Effect of a Split Rail Fence on Trail Use Compliance & Off-Leash Dogs in Tilden Park

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Abstract An increasing number of parklands require owners to keep their dogs on-leash, thereby concentrating off-leash dogs in shrinking recreational habitat and increasing their impact on these parklands. Off-leash dogs trample parkland vegetation, which damages stream banks because the behavior leads to increased erosion and results in higher sediment loads in the rivers and streams; sediment can be detrimental to aquatic animals. To reduce this behavior, the East Bay Regional Park District (EBRPD) constructed a two-rail high split rail fence along sensitive areas of Wildcat Creek with the objective of decreasing the number of dogs on the bank and in the creek. However, no studies have actually gauged whether this type of fence reduces the number of on and off-leash dogs, their owners as well as regular park visitors leaving designated trails. Quantifying the effectiveness of this fence is important for future treatments in impacted parklands because the money may be better-spent pursuing alternative, more effective options. In order to quantify human and dog behaviors before and after fence construction, 95 hours of observational data were collected at Wildcat Creek's heavily impacted Nook Pool. The fence did significantly decrease the overall non-compliance of trail users ($p = 0.0038$) and their pets ($p = 0.0441$).

Introduction

Wildcat Creek's headwaters are located near Vollmer Peak in the hills of Berkeley, California. From headwaters to mouth, the creek meanders nearly ten miles and its watershed encompasses approximately 4,500 acres (Hassler 2002). As it winds its way from the Berkeley Hills to its outlet in the San Pablo Bay, it passes through a golf course, a nature preserve, a working farm and a residential area. Wildcat Creek also passes through two reservoirs (Jewel and Anza) and two East Bay Regional Park District (EBRPD) parks, Tilden Park, located in Berkeley, California and Wildcat Canyon/Alvarado Park, located in San Pablo/Richmond.

Over the course of a year, the stream flow in Wildcat Creek is highly variable. Peak flow corresponds to the period of highest rainfall, which usually occurs between January and March and low flow usually occurs between June and September. Wildcat Creek provides habitat for numerous flora and fauna including two native fish species, the three spine stickleback (*Gasterosteus aculeatus*) and rainbow trout (*Oncorhynchus mykiss irideus*, formerly: *Salmo gairdneri irideus*). Sometime in the early to mid-twentieth century, the rainbow trout in Wildcat Creek were extirpated (Alexander 2003). The District is particularly concerned with the rainbow trout because their population numbers have been fluctuating since they were reintroduced to the creek in 1983.

In the summer of 2002, Steve Brumbaugh conducted a survey of the Wildcat Creek rainbow trout population and observed that "trout numbers appear lower than they have … since the years immediately following the reintroduction in 1983" and hypothesized that the population decline may be attributed to "below average precipitation during recent years" as well as the behavior of trail users and their pet dogs (Brumbaugh 2002). In fact, the annual EBRPD trout surveys have found that the population of the native rainbow trout has been in decline from 1999 through 2002 (Brumbaugh 2002).

As a result of disturbances by trail users and their off-leash dogs, portions of Wildcat Creek are experiencing increased rates of stream bank erosion (Brumbaugh 2002, Sheppard 2001). To curb the frequency of these disturbances, in the summer of 2002 the District erected twelve signs along stretches of Wildcat Gorge Trail, located in Tilden Park. The specific purpose for the signs was to deter the public and their off-leash dogs from entering the Wildcat Creek riparian corridor by educating the public how their actions were contributing to the stream bank erosion

hypothesized to be negatively affecting the rainbow trout population; however, these signs were unsuccessful "… in diverting invasive activity" (Brumbaugh 2002).

To further reinforce the effort to keep the public and their dogs from entering the creek, on June 26, 2003 a new split rail fence with two horizontal rails per section – commonly referred to as a "two rail high split rail fence" – was erected in Tilden Park adjacent to Wildcat Creek. Each horizontal rail was approximately two meters in length with the vertical posts being approximately one and a half meters tall. The spacing between the rails varied due to the uneven terrain on Wildcat Gorge Trail. The fence was placed along stretches of the trail, at points where many dogs and people access the Wildcat Creek riparian corridor. The overall goal of this treatment was to decrease the number of people and dogs treading upon the stream banks and entering water at the Nook Pool study site.

Figure 1. This is the split rail fence at Nook Pool. Notice the variable spacing between the ground and lower rail. Wildcat Gorge Trail is located on the opposite side of the fence. The trail user is standing on the denuded portion of the stream bank after having crossed the fence line. The vegetation located on the right hand side is on a steep slope and is therefore not used by trail users or dogs.

To determine the effectiveness of this new split rail fence, observational data were collected at Nook Pool, a pool located in Tilden Park approximately 0.5 miles northwest of Lake Anza along the Wildcat Gorge Trail. This popular public walkway for hikers with off-leash dogs runs

northwest from Lake Anza to Lone Oak road covering an approximate total distance of 1600 meters (about one mile). The banks of Nook Pool are completely denuded due to the high volume of trail users and pets that leave Wildcat Gorge Trail and walk upon the stream banks. The Nook Pool site was selected for this study because the high rate of visitors and their pets facilitated the collection of a large sample size. Additionally, the topography surrounding Nook Pool was such that the data collector was easily obscured from the trail users, thereby exerting minimal influence on the study subjects.

The effectiveness of this particular treatment is relevant to all parks considering new pet-control methodologies. Specifically, many recreational areas are beginning to institute leash laws as a way of curbing the detrimental effects incurred by dogs on the environmental aesthetic. However, public resistance to "heavy-handed" treatments, like leash laws, is ultimately undesirable for both the public and the parkland stewards. Therefore, detailing the effectiveness of less sever control methods, like the new split rail fence in Tilden Park, is useful for the EBRPD, as well as other agencies considering similar actions because it enables them to estimate the effectiveness of barriers before investing the time and money necessary to erect them.

The objective of this report is to enumerate the effectiveness of the split rail fence with respect to people and their off-leash dogs by testing the following null hypothesis:

The split rail fence along Wildcat Gorge Trail has significantly reduced the numbers of people and dogs treading on the banks and entering the water at Nook Pool.

Methods

Between 6/16/03 and 8/24/03, 95 hours of observational park users compliance data were gathered at Nook Pool (N 37.90367, W 122.25863), which is located along the Wildcat Gorge Trail about 8 hundred meters northwest of Lake Anza in Tilden Park – see Figure 2 (Poskanzer 2003). The pool has a diameter of approximately 6 meters, and as it is positioned at the base of a small cascade.

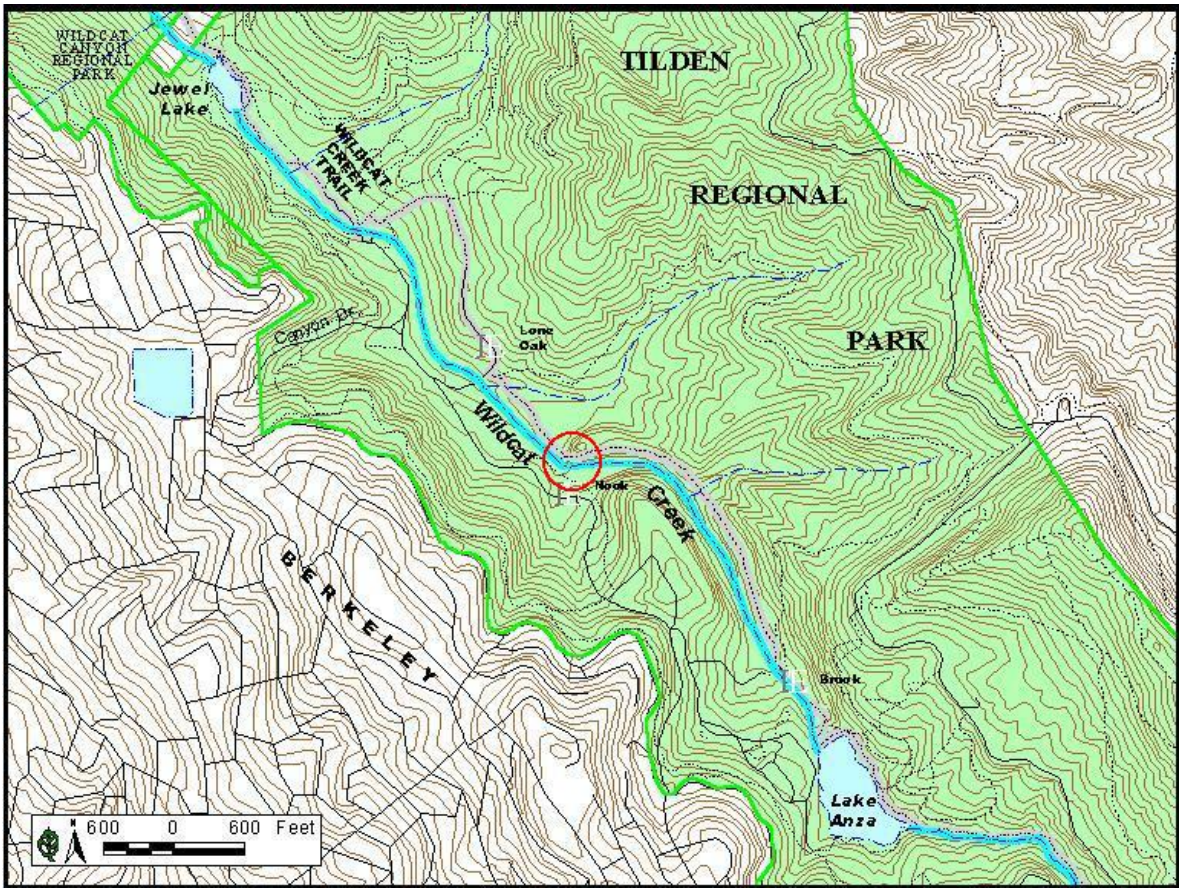

Figure 2. Wildcat Creek with the Nook Pool study site circled in red. Source: East Bay Regional Park District

This pool was chosen as the primary study site because of the high number of trail users, dogs and the presence of heavily denuded banks (Brumbaugh 2002). The observation point was located on the side opposite Wildcat Gorge Trail, across Wildcat Creek and about half way up the steep, east-facing hillside. From this position, the data collector was generally obscured from public view, but all pets and trail users were clearly visible on the trail and in Nook Pool. Table 1 shows the data collected at the study site.

Park Visitors' Behavior	Dogs' Behavior
On the stream banks	On the stream banks
In Nook Pool	In Nook Pool
Owner encouraged the dog to enter Nook Pool.	On-leash
Owner discouraged the dog from entering Nook Pool.	Off-leash
	Duration, in seconds, the dog was in Nook Pool

Table 1. The data collected at the Nook Pool study site.

Upon arriving at the study site, the time was noted and observation periods were divided into one-hour intervals from the initial recorded time. When people and pets entered the study site, they were tallied and placed into the categories defined as follows:

"In the pool" was defined as when a person or dog stepped foot in the water at Nook Pool, no matter how briefly.

Before the fence was constructed, "on the banks" was defined as the point where the ground began to slope downward from Wildcat Gorge Trail. If the dog or person ran into the streambed but did not enter the water, it was categorized as having been on the banks. After the fence was constructed, "on the banks" was defined as the point where a person or dog crossed the fence, though they did not necessarily have to walk onto the sloping portion of the banks. In most places, there was approximately one-half a meter between the fence line and the sloping portion of the banks.

All people and dogs categorized as "in the pool" were by definition also "on the banks" because they had to run down the banks to enter the pool; however, the dogs in the pool were only enumerated as "in the pool" not as both "in the pool" and "on the banks."

The "off-leash" category was defined as any dog not under the influence of a leash. Similarly, the "On-leash" category was marked when a dog was observed attached to a leash. Occasionally, an off-leash dog would be placed on-leash when it arrived at Nook Pool. If the dog had been on the banks or in Nook Pool before being placed on-leash, it was marked as an

off-leash dog. Likewise, an on-leash dog was occasionally taken off-leash upon arriving at Nook Pool. If the dog then became non-compliant and went on the banks or entered Nook Pool, it was marked as an off-leash dog: it was assumed that if they had been on-leash they would have been compliant. However, if a dog was on-leash when on the banks or in Nook Pool, it was marked as on-leash.

The "owner encouraged" category was marked when an owner used verbal or non-verbal prompts to encourage their pet to enter the water. Some examples of prompting include throwing any toy (ball, stick, etc) that resulted in the dog entering the water or positively reinforcing the behavior by petting or saying 'good boy' when the dog left the water on its own accord and returned to its owner.

"Owner discouraged" was defined as any behavior, such as a negative comment, tone ("Get out of there Fido!") or gesture that resulted in the dog avoiding Nook Pool or hastening its departure from it.

When a dog entered Nook Pool, a stopwatch was started at the time of entry and stopped when the dog exited the pool. Dogs would frequently re-enter the pool, in which case the timing cycle was repeated thus generating the entire time (in seconds) that each individual dog was in the pool. For example, when three dogs entered the pool, each dog's time of entry and exit was noted. If a dog then re-entered the pool, the recording process was repeated and the two times were summed.

Results

Over 95 hours of observational data were collected at the Nook Pool study site. The total number of trail user visits observed from the June to August 2003 was 2770. A total of 851 dog visits were also observed during this period. Of these 851 dogs visits, 730 were off-leash and 121 were on-leash.

Before the fence was constructed in June of 2003, an average of 12.0% of the trail users were walking on the denuded banks every day. After the fence was erected, this value dropped to 1.02% in July and increased to 2.4% in August. The nonparametric Kruskal-Wallis (K-W) test was employed because the data were not normally distributed and found the decrease between June and the July and August values to be statistically significant ($p = 0.0038$). No difference

was detected in the increase between July and August ($p = 0.6738$). Therefore, it appears that the split rail fence did decrease the percentage of people treading on the stream banks every day.

It was found that the percentage of trail users entering the water at Nook pool was zero percent for June and August and was essentially zero (0.069%) for July: only one individual was observed in Nook Pool.

Before the fence was constructed in June, the percentage of off-leash dogs frequenting the banks every day was 7.8%. This percentage increased to 8% in July and 10.1% in August. As these data were normally distributed, the ANOVA parametric test was employed, but found no significant differences between any of the months ($p = 0.7510$).

In June, the percentage of off-leash dogs in Nook Pool was 46.5%, which dropped to 28.7% in July and 26.9% in August. ANOVA found this decrease to be statistically significant ($p = 0.0182$). A regression to determine how the number of off-leash dogs in Nook Pool varied by the number of off-leash dogs on the banks was performed and the R-square value was 0.065.

Before the fence was constructed in June, the percentage of on-leash dogs in Nook Pool was nearly 32.3%, which decreased to zero percent for both July and August. The K-W test found this to be statistically significant (0.0014).

The time that off-leash dogs spent swimming in Nook Pool dropped from 45.1 seconds per dog (spd) in June to 27.0 spd in July and increased to 35.8 spd in August. ANOVA did not find these differences to be statistically significant ($p = 0.1963$).

Perhaps some of the previous complex relationships can be further explained by looking at the behavior of off-leash dogs in conjunction with their owners. In June, the number of owners encouraging their dogs to be non-compliant and enter Nook Pool was 1.39 people per hour (pph), which dropped in July to 0.58 pph and in August increased slightly to 0.59 pph. The K-W test found these values to be significantly different from one another ($p = 0.0218$).

Conversely, the number of owners discouraging their dogs from entering Nook Pool in June was 0.29 (pph). After the fence was constructed, this rate increased to 0.47 pph in July and then decreased to 0.13 pph in August, which was less than the original June rate. The K-W test did not detect a significant difference in these values ($p = 0.3715$), but the number of people actively discouraging their dogs from entering Nook Pool immediately after the fence was constructed did increase, but this may have been do to chance.

Overall off-leash non-compliance decreased from 3.85dph in June to 2.86dph in July and 2.78 in August. However, though overall non-compliance decreased after the fence was constructed, the K-W test did not find these decreases to be significant (p = .5913). However, when the overall number of non-compliant dogs per hour was divided by the total number of dogs per hour, the K-W test found a significant difference (p = .0441). In essence, this calculation is the overall number of "bad" dogs in the population of total dogs. The June data indicated that 45.8% of the dogs were non-compliant, which dropped to 34.0% in July and 33.3% in August.

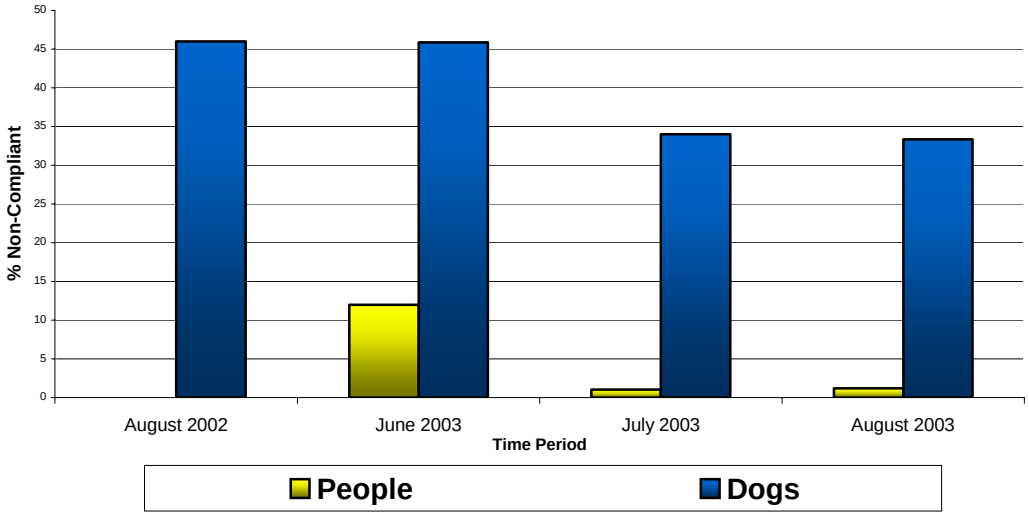

Figure 3. This shows the trend of overall non-compliance for both trail users and pets. The August 2002 data was collected by Brumbaugh in 2002. The decreases for both people and pets were found to be statistically significant (p = 0.0038 and p = 0.0441, respectively)

Discussion

The East Bay Regional Park District's original intent was to erect a psychological barrier that would reduce the overall amount of non-compliant people and dogs at Nook Pool. To this end, it appears that the fence has had a significant impact on reducing the number of people treading on the stream banks and is likely responsible for reducing the number of non-compliant people to near zero. The fence also appears to have caused the number of non-compliant on-leash dogs to decrease to near zero values. Therefore, the null hypothesis must be accepted: the split rail fence along Wildcat Gorge Trail has significantly reduced the numbers of people and dogs treading on the banks and entering the water at Nook Pool.

As illustrated by the significant decrease, the fence seems to be responsible for causing dog owners to decrease their tendency to encourage their pets to swim in Nook Pool. However, the number of owners actively discouraging their pets from entering Nook Pool increased immediately after the fence was constructed, but then dropped back to a similar value at the end of the study. Therefore, while the fence has tempered dog owners from encouraging their pets, it has not succeeded in persuading the owners to actively police them.

These data indicate that people have a rather significant effect on their pets. Specifically, even though the dogs are capable of bypassing the fence, fewer now do so. This is likely a combination of the fence's presence – some dogs are unwilling to cross the fence line – in conjunction with the decrease in the number of owners actively encouraging their pets to enter Nook Pool. It is therefore reasonable to conclude that affecting the psychology of the dog owners is effective in altering the behavior of their pets. However, the dogs do possess complex behavior and it is likely that there is a plateau as to how much the dogs – especially the off-leash variety – can be controlled by their owners.

Similarly, the decrease in non-compliant on-leash dogs should be attributed to the fence's effect on the dog owners. By decreasing invasive activity of the dog owners, the on-leash dogs' invasive behavior is necessarily decreased.

Over the course of the study period, the percentage of off-leash dogs on the stream banks increased. Specifically, the fence did not alter their behavior. However, overall non-compliance decreased at Nook Pool because the percentage of dogs swimming in the pool decreased. It is interesting to note that trail users rarely ever discouraged their pets from crossing the fence line and running on the banks. The bulk of their discouragement was generally centered on dogs entering the creek. Whether this was do to the owners' desire to adhere to the psychological barrier or to their own desire of not wanting a wet dog in their car is unknown.

Owners encouraging their dogs to enter the creek end up with dogs that are non-compliant and may spend more time swimming in Nook Pool. Conversely, when owners actively police their dogs, the overall amount of non-compliance does not necessarily drop – likely because they only police their pets once they are in the water – but the amount of time that dogs are non-compliant in the pool is reduced. Additionally, many owners actively discouraging their pets after the animals have spent sufficient time swimming in the pool. This may be due to the owner

becoming impatient waiting for their dog to leave the pool. Unfortunately, these relationships cannot be confirmed by these data because the relationships are not statistically significant.

Overall, number of non-compliant dogs has dropped significantly, which was the goal of the District. The percentage of non-compliant dogs is around 33%. Whether this level of non-compliance is a sufficient reduction for enabling the stream banks to revegetate is unknown and further research will be needed to determine this in order to decrease overall erosion. Additionally, it is possible that the fence's effectiveness will vary over the coming months and it will be interesting to see where the overall non-compliance numbers are in one year's time. It seems likely that the numbers will either remain similar or increase slightly as people become desensitized to its presence, particularly because there is no penalty for crossing the fence line – the District does not issue citations for doing so. Once people become aware of this, it may decrease the fence's overall effectiveness.

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