

MUD SPRINGS GULCH DEER UNDERPASS STUDY

Summer 2000

Conducted for:

Town of Vail

By:

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EXECUTIVE SUMMARY

During 1998 and 1999, we evaluated deer use of the Mud Springs Gulch deer underpass. Applying results of a treatment/control experiment evaluating the efficacy of a visual barrier to screen humans from the view of deer attempting to use the underpass, we made recommendations to facilitate both deer and human use. Prior to complete implementation of our recommendations, the Town of Vail requested that we again monitor deer use of the underpass during their spring migration with a temporary visual barrier in place. That barrier was an opaque curtain, approximately 8 feet tall and extending 300 feet along the recreational path between it and Interstate Highway 70 at the deer underpass. Additionally a visual barrier was placed at the underpass between the path and Gore Creek in an attempt to reduce disturbance by humans of deer that had traversed the underpass.

We visually monitored deer use from 11 May through 4 July, 2000, between 0500 and 0900 hrs. from a blind south of Gore Creek. During darkness deer use was monitored with a remote video camera. Results of our monitoring with the visual barrier continually in place indicated that it was very effective in allowing both humans and deer to use the area. Only one deer out of 130 deer observed was disturbed by human presence on the path. Two deer that had traversed the underpass were disturbed by humans using the path. We documented fewer deer using the underpass during spring 2000 (113) than in 1999 (162), but in 1998 only 88 were documented using the underpass. We emphasize that these are minimum estimates of deer use. More deer (10) were killed on I-70 during spring 2000, compared to 4 in 1999 and 6 in 1998. The segment of I-70 monitored for deer kills was between mile markers 171 and 173. We recommend patching holes in the deer proof fence and addition of 2 one-way deer gates along I-70 to reduce deer-auto collisions.

We conclude that placement of visual barriers along both sides of the pedestrian path at the Mud Springs Gulch deer underpass, as we recommend, will allow for humans to use the path without interfering with deer seeking to migrate through the tunnel. This report summarizes data collected and reiterates recommendations made in our previous reports. We also recommend that deer-proof gates be placed on the path at the east and west approaches to the underpass to eliminate deer from traversing the path and accessing I-70. People could use the path, but gates would remain closed during migration periods, 1 May-20 June and 1 October-1 December. Some sort of automated gate would facilitate human use while precluding deer use of the path. River users (kayakers and anglers) need to be regulated at Mud Springs Gulch during deer migration periods and the gate across Gore Creek must be maintained.

Implementation of our results will require cooperation between the Town of Vail, the Colorado Department of Transportation, The Colorado Division of Wildlife and all involved publics. We believe that such cooperation is achievable and that with implementation of our recommendations deer can successfully use the underpass while humans use the pedestrian path. Public relations efforts and local buy-in will help assure successful results.

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INTRODUCTION

We began studying mule deer (*Odocoileus hemionus*) use of the Mud Springs Gulch deer underpass during Spring 1998 at the request of the Town of Vail (G. Hall, Town of Vail, pers. comm. 1998). Our objective was to evaluate deer use of the underpass and to ascertain the potential for human use during deer migration periods of a recently constructed pedestrian path at that underpass. Results of our 1998 work (Alldredge 1998) conducted when the pedestrian path was closed to human use, indicated that the majority of deer use occurred between the hours of 0500 and 0900. This is the same time period when people commuting to work or conducting morning exercise might also be using the path. Albeit the pedestrian path was closed to human use during our study, deer attempting to use the underpass fled from people who violated the closure and used the path. These observations prompted additional study to determine the efficacy of a visual barrier that screened humans using the path from the view of deer attempting use the underpass.

During the spring migration period for deer in 1999, we conducted a treatment-control experiment evaluating a visual barrier (Alldredge and Phillips 2000). Our results indicated that deer were less likely to be disturbed by pedestrians using the path when the visual barrier was in place (Fisher's Exact Test, $P = 0.007$). We made a number of recommendations that we believed would facilitate both human and deer use of the Mud Springs Gulch area, among which was construction of a visual barrier similar to what we employed in our experiment. Prior to construction of such a barrier, the Town of Vail requested we monitor deer use of the underpass when a temporary barrier remained in place throughout the spring migration period, 2000, with the path open to public use (G. Hall, Town of Vail, pers. comm. 2000).

In this report, we summarize results of those observations and deer use of the Mud Spring Gulch Underpass. We also include recommendations that we believe will facilitate deer and human use of the area during critical periods of deer migration.

Acknowledgments: Our work was funded by the Town of Vail. Madeline Feely, Colorado State University (CSU) wildlife graduate was employed by the Town of Vail to conduct the visual observations and maintain the remote monitoring of the deer underpass. We are grateful for Madeline's dedication and diligence in data collection. Kirk Shively, a wildlife graduate student from CSU was also employed by the Town of Vail to monitor on days when Madeline needed a break. Bill Andree of the Colorado Division of Wildlife helped with study design, maintained remote monitoring equipment and helped conduct observations. Greg Hall and Todd Oppenheimer from the Town of Vail assisted in logistics and helped construct and maintain the visual barrier.

METHODS

We employed essentially the same methods during our 2000 study as we used during 1998 and 1999, but concentrated more on documenting deer response to people on the pedestrian path rather than numbers of deer passing through the underpass. Each day we counted tracks in sand-covered "track beds" at each end and in the middle of the tunnel and then raked the beds smooth. We installed an infrared video camera and light, actuated by a motion sensor-counter, at the north end of the tunnel to monitor deer use. Sensor and video camera at the north end of the tunnel were deactivated daily between the hours of 1000 and 1600 because unacceptably large numbers of false triggers occurred during that period. The video camera recorded deer use of the underpass from 12 May through 4 July.

Visual observations were made daily, 11 May through 4 July, from a blind approximately 50 m uphill from the south bank of Gore Creek. Observers were not visible and their presence did not appear to affect deer. We occupied the blind daily from 0500-0900 hr, because Alldredge (1998) determined this to be the period when most deer used the tunnel. Objectives were to document number of deer crossing through the tunnel, cyclist and pedestrian use of the recreational path, and behavior of deer while humans were present on the path. Throughout the period, a visual barrier remained in place.

Town of Vail personnel installed a visual barrier following our recommendations (Alldredge and Phillips 2000). The barrier consisted of an opaque curtain 91.44 m (300 ft) long and 2.44 m (8 ft) high positioned along the south side of Interstate Highway 70 (I-70), between the highway and the recreational path, extending approximately equal distances east and west from the underpass. The curtain was suspended from a cable supported by steel posts. The base of the curtain was tied to support posts and weighted with rocks and dirt to minimize motion from wind. When the curtain was up it screened bicyclists and pedestrians from the view of deer on the hillside above the north underpass entrance within a strip extending approximately 10 m above the level of I-70. The visually screened area on the north hillside effectively ran from just west of the large spruce tree west of the underpass entrance, eastward across the draw to the double spruce tree on the east side of the tunnel entrance near the eastern highway fence. In addition, the eastern portion of the draw was screened up to the conifers in the bottom of the draw. Deer typically used several locations within this "screened zone" to stand and watch in the direction of highway and bike path, prior to deciding whether or not to approach the underpass. A second visual barrier was placed along the south side of the pedestrian path where it intersects the deer underpass to screen humans from the view of deer that had traversed the underpass.

These methods allowed us to effectively monitor the response of deer to pedestrian traffic on the path. This approach simulated, as best possible, the situation we might anticipate if the path was open to public use and a visual barrier was permanently in place.

RESULTS

We summarize results of our Spring 2000 observations in Table 1. Due to video camera failure, time of day was not recorded when deer were photographed. Our data do, however, indicate that the majority of deer use occurred during daylight hours in the early morning: 83 deer visually observed compared to 30 recorded on the video during darkness. A minimum of 113 deer were recorded passing

through the underpass from north to south. Track counts provided no additional information. We observed 4 deer passing through the underpass that immediately returned north. None of these returns occurred when humans were present on the path. Additionally, the video recorded 15 deer passing through the tunnel from south to north. We observed 3 deer crossing Gore Creek from the south that traversed north through the underpass.

Table 1. Observations of wildlife using the Mud Springs Gulch Underpass along I-70 west of Vail, Colorado, 11 May - 4 July 2000.

Observation Category	Number
Deer visually counted (0500-0900 hr) ^{1,2}	83
Deer recorded on video camera ³	237
Deer recorded on video camera that passed through tunnel at night	30
Minimum number of deer based on tracks from track beds ¹	68
Minimum deer through underpass ^{1,4}	113
Elk (visual observation)	1
Raccoon (tracks)	2
Marmots (tracks and video)	8
Deer killed on I-70 ⁵	10
¹ Deer moving through underpass from north to south. ² Excludes 4 deer that returned to north side of I-70 after a complete north-to-south transit of underpass. Visual observations obtained from 11 May through 4 July. ³ Includes all deer recorded on video regardless of whether or not they passed through the underpass. Because deer were not individually recognizable, deer could have been counted more than once. ⁴ This estimate is the sum of visual observations and the number of deer that were recorded passing through the underpass during darkness. ⁵ Reflects the number of dead deer observed on I-70 between mile markers 171 and 173.	

Our minimum estimate of deer using the underpass in 2000 (113) was greater than in 1998 (88) but less than in 1999 (162). In 1999 it appeared that few deer used the tunnel before mid-May. However, Fig. 1 indicates that deer use may have been underway before we began monitoring the tunnel in 2000 (11 May), which helps to explain the numerical difference between 1999 and 2000. In 2000, deer use essentially ended after 12 June, but a few deer continued to use the tunnel in the latter half of June in 1998 and 1999. Deer use of the tunnel past 20 June was 7%, 4%, and 1% of annual minimum estimates of deer use in 1998, 1999, and 2000, respectively.

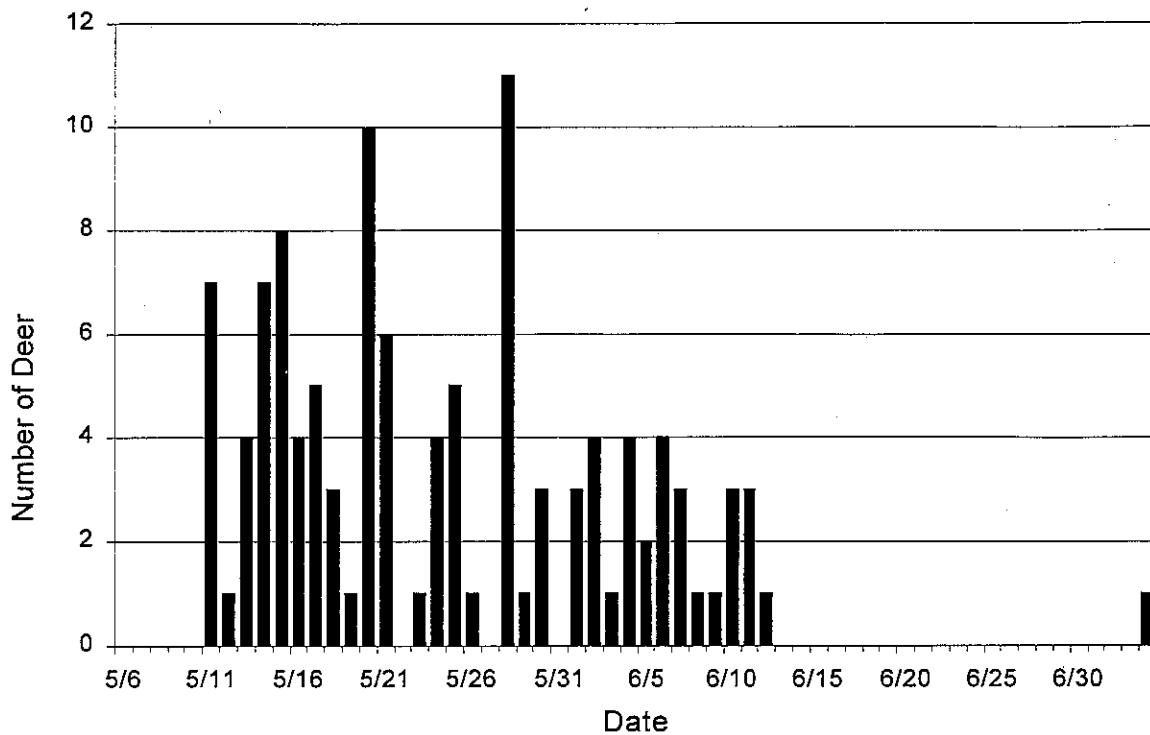


Figure 1. Minimum number of deer moving daily through the Mud Springs Gulch deer underpass, Vail, Colorado, 2000.

Our emphasis during summer 2000 was documentation of the response of deer attempting to migrate southward through the underpass when humans were using the path and a visual barrier was continually in place. We previously defined a "screened zone" as the area on the north side of the underpass from which deer could not see humans on the pedestrian path because of the presence of the visual barrier (Aldredge and Phillips 2000). The area visually screened is where we have repeatedly observed deer standing while they decide whether or not to approach the underpass entrance. Besides the visual screen, during late summer 1999, volunteers and the Town of Vail planted some evergreen trees for deer cover in this area as well as planting willow on the south end of the underpass. As these trees and willows grow, they will add visual screening and hopefully increase deer security.

We recorded 68 occasions when deer were in the screened zone with humans on the recreation path behind the visual barrier. These observations involved 130 deer (not individually identifiable thus there may have been repeated observations on some deer), but only 1 deer appeared to be disturbed by human presence, a westbound cyclist. On 58 occasions involving a single human per occasion and 106 deer, only 1 deer appeared disturbed. A single cyclist was on the path on 47 of these occasions and 95 total deer were involved. A single pedestrian and 14 total deer were involved on 11 occasions.

On 10 occasions involving 2 humans per occasion (1 occasion defined as both humans passed within same 1 min period) and a total of 21 deer, no deer appeared disturbed. Seven of these occasions

involved 2 cyclists/occasion (within 1 min) and 16 deer. Two occasions involved 2 pedestrians per occasion (within 1 min) and 4 deer and 1 occasion involved 1 cyclist, 1 pedestrian (within 1 min) and 1 deer.

We also evaluated the apparent effectiveness of the visual barrier placed south of the path that would screen deer that had passed through the underpass from humans on the path. On 11 occasions involving a single human on the path and 1-3 deer between the tunnel and Gore Creek (20 total deer), 2 deer were frightened by humans. One disturbance involved a moving cyclist but the other occurred when a pedestrian stopped to look at deer over the curtain. All other observations suggested that deer were unaware of humans or apparently undisturbed by them. One deer that did not appear to notice a passing cyclist returned through the tunnel 3 minutes after the cyclist passed. We conclude that this deer's return was not caused by human presence.

From 11 May through 4 July we observed 13 total deer on 9 occasions on the shoulder of I-70. On 4 occasions involving 6 deer, animals were in traffic lanes of I-70, and 3 deer were nearly struck by a car. We recorded 10 deer killed on I-70 between mile markers 171 and 173 during the same period.

DISCUSSION

We documented 113 deer using the underpass during spring migration 2000, compared to 162 in 1999 and 88 in 1998. Explanations for these differences may include changes in deer population size, normal variation in deer use of the underpass (e.g. seasonally earlier use in 2000), or chance events associated with sampling. Also, it is likely that our video recorder missed deer traversing the tunnel during periods when our observer was not present in 2000, because we visually documented nearly equal deer use in 1999 and 2000, 83 and 84 deer, respectively. The majority of deer use appears to occur between the hours of 0500 and 0900 and between early May and mid June.

Deer were much less likely to be disturbed by humans on the recreation path in 2000 (curtain always up) than when the curtain was up in 1999 (Fisher's Exact Test, $P < 0.001$). In 1999 16% of 136 deer inside the screened zone when the curtain was up appeared disturbed by cyclists, but in 2000 only 1 deer of 130 (<1%) appeared disturbed. Several factors may have contributed to this observed difference between years. First of all, we conducted a manipulative experiment in 1999 and an observational study in 2000. In 1999 we controlled numbers and timing of cyclists passing on the recreation path but in 2000 we simply observed interactions between deer and public cyclists and pedestrians. In 2000 there was a lower number of cyclists per occasion and mostly a single human on each occasion. In 1999 we used 3 or 4 cyclists per occasion which may have been more disturbing to deer. We documented 7 occasions in 1999 when the first cyclist disturbed ≥ 1 deer inside the screened zone (12 total deer with potential repeated observations/individual and cyclists spaced at approximately 15 sec intervals rather than in a group), and 4 occasions when the first cyclist did not disturb deer but the second cyclist disturbed ≥ 1 deer (6 total deer with potential repeated observations/individual). Also, because the curtain was continuously in place in 2000, compared to 1999 when we alternated between 3-day periods with the curtain up and down, deer may not have had sufficient opportunity to acclimate to the presence of the curtain in 1999 thus reducing its effectiveness. Finally, different observers were used between years and, despite identical protocols for documenting deer behavior, observer differences may have influenced results between years.

We documented 10 deer killed on I-70 in the study area during 2000 compared to 4 in 1999 and 6 in 1998. These fatalities are indicative of a safety problem for both deer and humans and emphasize the need to patch holes in the deer-proof fence and add one-way gates on the south side of I-70 downstream from the underpass and on the north side of I-70 west of the underpass. During summer 2000, Americorp volunteers under the supervision of Bill Andree, Colorado Division of Wildlife, repaired a number of holes in the fence (Andree, CDOW pers. comm. 2000) Additionally, river users are still tearing down the gate over Gore Creek. Maintenance of this gate is crucial in keeping deer from washing downstream and accessing I-70.

CONCLUSIONS AND RECOMMENDATIONS

Throughout our study, 1998-2000, deer use of the Mud Springs Gulch deer underpass during spring migration has been concentrated during the period from early May to mid June. Deer also have appeared to use the underpass more between the hours of 0500 and 0900 than at other times of the day. From observations of animals and-or their tracks, we have observed elk, mountain lions, racoons, marmots, coyotes, bears, foxes and humans using the underpass. We believe that security is essential for animals to continue to use the underpass. To that end, we recommended planting trees and shrubs at both ends of the underpass and constructing visual barriers. The Town of Vail implemented both these recommendations prior to deer migration in spring 2000; albeit, the visual barrier was still a temporary curtain.

With a visual barrier permanently in place at the Mud Springs Gulch underpass during spring migration, 2000, deer used the underpass with less reluctance than in 1999 when the barrier was not continually in place. Because less than 1% of deer using the underpass (1 deer out of 130) appeared to be disturbed by human presence on the path when the barrier was in place, we conclude that this is an effective method of allowing for both deer and human use of the pedestrian path. A second visual barrier was placed along the south side of the path to screen deer that had passed through the tunnel from pedestrians on the path. In all but 2 cases this screen appeared to shield deer from human disturbance. In one case a deer fled in response to a person peering over the curtain.

Results of 3 years of study on the Mud Springs Gulch deer underpass enforce our previous recommendations (Alldredge and Phillips 2000, Alldredge 1998) and we reiterate those here with the addition of closed, deer-proof gates at both approaches to the underpass during spring and fall migration.

Corridor/Underpass Modification

Critical Public Safety Recommendations

- Maintain fencing in good repair on both sides of I-70 for at least 50 m on either side of underpass entrances.
- Provide a 1-way gate for deer in the fence south of Gore Creek, west of the underpass, and another in the fence north of I-70 immediately west of the underpass.

Critical Deer Migration Recommendations

- Construct and install a solid visual barrier along the south shoulder of I-70, north of the recreational path, 3.05 m (10 ft) high, extending approximately 46 m east and west from the center of the bridge. We envision some combination of wood and steel, to facilitate seasonal removal if necessary. Increasing the lineal duration of the visual barrier to 60 meters along the I-70 interface at the approaches to the underpass would further reduce deer visibility of humans using the path. We believe the additional 2 feet increase in height over what we implemented during 1999 and 2000, will further screen humans on the path from deer attempting to use the path.
- Construct and install a solid visual barrier, 2.44 m (8 ft) high, along the south rail of the bridge and both ramps. Such a barrier should mitigate the problem of deer that have traversed the tunnel being frightened by people on the path. We envision some combination of wood and steel, to facilitate seasonal removal if necessary.
- Construct and install 2 solid visual barriers at the south underpass entrance, 2.44 m (8 ft) high, flaring outward from bridge abutments to where the bank rolls off steeply to Gore Creek. We envision these to be permanent wood structures that may incorporate elements of existing fences, and eventually the area between filled in with shrubs taller than standing deer (approximately 1 m tall)
- All three of the above visual barrier recommendations could be addressed if the entire path overpass including the entrance ramps were enclosed in a permanent tunnel.
- Assure that deer proof gates at both the east and west approaches to the deer underpass are closed during spring and fall migration periods. People would be allowed to use the path, but the gates should be closed to preclude deer from traversing the path and potentially accessing I-70. We realize that opening and closing gates presents a problem for human users and possibly some sort of automated gate could be employed. Dates of gate closure in spring should be 1 May through 20 June and in fall gates should be closed from 1 October to 1 December. Dates of fall closure should be modified to concur with fall migration that appears to be more weather driven and less predicable than spring migration.
- Repair and maintain the gate across Gore Creek at Mud Springs Gulch.
- Plug the drain/skylight in underpass ceiling to eliminate ice and water in underpass, and reduce excessive noise generated when vehicles drive across grating. Based on video-recorded deer behavior at the north underpass entrance, highway noise may be the single greatest deterrent to deer crossing through the underpass. If drainage on I-70 is required, then the grate should be eliminated and replaced with an "in curb" type of drain such as used on city streets.

Additional Recommendations

- Maintain (and supplement or replace, if necessary) trees and willows planted in 1999 at tunnel entrances.

- Prior to deer migration each spring, clean debris from underpass.

Structurally altering the underpass by increasing height and width would also be an improvement, but is probably the responsibility of the Highway Department and not the Town of Vail. Many of the modifications suggested above may be accomplished with the cooperation of both these agencies, and the Colorado Division of Wildlife.

Recreational Path Use

Recommendations for human use of the path at the deer underpass depend partially on adoption of our corridor and underpass modification recommendations above. We believe that if those recommendations are implemented deer will use the underpass during their yearly migrations. If critical corridor modifications we recommend are not adopted, then the path should remain closed to human use from 1 May through 20 June to facilitate deer spring migration. Once visual barriers are in place we also recommend the following.

- Initiate a public relations effort to inform potential path users about the situation, why cooperation is important, and what they can do to reduce impacts.
- Request that use be limited as much as possible, especially pedestrian use, and that cyclists ride in small groups rather than individually from 0500-0900 hr, from 1 May to 20 June when traversing the overpass at Mud Springs Gulch.
- Establish no-stopping zones on the bridge and 100 m each way from the bridge, from 1 May to 20 June, with informational signs as to why this is requested. Kayak users should also be restricted from stopping in this area.
- Restrict anglers from use of Gore Creek within 100 m of the underpass between 0500-0900 hr, from 1 May to 20 June.
- Require pets accompanying path users be kept on leash at all times.
- Gain concurrence with Town of Vail, path users, Colorado Department of Transportation and Colorado Division of Wildlife on implementation of these recommendations.

We recognize that our recommendations involve cooperation between the Town of Vail, Colorado Department of Transportation, Colorado Division of Wildlife and all involved users. Implementation of some of our recommendations is the responsibility of organizations other than the Town of Vail. We believe, however, that this cooperation can be achieved and the result will allow for year-long use of the pedestrian path and facilitate deer migration through the Mud Springs Gulch deer underpass.

LITERATURE CITED

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