidents of campground and recreational area closures, such as the Mann Creek Campground operated by Payette National Forest due to vandalism and littering starting May 2021; Kirkham Hot Spring in Lowman, ID has undergone frequent closings and re-openings since May 2021 because of excessive littering; temporary closings of part of Grimes Creek recreation area in Boise County in summer of 2020 because of the amount of trash left behind including human waste (*Popular Campground near Highway 95 Now Closed*, 2021; *Boise National Forest - News & Events*, 2020).

Many public lands, especially those that have campground areas, make use of camp hosts to help manage visitor experience and to control mismanaged waste. A camp host is a volunteer who is often the on-site point of contact for campers and acts as a liaison between the campers and the park/forest staff. According to the Idaho Department of Parks and Recreation, hosts usually work at least 20-24 hours per week and are on call at all times of the day and night (*Idaho Parks & Recreation Volunteer Program*, n.d.). While primarily responsible for campground duties (greeting visitors, checking campsite reservations, informing campers of rules and regulations, cleaning sites after the campers leave and getting them ready for the next group, general maintenance tasks, and cleaning campground areas), camp hosts also help in collecting fees, in the visitor center, and other park programs as needed. Their presence in the campground serves to maintain the cleanliness of the campground by removing litter that campers leave behind, intentionally or accidentally (*Idaho Parks & Recreation Volunteer Program*, n.d.). Despite this active intervention, some litter remains and is lost to the environment, though it is unclear how much. Quantifying the litter flux and developing a more complete understanding of the quantity and composition of litter left by visitors and what is missed by camp hosts would help the park management to create interventions better suited to their waste disposal needs.

Thus, the main objective of this chapter is to quantify the amount and types of litter within four Idaho state parks and one national forest during the summer camping season of 2021.

2.2. Research Questions

Hypothesis 1 (H_1): There will be a significantly higher amount of plastic flux per occupied day and per camper than other litter types across all campgrounds.

The types of litter found in any surrounding area vary based on different factors. The 2009 and 2021 KAB results showed that the trend in types of litter across waterways and roadways were very similar in terms of number, with plastics occupying the highest category in terms of quantity (KAB, 2009; KAB, 2021). While there have been no studies on litter flux, the quantity results would also apply to flux. Thus, we hypothesize that plastic flux per occupied day and camper will be higher than non-plastic flux.

Hypothesis 2 (H_2): There will be a significantly higher amount of litter flux per occupied day in day-use areas than in campgrounds.

A litter quantity study has yet to be done in the 2000s that shows the difference between litter quantity between day-use areas and campgrounds. However, unlike campgrounds, day-use areas have a limited number of people using that area on any given day, and they are open throughout the year as long as the locations are open. Additionally, day-use areas are cleaned sporadically compared to campgrounds, where hosts clean regularly. Based on this, we hypothesize that litter flux per occupied

day will be higher in day-use areas than in campgrounds. As day-use areas do not have defined occupancy, we are counting occupied days as the total number of days between the first litter collection and the last litter collection.

Hypothesis 3 (H_3): There will be higher litter flux as occupied days and number of campers increase.

Pierno (2017) linked increased visitation in national parks to increased waste production and management and disposal issues. Another study by Martins and Cró (2021) in Madeira showed that increased tourism led to increased solid waste generation. Also, Jambeck et al. (2015) hypothesized that population size was one of the most important predictors of the number of debris lost into the marine environment. Extrapolating these findings to campground environments, we hypothesize that more campers in a campsite will result in a higher litter flux.

The more days that campsites are occupied, the greater the opportunity for litter to accumulate. While there has been no research done on occupancies concerning waste or litter, greater occupancy of a campsite is an indication of a more continuous human presence in an area. We expect this increased human presence to result in a higher overall flux.

Hypothesis 4 (H_4): The presence of trash receptacles impacts the litter flux per day in campgrounds.

Studies have found that an increase in trash receptacles leads to an increase in proper trash disposal. A series of studies conducted by Finnie (1973) reported a 28.6% reduction in litter along highways and a 16.7% reduction on urban city blocks when trash cans were present. Cialdini, Reno, and Kallgren (1991) found a 50% increase in litter when no trashcans were visible. Thus, we hypothesize that campgrounds with trash receptacles will have a lower litter flux per day and per camper than campgrounds without trash receptacles.

2.3. Methods

To answer our questions, we chose to look at public lands under both state and federal management and look at a mixture of overnight camping and day-use areas.

Study sites and characteristics

For this study, litter sampling sites were selected in four state parks and one national forest location. The campgrounds contain tents and RV camping to represent the diversity of camping styles available to the public. Table 2.1 shows the study sites, and comprehensive location information is included in Appendix 1. Sampling at each

location was stratified by campground, and specific campsite sampling locations were selected using a random number generator. Campsites in national forests were not labeled sequentially. Thus, campsite numbers were chosen using a random number generator based on the total number of sites in each campground.

Day-use areas were chosen for sampling in all state parks except Ponderosa State Park. North Beach, the most popular day-use area in Ponderosa State Park, consists of a long strip of sandy beach soil. Different from the other day-use areas we selected, this beach area was right up against the lake, and, from observation, it would be hard to determine if the litter found in that area had been left behind by recreationists or deposited by the currents. Thus, we decided to keep samples from a different day-use area.

Table 2.1. Basic information of all study sites for litter collection in 2021

Locations	Sites
Heyburn State Park: May 26 – September 25, 2021	
Hawley's landing	2, 7, and 18
Chatcolet	102, 113, and 119
Benewah	205, 217, and 225
Plummer Point Day use area *June 16- September 2021*	
Farragut State Park: May 27 – September 25, 2021	
Waldron	156, 180, and 200
Snowberry	106, 121, and 134
Whitetail	7, 42, and 49
Beaver Bay Beach *June 16- September 2021*	
Ponderosa State Park: June 24 – October 3, 2021	
RV	201, 234, and 236
Peninsula	2, 17, and 72
Lake Cascade State Park: June 24 – October 3, 2021	
Poison Creek	241, 242, and 247
Van Wyck	A6, C4, and D5
Ridgeview	183, 185, and 191
Van Wyck Day Use Area	
Payette National Forest: June 24 – October 3, 2021	
Cold Springs	10, 19, and 27
Last Chance	2, 10, and 16
Upper Payette	4, 12, and 18

Sampling period

We and the camp hosts collected multiple samples over the summer camping period between the last week of May and the first week of October 2021. Table 2.1 shows the sampling periods for each campground.

Macro Litter collection and categorization

For each of the campsite sample sites, an area including the fire pit, the tent pads, part of the driveway, and parts outlying the camping area consisting of natural vegetation was defined and flagged for repeat sampling. The defined area was measured to get a total sample area. The sampling area for day-use sites is chosen similarly. The central area of the day-use site contains a seating area (whether the site is a beach or a picnic area). It extends into the surrounding area to ensure coverage of various day-use activities.

There is no standard method for collecting and categorizing litter (Sullivan, 1985). However, two of the most common methods are item-oriented surveys and visually oriented surveys (Marques & Zandi,1985; Syrek, 1985). In item-oriented surveys, all the litter in specified places is counted and classified to understand the composition and spatial distribution. In visual surveys, litter within the specified area is counted or photographed as observed by the researcher while walking at a specified speed. We conducted an item-oriented survey to gain a more detailed understanding of the amount and type of litter in our specific environment.

Litter item collection occurred in two ways. First, for our specific study sites, the litter collected by camp hosts was retained and stored in labeled paper bags provided by us. For safety and hygiene purposes, the camp hosts were instructed not to save any biodegradable or hazardous waste for us and instead dispose of such waste as required by the park waste management policy. Camp hosts stored collected litter in provided waterproof collection bins until the researchers could retrieve them. Second, every two to three weeks, we visited the sampling sites in person. We did a thorough litter collection within pre-flagged sampling footprints (campsite and day use) to retrieve any litter not already collected by campers or camp hosts. This additional litter was bagged, labeled, and stored separately from the waste collected by camp hosts. This collection depended on whether the campsite was unoccupied at that time or occupied; it was cleaned if we could get explicit permission from the occupants to do our work. Most study sites receive an average of three individual cleanings throughout the camping season. Five of the sites received only two cleanings.

The day-use areas in the state parks in our study sites do not have a regular cleaning schedule, nor are there any volunteers who clean up at regular intervals. Park management officials do irregular clean-ups depending on time availability, and a significant portion of the clean-up responsibility falls on the recreational user's waste disposal habits using designated waste disposal bins. For this study, day-use site litter was collected periodically by the research team. If the park management team cleaned the site, no litter would be collected separately for this study.

All litter (both researcher and camp host collected) was returned to the lab for cleaning, categorization, and analysis. Most litter pieces were covered in soil due to exposure to natural conditions, necessitating cleaning before determining litter weight. Where possible, litter pieces were washed with tap water and air dried for 24 hours at room temperature before categorization. The few exceptions to the washing protocol were items that were primarily or partially burned, cardboard pieces, and fragile pieces on the verge of further fragmentation. For these samples, the soil, dust, and anything else attached to them were gently removed using a soft bristle brush. Care was taken to protect the stored litter from any impact that could create post-collection fragmentation.

Appendix 2 shows the sheet used during the categorization of the collected litter. The sheet is a modified version taken from the Keep American Beautiful (KAB) 2009 report, where they drew a comprehensive list from multiple prior studies conducted worldwide (Schultz et al., 2009). After cleaning and drying, litter pieces were sorted into five broad categories: plastic, metal, glass, rubber, and miscellaneous, with more sub-categories, photographed, and weighed. The miscellaneous litter category contains items whose exact type could not be determined, as well as those that are a mixture of two or more categories, e.g., twist ties for bags with a thin metal wire covered by plastic. Within each broad category (plastic, metal, glass, and rubber), there is a miscellaneous sub-category that

includes litter types that do not fall explicitly within the other sub-categories. If a whole piece of litter was found fragmented and divided into multiple pieces, each piece was counted as one piece of litter. The weight of litter items was not measured per item but rather per category due to a tendency toward increased fragmentation with the age of certain litter classes (plastic, most notably). The dry weight of litter items within each sub-category was determined and recorded to the nearest 0.0001g on an electronic balance. Figure 2.1 shows the image of one collection after it has been sorted, cleaned, and categorized.

Figure 2.1. Left: Van Wyck (A6) Research Team collection on June 23, 2021. Right: Last Chance Campground (10) Camp host collection on August 3, 2021.

Litter flux

The component of litter left behind after recreational area visits is what we quantify as litter flux to the environment. For this study, we are mainly concerned about the litter flux after host intervention, i.e., the litter that enters the natural environment despite the visit and camp host intervention. We calculated flux by first calculating litter density.

$$\textit{Litter density} = \frac{\textit{Number of litter pieces collected by the research team}}{\textit{Area of study site}}$$

Then, we calculate the litter flux per day:

$$\textit{Litter flux per day} = \frac{\textit{Litter density}}{\textit{Estimated occupied days within the research period}}$$

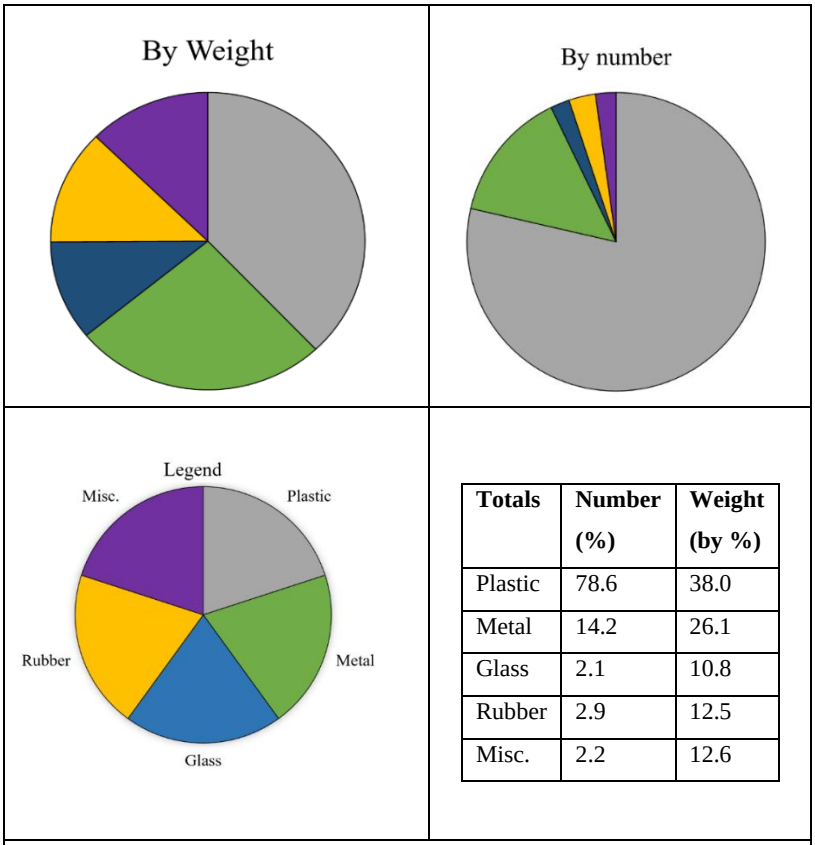
The occupancy rate was calculated from campground visitor data from the different state parks and the national forest for the 2021 camping season (Memorial Day and Labor Day, 100 days). From the occupancy rate, we estimated the number of occupied nights during the research duration (time between the first research collection and the last research collection). The occupancy data for Payette could not be broken down on a campsite basis, and so is instead presented at the campground

level. The total occupied days do not consider the number of total turnovers during the season.

Per-person litter flux was also calculated based on the number of campers per site during the research period. Camper numbers were provided at an individual campsite level by the state parks. However, national forest camper numbers were estimated for each campsite using the total number of campground visitors. Appendix 5 includes a table showing the area, occupancy days, and number of people staying on the campsites for each location.

$$\textit{Litter flux per person} = \frac{\textit{Litter density}}{\textit{Estimated number of campers in the campsites within the research period}}$$

2.4. Results



Totals	Number (%)	Weight (by %)
Plastic	78.6	38.0
Metal	14.2	26.1
Glass	2.1	10.8
Rubber	2.9	12.5
Misc.	2.2	12.6

Figure 2.2. Composition of all litter, collected over 3 months in all 5 locations in Idaho. (A) Percentages of litter types by number of litter weights (B) Percentages of litter types by number. (C)Legend indicates litter type color coding. (D) Table insert presents actual percentages.

Litter material composition

A total of 4805 litter items, weighing 13,447.8 grams (28.9 lbs.), were collected from all the sampling sites during the study period of May through October 2021. While most of the litter was plastic (3776 items or 78.6%), these items only represent 38% (5105 grams) of the gross litter weight. The second most common material was metal at 14.2% by number and 26% by weight. By number, glass, metal, and misc. items each represented about 2–3% of the total by number but by weight, glass, metal, and misc. items represented 10-13% of the total weight (Fig. 3).

Overall, the average weight of a litter piece is 2.8 grams. By category, the mean weight of a plastic items is 1.35 g. For the non-plastic litter types, the average weight of miscellaneous litter types (litter with two or more types) is heaviest at 15.83 g per litter piece, followed by glass with an average of 14.74 g, rubber at 12.07g, and metal at 5.12 g. Note the average for rubber is highly skewed by a

single tire weighing 1186 grams. With that tire removed, the average weight of rubber litter pieces falls to 3.5 g.

Litter type

When looking at litter by type (Table 2.2), the miscellaneous category within each material type has the most pieces (except in metal) and is heaviest subcategory by weight (except glass). Some of these results because a) there are limited number of item types within each material type and everything which could not be identified as a specific item types was classified as miscellaneous; and b) All the fragmented pieces which could not be positively identified as a specific item type, especially plastic films, scraps of metal, or broken glass pieces, were counted as miscellaneous. Food wrappers (15.17%, 729 pieces), cigarette butts (11.30%, 543 pieces), aluminum foil (6.01%, 289 pieces), and plastic-coated paper/cardboard (5.85%, 281 pieces) round out the top 4 item types found. No other type of litter represented more than 5% of the total. The miscellaneous subcategory within plastics (1535, 31.95%), metal (158, 3.29%), glass (92, 3%), rubber (131, 12.57), and combination items (107, 15.83) contribute to a total of 2023 pieces which represents 66.64% of the total litter quantity.

Excluding the miscellaneous subcategories, glass bottles (1172 g, 8.72%), synthetic clothing (913 g, 6.79%), and plastic-coated cardboard/paper (697 g, 5.05%) make up the top three litter types by weight. No other type of litter represented more than 5% of the total weight. The miscellaneous subcategory within plastics (1808 g, 13.44%), metal (2319 g, 17.24%), glass (276 g, 2.06%), rubber (1647 g, 12.24), and combination items (1694 g, 12.6%) contribute to a total of 7,743 gram which represents 57.58% of the total litter weight.

Table 2.2.Litter statistics of total litter collected from all campground locations and day use sites.

Item(s)	Number of pieces (#)	Weight (grams)	Mean weight of each litter (grams)	Percent by number (%)	Percent by weight (%)
PLASTIC					
Food Wrappers	729	252.079	0.35	15.17	1.87
Beverage Bottles	25	414.926	16.60	0.52	3.09
Other Plastic Containers	19	323.695	17.04	0.40	2.41
Container Lids/Caps	154	159.891	1.04	3.20	1.19
Cigarette Butts	543	141.137	0.26	11.30	1.05
Plastic Rope	18	184.948	10.27	0.37	1.38
Fishing Line and Lures	5	14.135	2.83	0.10	0.11
Polystyrene	148	27.826	0.19	3.08	0.21
Plastic Utensils	25	81.766	3.27	0.52	0.61

Table 2.2. continued.

Plastic Straws	48	22.307	0.46	1.00	0.17
Synthetic Clothing Material	115	912.549	7.94	2.39	6.79
Personal Care Products	55	78.415	1.43	1.14	0.58
Plastic Tarp	69	2.527	0.04	1.44	0.02
Plastic Balloons	7	1.805	0.26	0.15	0.01
Plastic Coated Cardboard	281	679.25	2.42	5.85	5.05
MISC. Plastic Pieces	1535	1807.868	1.18	31.95	13.44
METAL					
Aluminum/Tin Foil	289	140.435	0.49	6.01	1.04
Aluminum/Tin Container	27	235.643	8.73	0.56	1.75
Bottle Caps	113	227.842	2.02	2.35	1.69
Can Tabs	62	36.562	0.59	1.29	0.27
Beverage Cans	26	382.092	14.70	0.54	2.84
Aerosol Cans	9	169.815	18.87	0.19	1.26
MISC. Metal Pieces	158	2318.906	14.68	3.29	17.24
GLASS					
Glass Bottle	6	1172.118	195.35	0.12	8.72
Jar	1	10.556	10.56	0.02	0.08
MISC. Glass Pieces	92	276.373	3.00	1.91	2.06
RUBBER					
Gloves	6	28.11	4.69	0.12	0.21
Latex Balloons	2	3.591	1.80	0.04	0.03
MISC. Rubber Pieces	131	1646.567	12.57	2.73	12.24
MISC. (Combination items)					
Item(s)	107	1694.085	15.83	2.23	12.60
TOTALS	**4805**	**13447.819**	**2.80**		

Litter composition by location

Despite the difference in the number of pieces collected in each location, the trend in types of litter collected across the five locations and the day-use sites are similar, with the top five types of litter being consistent across recreation areas, campgrounds, and day-use sites. Figure 2.2 shows the trend in litter types in all categories across all the locations by campgrounds and combined three-day use areas.

Appendix 3 shows the breakdown of litter types by individual campgrounds and day-use areas. Among the 4805 pieces of litter recovered from all the locations, 4322 (210.13 kg) were collected in campgrounds, and the remaining 483 pieces (3.31 kg) came from day-use areas. Within the campgrounds, camp hosts recovered 2223 litter items (51.43%), and the researchers collected the remainder. Researchers collected all the litter items from day-use areas.

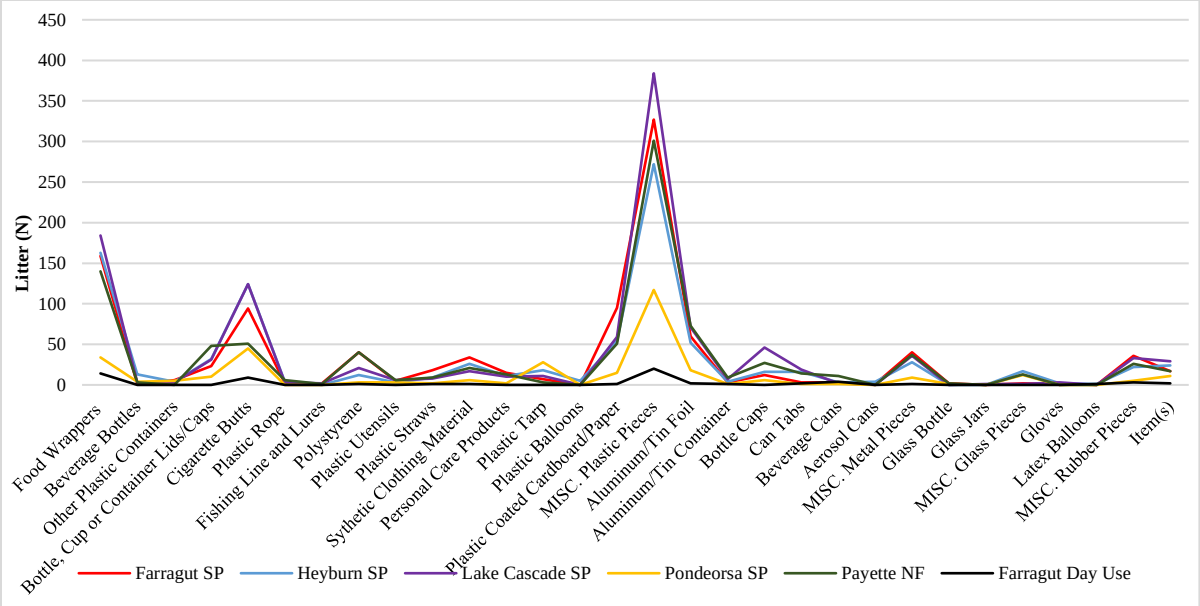


Figure 2.3.Trend for all the litter types found in campgrounds of all locations.

Litter flux

The litter flux per occupied day ranges from 0.0006 to 0.039 pieces of litter per square meter per occupied day in the campsites. When the entire campsite data is averaged to look at campgrounds, Upper Payette campground of Payette NF has the lowest litter flux of 0.00079 pieces of litter per sq. meter per occupied day, and Van Wyck of Lake Cascade SP has the highest with 0.006 (Fig. 2.4).

The litter flux per camper ranges from 0.00065 to 0.585 pieces of litter per square meter per camper in a campsite. At the campground level, Upper Payette campground of Payette NF has the lowest litter flux of 0.00051 per person, and Van Wyck of Lake Cascade SP has the highest with 0.006 (Fig. 2.5). Appendix 5 shows the litter flux by occupied days as well as the number of campers on a campsite level.

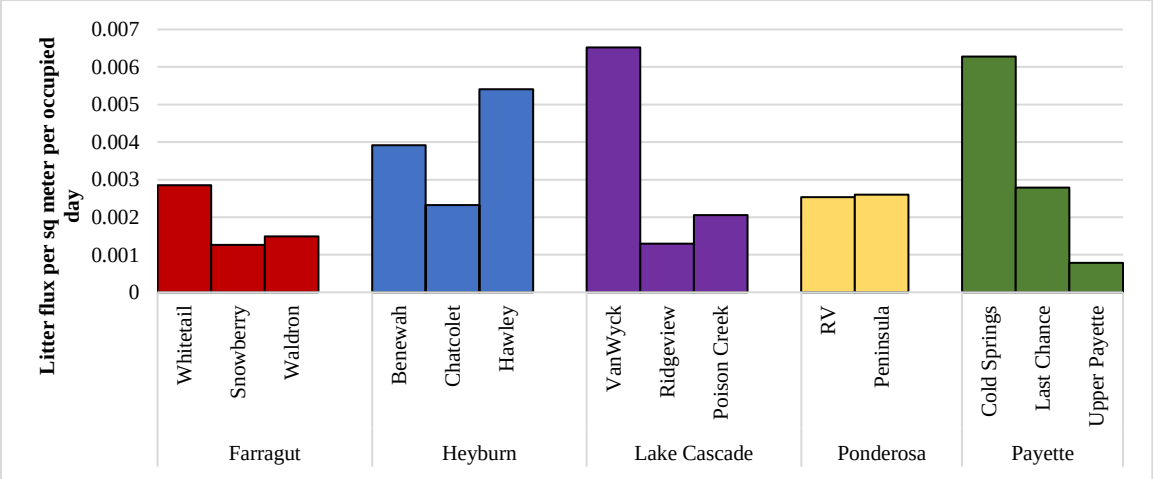


Figure 2.4. Litter flux based on occupancy and area by campgrounds.

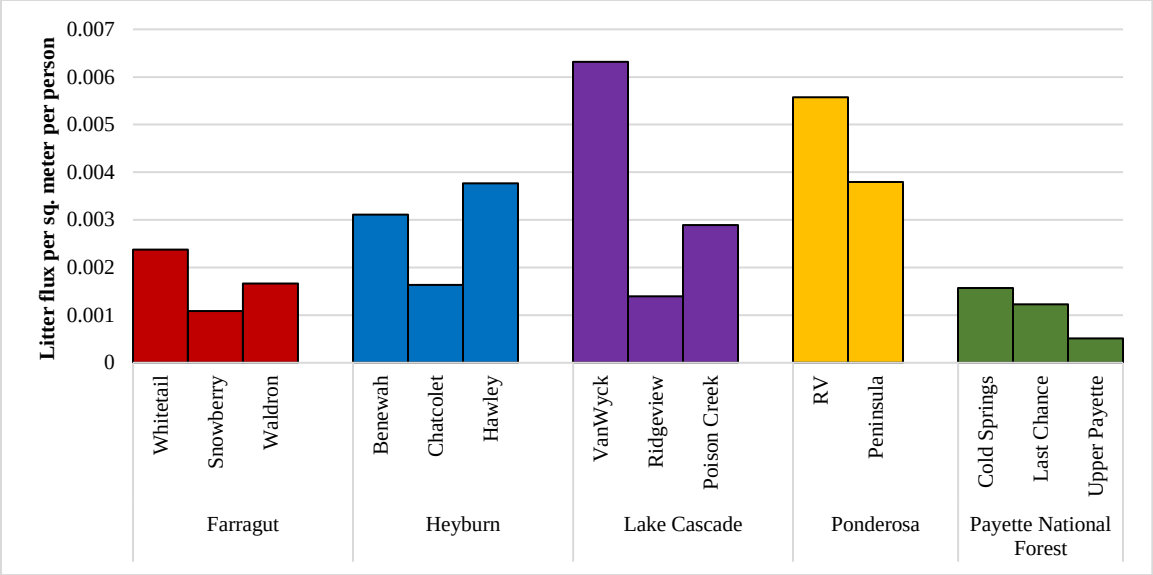


Figure 2.5. Litter flux based on visitor data and area by campgrounds.

Camp host impact

Camp hosts collected litter from all our study sites in 12 of 14 campgrounds (Appendix 4). The campgrounds where camp hosts did not collect litter for this study were Peninsula and Cold Springs campgrounds in Ponderosa and Payette NF, respectively. Camp hosts collected 2223 pieces (51.4%) of litter from the study sites during the study period. Figure 2.6 below shows the litter pieces collected by the research team and the camp hosts aggregated to the campground scale.

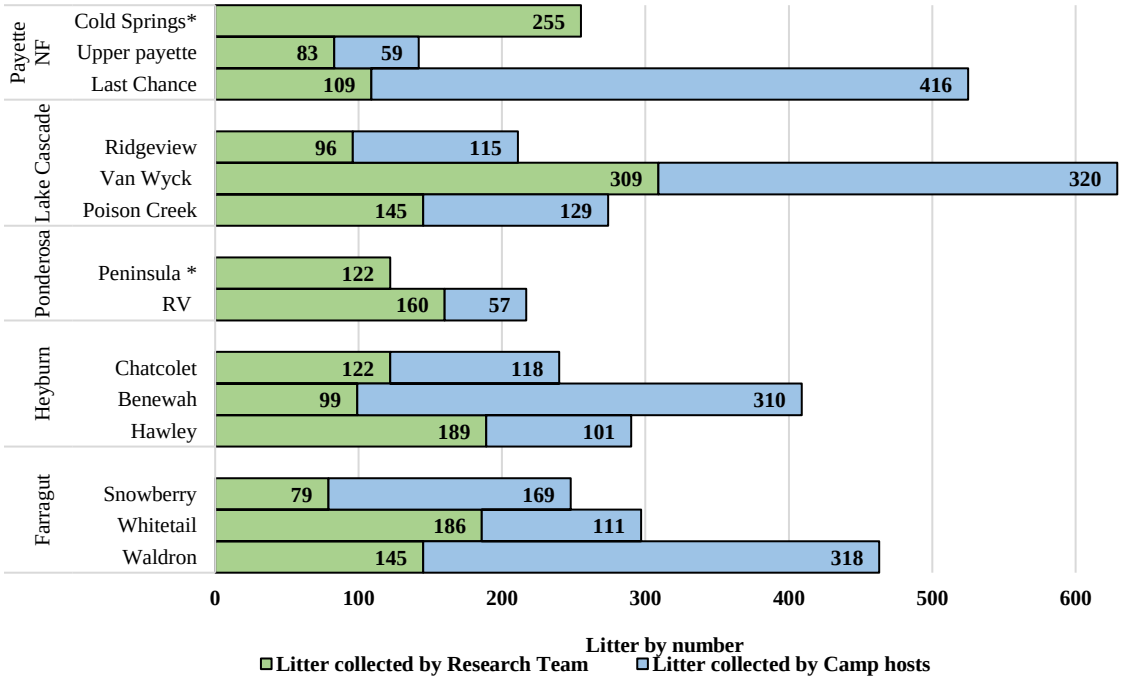


Figure 2.6. Litter collected by the research team (green) and camp hosts (blue) within campgrounds of each location.

Based on camp host collection data from our study sites, the total number of campsites per campground, the occupancy rate, and litter rate (average litter picked up by hosts per day) during the camping season, we estimate that camp hosts prevented more than 25,000 pieces of litter from entering the natural environment in these 12 campgrounds alone (Table 2.3).

Table 2.3. Estimated total litter collection during 100-day camping season based on campground campsite numbers, average litter collection rates, and estimated occupancy rates.

	Campground	Total campsites	Average litter collected by the camp hosts each day per site	Estimated occupancy between Memorial Day and Labor days (100 days) *	Estimated total litter collected during the camping season
Farragut**	Waldron	73	1.082	80	6318.88
	Whitetail	61	0.374	81	1847.934
	Snowberry	44	0.508	91	2034.032
Heyburn	Hawley's landing	52	0.432	64	1437.696
	Benewah	39	1.520	56	3319.68
	Chatcolet	37	1.157	42	1797.978
Ponderosa**	RV	50	0.192	98	940.8
	Peninsula***	113	0.000	93	0
Lake Cascade**	Poison Creek	22	0.462	92	935.088
	Van Wyck	25	1.778	59	2622.55
	Ridgeview	24	0.391	97	910.248
Payette NF**	Last Chance	23	7.704	18	3189.456
	Upper Payette	20	0.269	72	387.36
	Cold Springs***	30	0.000	25	0
					25741.7

**Camping season in Idaho usually falls between Memorial Day and Labor Day (100 days). As opening day varies based on individual campground situation and weather, we used this as a standard to measure the average number of days any campground regardless of its location might be open. The occupancy rate for the entire campground is then used to estimate the number of possible occupied days between Memorial and Labor Day.*

***This location has more campgrounds than the ones included in the study and the estimates do not represent the entire SP/NF but only the campgrounds included in this research*

****No camp host data*

Suppose we use the same extrapolation method for the litter collected by the research team. In that case, we can estimate the seasonal amount of litter entering the natural environment in each study location without the research team's intervention. Table 2.4 shows the extrapolation done to the litter data collected by the research team based on occupancy rate. It shows that despite camp host intervention, approximately 27,550 pieces entered the environment for 14 of the campgrounds (20,367 pieces for 12 of the campgrounds that also have host collection). This means that of the total litter left behind by campers, the camp hosts divert 55.8% of the litter to proper waste disposal

channels. This is an incredible contribution, and despite that, there is still a tremendous amount of litter being left behind in our public recreational areas.

Table 2.4. Estimated total seasonal litter amount based on litter rate & campsite occupancy.

	Campground	Total campsites	Litter rate [litter/day] for one campsite per day	Estimated occupancy during the camping season	Estimated total seasonal flux
Farragut	Waldron	73	0.51	80	2978.4
	Whitetail	61	0.63	81	3112.83
	Snowberry	44	0.24	91	960.96
Heyburn	Hawley's landing	52	0.81	64	2695.68
	Benewah	39	0.54	56	1179.36
	Chatcolet	37	0.65	42	1010.1
Ponderosa	RV	50	0.54	98	2646
	Peninsula	113	0.44	93	4623.96
Lake Cascade	Poison Creek	22	0.52	92	1052.48
	Van Wyck	25	1.76	59	2596
	Ridgeview	24	0.33	97	768.24
Payette NF	Last Chance	23	1.98	18	819.72
	Upper Payette	20	0.38	72	547.2
	Cold Springs	30	3.41	25	2557.5
					27548.43

Hypothesis testing

Hypothesis 1 (H_1): There will be a significantly higher amount of plastic litter flux per occupied day and per camper compared to non-plastic types across all campgrounds.

Within litter flux after camp host intervention, they can be further divided into plastic litter flux and non-plastic litter flux. An independent t-test was conducted to compare the flux between plastic and non-plastic litter in all campgrounds.

As the litter flux has an unequal variance, Welch's t-test for litter flux per camper demonstrated significantly higher plastic flux than non-plastic flux, t (18) =2.623, p=0.017. This means that a higher number of campers means higher plastic flux into our recreational areas. Repeating the same test for flux per occupied day showed that there was no significant effect of occupancy, t (18) =1.049, p=0.308 despite the mean plastic flux (M=0.002) being higher than that of non-plastic flux (M=0.0007). Higher occupied days do not necessarily equate to higher plastic flux into the environment.

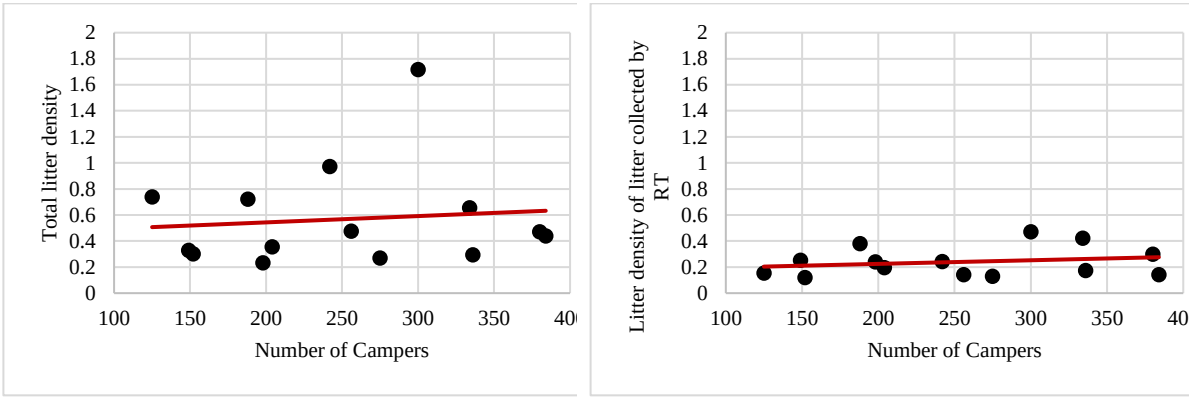
Hypothesis 2 (H_2): There will be a significantly higher amount of litter flux per occupied day in day-use areas compared to campgrounds.

In day-use areas, only the research team collected litter. So, litter flux is measured during the 101 days of research duration with the assumption that it was open and occupied each day. Results of

the Welch t-test between all campgrounds and the three day-use areas showed no significant difference in flux between campgrounds and day-use areas t (15) =0.606, p=0.553 even though the mean flux in day-use areas (0.0043) is slightly higher than that of campgrounds (0.0032) per occupied day.

Hypothesis 3 (H_3): There will be higher litter flux as occupied days and number of campers increase.

Two simple linear regressions were used to test if the number of campers can explain the litter density. For the first one, the total litter density (litter collected by hosts + litter collected by the research team) was used, which indicated that the number of campers explained 1.1% of the variation in litter density [R2=0.011, F (1,12) = 0.135, p = 0.719]. Another linear regression using only litter collected by the research team showed that the number of campers explained 4.4% of the variation [R2=0.044, F (1,12) = 0.135, p = 0.472]. This means that the number of people in campgrounds does not adequately explain litter flux per day in campgrounds, but as we saw in Hypothesis 1, it does affect plastic litter flux. However, as seen in Fig 2.7, there is a slightly positive correlation between campers and litter density.

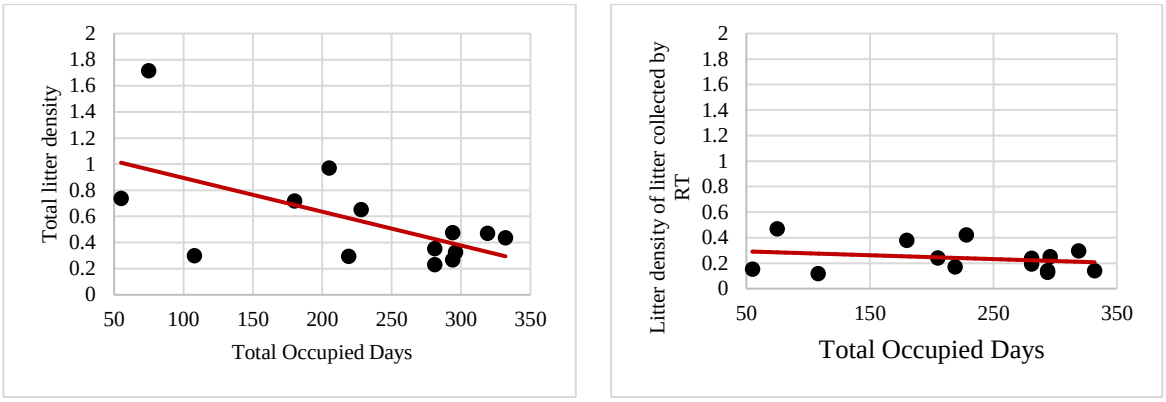


(a) ***(b)***

Figure 2.7. (a) Total litter flux (litter from hosts + litter from research team) per camper. (b) Litter flux from litter collected by the research team per camper.

Again, two simple linear regressions were used to test if the number of days that the campgrounds are occupied can explain the litter flux per day. First, the total litter density was used to calculate linear regression, and the result of the regression indicated that the number of occupied days explained 35.8% of the variation in litter flux [R2=0.358, F (1,12) = 6.691, p = 0.024]. as shown in figure 9(a). The second linear regression (figure 2.8b) shows litter density with litter collected by the research team, which explains 5.8% of the variation in litter density [R2=0.058, F (1,12) = 0.738, p = 0.407]. In the first case, we saw that the more days that the campgrounds are occupied means significantly less amount of litter is left behind by the campers. However, with the intervention of camp hosts, the relationship between litter density and occupancy is not significant anymore. In

Figure 9, we can see a slightly negative correlation with litter density decreasing as occupied days increase.



(a) ***(b)***

Figure 2.8. (a) Total litter flux (litter from hosts + litter from research team) per occupied day. (b) Litter flux from litter collected by the research team per occupied day.

Hypothesis 4 (H_4): The presence of trash receptacles impacts the litter flux per day in campgrounds.

In this study, only the three campgrounds in Payette National Forests did not have a trash receptacle, while the other 11 State Park campgrounds did. All the sites, regardless of the presence of trash receptacles, did have camp hosts. Thus, we used the litter flux data from litter collected by the research team to see if trash receptacles impacted the litter flux per day and camper. One-way ANOVA at the campground level to see if trash receptacles impacted the litter flux per day showed no significant difference, t (2) =-0.208, p=0.85. At the same time, there was a significant difference in litter flux per visitor t (11) =3.247, p=0.008. This shows that in situations with higher campers or higher traffic through campgrounds, the presence of trash receptacles has a significant impact. All the state parks with designated trash disposal receptacles have significantly lower litter flux per visitor than the national forest campgrounds.

2.5. Discussion

This study presents the first data on campground litter abundance and composition in Idaho. Accumulation of litter (both plastic and non-plastic) debris on land is simultaneously one of the most ignored and the most visible emerging environmental issues (KAB, 2021). The results of this study highlight litter and littering in our state parks and national forests and add to our understanding of the amounts, flux, and rates of litter in terrestrial systems.

General litter characteristics

While 78.6% of the litter in this study is plastic, it constitutes only 38% of the total litter mass. This difference can be attributed to the lightweight property of plastic material, which makes it incredibly valuable for consumer material production (He et al., 2018). This finding is near the high

end of other litter and marine debris studies, which range from 38.6-80% recovered plastic litter content (Barnes & Milner, 2005; KAB, 2021), and the weight of the plastic litter found is comparatively lower (Jayasiri et al., 2012). This is an exciting finding because plastic waste comprises approximately 7%, 16.3%, 5.8%, 7.3%, 8-10%, and 10% percent of waste mass in European countries, the United States, Singapore, Australia, the UK, and Finland respectively (Eurostat, 2007; US EPA, 2006; Barlaz, 2006; Burnley, 2007; Sokka et al., 2007). Also, unlike in aquatic environments, there is no density separation of litter, which might skew litter percentages toward lightweight, buoyant plastics. The percentage of plastic litter found in these recreation areas is more than 40% higher than is found in litter found along roadsides and in waterways across the US (36.8%, KAB, 2021). This means that the waste composition in our recreational areas is skewed toward more significant amounts of plastic than in traditional waste streams. We have a more significant percentage of plastics than other litter types in all our locations. This is supported by the first hypothesis, where we saw that while an increase in visitors might not result in a significant increase in litter flux, it certainly increases plastic flux.

The top 5 identifiable individual item types are plastic food wrappers (729), cigarette butts (543), aluminum foil (289), plastic coated cardboard/paper (281), and metal caps of bottles (113), all items generally associated with food packaging or consumer good. These same item categories are among the top 20 most littered items in the KAB 2020 list (KAB, 2021). This is likely related to a higher percentage of food packaging and consumer goods in litter streams than in traditional waste streams, and this aligns with what we see when we analyze litter by type. As this study occurred in the summer of 2021, the first summer after the COVID-19 pandemic, there was a strong possibility of PPE gloves and masks being highly littered as that was a new category added in the KAB survey conducted in 2020 (KAB, 2021). Surprisingly, we found only ten masks and 2 PPE gloves combined in our study sites. The public views public recreational areas as safe spaces to recreate and gather unmasked while still following the public safety guidelines.

Individual site characteristics

While we know that litter is being generated in all our recreation areas, we are particularly interested in the portion that escapes management (either by campers, staff, or camp hosts) of the litter flux into the environment. In general, we can see a similar trend in litter flux by days and by campers. Overall, there is a higher litter flux per day than per person, except for Ponderosa. Ponderosa had the highest occupancy compared to all other campgrounds and lower campers. Both the campgrounds in Ponderosa have higher litter flux per person than flux per day. This can be because we have the least amount of litter collection from Ponderosa due to various reasons such as only two campgrounds compared to three in all other locations, lack of host collection entirely for one

of the two campgrounds, and fewer collection by the research team due to the sites being occupied during visits. However, all other four locations follow the trend of litter flux being higher for occupied days compared to campers.

For flux based on camper visits, the raw data shows that when the amount of litter left behind by campers increases, the number of campers increases, and so does the number of plastics. However, the total amount of litter and that collected by the research team (i.e., the litter that would have remained behind in the environment) is independent of the number of visitors. The litter collected by the research team is lower than the litter collected by the hosts. This shows the importance of hosts and the role they play in keeping our campgrounds clean. Linking this with the results from hypothesis one, despite the litter density not being significant with the number of visitors, the flux of plastics entering the environment is significant. This alludes to the types of litter that capture the hosts' attention and are made a priority for the cleanup. Non-plastic items, which are bigger in size and more noticeable, are prioritized for cleanups compared to fragments piece of plastic materials that are hiding in plain sight.

For flux based on occupancy, contrary to our hypothesis, the raw data shows a decrease in litter when the occupancy days increase. The decrease in total litter is significant for occupied days, but this decrease is not significant when we look at litter left behind in campgrounds after host intervention. Again, this shows the importance of hosts and how their intervention significantly decreases the litter quantity that remains behind. As we do not know the total number of turnovers for the campgrounds, there are a few reasons why this might happen: high occupancy can mean more frequent turnovers and frequent turnovers can mean an increase in the frequency of cleaning by both the campers and the hosts which lead to even residual litter being cleaned up. Higher occupancy can also mean more prolonged stays for the campers, and when that happens, they clean up the areas more thoroughly during their stay and leave the areas cleaner than they found them. These two results show that rather than the number of people, it might be people's behaviors that have a more significant impact on the litter situation.

As has been found in other studies, our study indicates that the presence of trash receptacles impacts litter flux (Hypothesis 4) (Finnie, 1973; Heberlin, 1971; Zane, 1974; Arafat et al., 2007). When the litter results normalized by density (abbreviated results in Fig 5 and 6, and the extended results in Appendix 5), Payette National Forest, which does not provide a designated garbage disposal area in their campgrounds, has the highest litter density, 0.47 pieces per occupied sq. meter., despite intervention from camp hosts. Looking at the litter flux by campers, this difference is supported by the ANOVA analysis (p-value of 0.008). In areas with lower visitor rates, trash receptacles might

slightly differ in litter flux. However, in areas with higher visitors, the presence of trash receptacles contributes immensely to keeping litter away from natural areas.

Interestingly, we found that litter flux based on occupancy is not impacted by the presence or absence of trash receptacles. The third campground within Payette, the Upper Payette campground, has the third lowest flux by day and by campers of all sites. The difference in the Upper Payette campground can be attributed to the adjoining day-use area, which has a trash receptacle that happens to be positioned on the entry/exit to the campground. Just having an easily accessible trash receptacle on the way to the campground appears to encourage people to dispose of their trash correctly.

While no statistical difference was found in litter flux between campsites and day-use areas, the difference in types of litter found was significant. The trend in types of litter collected across the five locations is similar, with the top five types of litter being consistent across recreation areas and being the top categories in the KAB litter categories (KAB, 2009; KAB, 2021) with the quantity of plastic litter collected being very significant. This shows that despite the location, the types of litter found are comparable and that litter reduction strategies developed for non-recreational areas may apply in recreational settings as well. Litter reduction strategies can be aimed mainly at plastic to reduce the total litter quantity.

Camp Host Impact

Separating litter collected by us and the camp hosts allowed us to estimate potential camp hosts' impact. We say potential camp host impact because several factors impact the quality of the camp host collection data. First, the camp hosts collected and stored the litter they collected from campsites without any incentives from our side, meaning this work was potentially a low priority for the camp hosts. Additionally, in many campgrounds, there was a camp host turnover in the middle of the summer, and the litter was not collected separately by the new hosts for a brief period. Third, in certain circumstances, when the litter left behind was intermixed with biodegradable waste, none of the litter was collected for us. Finally, several camp hosts admitted needing to remember to collect the litter from the sites separately for us. Thus, the quantity and quality of litter collected by the camp hosts varied significantly. Because of these complications, with a few exceptions, the discussion of the camp host data is treated as suggestive only.

Despite these limitations, Table 4 shows the estimated data for all the litter collected by camp hosts that are diverted back to proper waste disposal channels. When extrapolating from campsite to entire campgrounds, we estimate camp hosts recovered at least 25,741 pieces of litter, with 78% of it estimated to be plastics in 12 campgrounds over the summer. Following the same extrapolation method regarding weight, camp hosts remove ~44.2 kg (97 pounds) of litter during the season. This represents 56% of all litter being intercepted and redirected to proper waste disposal channels by

camp hosts. This is a significant amount of litter being diverted that would otherwise end up in the environment. This is important as plastic litter undergoes further degradation through physical, chemical, or biological processes. Even for plastics that claim to be biodegradable, studies have shown that they are more likely to disintegrate rather than degrade, which means they result in the formation of secondary microplastics (Whitacre, 2014). With all our study sites being near lakes and streams, the higher the flux of litter into the surroundings, the higher the chances of this litter, either in macro litter form or in micro-plastic form, entering the freshwater source nearby. Limiting the litter flux into these recreational areas helps decrease the pool of potential mobile pollutants to the freshwater system nearby.

Our data suggest that camp hosts play an essential role in limiting litter flux to the environment by intercepting >50% of the litter left behind by the campers and routing that to proper waste disposal channels. Unlike the campsites, the day-use areas did not have a regular cleanup schedule by park staff or volunteers, relying instead on the recreational user's responsibility and the occasional cleanup by the park official's time availability. Our data did not show a significant difference in the litter flux between day-use areas and campgrounds, even though the mean flux is higher for day-use areas. We only had three day-use sites in our study compared to 14 campgrounds. This might have skewed our results when finding the difference in litter flux between day-use and campsites. Despite the lack of data for day-use sites, this study highlights the importance of human intervention in managing litter in public areas.

Litter cleanup poses a financial burden for management organizations. Stein (2005) estimated the cost of litter cleanup to be $1.29 per piece of litter when work was done by paid employees and 18 cents per item when using voluntary labor under Adopt-a-Highway litter cleanup programs. Let us consider the camp host's efforts as voluntary efforts and based on our estimates of whole campground litter amounts removed per season, as per Table 2.4. Their economic contribution in just these 12 campgrounds (two campgrounds do not have camp host collection data) is $4,650. As paid employees, their contribution amount in these 12 campgrounds would be $33,325. Accounting for inflation since 2005, these numbers reached $7,233 and 51,925 for volunteers and paid employees' contributions. Thus, we can say that the camp hosts, in just these 12 campgrounds (approx. 470 sites), have saved the state as much as $50,000 in a single camping season in litter cleanup costs, i.e., In terms of cost per campsite, it would be ~$15- $110 for volunteer and paid employee costs. Across the state, there are 27 state parks and five national forests, and if we measure the financial impact of littering and how much the camp hosts are contributing, it will undoubtedly be in millions of dollars. This is a massive contribution to the state and federal park systems when they are already under financial strain.

Out of the 27 state parks in Idaho, 18 state parks have one or more overnight campgrounds, and each of these campgrounds has over 40 campsites. So, there are between 40-50 campgrounds in Idaho state parks that utilize the service of camp hosts and around 1850 campsites. Each campground varies in number of sites, usage, and visitors. Not all campsites may be in full use during summers due to maintenance, weather, and more. Thus, using a conservative estimate and considering that camp hosts look over 1800 sites in state parks in Idaho, we can say that camp hosts are saving the state of Idaho anywhere between $27,000 (if volunteers do the cleanup)- and $198,000 (if someone is paid for the cleanup) in a single season. Moreover, this does not include the economic benefits of other services they provide. This also does not include the camp hosts working for other campgrounds operated by the park system or by the federal government like BLM or National Forest Service.

2.6. Conclusion

This study was a response to the clear need for more research on the quantities of litter in terrestrial environments. Much non-biodegradable litter ends up in all our recreational areas through campers, even when the composts divert 56% of that litter towards proper disposal channels. More than 75% of the litter collected by hosts and of the litter that remains behind was plastic. This highlights the immediate need to address the issue of plastic litter in our recreational areas. We also found that if the campsites have high occupancy, there is less litter flux into the environment daily. However, if that occupancy is combined with more visitors in any area, those areas must have adequate trash receptacles to keep the litter flux down. While the number of campers might not directly impact the litter flux, it is a significant factor in keeping our recreational areas clean. Nevertheless, the biggest takeaway is the importance of designated trash disposal areas/receptacles, as their presence hugely decreases campground litter flux.

References

Arafat, H. A., Al-Khatib, I. A., Daoud, R., & Shwahneh, H. (2007). Influence of socio- economic factors on street litter generation in the Middle East: effects of education level, age, and type of residence. *Waste Management & Research*, *25*(4), 363–370. https://doi.org/10.1177/0734242X07076942

Barlaz, M. A. (2006). Forest products decomposition in municipal solid waste landfills. *Waste Management (Elmsford)*, *26*(4),321–333. https://doi.org/10.1016/j.wasman.2005.11.002

Barnes, D. K. A., & Milner, P. (2005). Drifting plastic and its consequences for sessile organism dispersal in the Atlantic Ocean. *Marine Biology*, *146*(4), 815–825. https://doi.org/10.1007/s00227-004-1474-8

Boise National Forest - News & Events. (2020). Usda.gov. Retrieved from: https://www.fs.usda.gov/detail/boise/news-events/?cid=FSEPRD795424

Burnley, S. J. (2007). A review of municipal solid waste composition in the United Kingdom. *Waste Management (Elmsford)*, *27*(10), 1274–1285.https://doi.org/10.1016/j.wasman.2006.06.018

Chow, A. (2020). National parks are getting trashed during COVID-19, Endangering Surrounding Communities. *TIME.* Retrieved from: https://time.com/5869788/national-parks-covid-19/.

Cialdini, R. B., Reno, R. R., & Kallgren, C. A. (1990). A focus theory of normative conduct:recycling the concept of norms to reduce littering in public places. *Journal of Personality and Social Psychology*, *58*(6), 1015–1026. https://doi.org/10.1037/0022-3514.58.6.1015

Department of parks and Recreation. (2021). Idaho State parks Enact Non-resident Fee Increases at Popular Parks. *IDPR.* Retrieved from: https://parksandrecreation.idaho.gov/pressrelease/ idaho-state-parks-enact-non-resident-fee-increases-at-popular-parks/.

Eurostat. (2007). Waste generated and treated in Europe 1995–2003. Retrieved from: https://ec.europa.eu/eurostat/web/products-statistical-books/-/ks-69-05-755

Finnie, W. C. (1973). Field Experiments in Litter Control. *Environment and Behavior*, *5*(2),123–144. https://doi.org/10.1177/001391657300500201

Fortin, M.-J., Drapeau, P., & Legendre, P. (1989). Spatial Autocorrelation and Sampling Design in Plant Ecology. *Vegetatio*, *83*(1/2), 209–222. doi.org/10.1007/BF00031693

Grima, N., Corcoran, W., Hill-James, C., Langton, B., Sommer, H., & Fisher, B. (2020). The Importance of urban natural areas and urban ecosystem services during the COVID-19 pandemic. *PloS One*, *15*(12), e0243344e0243344. doi.org/10.1371/journal.pone.0243344

Griffith, D. A. (2005). Effective Geographic Sample Size in the Presence of Spatial Autocorrelation *Annals of the Association of American Geographers*, *95*(4), 740–760. https://doi.org/10.1111/j.1467-8306.2005.00484.x

Heberlein, T.A. (1971). Moral norms, threatened sanctions, and littering behaviour. *Ph.D.dissertation, University of Wisconsin.* (University Microfilms no. 72-2639).

Idaho Parks & Recreation Volunteer Program. (n.d.). Idaho Department of Parks and Recreation. https://parksandrecreation.idaho.gov/wp-content/uploads /activities/ volunteer/Campground-Host-Template.pdf

Jambeck, J., Geyer, R., Wilcox, C., Siegler, T. R., Perryman, M., Andrady, A., Narayan, R., &Law,K. L. (2015). Plastic waste inputs from land into the ocean. *Science*, 347(6223), 768–771. https://doi.org/10.1126/science.1260352

Jayasiri, H. B., Purushothaman, C. S., & Vennila, A. (2013). Erratum to: Plastic litter accumulation on high-water strandline of urban beaches in Mumbai, India. *Environmental Monitoring and Assessment*, *185*(9), 7721–7722. https://doi.org/10.1007/s10661-013-3187-2

KAB. (2009). 2009 National Visible Litter Survey and Litter Cost Study. *Keep America Beautiful, Inc*. www.kab.org/site/DocServer/Final_KAB_Report_9-18-09.pdf

KAB 2020. (2021). 2020 National Litter Study. Summary Report. *Keep America Beautiful, Inc.* https://kab.org/wp-content/uploads/2021/05/Litter-Study-Summary-Report-May2021_final_ 05172021.pdf

Kupfer, J. A., Li, Z., Ning, H., & Huang, X. (2021). Using Mobile Device Data to Track the Effects of the COVID-19 Pandemic on Spatiotemporal Patterns of National Park Visitation. *Sustainability (Basel, Switzerland)*, *13*(16), 9366. https://doi.org/10.3390/su13169366

Martins, A. M., & Cró, S. (2021). The Impact of Tourism on Solid Waste Generation and Management. Cost in Madeira Island for the Period 1996–2018. *Sustainability (Basel, Switzerland)*, *13*(9), 5238. https://doi.org/10.3390/su13095238

Marquez, J. A. and Zandi, I. (1985) Litter management-measurement aspects. *Journal of Resource Management and Technology 14*(2), 67-75.

Morse, J. W., Gladkikh, T. M., Hackenburg, D. M., & Gould, R. K. (2020). COVID-19 and human-nature relationships:Vermonters' activities in nature and associated nonmaterial values during pandemic. *PloS One*, *15*(12), e0243697–e0243697. doi.org/10.1371/journal.pone.0243697

Parris, J. (2020). Boise County camping areas trashed, forcing locals to clean up after visitors. *KTVB.* Retrieved from: www.ktvb.com/article/news/local/208/boise-county-camping-areas-trashed-forcing-locals-to-clean-up-after-visitors/277-9d588217-7486-4b15-a5c3-19acfe72b7f4.

Pierno, T. (2017). President's outlook: Trash talk. National Parks Magazine. *Popular campground Near Highway 95 now closed. (2021). Ktvb.com. Retrieved from:* https://www.ktvb.com/article/sports/outdoors/popular-campground-near-highway-95-now-closed/277-e71d9f4b-ffa3-489d-b229-73003b05769a

Schultz, P. W., Bator, R. J., Large, L. B., Bruni, C. M., & Tabanico, J. J. (2009). Littering behavior in America: Results of a National Study. *Keep American Beautiful.* https://kab.org/wpcontent/uploads/2019/10/NewsInfo_Research_LitteringBehaviorinAmerica_2009Report_Final.pdf

Shartaj, M., Suter, J. F., & Warziniack, T. (2022). Summer crowds: An analysis of USFS Camp-Ground reservations during the COVID-19 pandemic. *PloS One*, *17*(1),e0261833–e0261833. https://doi.org/10.1371/journal.pone.0261833

Sokka, L., Antikainen, R., & Kauppi, P. E. (2007). Municipal solid waste production and composition in Finland—Changes in the period 1960–2002 and prospects until 2020. *Resources, Conservation and Recycling*, *50*(4), 475–488. https://doi.org/10.1016/j.resconrec.2007.01.011

Stein, S.R., 2005. Sweating the litter things. Resour. Recycl. 24 (5), 25–30.

Volenec, Z. M., Abraham, J. O., Becker, A. D., & Dobson, A. P. (2021). Public parks and the pandemic: How park usage has been affected by COVID-19 policies. *PloS One*, *16*(5), e0251799–e0251799. https://doi.org/10.1371/journal.pone.0251799

Sullivan, R. H. (1985). Measurement of Relative Amounts of Litter. *Journal of Resource Management and Technology*, *14*(2), 91–91.

Syrek, D. B. (1985) Full scale and visible litter surveys. *Journal of Resource Management and Technology* 14 (2), 83-89.

US EPA. (2006). Municipal Solid Waste in the United States: 2005 facts and figures. *United State Environmental Protection Agency, Office of Solid Waste*.

Whitacre, D. (2014). *Reviews of environmental contamination and toxicology, vol. 227*. NewYork, NY: Springer. https://doi.org/10.1007/978-3-319-03777-6

Zane, Lee, T. (1974). The Effects of Different Litter Control Procedures on Movie Audiences. *Western Michigan University. Master's Theses*. Retrieved from: https://scholarworks.wmich.edu/masters_theses/2625.

Zhang K., Su J., Xiong X., Wu X., Wu C., & Liu J. (2016). Microplastic pollution of lakeshore sediments from remote lakes in Tibet plateau, China. *Environment Pollution*, 219:450 455.

Chapter 3: Environmental Concern and Associated Waste Disposal Habits

3.1. Introduction

The United States has a littering problem. The 2020 survey Keep America Beautiful (KAB) survey showed that there are estimated to be approximately 50 billion pieces of litter in US roads and waterways, which equates to 152 pieces of litter per US resident (KAB, 2020). Identifying underlying factors contributing to littering behavior is essential in evaluating the effectiveness of the existing waste management policies, redefining public education and awareness regarding proper waste disposal, and creating more effective waste management strategies. To date, very little of the litter research has focused on recreational settings like State Parks and National Forests. However, increasing visitation combined with reduced or stagnant operational budgets means that litter is an increasing problem in these areas. This chapter aims to understand better recreational user attitudes and preferences regarding litter management and the environmental worldviews that may contribute to littering behavior through a survey administered to the campers in four State Parks and one National Forest in Idaho. The revised New Ecological Paradigm (NEP) is used in the survey to measure the camper's environmental worldview.

Theoretical Framework

Pro-environmental behavior can be defined as behaviors aimed at avoiding harmful and reducing environmental impacts through public (e.g., participation in environmental movements) or private (e.g., recycling) actions (Steg & Velk, 2009). Multiple theoretical frameworks have been formulated to understand the reasoning behind pro-environmental attitudes and behaviors. Some of the models, like Hines' Hungerford's and Tomera's (1987) Model of Responsible Environmental Behavior or Ajzen's & Fishbein's (1967) Theory of Reasoned Action, are highly sophisticated and include multiple variables that are associated with measuring pro-environmental behavior. All these models attempt to explain the gap between environmental attitudes and how they translate into pro-environmental behavior. However, all these models have been found to only have some degree of validity in certain situations, and none can fully predict human behavior with complete success.

Kollmuss and Agyeman (2002) argue that demographics, external factors (e.g., institutional, economic, and social), and internal factors (e.g., motivation, environmental knowledge, values, and awareness) are some of the most influential factors behind pro-environmental behavior. One way to measure pro-environmental behavior is by utilizing the New Ecological Paradigm (NEP) scale. The NEP, designed by R. E. Dunlap and K. D. Van Liere (1978), is one of the most widely used measures of the environmental worldview globally. The NEP scale is used to understand an individual's broader environmental worldview, which can help to determine whether they may engage in specific

pro-environmental behavior given the right circumstances. Revised NEP has become a common predictor in environmental behavior studies (Barr, 2007; Wynveen et al., 2014; Brick & Lewis, 2016).

The revised NEP is an updated survey instrument comprising fifteen statements in which the respondents must indicate how much they agree or disagree with the statement using a Likert scale ranking (strongly agree, agree, unsure, disagree, strongly disagree). Addressing the directionality criticism, eight odd-numbered statements/items reflect the new worldview, while the others adhere to the dominant social paradigm (DSP). The responses after statistical analyses can be used to measure environmental concerns. The fifteen items are divided into five subdomains: Balance of nature, eco-crisis, anti-exceptionalism, limits to growth, and anti-anthropocentrism (Dunlap et al., 2020). After extensive review of the revised NEP over an almost 20-year period, the meta-analysis on revised NEP conducted by Hawcroft & Milfont (2010) concludes that unless we can find a gold standard for environmental attitude measurement, the NEP scale as the best-standardized measure we have.

While most NEP questionnaires include all fifteen statements, some studies have been carried out that do not include the complete questionnaire and have used a subset of questions only. Studies have also been carried out with only eight items in their survey instrument, such as Liu and Sibley (2004) and Marshall, Picou, and Bevc (2005). Other studies like Blake, Guppy, Urmetzer (1997) and Hall and Moran (2006) have used a 10-item version. The use of the Likert scale is, however, consistent among all these studies. While no single framework can fully encompass all the facets that influence pro-environmental human behavior and actions, the revised NEP is one of the most suitable frameworks for our survey purpose.

The survey we designed would need more questions in addition to the Revised NEP items, which would significantly increase the time needed to complete the survey, resulting in a lower completion rate, which also means a higher bias possibility. Therefore, we followed in the footsteps of Zhu & Lu (2017), who used the item response theory (IRT) to reevaluate the psychometric properties of the NEP scale using a survey dataset from China. NEP was designed to measure a "single latent trait" by adding all the individual scores. Hence, Zhu and Lu (2017) utilized the IRT methodology in the current Chinese-version NEP scale to show that a short version consisting of only positive items performed and the full version. While Zhu and Lu (2017) have cautioned that this might not be generalizable to all other contexts, we believe using only positive questions would benefit our context.

Studies have shown that a high NEP score is associated with a high eco-centric orientation, where an eco-centric view means that the intrinsic values of nature are valued, and individuals understand the need to protect it (Ntanos et al., 2019). Boubonari, Markos, and Kevrekidis found in

2013 that a higher NEP score resulted in more robust pro-environmental behavior towards marine pollution in general.

The critical assessment of what factors shape an individual's pro-environmental beliefs, values, and behaviors may provide insight into anti-littering attitudes that can be fostered among recreational users and decrease the impact of littering. Using the NEP questionnaire, we aim to take a closer look at the camper's ecological consciousness and see if litter reduction and control would be a feasible goal for the park management to oversee. The NEP results, combined with the rest of the survey questions, will provide a valuable framework of environmental beliefs held by recreational users in Idaho. This will help to understand litter-related attitudes in campgrounds and the best ways to target litter reduction strategies.

3.2. Research Questions and hypothesis

Understanding public perceptions of litter and its associated environmental impact can be valuable in helping public land managers design targeted approaches to litter reduction in recreational areas. The main question for this chapter is, *"How do recreational users' perceptions of litter in recreational areas and their environmental concern reflect their litter disposal actions and management preferences?"* To address this question, we formulated several hypotheses which address various aspects of this question.

Hypothesis 1 (H_1): *More experienced campers with higher NEP scores will show a more pro-environmental approach to their actual waste disposal behavior during camping.*

The types of environmental actions performed by individuals are said to reflect their environmental perceptions (Marcinkowski & Reid, 2019). So, campers with high NEP scores will also reflect more pro-environment behavior in their waste disposal behavior in the campgrounds. There are several popular methods of waste disposal generally preferred in recreational areas, such as using dumpsters, multiple types of recycling such as paper, glass, aluminum, burning in fire pits, and others. Many studies have shown that NEP is significantly related to behavioral intentions (Pahl et al., 2005; Gansser & Reich, 2022; Davis and Stroink et al., 2015). Emotional connectedness to nature and environmental knowledge, which can be reflected in the experience level of campers, are found to predict environmental behavior, such as people carrying their litter when doing outdoor activities like hiking (Hu et al., 2018). Thus, NEP scores combined with experience can predict a camper's waste disposal habits. The higher the scores and the more experienced campers are, they will dispose of their waste in a more pro-environmental way.

Hypothesis 2 (H_2): *Campers with higher NEP scores are more likely to support litter reduction strategies, especially non-monetary options.*

Littering in all fifty United States is a criminal offense, with the penalties varying based on the amount of litter and the severity of the littered items. However, in all littering cases, the litterer must be caught in the act to be penalized, and citations cannot be issued based on public reports alone. This makes enforcement very difficult and ineffective. Fines are more effective when the perceived likelihood of receiving the penalty is high (Fung & Wodak, 2022); however, with the difficulty in enforcing fines, it fails to become an effective deterrent to littering (Lyndhurst, 2013). The Fung and Wodak(2022) report also found that increasing fines had no impact on litter quantity, and even if a short-term change is seen due to fines, it will not fix the long-term behaviors associated with littering (2022). However, studies have shown that there are other methods to reduce litterings, such as anti-littering signs and proper waste disposal method signs (Huffman et al., 1995; Dwyer et al., 1993; Reiter & Samuel, 2006), changing the number, type, and position of garbage containers (KAB, 2009; KPB, 2017) and increasing the types of disposal options available (Bator et al., 2011). Additionally, the 2022 national Litter consultation conducted by the Scottish government showed that people would prefer alternative penalties instead of fines for littering (National Litter and Fly-tipping Strategy Consultation Analysis Report, 2022). So, this suggests that campers with higher NEP scores will support all litter reduction strategies but that support for non-monetary litter reduction strategies will be greater than for a monetary penalty strategy.

3.3. Methods

Survey development

To understand campers' perceptions of litter and how it is connected to their waste disposal habits, we developed an 11-question survey on personal waste disposal habits, awareness, and knowledge of litter, along with their concern for the issue. We asked for demographic information, including the age of the primary survey respondent, the number of people in the camping group, total nights of stay, and experience with camping. The middle portion of the survey asked respondents to rate the helpfulness of 5 strategies that could be introduced at state parks to combat litter. As a measure of ecological worldview, respondents were also asked to rate their agreement on statements taken from the New Ecological Paradigm (NEP). See Appendix 6 for the complete survey instrument and the informed consent form.

Qn. 1-3 were used for general demographic understanding, Qn. 2, 9, and 11 were used to address hypothesis 1, Qn. 10 and 11 to address H2. Qn. 4, 6, 7, and 8 were added to directly address some of the questions posed by the park managers.

Survey distribution and collection

On average, the surveys were in circulation for five weeks in each campground location. Surveys in Heyburn and Farragut State Park were given out between August 19- September 24. All surveys were collected on September 25. The surveys in Ponderosa, Lake Cascade State Park, and Payette National Forest were given out between August 21- October 3, with the final collection occurring on October 10.

Surveys were distributed in two ways: directly through the camp hosts and through visitor centers. Surveys distributed by camp hosts were hand-delivered to all campers who checked in with the hosts upon arrival, and camp hosts explained collection procedures for completed surveys, i.e., surveys were either to be handed back to the camp hosts or they were to be dropped off in the visitor center. Surveys distributed through visitor centers were given to all campers upon check-in, and campers were instructed to return completed surveys to their camp hosts or the visitor center as appropriate. All the surveys were pre-packaged in a sealable envelope to enhance survey privacy.

Locked file boxes with an insertion slot were provided to camp hosts (campground collection points) and park employees (visitor center collection points) for secure storage of completed surveys. The research team, the only ones with keys to the boxes, collected all collected surveys at the end of the collection period. The survey locations and their dissemination methods are summarized in Table 3.1.

Table 3.1. Survey distribution and collection method employed at various campgrounds.

	Location	**Distribution**	**Collection**
1	Heyburn	Camp hosts	Camp hosts
2	Farragut	Visitor Center	Visitor Center
3	Ponderosa	Visitor Center	Visitor Center
4	Lake Cascade*	Camp hosts	Camp hosts
5	Payette	Camp hosts	Camp hosts

**On top of the existing three campgrounds, surveys were also conducted on three other additional campgrounds.*

Survey Processing

After all the surveys were collected and sorted, they were entered into an Excel sheet and coded for initial statistical analysis. The responses to each question were coded with numbers ranging from 1 to 5 based on the order and quantity of the response options. In other words, the first response is coded as 1, the second as 2, and so on, depending on how many options were there in that question.

Statistical Analysis

All the figures were generated using Microsoft Excel 365 (Version 2308) and the analyses were conducted with RStudio (2023.06.01). Cronbach's Alpha test was carried for Qn 11 responses to

assess the internal consistency of the partial Revised NEP scale used for the survey. Subsequently, a Principal Component Analysis (PCA) was carried out for the same data set to see if there are any trends, jumps, clusters, or outliers in our NEP response.

A multiple linear regression was conducted to test our first hypothesis and see if camper's experience and their NEP scores impacted their waste disposal habits in campgrounds. We also conducted a two way ANOVA to look at campers support towards different types of litter reduction strategies and if certain strategies were more favored than the others or not.

3.4. Results

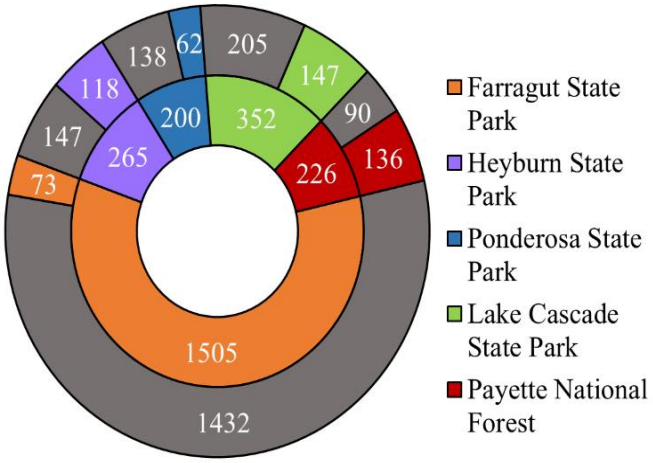


Figure 3.1. Survey rates for all locations. The inner circle represents the total surveys given out in each location. The outer ring represents the number of surveys received in each location by the campground. Surveys in Farragut and Ponderosa were handed back to the visitor center and thus, the surveys that were returned could not be broken down into campgrounds.

Survey results

Of the 2548 surveys distributed through various methods, 545 full and partial responses were received. Nine surveys were discarded because less than 3 out of 11 questions were answered. Thus, data was entered from 536 surveys. This includes data from several partially completed surveys, meaning each question had a minimum of 485 responses and a maximum of 536 responses. Figure 1 shows the ratio of surveys given out in each location, and the number of surveys received back. The overall response rate is 21.3%, with the individual rates for Farragut SP, Heyburn SP, Ponderosa SP, Lake Cascade SP, and Payette NF being 4.9%, 44.53%, 31%, 41.9%, and 60.2%, respectively. For additional details of survey response by site, see Appendix 7.

Profile of Survey Respondents

The respondents ranged in age from 18, the minimum age required to participate, to 85. Seventeen respondents did not mention their age. There were 68 respondents between the ages 18-35, 209 between 36-60, and 242 between the ages 61-85. The most common age was between 58-75. The average age was 55 years old. One hundred twenty-three respondents came alone, and 417 were in a group of 2-10. Twenty-four respondents were in groups of 10-20. The stay duration ranged from 1-45. Four respondents said they stayed at the site for more than 18 days. Those four are outliers in this response. More than half of campers (70.2%) stayed in the campground for 1-3 days.

66.4% of the campers' response indicates that they are experienced campers with more than six camping trips over the last two years. However, it was the first camping trip in 2 years for 8% of

the respondents. 76.7% of our respondents were RV campers, 22.8% were tent camping, and only 3 were backpackers.

Litter Concern

Question 5 of the survey asked people how concerned they are about litter in public spaces such as parks and campgrounds. Of the 536 responses, 248 mentioned they were highly concerned, and 212 were concerned, which means that 86% of the respondents are concerned about litter in public spaces. Delving deeper into what types of objects they might consider litter, figure 3 shows the camper responses to survey question six regarding concern for some of the common litter items (survey question 6). There were 534 total respondents for this question. The concern category includes the extremely concerned and the concerned rating on the Likert scale. Campers were most concerned about drink bottles (plastic and glass), cigarette butts, aluminum cans, pet waste, and plastic film and food wrappers respectively. More than any other litter category, survey respondents indicated extreme concern about pet waste despite being biodegradable. All the categories of litter concerned respondents, but biodegradable litter, except for pet waste, were less concerning to campers compared to the other categories of litter.

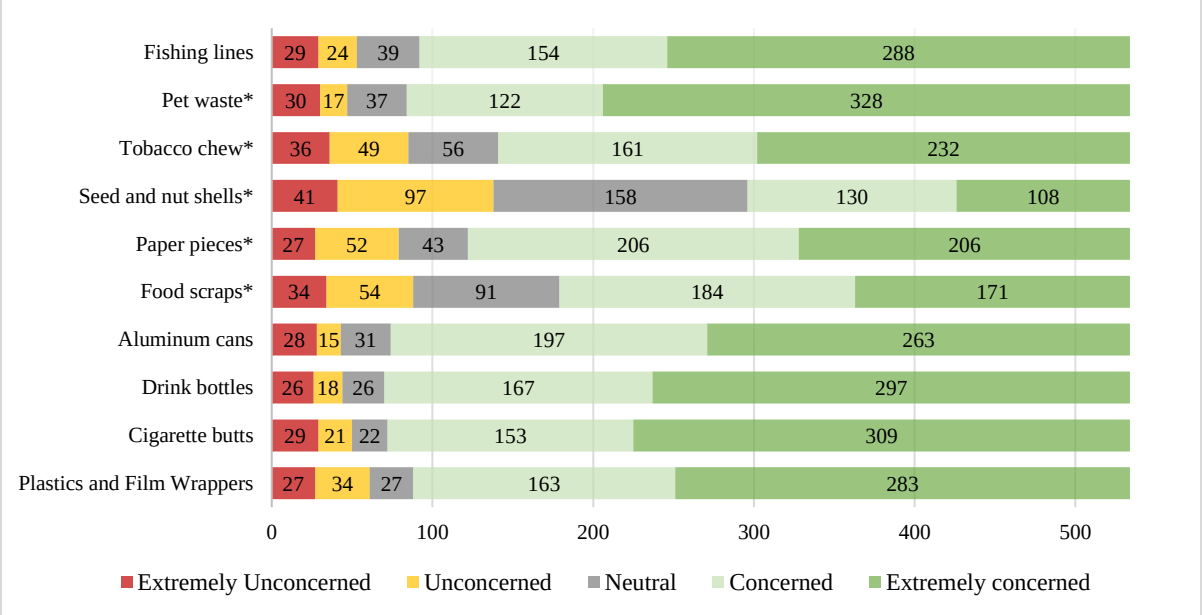


Figure 3.2. Distribution of the level of concern that certain litter types generate among survey respondents (Survey question 6). *Shows the items considered biodegradable.

Waste disposal methods

We asked the campers about their waste disposal methods on their camping trips (survey question 9). Their responses are summarized in Table 3. Some of the respondents skipped some of the options when answering the question. 69.3% of campers admit to dumping everything in the dumpster often (often and very often). There was a split when asked if they would sort their garbage

and take recycling home if needed. Most campers denied burning trash in the firepit and leaving biodegradables in the campsites.

Table 3.2. Waste disposal by campers in their last two years of camping (Survey question 9)

	Take trash when leaving	**Burned trash in the fire pit**	**Dispose everything in dumpster**	**Sorted trash for appr. Disposal**	**Take recycling home**	**Left biodegradables in the campsites**
Never	22 (4.1%)	206 (38.8%)	23 (4.3%)	113 (21.3%)	117 (22.0%)	388 (72.7%)
Rarely	53 (9.9%)	116 (21.8%)	25 (4.7%)	90 (16.9%)	113 (21.2%)	75 (14.0%)
Sometimes	102 (19.1%)	114 (21.5%)	115(21.7%)	139 (26.2%)	107 (20.1%)	56 (10.5%)
Often	130 (24.4%)	61 (11.5%)	116 (21.9%)	86 (16.2%)	83 (15.6%)	10 (1.9%)
Very Often	227 (42.5%)	34 (6.4%)	251 (47.4%)	103 (19.4%)	112 (21.1%)	5 (0.9%)
Total	**534**	**531**	**530**	**531**	**532**	**534**

Campers were asked what their disposal options would be in an ideal scenario with all the disposal methods available (survey question 7). Their responses summarized in Table 4 show that dumpsters (99.3%) are the most preferred options with composting being the least preferred. 40.5% of the campers were amenable to using all the available disposal options.

Table 3.3. Ideal waste disposal behavior of campers (Survey question 7)

	Dumpsters	**Paper recycling**	**Aluminum recycling**	**Composting**	**RV dump station**
Yes	530 (99.3%)	455 (85.4%)	484 (90.8%)	255 (47.8%)	449 (84.4%)
No	4 (0.7%)	78 (14.6%)	49 (9.2%)	278 (52.2%)	83 (15.6%)
Total	**534**	**533**	**533**	**533**	**532**

Litter reduction

Survey question ten asked campers' opinions about various approaches to further reducing campground litter. Table 5 summarizes the survey results. Respondents supported all reduction strategies, with increasing the number of disposal bins having the greatest support. On average, our survey respondents think that strategies that do not require campers to pay monetary fines will be more helpful in litter reduction. Increasing the number of disposal bins was supported by 82.2% of the respondents, followed by increased signage directing towards disposal sites (80.4%), increase in disposal options (75.2%), and better dissemination of disposal information (72.9%). The increase in monetary fines was supported by 66.2% of the respondents.

Table 3.4. Response towards litter reduction strategies

	No. of disposal bins	Disposal options	Signage	Better information	Increase fines
Very Unhelpful	24 (4.6%)	18 (3.4%)	16 (3.0%)	20 (3.8%)	28 (5.3%)
Unhelpful	7 (1.3%)	23 (4.4%)	11 (2.1%)	16 (3.0%)	44 (8.4%)
Neutral	63 (12%)	90 (17.0%)	76 (14.5%)	107 (20.3%)	106 (20.1%)
Helpful	224 (42.5%)	196 (37.2%)	235 (44.7%)	223 (42.3%)	152 (28.8%)
Very helpful	209 (39.7%)	200 (38.0%)	188 (35.7%)	161 (30.6%)	197 (37.4%)
Total	**527**	**527**	**526**	**527**	**527**

Waste disposal communication

One of the most common methods employed by public parks to combat littering and encourage appropriate waste disposal is by disseminating proper information to recreational users. Survey question eight asked how effectively the recreation area gave out information regarding waste disposal. Table 6 shows whether campers received any information about waste disposal during their stay and if the information received was helpful or not. Thirty-one respondents did not see or receive any of the four methods. 38% of campers said they did not receive any written guidelines, and 39% said they did not receive any verbal instructions. However, 90% of the respondents did see the signage showing disposal sites, 78% of them found the signs helpful, 8.8% found it unhelpful, and 13.2% were neutral. Similarly, 74% of them found the signs helpful, 9.1% found it unhelpful, and 16.9% were neutral.

Table 3.5. Information received through the park and its helpfulness (Survey question 8)

	Written guidelines	Verbal instructions	Signage for sites	Signage encouraging behavior
Very Unhelpful	11 (2.1%)	13 (2.4%)	15 (2.8%)	25 (4.7%)
Unhelpful	4 (0.8%)	5 (0.9%)	27 (5.1%)	12 (2.3%)
Neutral	84 (15.9%)	74 (13.9%)	63 (11.8%)	69 (13.0%)
Helpful	136 (25.8%)	99 (18.6%)	201 (37.8%)	171 (32.3%)
Very Helpful	92 (17.5%)	133 (25.0%)	173 (32.5%)	130 (24.5%)
Not received	200 (38.0%)	208 (39.1%)	53 (10.0%)	123 (23.2%)
	527	**532**	**532**	**530**

NEP responses

Among the 536 surveys received, 485 respondents fully completed the Revised NEP question, ten respondents partially completed the question, and 41 respondents left the entire question unanswered. Partial and incomplete responses were removed from further analysis, and the results below are based on the remaining 485 complete responses. A summary of the NEP results is displayed in Table 3.6. Partial and incomplete responses were removed from further analysis, and the results below are based on the remaining 485 complete responses. The table shows the NEP scale questions, the number and percentages of responses for each option, the mean, standard deviation, and item correlations. Figure 3.3 graphically shows the response for the NEP scores for each Likert scale option.

Table 3.6. Frequency Distributions and Corrected Item-Total Correlations for New Ecological Paradigm Scale Items (Survey question 11)

**Question wording: For each of the following statements, please indicate how much you agree or disagree SD = Strongly Disagree, D = Disagree, Neutral = Neutral, A = Agree, and SA = Strongly Agree.*

Do you agree or disagree that: *	**Strongly Disagree**	**Disagree**	**Neutral**	**Agree**	**Strongly Agree**	**Mean**	***r (Items total Correlations)***	**Standard Deviation**
NEP 1: We are approaching the limit of the number of people the Earth can support.	55 (11.3%)	90 (18.6%)	99 (20.4%)	125 (25.8%)	116 (23.9%)	3.32	0.72	1.32
NEP 2: When humans interfere with nature, it often produces disastrous consequences.	27 (5.6%)	42 (8.7%)	98 (20.2%)	171 (35.3%)	147 (30.3%)	3.76	0.80	1.14
NEP 3: Humans are seriously abusing the environment.	22 (4.5%)	30 (6.2%)	68 (14.0%)	179 (36.9%)	186 (38.4%)	3.98	0.87	1.09
NEP 4: Plants and animals have as much right as humans to exist.	29 (6.0%)	32 (6.6%)	64 (13.2%)	146 (30.1%)	214 (44.1%)	4.00	0.76	1.17
NEP 5: Despite our special abilities, humans are still subject to the laws of nature.	11 (2.3%)	14 (2.9%)	54 (11.1%)	179 (36.9%)	227 (46.8%)	4.23	0.71	0.92
NEP 6: The Earth is like a spaceship with very limited room and resources.	43 (8.9%)	53 (10.9%)	98 (20.2%)	137 (28.2%)	154 (31.8%)	3.63	0.82	1.27
NEP 7: The balance of nature is very delicate and easily upset.	17 (3.5%)	48 (9.9%)	77 (15.9%)	178 (36.7%)	165 (34%)	3.88	0.83	1.09
NEP 8: If things continue their present course, we will soon experience a major ecological catastrophe.	33 (6.8%)	51 (10.5%)	87 (17.9%)	135 (27.8%)	179 (36.9%)	3.78	0.86	1.24

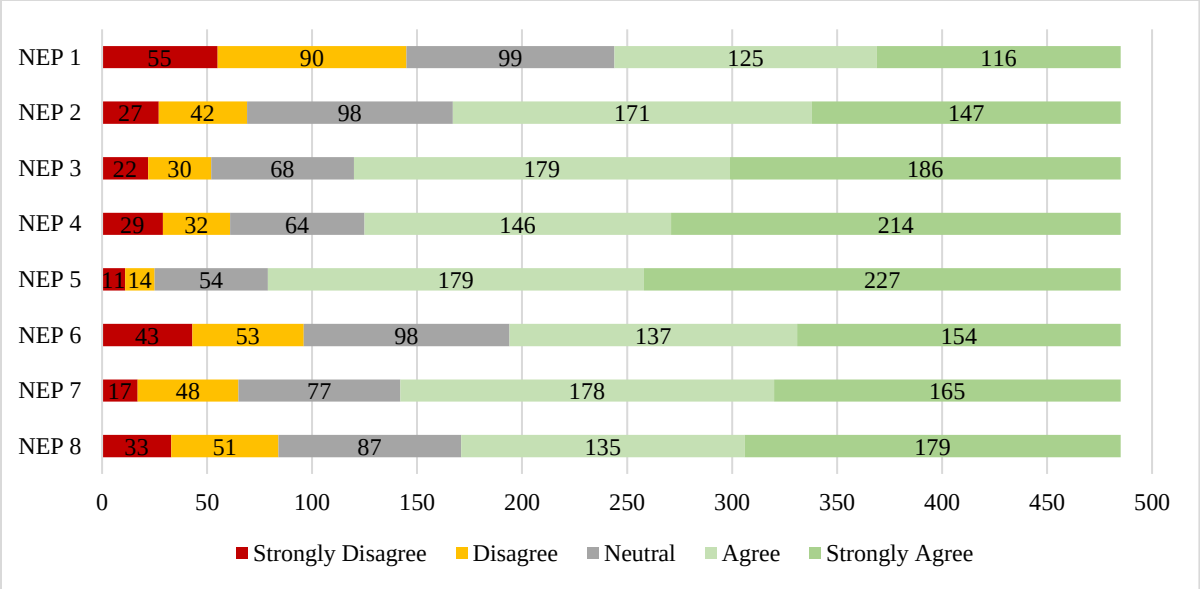


Figure 3.3. Response to the NEP statements by the survey respondents

The mean NEP score was 3.82, and the Cronbach's alpha was 0.932. High Cronbach's alpha means these items can be combined into a single measure, and item responses constitute a reasonably consistent worldview. We conducted a corrected item-total correlation among the statements. The results (all greater than 0.70) indicate that each item highly correlates with the overall scale.

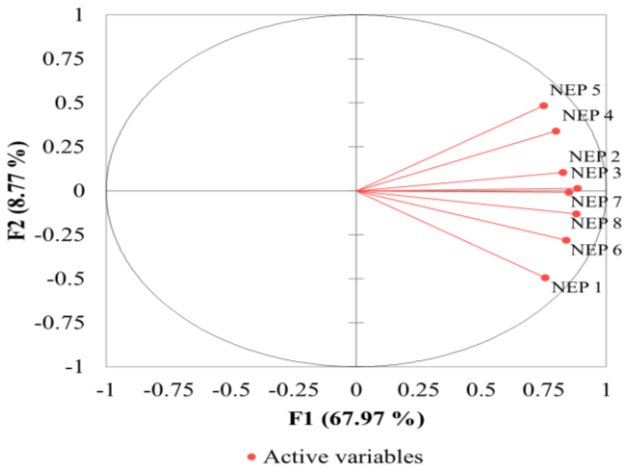


Figure 3.4. Correlation circle obtained by the PCA of all NEP responses in the factor space of (F1 and F2).

Additionally, we also conducted a Principal Component Analysis (PCA) to check if we can find any small highly related clusters within our NEP dataset. As the correlation circle in Figure 3.4 shows, the very slight angle between each of the variables and the distance between the variables and the origin as well as how all the variables are all within the same part of the circle shows that all the responses are very highly correlated. All these factors negate the need to conduct a factor analysis.

Hypothesis Testing

Hypothesis 1 (H_1): *More experienced campers with higher NEP scores will show a more pro-environmental approach to their actual waste disposal behavior during camping.*

For their actual waste disposal methods (survey question 9), the options provided to the

campers included burning trash in the fire pit and leaving biodegradable items in the campsites were considered anti-environmental behavior, and the other options were considered pro-environmental. So, for those two anti-behavior options, the reverse survey coding was done. As for experience, 66.4% of the campers' response indicates that they are experienced campers with more than six camping trips over the last two years. However, it was the first camping trip in 2 years for 8% of the respondents.

Multiple linear regression was used to test if NEP scores, and the experience level of campers predicted the actual waste disposal behavior. As shown in table 3.8, the hypothesis partially supported NEP scores predicting the actual waste disposal behavior (t=5.256, p<0.005*),* but did not support the same for experience of campers (t=0.051, *p>0.959).*

Table 3.7. Summary of multiple regression for Experience and NEP scores impacting actual disposal behavior (n=476)

	R^2(regression coefficient)	**SE**	**t-value**	***p-value***
Experience	0.001253	0.024501	0.051	0.959
NEP	0.134857	0.025659	5.256	<0.005

Hypothesis 2 (H_2): *Campers with higher NEP scores are more likely to support litter reduction strategies, especially non-monetary options.*

Table 5 shows that, on average, our survey respondents think that strategies that do not require campers to pay monetary fines will be more helpful in litter reduction. To check if the differences between these different options were significant or not, two-way ANOVA was carried out, which showed that the response between the support for all litter reduction strategies is significant compared to the population which found those measures unhelpful (F (1,4) = 252.368, p=9.2e-5). However, there was no significant difference between the reduction strategies themselves (F (1,4) = 0.143, p= 0.957). Using Pearson's correlation to look at the mean NEP score and mean score for the respondents' support of litter reduction strategies produced a low positive coefficient of 0.30, which shows that an increase in NEP scores also increases respondents' support towards litter reduction strategies. Higher NEP scores correspond to a higher inclination of support towards litter reduction strategies despite the monetary component in it. While there is a higher support for non-monetary support in the raw data, the difference in support is not statistically significant.

3.5. Discussion

Respondents Demographics

Survey distribution was done through two primary methods: centralized distribution through the visitor center and distribution by camp hosts in each campground. The response rate for the

second method is consistently better than the first one (17.9% vs 48.7%). This difference can be attributed to one primary reason: camp hosts are more likely to form relationships with the campers. The National Park Service website calls hosts the "eyes and ears of campgrounds" (*Volunteer to be a campground host*, n.d.). As Idaho's Department of Park and Recreation's host information sheet says, the hosts are often the first point of contact for the visitors within the park (*Idaho Parks & Recreation Volunteer Program*, n.d.). Their presence as authority figures can inspire the visitors to adhere to the campground rules. In return for the services provided by the hosts, the visitors are more amenable to listening to the hosts. During the stay and when they give out the survey, the hosts are more likely to explain what the survey is about in detail, which prompts a response from the campers. This is an important finding when considering implementing campground-wide changes in waste management and disposal. Our work suggests that procedural changes disseminated directly through camp hosts are more likely to be adopted by campers than procedures addressed only at visitor center interactions.

The 2021 NAC report (NACR, 2021) nationally shows that 25% of primary accommodation of campers was RVs, with 64% of tent camping. Though there was an increase in ownership and use of RVs (NAC, 2021), tent camping remained the primary way of camping nationally. By contrast, 77% of our respondents were RV campers. This may be because all our sample locations are in developed campgrounds with RV hookups. Additionally, the average age of campers in our study was 55 years, with most campers between 61-85. The NAC report also says that the younger generation is less likely to show interest in RV camping as they tend to prefer shorter trips (2021). These demographic differences may have influenced our survey results, as tent campers tend to be younger than RV campers. With age being a negative predictor of littering, i.e., the younger population littering more than the older (Schultz et al., 2013; Bator et al., 2011), the results from the survey might reflect a tendency of pro-environmental behavior.

Revised NEP and pro-environmental behavior

Based on the data analysis from the NEP scale, more than 50 percent of the respondents answered positively, either strongly agreed or agreed with the NEP statements presented. All the statements were odd-numbered statements from the complete revised NEP questionnaire. Each odd-numbered statement positively answered reflects a positive environmental attitude and pro-environmental behavioral reflection and represents the New Ecological Paradigm. Despite the overall positive response, there were variations within the individual responses. Statement number 5, "Despite our special abilities, humans are still subject to the laws of nature," had a mean of 4.23 with 406 positive responses compared to statement number 1, "We are approaching the limit of the number of people the Earth can support" which had the lowest individual mean of 3.32. This shows that

despite the general agreement towards the new ecological paradigm idea, there is still some variation in their thinking.

Our mean NEP score of 3.82 is comparable to other studies done on outdoor recreation. A study done in Southeast Asia to look at the pro-environmental behavior of urban forest recreationists produced a mean NEP range of 3.59. 4.08 and 3.11 for Korea, Taiwan, and Indonesia, respectively (Kim et al., 2021). Another global study looking at NEP endorsement and its relationship with consumerism produced a mean score of 3.46, 3.75, 3.64, and 3.63 for the UK, Germany, Japan, and Hungary, respectively (Hofmeister-Toth et al., 2012). This gives us an idea that our mean NEP scores are comparable to other groups of people, and the scores are not skewed because of their presence in the natural environment while filling out the questionnaire.

Returning to the central question of this study, we wanted to understand *how recreational users' perceptions of litter in recreational areas and their environmental concern reflect their litter disposal action and management preferences?"* From our data, we can see that recreational users in this context have a high level of concern about litter, with 86% of our survey respondents being concerned or highly concerned about litter in public spaces. This is consistent with litter concern findings from the recent Keep America Beautiful Public Attitudes Survey, which found that 90% of survey respondents consider litter a problem in their state (KAB, 2021). Additionally, our respondents expressed more concern about issues that affect them personally than global issues (Dunlap & Heffernan, 1975). This can be extremely important when creating anti-littering strategies as they can target the intended audience without knowing or understanding their environmental worldview.

When asked what type of litter they find especially concerning, campers in our survey were most concerned (concerned and extremely concerned categories) about drink bottles (plastic and glass), cigarette butts, and aluminum cans. The levels of concern about beverage bottles are interesting in part because beverage bottles (plastics, glass, and aluminum) make up a relatively small fraction of litter found, either in our litter survey (see Chapter 2) or in national-level surveys where bottles are ~5.6% of all the litter found (KAB, 2021). By contrast, cigarette butts are one of the most found items, both in our surveys (Chapter 2) and in other studies of terrestrial and marine litter (KAB, 2009; KAB 2021; Shultz et al., 2013; Andrady, 2015). In the KAB 2020 survey alone, it made up 19.6% of the total litter pieces collected (KAB, 2021). 98% of all cigarette filters contain plastic non-biodegradable filters, which can break down only under severe biological conditions making cigarette butts a serious hazard and a proper concern (Curtis et al., 2017). So, it is interesting to see the alignment of public concern with the actual measured problem.

Reasons for differences in the level of concern about the item and the actual litter percentage may stem from the relative size difference, with beverage containers being much easier to see and

commanding greater visual attention in the environment. Additionally, though both items have been in people's mouths, beverage containers are large enough that you can reasonably handle these items without contacting the drinking portion of the container. The same cannot be said of cigarette butts. These differences may result in differential rates of litter picked up by individuals, and thus, though both types of items are of high concern, individuals act on one while the second is not.

Biodegradable pet waste was the fourth highest category of concern (concerned and extremely concerned categories), with concern levels like other non-biodegradable waste. By contrast, all other categories of biodegradable litter (food scraps, seed and nut shells, and tobacco chew) were litter types of least concern to the campers. The driving concern behind pet waste may be both that pet waste can spread disease (Overgaauw et al., 2009) and that it can be toxic (Holderness-Roddam, 2012) and that left behind pet waste represents a breakdown of social norms governing pet waste management by owners (Scruggs et al., 2021). The camper's opinion about the biodegradable waste not being a concern was reflected in the question about their ideal disposal options. More than 50% of people said they would not use the composting services even if they were available.

Through our survey, we also found that NEP results positively indicated the actual waste disposal behavior of campers. Higher NEP scores mean more campers dispose of their waste as responsibly as possible, depending on the available facilities. Combining this with the descriptive statistics obtained on their ideal waste disposal habits, increased litter might have stemmed from the lack of available infrastructure to address the waste disposal needs. If provided with adequate infrastructures like disposal methods and proper instructions, campers will undoubtedly contribute towards proper waste disposal. When asked about their ideal waste disposal behavior, 99.3% of campers responded that they would use garbage, 85.4% would use paper recycling, 90.8% would use recycling, and 84.4% would use RV dump stations. Combining this information with the communication methods that the campers found helpful, parks can certainly implement multiple waste disposal streams with proper educational and outreach mechanisms.

We also wanted to see if the endorsement of NEP had any impact on the litter reduction strategies that could be implemented in recreational areas. We found a significant difference in the respondent section who reacted positively to implementing such strategies compared to those who did not. However, there were no significant preferential choices between different strategies, whether monetary or not. This can mean that if the recreational areas were to roll out litter reduction strategies, it would be met with positive feedback from the general crowd.

Another important aim of this survey was to understand if the existing waste disposal infrastructure is meeting the needs of campers. None of the national forest campgrounds have garbage disposal facilities, but the campgrounds in state parks do. Overwhelmingly (99%) survey respondents

indicated they would use garbage dumpsters if provided. This is supported by the Chapter 1 conclusion, which suggests that if the National Forest campgrounds provided dumpsters, they would be highly utilized. In addition to dumpsters, our survey response indicates that if more disposal options were available, campers would be willing to use them. This points to infrastructure needing to be improved in all the campgrounds. Within the state parks, there is variability in the types of services provided; two of the campgrounds (Hawley's Landing and Waldron) have a recycling bin for aluminum cans in addition to a centralized garbage receptacle, and the rest of the campgrounds only have a garbage disposal.

When combined with the lack of information dissemination happening in the campgrounds right now, it shows that parks can do better in how the waste disposal information is given out to the campers. While the exact percentage of litter attributed to improper disposal behavior by individuals is unknown, there is evidence to suggest that a large majority of litter is linked with individual disposals (KAB, 2009). However, with effective outreach strategies from the park management, individual disposals can be changed, as our study shows that the campers are amenable to changes.

This also helped to assess the impact of the current system of distributing information on waste disposal within the campgrounds. The results showed that while a more significant percentage of campers found the available information helpful, many campers also said they did not receive the information at all. This suggests a communication barrier or breakdown regarding how information is communicated and how accessible it is to everyone. The results summarized in Table 6 show that signage showing where the disposal sites were the most helpful to the campers. ~77% of the respondents indicated that they received no written guidelines or verbal instructions regarding waste disposal sites or behavior. Comparatively, more people have seen the signage for disposal sites and the signs encouraging good disposal behaviors. Brown et al. (2010) and Marion and Reid (2007) showed that personalized verbal requests can be more effective than signs or brochures. However, in our cases, existing signs are more visible to visitors. Additionally, people who did receive some form of written or verbal instruction found it incredibly helpful. This is what is already happening in the campgrounds which have camp hosts. The hosts play an integral role in connecting with the campers and making them aware of the existing waste disposal options.

After evaluating the waste disposal system in the park, the next step is to identify the changes that can be made and how those changes would be perceived by the intended recipient group (i.e., the campers). Both non-monetary and social incentives can reduce littering (Kolodko, Read, and Taj, 2016). Various studies conducted in different countries have shown that demonstrative and persuasive actions can promote pro-environmental behavior (Brown et al., 2010; Marion & Reid, 2007). Alongside, there have also been studies like Heberlein's (1971), which concluded that litter control

signs on highways did not impact littering and that there was no relationship between anti-litter attitudes and littering behavior. In another research, it was seen that anti-litter leaflets were handed out to campers, but only one-third of them read them (Marler, 1971). In our survey, campers were more supportive of increasing the number of disposal bins and better signage. While 66% of the respondents said increasing fines would be helpful, support for this measure was less than the others, with support ranging from 73%-83%. This, along with the results from hypothesis three, suggests that most campers are amenable to litter reduction strategies.

3.6. Conclusion

From this study, we found that: a) Campers with higher endorsement of NEP paradigm (i.e., higher NEP scores) are inclined to dispose of their waste more responsibly even when limited by the types of waste disposal facilities available. b) Campers are not provided with the facilities that suit their ideal disposal habits. c)Information that the campers need to dispose of waste is inadequate. The high NEP scores bode well for future pro-environmental strategies imposed in public spaces either to reduce littering or to address other environmental issues. These findings could help inform efforts that aim to increase pro-environmental behaviors, because ultimately recreational users with a pro-ecological worldview will support policies to keep our public recreational areas litter free.

References

Andrady, A., & Neal, M. (2009). Applications and societal benefits of plastics. *Philosophical transaction of the Royal Society biological sciences, 364*(1526), 1977-1984.

Barr, S. (2007). Factors Influencing Environmental Attitudes and Behaviors. *Environment and Behavior*, *39*(4), 435–473. https://doi.org/10.1177/0013916505283421

Brown, T. J., Ham, S. H., & Hughes, M. (2010). Picking up litter: an application of theory-based communication to influence tourist behaviour in protected areas. *Journal of Sustainable Tourism, 18*(7), 879–900. https://doi.org/10.1080/09669581003721281

Blake, D., Guppy, N., & Urmetzer, P. (1997). Canadian Public Opinion and Environmental Action: Evidence from British Columbia. *Canadian Journal of Political Science, 30*(3), 451-472.

Bob Holderness-Roddam. (2012). Are domestic dogs compatible with urban bushland reserves? *Australasian Parks and Leisure*, *15*(2), 21–22.

Brick, C., & Lewis, G. J. (2016). Unearthing the "Green" Personality. *Environment and Behaviour, 48*(5), 635–658. https://doi.org/10.1177/0013916514554695

Boubonari, T., Markos, A., & Kevrekidis, T. (2013).Greek Pre-Service Teachers' knowledge, Attitudes, and Environmental Behavior Toward Marine Pollution. *The Journal of Environmental Education, 44*(4), 232–251. doi.org/10.1080/00958964.2013.785381

Davis, A. C., & Stroink, M. L. (2016). The Relationship between Systems Thinking and the New Ecological Paradigm. *Systems Research and Behavioral Science*, *33*(4), 575–586. https://doi.org/10.1002/sres.2371

Derdowski, L. A., Grahn, A. H., Hansen, H., & Skeiseid, H. (2020). The New Ecological Paradigm, Pro-Environmental Behaviour, and the Moderating Effects of Locus of Control and Self-Construal. *Sustainability (Basel, Switzerland), 12*(18), 7728. doi.org/10.3390/su12187728

Dunlap, R. E., & Heffernan, R. B. (1975). Outdoor Recreation and Environmental Concern: Empirical Examination. *Rural Sociology, 40*(1), 18–30.

Dunlap, R. E., & Van Liere, K. D. (1978). The "New Environmental Paradigm". *The Journal Of Environmental Education, 9*, 10-19. doi.org/10.1080/00958964.1978.10801875

Dunlap, R., Van Liere, K., Mertig, A., & Jones, R. (2000). New Trends in Measuring Environmental Attitudes: Measuring Endorsement of the New Ecological Paradigm: A Revised NEP Scale. *Journal of Social Issues, 56*(3), 425-442.

Dwyer, W. O., Leeming, F. C., Cobern, M. K., Porter, B. E., & Jackson, J. M. (1993). Critical review of behavioral intervention to preserve the environment: Research since 1980. *Environment & Behavior*, 25, 275-321. doi:10.1177/0013916593255001

Fung, B., & Wodak. S., (2022). Are fines for littering effective in reducing and preventing Littering behaviour in NSW? *NSW EPA.* Retrieved from:www.epa.nsw.gov.au/-/media/fines-for-littering-research.pdf?la=en&hash=305ECF997EC4D48C540C2BFADC3F6C13B92A C20B

Gansser, O. A., & Reich, C. S. (2023). Influence of the New Ecological Paradigm (NEP) and environmental concerns on pro-environmental behavioral intention based on the Theory of Planned Behavior (TPB). *Journal of Cleaner Production*, *382*, 134629. https://doi.org/10.1016/j.jclepro.2022.134629

Volunteer to be a Campground Host - Glacier National Park. (n.d.). *U.S. National Park Service. Retrieved from:* https://www.nps.gov/glac/getinvolved/vip-campground.htm

Hawcroft, L., & Milfont, T. (2010). The use (and abuse) of the new environmental paradigm scale over the last 30 years:A meta-analysis. *Journal of Environmental Psychology, 30*(2),143-158.

Hofmeister-Toth, A., Kelemen, K., & Piskóti, M. (2012). Segmentation of the Hungarian consumers using the new ecological paradigm (NEP) scale. *Interdisciplinary Environmental Review, 13*(1), 21–41. https://doi.org/10.1504/IER.2012.046098

Hu, H., Zhang, J., Chu, G., Yang, J., & Yu, P. (2018). Factors influencing tourists' litter management behavior in mountainous tourism areas in China. *Waste Management, 79*(September), 273–286. doi:10.1016/j.wasman.2018.07.047

Huffman, K. T., Grossnickle, W. F., Cope, J. G., & Huffman, K. P. (1995). Litter reduction: A review and integration of the literature. *Environment and Behavior*, 27, 153-183.

Idaho Parks & Recreation Volunteer Program. (n.d.). Idaho Department of Parks and Recreation. https://parksandrecreation.idaho.gov/wp-content/uploads/ activities/ volunteer/Campground-Host-Template.pdf

KAB. (2009). 2009 National Visible Litter Survey and Litter Cost Study. *Keep America Beautiful, Inc*. www.kab.org/site/DocServer/Final_KAB_Report_9-18-09.pdf

KAB 2020. (2021). 2020 National Litter Study. Summary Report. *Keep America Beautiful, Inc.* Retrieved from: https://kab.org/wp-content/uploads/2021/05/Litter-Study-Summary-Report-May-2021_final_05172021.pdf

Kim, D., Avenzora, R., & Lee, J. (2021). Exploring the Outdoor Recreational Behavior and New Environmental Paradigm among Urban Forest Visitors in Korea, Taiwan and Indonesia.*Forests*, *12*(12), 1651. https://doi.org/10.3390/f12121651

Kollmuss, A., & Agyeman, J. (2002). Mind the Gap: Why do people act environmentally and what are the barriers to pro-environmental behavior? *Environmental Education Research*, *8*(3), 239–260. https://doi.org/10.1080/13504620220145401

Kolodko, J., Read, D., & Taj, U. (2016). Using behavioral insights to reduce littering in the UK. *Clean Up Britian.* Retrieved from: http://cleanupbritain.org/WBS-Report-for-CLUB.pdf

Lyndhurst, B. (2013). Rapid Evidence Review of Littering Behaviour and Anti-Litter Policies. A Brook Lyndhurst Report to Zero Waste. *Zero Waste Scotland. Scotland*, Stirling.

Liu, J. H., & Sibley, C. G. (2004). Attitudes and behavior in social space: Public good interventions based on shared representations and environmental influences. *Journal of Environmental Psychology, 24*, 373-384.

Marcinkowski, T., & Reid, A. (2019). Reviews of research on the attitude-behavior Relationship & their implications for future environmental education research. *Environmental Education Research*, *25*(4), 459–471. doi.org/10.1080/13504622.2019.1634237

Marler, L. (1971). A Study of Anti-Litter Messages. *The Journal of Environmental Education*, *3*(1), 52–53. https://doi.org/10.1080/00958964.1971.10801609

Marion, J. L., & Reid, S. E. (2007). Minimising Visitor Impacts to Protected Areas: The Efficacy of Low Impact Education Programmes. *Journal of Sustainable Tourism, 15*(1), 5–27. https://doi.org/10.2167/jost593.0

Marshall, B., Picou, J., & Bevc, C. (2005). Ecological Disaster as Contextual Transformation. *Environment and Behavior, 37*(5), 706-728.

Milfont, T. L., & Schultz, P. W. (2016). Culture and the natural environment. *Current opinion in psychology*, *8*, 194–199. https://doi.org/10.1016/j.copsyc.2015.09.009

National litter and flytapping strategy consultation: Analysis Report. (2022). *Scottish Government. orth American Caming and Outdoor Hospitality Report (NACR).*(2021). *Kampgrounds of America.*Retrieved from: http://koa.uberflip.com/i/1362448-2021-north-american-camping-report/0?

Ntanos, S., Kyriakopoulos, G., Skordoulis, M., Chalikias, M., & Arabatzis, G. (2019). An Application of the New Environmental Paradigm (NEP) Scale in Greek Context. *Energies (Basel), 12*(2*),* 239.

Overgaauw, P. A. M., van Zutphen, L., Hoek, D., Yaya, F. O., Roelfsema, J., Pinelli, E., van Knapen, F., & Kortbeek, L. M. (2009). Zoonotic parasites in fecal samples and fur from dogs and cats in The Netherlands. *Veterinary Parasitology*, *163*(1-2), 115–122. https://doi.org/10.1016/j.vetpar.2009.03.044

Pahl, S., Harris, P. R., Todd, H. A.,& Rutter, D. R. (2005). Comparative optimism for environmental risks. *Journal of Environmental Psychology*, *25*(1), 1–11. doi.org/10.1016/j.jenvp.2004.12.004

Reiter, S. M., & Samuel, W. (1980). Littering as a Function of Prior Litter and The Presence or Absence of Prohibitive Signs. *Journal of Applied Social Psychology*, *10*(1), 45–55. https://doi.org/10.1111/j.1559-1816.1980.tb00692.x

Schultz, P. W., Bator, R. J., Large, L. B., Bruni, C. M., & Tabanico, J. J. (2009). Littering behavior in America: Results of a National Study. *Keep American Beautiful.* https://kab.org/wpcontent/uploads/2019/10/NewsInfo_Research_LitteringBehaviorinAmerica_2009Report_Final.pdf

Schultz, P. W., Bator, R. J., Large, L. B., Bruni, C. M., & Tabanico, J. J. (2013). Littering in context: personal and environmental predictors of littering behavior. *Environment and Behavior,45*(1), 35–59. https://doi.org/10.1177/0013916511412179

Scruggs, C. E., Lozoya, S., Rumsey, K. N., Bronson, K., & Chavez, P. (2021). Voluntary Public Campaigns to Benefit the Environment: Assessing the Effectiveness of the There Is No Poop Fairy Campaign. *Journal of Planning Education and Research*, 739456. https://doi.org/10.1177/0739456X211020357

Steg, L. & Vlek, C. (2009). Encouraging pro-environmental behaviour: An integrative review and research agenda. *Journal of Environmental Psychology, 29*(3), 309-317.

Wynveen, C. J., Kyle, G. T., & Sutton, S. G. (2014). Environmental Worldview, Place Attachment, and Awareness of Environmental Impacts in a Marine Environment. *Environment and Behavior*, *46*(8), 993-1017. doi.org/10.1177/0013916513484325

Zhu, X., & Lu, C. (2017). Re-evaluation of the New Ecological Paradigm scale using item response theory. *Journal of Environmental Psychology, 54,* 79-90. 90. https://doi.org/10.1016/j.jenvp.2017.10.005

Chapter 4: Conclusion

4.1. Summary

Public lands (both state and federal) are a massive draw for recreational purposes, but mismanaged waste, both illegal dumping, and littering, is a constant management concern for officials trying to maintain the services that public lands have to offer. The campgrounds in Idaho, even with the presence of camp hosts do have litter problems with 78.6% of the litter being plastic. Plastic food wrappers and cigarette butts make up most of the plastic litter. The camp hosts help divert approximately 56% of the litter to proper channels. The most important take away is that the presence of trash receptacles will help reduce litter especially in areas of high occupancy/visitor rate. The presence of trash receptacles in high occupancy areas combined with the clean-up support from camp hosts can really help in lowering litter in our public lands.

The mean value of NEP scores among our survey respondents was generally higher showing that on average, the people using our campgrounds have a positive environmental worldview. Campers with higher endorsement of NEP paradigm (i.e., higher NEP scores) are more likely to dispose their waste properly even if the waste disposal facilities might not be adequate. So, understanding the campers waste disposal need and adequately addressing those needs might help reduce littering in our public campgrounds. From the survey administered to the campers, it was clear that the campers feel that the information on waste disposal disseminated to the visitors is insufficient. These findings could help inform anti-littering efforts in public lands.

4.2. Limitations

The plot size of campsites and day-use areas, replication of litter collection sites and times, site selection, and other aspects of survey designs impact the "density and abundance estimates in ecological studies" like this (Fortin et al., 1989; Griffith, 2005). In our study, many variables were involved in the data collection process. With most of the data collection resting upon the camp hosts, who already had a lot of existing responsibilities, we tried to make the collection process as simple and straightforward as possible. Despite that, some confusion was involved in the collection process, ranging from the collection dates to the types of items collected. Additionally, the camp host turnovers mid-season also created a gap in the collection periods.

When the research team visited the campgrounds, it was impossible to collect litter from the research sites if occupied. Entering any site requires explicit permission from the site occupants, and depending on the time of the day, many occupants were not physically present on the site. The litter study was carried out for one summer. While this gives us a snapshot of this particular year, it requires consistent monitoring over multiple years to establish long-term trends regarding the presence of litter.

For the survey portion of the research, the main limitation was using a self-report method to measure littering habits and patterns in campgrounds. Relying on self-reporting from campers on their habits results in potential under-reporting due to personal bias. Additionally, our study did not include any infrastructural factors, such as the existing level of litter already in place, any additional waste removal or cleanups other than the trash receptacles in place, and waste disposal patterns in previous years.

4.3. Future studies

During the summer of 2021, when this data collection was taking place, several news reports emerged on several campsites and day-use areas across Idaho closing temporarily or indefinitely due to litter issues. Mann Creek Campground in Payette National Forest was closed in May of 2021 due to vandalism and other damage to signs posted within the campground. Closures also happened in the Grimes Creek area in Boise County, where part of the Creek was closed due to excessive trash left behind by recreational visitors, and in other parts of Boise National Forest. We need similar studies on agricultural land and freshwater spanning several sampling seasons. To understand and predict the rates of litter accumulation and to establish remediation or cleanup measures, we need more data on the abundance of plastic and non-plastic debris. Objective methods such as observations, weight measurement of the managed trash originating in the campgrounds, GPS technology to monitor human behaviors, or citizen science data on littering could be used. More measurable and diverse demographic information is also required to explore the effects of demographic characteristics on the littering intention and habits of campers. The multiyear repeated study is recommended for future research to understand littering behavior comprehensively. Conducting a long-term study on littering habits, given the costs associated with cleanup efforts, makes this a matter of great concern. While the park management is responsible for keeping these areas clean, a more significant share of the responsibility falls on the people using these places. It is the responsibility of recreational users to properly dispose of the waste they have produced and leave the space as clean as it was before or even more.

Appendices

1. Study locations

Locations	Sites	Type	Trash Receptacle	Camp host
Heyburn State Park: May 26 – September 25				
Hawley's landing	2, 7, and 18	Basic* (2,7) RV (18)	Yes	Yes
Chatcolet	102, 113, and 119	Basic	Yes	Yes
Benewah	205, 217, and 225	Electric** (205) Basic (217, 225)	Yes	Yes
Plummer Point Day use area			Yes	No
Farragut State Park: May 27 – September 25				
Waldron	156, 180, and 200	Electric	Yes	Yes
Snowberry	106, 121, and 134	Electric	Yes	Yes
Whitetail	7, 42, and 49	Basic	Yes	Yes
Beaver Bay Beach			Yes	No
Ponderosa State Park: June 24 – October 3				
RV	201, 234, and 236	Electric	Yes	Yes
Peninsula	2, 17, and 72	Electric	Yes	Yes
Lake Cascade State Park: June 24 – October 3				
Poison Creek	241, 242, and 247	Electric	Yes	Yes
Van Wyck	A6, C4, and D5	Basic	Yes	Yes
Ridgeview	183, 185, and 191	Electric	Yes	Yes
Van Wyck Day Use Area			Yes	No
Payette National Forest: June 24 – October 3				
Cold Springs	10, 19, and 27	Basic	No	Yes
Last Chance	2, 10, and 16	Basic	No	Yes
Upper Payette	4, 12, and 18	Basic	No	Yes

**Basic: Campsites with toilets, trash removal (in the case of state parks), picnic tables, fire rings, grill. Suitable for tent camping, car camping, or even RV if electric hookups aren't necessary.*
**Electric: Campsites with electric hookups to plug your vehicle to power electric appliances. Especially for RV users.*

2. Sheet for litter categorization

Date: Total Pieces: Total Weight (grams):		
Item(s)	**WEIGHT (grams)**	**NUMBER OF PIECES**
PLASTIC		
Food Wrappers		
Beverage Bottles		
Other Plastic Containers		
Bottle, Cup or Container Lids/Caps		
Cigarette Butts		
Plastic Rope		
Fishing Line and Lures		
Polystyrene		
Plastic Utensils		
Plastic Straws		
Synthetic Clothing Material		
Personal Care Products		
Plastic Tarp		
Plastic Balloons		
Plastic Coated Cardboard		
Misc. Plastic Pieces		
METAL		
Aluminum/Tin Foil		
Aluminum/Tin Container		
Bottle Caps		
Can Tabs		
Beverage Cans		
Aerosol Cans		
Misc. Metal Pieces		
GLASS		
Glass Bottle		
Jar		
MISC. Glass Pieces		
RUBBER		
Gloves		
Latex Balloons		
Misc. Rubber Pieces		
MISC. ITEMS (Combination)		
Item(s)		

3. Individual campground information

a. Farragut State Park

FARRAGUT	Waldron		Whitetail		Snowberry		Beaver Bay		Campgrounds Only		Total	
	N	W(g)	N	W(g)	N	W(g)	N	W(g)	N	W(g)	N	W(g)
PLASTIC												
Food Wrappers	63	12.529	66	15.733	30	9.849	14	1.422	159	38.111	173	39.533
Beverage Bottles	0	0	1	30.51	0	0	0	0	1	30.51	1	30.51
Other Plastic Containers	0	0	4	137.523	2	39.968	0	0	6	177.491	6	177.491
Container Lids/Caps	5	6.98	11	15.981	7	15.634	0	0	23	38.595	23	38.595
Cigarette Butts	65	15.464	22	6.084	7	1.531	9	2.124	94	23.079	103	25.203
Plastic Rope	0	0	1	3.163	1	0.217	0	0	2	3.38	2	3.38
Fishing Line and Lures	2	0.366	0	0	0	0	0	0	2	0.366	2	0.366
Polystyrene	20	2.282	15	1.026	5	1.779	1	0.502	40	5.087	41	5.589
Plastic Utensils	2	9.731	1	5.663	2	7.293	0	0	5	22.687	5	22.687
Plastic Straws	4	1.564	11	4.092	3	2.579	1	0.544	18	8.235	19	8.779
Synthetic Clothing Material	8	3.899	10	7.205	16	124.796	1	2.198	34	135.9	35	138.098
Personal Care Products	2	1.123	5	1.702	8	39.687	0	0	15	42.512	15	42.512
Plastic Tarp	3	0.043	1	0.02	3	0.098	0	0	7	0.161	7	0.161
Plastic Balloons	0	0	0	0	0	0	0	0	0	0	0	0
Plastic Coated Cardboard	36	6.563	27	43.806	32	6.166	1	0.587	95	56.535	96	57.122
MISC. Plastic Pieces	161	171.898	80	99.423	86	87.184	20	19.207	327	358.505	347	377.712
METAL												
Aluminum/Tin Foil	24	3.597	17	7.363	19	11.73	2	1.072	60	22.69	62	23.762
Aluminum/Tin Container	3	53.3	0	0	0	0	1	12.774	3	53.3	4	66.074
Bottle Caps	8	15.64	2	4.42	2	4.014	0	0	12	24.074	12	24.074
Can Tabs	2	0.517	0	0	1	0.33	2	0.547	3	0.847	5	1.394
Beverage Cans	1	14.14	0	0	2	26.347	4	52.106	3	40.487	7	92.593
Aerosol Cans	0	0	0	0	1	113.709	0	0	1	113.709	1	113.709
MISC. Metal Pieces	29	66.133	8	89.144	3	14.456	1	46.702	40	169.733	41	216.435
GLASS												
Glass Bottle	2	9.413	0	0	0	0	0	0	2	9.413	2	9.413
Jar	0	0	0	0	0	0	0	0	0	0	0	0
MISC. Glass Pieces	1	0.441	0	0	1	2.844	0	0	2	3.285	2	3.285
RUBBER												
Gloves	0	0	0	0	1	3.03	0	0	1	3.03	1	3.03
Latex Balloons	0	0	0	0	0	0	1	3.42	0	0	1	3.42
MISC. Rubber Pieces	10	23.497	12	10.318	14	17.195	3	3.948	36	51.01	39	54.958
MISC. ITEMS (Combination)												
Item(s)	12	127.057	3	1.019	2	0.634	2	3.726	17	128.71	19	132.436
TOTALS	**463**	**546.177**	**297**	**484.195**	**248**	**531.07**	**63**	**150.879**	**1008**	**1561.442**	**1071**	**1712.321**

b. Heyburn State Park

HEYBURN	Benewah		Chatcolet		Hawley		Day-use site		Campgrounds Only		Total	
	N	W(g)	N	W(g)	N	W(g)	N	W(g)	N	W(g)	N	W(g)
PLASTIC												
Food Wrappers	64	14.796	44	71.89	55	17.939	25	4.057	163	104.625	188	108.682
Beverage Bottles	2	40.15	9	108.483	2	1.753	1	73.981	13	150.386	14	224.367
Other Plastic Containers	1	0.97	2	17.92	1	0.86	1	65.935	4	19.75	5	85.685
Container Lids/Caps	16	23.193	8	8.251	8	6.002	6	6.359	32	37.446	38	43.805
Cigarette Butts	29	12.027	38	11.443	57	14.97	48	10.254	124	38.44	172	48.694
Plastic Rope	2	0.42	1	0.052	1	6.535	2	19.317	4	7.007	6	26.324
Fishing Line and Lures	0	0	0	0	0	0	0	0	0	0	0	0
Polystyrene	5	1.802	0	0	7	0.791	18	4.401	12	2.593	30	6.994
Plastic Utensils	0	0	3	9.29	0	0	1	5.828	3	9.29	4	15.118
Plastic Straws	5	2.553	4	2.215	0	0	1	0.223	9	4.768	10	4.991
Synthetic Clothing Material	16	66.389	6	80.985	4	1.11	6	562.899	26	148.484	32	711.383
Personal Care Products	2	0.787	5	12.631	4	1.153	0	0	11	14.571	11	14.571
Plastic Tarp	10	0.478	0	0	8	0.063	1	1.461	18	0.541	19	2.002
Plastic Balloons	5	0.029	0	0	0	0	2	1.776	5	0.029	7	1.805
Plastic Coated Cardboard	23	68.602	18	55.622	13	110.849	4	90.671	54	235.073	58	325.744
MISC. Plastic Pieces	155	239.193	47	146.03	70	87.585	80	193.594	272	472.808	352	666.402
METAL												
Aluminum/Tin Foil	20	4.866	10	3.155	22	16.757	8	1.454	52	24.778	60	26.232
Aluminum/Tin Container	2	16.711	2	14.422	0	0	2	21.986	4	31.133	6	53.119
Bottle Caps	8	15.181	3	6.298	5	9.715	5	10.052	16	31.194	21	41.246
Can Tabs	7	2.827	7	2.884	2	4.07	5	2.197	16	9.781	21	11.978
Beverage Cans	0	0	1	12.673	2	31.068	0	0	3	43.741	3	43.741
Aerosol Cans	4	11.099	0	0	0	0	4	45.007	4	11.099	8	56.106
MISC. Metal Pieces	5	43.927	15	658.445	8	62.581	3	27.867	28	764.953	31	792.82
GLASS												
Glass Bottle	0	0	0	0	0	0	1	220.893	0	0	1	220.893
Jar	0	0	0	0	0	0	0	0	0	0	0	0
MISC. Glass Pieces	3	0.946	6	55.699	8	19.802	32	90.347	17	76.447	49	166.794
RUBBER												
Gloves	0	0	0	0	2	16.109	0	0	2	16.109	2	16.109
Latex Balloons	1	0.171	0	0	0	0	0	0	1	0.171	1	0.171
MISC. Rubber Pieces	12	56.151	3	104.518	7	69.805	3	1211.312	22	230.474	25	1441.786
MISC. ITEMS (Combination)												
Item(s)	12	71.15	8	765.949	4	76.023	5	186.104	24	913.122	29	1099.226
TOTALS	**409**	**694.418**	**240**	**2148.855**	**290**	**555.54**	**264**	**2857.975**	**939**	**3398.813**	**1203**	**6256.788**

c. Lake Cascade State Park

LAKE CASCADE	Van Wyck		Ridgeview		Poison Creek		Van Wyck Beach		Campgrounds Only		Total	
	N	W(g)	N	W(g)	N	W(g)	N	W(g)	N	W(g)	N	W(g)
PLASTIC												
Food Wrappers	128	39.696	34	6.013	22	3.386	10	1.573	184	49.095	194	50.668
Beverage Bottles	2	17.601	0	0	1	35.291	0	0	3	52.892	3	52.892
Other Plastic Containers	0	0	2	32.119	1	10.267	0	0	3	42.386	3	42.386
Container Lids/Caps	14	11.54	5	6.88	12	10.498	4	6.21	31	28.918	35	35.128
Cigarette Butts	72	16.654	29	8.301	23	5.997	48	10.669	124	30.952	172	41.621
Plastic Rope	1	10.677	1	3.386	1	0.057	1	6.484	3	14.12	4	20.604
Fishing Line and Lures	1	0.42	0	0	1	13.327	0	0	2	13.747	2	13.747
Polystyrene	18	7.849	3	0.638	0	0	13	4.153	21	8.487	34	12.64
Plastic Utensils	4	11.421	0	0	2	9.337	1	1.213	6	20.758	7	21.971
Plastic Straws	2	0.785	4	1.1148	2	0.493	0	0	8	2.3928	8	2.3928
Synthetic Material	7	3.419	5	1.753	5	1.642	4	6.314	17	6.814	21	13.128
Personal Care Products	3	2.217	4	1.387	3	0.959	4	1.779	10	4.563	14	6.342
Plastic Tarp	7	0.043	4	0.0481	0	0	1	0.099	11	0.0911	12	0.1901
Plastic Balloons	0	0	0	0	0	0	0	0	0	0	0	0
Plastic Coated Cardboard	24	37.192	13	39.071	22	40.272	2	16.666	59	116.535	61	133.201
MISC. Plastic Pieces	207	278.534	102	87.903	75	55.413	34	44.096	384	421.85	418	465.946
METAL												
Aluminum/Tin Foil	34	10.992	22	6.682	15	13.03	5	0.981	71	30.704	76	31.685
Aluminum/Tin Container	6	31.612	1	11.899	0	0	0	0	7	43.511	7	43.511
Bottle Caps	36	75.928	6	12.64	4	6.212	1	3.078	46	94.78	47	97.858
Can Tabs	13	7.354	3	1.214	3	0.957	2	2.652	19	9.525	21	12.177
Beverage Cans	0	0	1	12.997	1	14.116	2	31.535	2	27.113	4	58.648
Aerosol Cans	0	0	0	0	0	0	0	0	0	0	0	0
MISC. Metal Pieces	18	745.422	14	116.316	4	42.256	4	37.035	36	903.994	40	941.029
GLASS												
Glass Bottle	0	0	0	0	0	0	0	0	0	0	0	0
Jar	0	0	1	10.556	0	0	0	0	1	10.556	1	10.556
MISC. Glass Pieces	0	0	1	1.916	0	0	15	51.826	1	1.916	16	53.742
RUBBER												
Gloves	2	8.703	1	0.268	0	0	0	0	3	8.971	3	8.971
Latex Balloons	0	0	0	0	0	0	0	0	0	0	0	0
MISC. Rubber Pieces	14	26.511	9	12.603	10	60.887	3	5.441	33	100.001	36	105.442
MISC. ITEMS (Combination)												
Item(s)	16	17.8	9	11.985	4	1.589	2	73.023	29	31.374	31	104.397
TOTALS	**629**	**1362.37**	**274**	**387.6899**	**211**	**325.986**	**156**	**304.827**	**1114**	**2076.046**	**1270**	**2380.873**

d. Ponderosa State Park

PONDEROSA	RV		Peninsula		Total	
	N	W(g)	N	W(g)	N	W(g)
PLASTIC						
Food Wrappers	18	1.235	16	1.142	34	2.377
Beverage Bottles	2	60.307	2	23.188	4	83.495
Other Plastic Containers	4	7.653	1	10.48	5	18.133
Container Lids/Caps	9	5.625	1	0.76	10	6.385
Cigarette Butts	39	10.981	6	0.987	45	11.968
Plastic Rope	0	0	0	0	0	0
Fishing Line and Lures	0	0	0	0	0	0
Polystyrene	3	0.048	0	0	3	0.048
Plastic Utensils	0	0	3	5.24	3	5.24
Plastic Straws	1	0.853	1	0.831	2	1.684
Synthetic Clothing Material	5	14.891	1	0.59	6	15.481
Personal Care Products	2	0.516	0	0	2	0.516
Plastic Tarp	18	0.098	10	0.043	28	0.141
Plastic Balloons	0	0	0	0	0	0
Plastic Coated Cardboard	7	2.474	8	0.254	15	2.728
MISC. Plastic Pieces	65	69.354	52	38.313	117	107.667
METAL						
Aluminum/Tin Foil	13	1.671	5	0.535	18	2.206
Aluminum/Tin Container	0	0	1	14.896	1	14.896
Bottle Caps	5	9.526	1	0.017	6	9.543
Can Tabs	1	0.344	0	0	1	0.344
Beverage Cans	1	17.131	0	0	1	17.131
Aerosol Cans	0	0	0	0	0	0
MISC. Metal Pieces	6	87.864	3	1.308	9	89.172
GLASS						
Glass Bottle	1	309.45	0	0	1	309.45
Jar	0	0	0	0	0	0
MISC. Glass Pieces	6	15.254	6	10.9	12	26.154
RUBBER						
Gloves	0	0	0	0	0	0
Latex Balloons	0	0	0	0	0	0
MISC. Rubber Pieces	3	10.185	2	4.715	5	14.9
MISC. ITEMS (Combination)						
Item(s)	8	17.543	3	144.857	11	162.4
TOTALS	**217**	**643.003**	**122**	**259.056**	**339**	**902.059**

e. Payette National Forest

PAYETTE NATIONAL FOREST	Upper Payette		Cold Springs		Last Chance		Total	
	N	W(g)	N	W(g)	N	W(g)	N	W(g)
PLASTIC								
Food Wrappers	20	22.15	17	2.21	103	26.459	140	50.819
Beverage Bottles	0	0	0	0	3	23.662	3	23.662
Other Plastic Containers	0	0	0	0	0	0	0	0
Container Lids/Caps	1	0.76	15	12.066	32	23.152	48	35.978
Cigarette Butts	9	3.694	22	5.857	20	4.1	51	13.651
Plastic Rope	1	1.55	3	110.773	2	22.317	6	134.64
Fishing Line and Lures	0	0	1	0.022	0	0	1	0.022
Polystyrene	3	0.204	30	2.159	7	0.192	40	2.555
Plastic Utensils	0	0	2	1.372	4	15.378	6	16.75
Plastic Straws	1	0.849	1	0.824	7	2.787	9	4.46
Synthetic Clothing Material	6	4.604	4	0.177	11	29.678	21	34.459
Personal Care Products	3	9.034	2	1.776	8	3.664	13	14.474
Plastic Tarp	0	0	0	0	3	0.033	3	0.033
Plastic Balloons	0	0	0	0	0	0	0	0
Plastic Coated Cardboard	2	0.162	16	113.564	33	46.729	51	160.455
MISC. Plastic Pieces	52	91.865	63	31.641	186	66.632	301	190.138
METAL								
Aluminum/Tin Foil	19	22.446	26	8.867	28	25.237	73	56.55
Aluminum/Tin Container	2	16.933	4	7.589	3	33.521	9	58.043
Bottle Caps	1	2.126	6	12.819	20	40.176	27	55.121
Can Tabs	1	2.266	4	5.645	9	2.758	14	10.669
Beverage Cans	2	29.694	8	127.072	1	13.213	11	169.979
Aerosol Cans	0	0	0	0	0	0	0	0
MISC. Metal Pieces	9	57.242	17	118.493	11	103.715	37	279.45
GLASS								
Glass Bottle	0	0	2	632.362	0	0	2	632.362
Jar	0	0	0	0	0	0	0	0
MISC. Glass Pieces	1	0.231	1	2.639	11	23.528	13	26.398
RUBBER								
Gloves	0	0	0	0	0	0	0	0
Latex Balloons	0	0	0	0	0	0	0	0
MISC. Rubber Pieces	5	4.718	5	2.457	16	22.306	26	29.481
MISC. ITEMS (Combination)								
Item(s)	4	7.647	6	185.02	7	2.959	17	195.626
TOTALS	**142**	**278.175**	**255**	**1385.404**	**525**	**532.196**	**922**	**2195.775**

4. Litter collected by campground hosts and the research team for all locations.

	Farragut SP		Heyburn SP		Lake Cascade SP		Ponderosa SP		Payette NF	
Collection by the research team in campgrounds	**N**	**W(g)**	**N**	**W(g)**	**N**	**W(g)**	**N**	**W(g)**	**N**	**W(g)**
PLASTIC										
Food Wrappers	70	26.017	73	87.279	79	25.766	29	1.972	39	39.853
Beverage Bottles	1	30.51	5	49.035	1	35.291	4	83.495	1	8.518
Other Plastic Contaniers	4	155.977	1	0.97	2	32.119	5	18.133	0	0
Bottle, Cup or Container Lids/Caps	9	14.47	9	16.324	13	14.603	6	4.934	21	16.382
Cigarette Butts	83	20.159	89	25.628	66	15.071	35	8.559	35	10.349
Plastic Rope	2	3.38	1	0.052	0	0	0	0	4	112.323
Fishing Line and Lures	0	0	0	0	1	13.327	0	0	1	0.022
Polystyrene	11	0.926	3	1.367	9	0.46	1	0.011	35	2.464
Plastic Utensils	3	13.147	1	4.048	1	2.797	3	5.24	3	4.814
Plastic Straws	11	5.191	5	2.72	6	1.7148	2	1.684	5	2.855
Sythetic Material	12	73.699	8	104.324	9	1.911	5	0.905	9	20.966
Personal Care Products	5	35.988	4	1.273	4	1.243	1	0.314	3	2.022
Plastic Tarp	4	0.129	6	0.431	8	0.0731	25	0.139	0	0
Plastic Balloons	0	0	0	0	0	0	0	0	0	0
Plastic Coated Cardboard	12	22.326	17	154.659	47	108.941	13	2.641	31	116.01
MISC. Plastic Pieces	113	152.274	99	203.574	211	279.279	104	103.358	130	121.587
METAL										
Aluminum/Tin Foil	21	12.994	23	8.998	31	10.464	12	1.654	45	43.929
Aluminum/Tin Container	0	0	2	16.711	3	42.744	1	14.896	6	24.522
Bottle Caps	3	6.426	6	12.497	14	29.59	4	5.77	12	24.797
Can Tabs	1	0.261	3	1.192	7	1.947	1	0.344	5	6.029
Beverage Cans	3	40.487	3	43.741	2	27.113	1	17.131	11	169.979
Aerosol Cans	1	113.709	3	2.364	0	0	0	0	0	0
MISC. Metal Pieces	24	55.699	13	189.408	14	820.336	7	71.56	26	158.514
GLASS										
Glass Bottle	0	0	0	0	0	0	1	309.45	2	632.362
Jar	0	0	0	0	0	0	0	0	0	0
MISC. Glass Pieces	2	3.285	14	73.202	1	1.916	12	26.154	6	9.271
RUBBER										
Gloves	1	3.03	2	16.109	2	8.703	0	0	0	0
Latex Balloons	0	0	0	0	0	0	0	0	0	0
MISC. Rubber Pieces	7	9.815	12	74.63	10	11.87	5	14.9	11	17.373
MISC. ITEMS (Combination items)										
Item(s)	7	46.172	8	116.798	9	5.183	5	145.374	6	185.02
	410	**846.071**	**410**	**1207.334**	**550**	**1492.4619**	**282**	**838.618**	**447**	**1729.961**

Collection by the hosts in Campgrounds	Farragut SP		Heyburn SP		Lake Cascade SP		Ponderosa SP		Payette NF	
	N	W(g)	N	W(g)	N	W(g)	N	W(g)	N	W(g)
PLASTIC										
Food Wrappers	89	12.094	90	17.346	105	23.329	5	0.405	101	10.966
Beverage Bottles	0	0	8	101.351	2	17.601	0	0	2	15.144
Other Plastic Containers	2	21.514	3	18.78	1	10.267	0	0	0	0
Bottle, Cup or Container Lids/Caps	14	24.125	23	21.122	18	14.315	4	1.451	27	19.596
Cigarette Butts	11	2.92	35	12.812	58	15.881	10	3.409	16	3.302
Plastic Rope	0	0	3	6.955	3	14.12	0	0	2	22.317
Fishing Line and Lures	2	0.366	0	0	1	0.42	0	0	0	0
Polystyrene	29	4.161	9	1.226	12	8.027	2	0.037	5	0.091
Plastic Utensils	2	9.54	2	5.242	5	17.961	0	0	3	11.936
Plastic Straws	7	3.044	4	2.048	2	0.678	0	0	4	1.605
Synthetic Material	22	62.201	18	44.16	8	4.903	1	14.576	12	13.493
Personal Care Products	10	6.524	7	13.298	6	3.32	1	0.202	10	12.452
Plastic Tarp	3	0.032	12	0.11	3	0.018	3	0.002	3	0.033
Plastic Balloons	0	0	5	0.029	0	0	0	0	0	0
Plastic Coated Cardboard	83	34.209	37	80.414	12	7.594	2	0.087	20	44.445
MISC. Plastic Pieces	214	206.231	173	269.234	173	142.571	13	4.309	171	68.551
METAL										
Aluminum/Tin Foil	39	9.696	29	15.78	40	20.24	6	0.552	28	12.621
Aluminum/Tin Container	3	53.3	2	14.422	4	0.767	0	0	3	33.521
Bottle Caps	9	17.648	10	18.697	32	65.19	2	3.773	15	30.324
Can Tabs	2	0.586	13	8.589	12	7.578	0	0	9	4.64
Beverage Cans	0	0	0	0	0	0	0	0	0	0
Aerosol Cans	0	0	1	8.735	0	0	0	0	0	0
MISC. Metal Pieces	16	114.034	15	575.545	22	83.658	2	17.612	11	120.936
GLASS										
Glass Bottle	2	9.413	0	0	0	0	0	0	0	0
Jar	0	0	0	0	1	10.556	0	0	0	0
MISC. Glass Pieces	0	0	3	3.245	0	0	0	0	7	17.127
RUBBER										
Gloves	0	0	0	0	1	0.268	0	0	0	0
Latex Balloons	0	0	1	0.171	0	0	0	0	0	0
MISC. Rubber Pieces	29	41.195	10	155.844	23	88.131	0	0	15	12.108
MISC. ITEMS (Combination items)										
Item(s)	10	82.538	16	796.324	20	26.191	6	17.026	11	10.606
	598	**715.371**	**529**	**2191.479**	**564**	**583.584**	**57**	**63.441**	**475**	**465.814**

5. Litter flux per day and per camper.

Location	Campgrounds	Campsites	Area (m^2)	Litter (N) by RT*	Density (litter/m^2)	Estimated Occupied Days	Campers within Research period	Flux per day (litter density/occupied days)	flux per camper (litter density /campers)
Farragut	Whitetail	7	178.8	63	0.3523	101	150	0.0035	0.0023
		42	247.7	71	0.2867	96	103	0.0030	0.0028
		49	204.8	52	0.2540	122	127	0.0021	0.0020
	Snowberry	106	201.9	33	0.1635	112	134	0.0015	0.0012
		121	163.8	26	0.1587	113	133	0.0014	0.0012
		134	201.9	20	0.0991	107	117	0.0009	0.0008
	Waldron	156	357.7	104	0.2908	93	89	0.0031	0.0033
		180	269.4	19	0.0705	95	108	0.0007	0.0007
		200	346.9	22	0.0634	106	59	0.0006	0.0011
Heyburn	Benewah	205	113.4	36	0.3174	106	106	0.0030	0.0030
		217	190.5	39	0.2048	61	83	0.0034	0.0025
		225	117.1	24	0.2050	38	53	0.0054	0.0039
	Chatcolet	102	239.3	56	0.2340	6	4	0.0390	0.0585
		113	251.4	33	0.1313	53	67	0.0025	0.0020
		119	311.0	33	0.1061	49	81	0.0022	0.0013
	Hawley	2	158.9	97	0.6106	82	137	0.0074	0.0045
		7	148.3	35	0.2361	64	107	0.0037	0.0022
		18	136.6	57	0.4174	82	90	0.0051	0.0046
L. Cascade	Van Wyck	C4	292.6	129	0.4408	56	71	0.0079	0.0062
		D5	209.0	102	0.4880	57	51	0.0086	0.0096
		A6	372.1	78	0.2096	67	66	0.0031	0.0032
	Ridgeview	183	199.0	32	0.1608	99	101	0.0016	0.0016
		185	306.6	25	0.0815	96	92	0.0008	0.0009
		191	278.7	39	0.1399	99	82	0.0014	0.0017
	Poison Creek	241	209.0	54	0.2583	96	84	0.0027	0.0031
		242	286.8	36	0.1255	91	67	0.0014	0.0019
		247	278.7	55	0.1973	94	53	0.0021	0.0037
Ponderosa	RV	201	338.9	74	0.2183	97	62	0.0023	0.0035
		234	183.4	47	0.2563	99	31	0.0026	0.0083
		236	141.2	39	0.2762	100	56	0.0028	0.0049
	Peninsula	2	217.4	38	0.1748	99	57	0.0018	0.0031
		17	169.7	44	0.2592	98	88	0.0026	0.0029
		72	140.5	40	0.2848	84	53	0.0034	0.0054
Payette	Cold Springs		541.6	255	0.4708	75	300	0.0063	0.0016
	Last Chance		710.7	109	0.1534	55	125	0.0028	0.0012
	Upper Payette		482.9	83	0.1719	219	336	0.0008	0.0005

**RT: Research Team*

6. Survey instrument with informed consent

THROWN AWAY

Understanding the impacts of terrestrial & freshwater plastic pollution on inland forest recreation areas

For additional info regarding this research, please contact:

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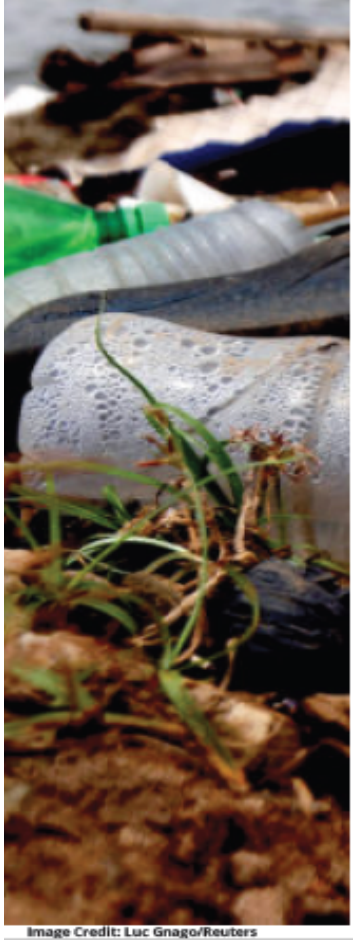

Image Credit: Luc Gnago/Reuters

As demand for safe, outdoor recreational opportunities has surged during the pandemic, the problem of littering and pollution is increasing in our public lands. This survey is part of a study being conducted by researchers at the University of Idaho to better understand the public's view of this problem and appropriate ways to manage it. **YOU** are being asked to participate in this study because of your role as a recreational visitor in state parks or national forests.

Your response to this survey is very important as it will help us better understand how current waste management systems serve the needs of visitors, and what types of litter might be getting into the environment despite everyone's best efforts.

The survey will take about 15 minutes to complete. Thank you in advance for your participation! **After completion of the survey, please return it back to your *camp host***.

Participation in this study is **voluntary**. This study has been reviewed and meets protection assurance standards, including protection of privacy and confidentiality by the University of Idaho's Institutional Review Board (IRB). If you have questions regarding your rights as a research subject, or about what you should do in case of any harm to you, or if you want to obtain information or offer input you may call the **Office of Research Assurances** at **(208) 885-6340** or **irb@uidaho.edu**. Any identifiable information obtained during this study will be kept confidential. There will be no identifiers linking you to this study.

Along with this survey, the project also includes collection of litter samples from randomly selected campsites within certain campgrounds. If your campsite is one of the selected study campsites, the students collecting data will ask for your permission before doing any field sampling. You are welcome to be in your campsite during sample collection, or not, as is comfortable to you.

You must be **18 or over** to complete this survey. By opening the survey, you confirm that you are 18 years old or older and consent to participate.

University of Idaho
College of Natural Resources

INSTRUCTIONS: Please answer every question by marking ONE box or FILLING IN THE BLANK. If you are unsure about a question, just answer to the best of your ability. All your answers are valuable to this study but if there is a question you are uncomfortable answering you may leave it blank.

Date: _____
Campground name: _____
Total nights of stay in the campground: _____
Age of person filling out this survey: _____

This section aims to collect general demographic information on you or your group, the campground, the campsite, and your concerns about littering in recreational areas.

1. How many people in the following age groups are with you today? (Please DO include yourself)

Under 18 years	_____	36-60 years	_____
18-35 years	_____	60 and above	_____

2. How many overnight camping trips have you done in the PAST 2 YEARS, excluding this one?

☐ None ☐ 1-3 ☐ 3-5 ☐ 6 or more

3. What style of camping are you doing today?

☐ RV camping ☐ Car camping (with tents) ☐ Backpacking

Other (please specify) _____

4. How clean was your campsite when you first arrived?

☐	Clean and tidy	☐	Needed clean-up before setting camp
☐	Small, negligible amount of visible litter	☐	Uninhabitable

5. In general, how concerned are you about the presence of litter in public spaces such as parks and campgrounds?

Extremely Unconcerned	Unconcerned	Neutral	Concerned	Extremely Concerned
☐	☐	☐	☐	☐

6. How concerned are you with the presence of the following specific items around your campsites?

	Extremely Unconcerned	Unconcerned	Neutral	Concerned	Extremely Concerned
Plastic film & food wrappers	☐	☐	☐	☐	☐
Cigarette butts	☐	☐	☐	☐	☐
Drink bottles (plastic & glass)	☐	☐	☐	☐	☐
Aluminum cans (beer, soda, etc.)	☐	☐	☐	☐	☐
Food scraps	☐	☐	☐	☐	☐
Paper pieces (gum wrappers, receipts, etc.)	☐	☐	☐	☐	☐
Seed & nut shells (sunflower, pistachio, etc.)	☐	☐	☐	☐	☐
Tobacco chew	☐	☐	☐	☐	☐
Pet waste	☐	☐	☐	☐	☐
Fishing lines/gear	☐	☐	☐	☐	☐

Please Turn Over

The next few questions relate to your preferred waste disposal methods and the waste disposal facilities available in your campground.

7. Would you use the following waste disposal methods if they are available to you while camping?

	Yes	No
Dumpsters	☐	☐
Recycling for paper, cardboard	☐	☐
Recycling for aluminum and glass	☐	☐
Composting	☐	☐
RV dump station	☐	☐

8. During your interactions in the park/forest, have you seen or received any of the following information regarding waste disposal? If yes, how helpful was it in managing your waste?

	Very Unhelpful	Unhelpful	Neutral	Helpful	Very Helpful	Did not receive
Written camp guidelines/policies during online reservation or during check-in process.	☐	☐	☐	☐	☐	☐
Verbal instruction from camp hosts or park employees.	☐	☐	☐	☐	☐	☐
Signs showing proper disposal sites and methods.	☐	☐	☐	☐	☐	☐
Signs discouraging or encouraging certain behavior regarding waste disposal.	☐	☐	☐	☐	☐	☐

9. In the last two years, what are the different ways you have disposed of the trash produced during your camping trips? Have you:

	Never	Rarely	Sometimes	Often	Very Often
Taken trash with you when you leave.	☐	☐	☐	☐	☐
Burned trash in the fire pit.	☐	☐	☐	☐	☐
Disposed of everything in the dumpster.	☐	☐	☐	☐	☐
Sorted garbage (recycling, composting, etc.) for appropriate disposal.	☐	☐	☐	☐	☐
Taken recycling with you and disposed the rest in provided receptacles.	☐	☐	☐	☐	☐
Left biodegradable (food scraps etc.) items in the campsites.	☐	☐	☐	☐	☐

The next question aims to identify the possible ways to decrease littering in public recreational spaces and improve environmental quality in natural settings.

10. How helpful do you think the following methods would be in reducing littering in campgrounds and encouraging proper waste disposal?

	Very Unhelpful	Unhelpful	Neutral	Helpful	Very helpful
Increase the number of disposal bins in campgrounds.	☐	☐	☐	☐	☐
Increase the types of disposal options (recycling, composting, etc.)	☐	☐	☐	☐	☐
Increase signage to direct visitors towards disposal sites.	☐	☐	☐	☐	☐
Provide better information on waste disposal in campgrounds.	☐	☐	☐	☐	☐
Increase fines and enforcement of fines for littering	☐	☐	☐	☐	☐

Please suggest any other options that you think can help reduce littering/pollution on our public lands:

Please Turn Over

The following questions ask about your environmental worldview. These questions come directly from a survey metric called the revised New Ecological Paradigm (NEP), which has been extensively used to assess the relationship between humans and the environment. We will use the answers to these questions to help evaluate which waste management solutions (like more education or more waste bins) are likely to work best for the populations visiting Idaho public lands.

11. For each of the following statements, please indicate how much you agree or disagree.

	Strongly disagree	Disagree	Neutral	Agree	Strongly Agree
We are approaching the limit of the number of people the Earth can support.	☐	☐	☐	☐	☐
When humans interfere with nature, it often produces disastrous consequences.	☐	☐	☐	☐	☐
Humans are seriously abusing the environment.	☐	☐	☐	☐	☐
Plants and animals have as much right as humans to exist.	☐	☐	☐	☐	☐
Despite our special abilities, humans are still subject to the laws of nature.	☐	☐	☐	☐	☐
The Earth is like a spaceship with very limited room and resources.	☐	☐	☐	☐	☐
The balance of nature is very delicate and easily upset.	☐	☐	☐	☐	☐
If things continue their present course, we will soon experience a major ecological catastrophe.	☐	☐	☐	☐	☐

Thank you for taking the time to fill out our survey! We really appreciate your participation. If you have any comments on the survey or about littering in public recreational spaces, please leave us a comment below.

7. Survey response rates

LOCATION	**CAMPGROUNDS**	**TOTAL SURVEYES GIVEN OUT**	**SURVEYS RECEIVED**	**RESPONSE RATE**
Farragut State Park	All	1505	73	4.85%
Heyburn State Park	Chatcolet	265	2	44.53%
	Hawley		43	
	Benewah		73	
Ponderosa State Park	All	200	62	31.00%
Lake Cascade State Park	Van Wyck	352	63	41.48%
	Sugarloaf		13	
	Huckleberry		5	
	Poison Creek		16	
	Ridgeview		37	
	Buttercup		13	
Payette National Forest	Last Chance	226	19	60.18%
	Cold Springs		13	
	Upper Payette		104	
		2548	**536**	