An Assessment of Wildlife Habitat Linkages on Interstate 70, Utah

November 2007

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CONNECTING COMMUNITIES

Antelope are present along the desert portions of Interstate 70

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Photo of a western fence lizard taken near one of the box culverts on I-70. Not all animals that benefit from wildlife crossings are large.

INTRODUCTION

Highways are an essential part of modern American society. They facilitate movement of people and commerce. Yet highways also pose a threat to wildlife and fish in a number of ways. Habitat is lost when highways occupy a landscape. Fragmentation of wildlife and fish habitat and populations can occur. Road-kill, also called wildlife mortality, is often an impact on wildlife populations. In combination, these factors can be a threat to long-term wildlife and fish sustainability.

Photo 1. Monte Aldridge and Randall Taylor from UDOT inspect a large bull elk killed on Interstate 70. I-70 has one of the highest accident rates with elk of any highway. These accidents result in damage to wildlife resources and also present serious road hazards to motorists.

Vehicle collisions with wildlife also pose a significant threat to property and human safety. Especially when large animals like deer, elk and moose are common on highway surfaces. This is true on Interstate 70 (I-70), which has one of the highest collision rates with large animals in Utah (and perhaps one of the highest collision rates in the United States for elk).

To meet these challenges a new science has emerged called road ecology. Many colleges and universities have developed programs in road ecology, including Utah State University. In a broad sense, the objective of a road ecology program is to identify impacts to wildlife, fish and the environment and to use scientific approaches to help agencies and the public reduce adverse impacts. One of the approaches used is called Wildlife Habitat Linkage Assessment. There are various ways to assess wildlife habitat linkages. One is described later and was used to identify wildlife habitat linkages along I-70 that are important to wildlife, fish and highway safety. Wildlife habitat linkages provide valuable location information to agencies about where wildlife and fish resources are a concern. They also help agencies plan and coordinate wildlife and fish crossings – and other ways to mitigate impacts of I-70 on these resources.

Wildlife crossings (with fencing) have been shown to reduce collisions with wildlife and reduce wildlife highway mortality. Many wildlife species on I-70 are important socially and economically. These include mule deer, elk, moose, mountain lion, and black bear. Wildlife crossings can be designed to benefit smaller animals such as fish, reptiles, amphibians and small mammals. Some of these animals are rare or becoming rare and are a conservation concern.

DESCRIPTION OF INTERSTATE 70, UTAH

Interstate 70 traverses a wide variety of wildlife and fish habitats ranging from pinion-juniper flats and rolling hills, to mountainous terrain and passes to salt desert (see Figure 1). Many aspects of how I-70 interfaces with wildlife are important. Where I-70 heads eastward from I-15, heading through the Fishlake National Forest, the collision occurrence with elk is one of the highest in the United States. These collisions often result in serious accidents with motorists and are a major highway safety issue.

In I-70's brief history, it has had a severe impact on mule deer in the Fishlake National Forest area. The area around Salina Canyon was once one of the major mule deer herds in Utah. Adjacent mule deer herds have experienced continual declines, partly due to I-70 and its effect on deer mortality, habitat loss, and habitat fragmentation. Since I-70 was built in the 1970s and 1980s, mule deer numbers have declined and elk numbers have increased. Limited numbers of black bear, mountain lion, and moose are also found in the mountains around I-70. Moose habitat is considered marginal and the area near I-70 is the southern most extent of moose range in Utah.

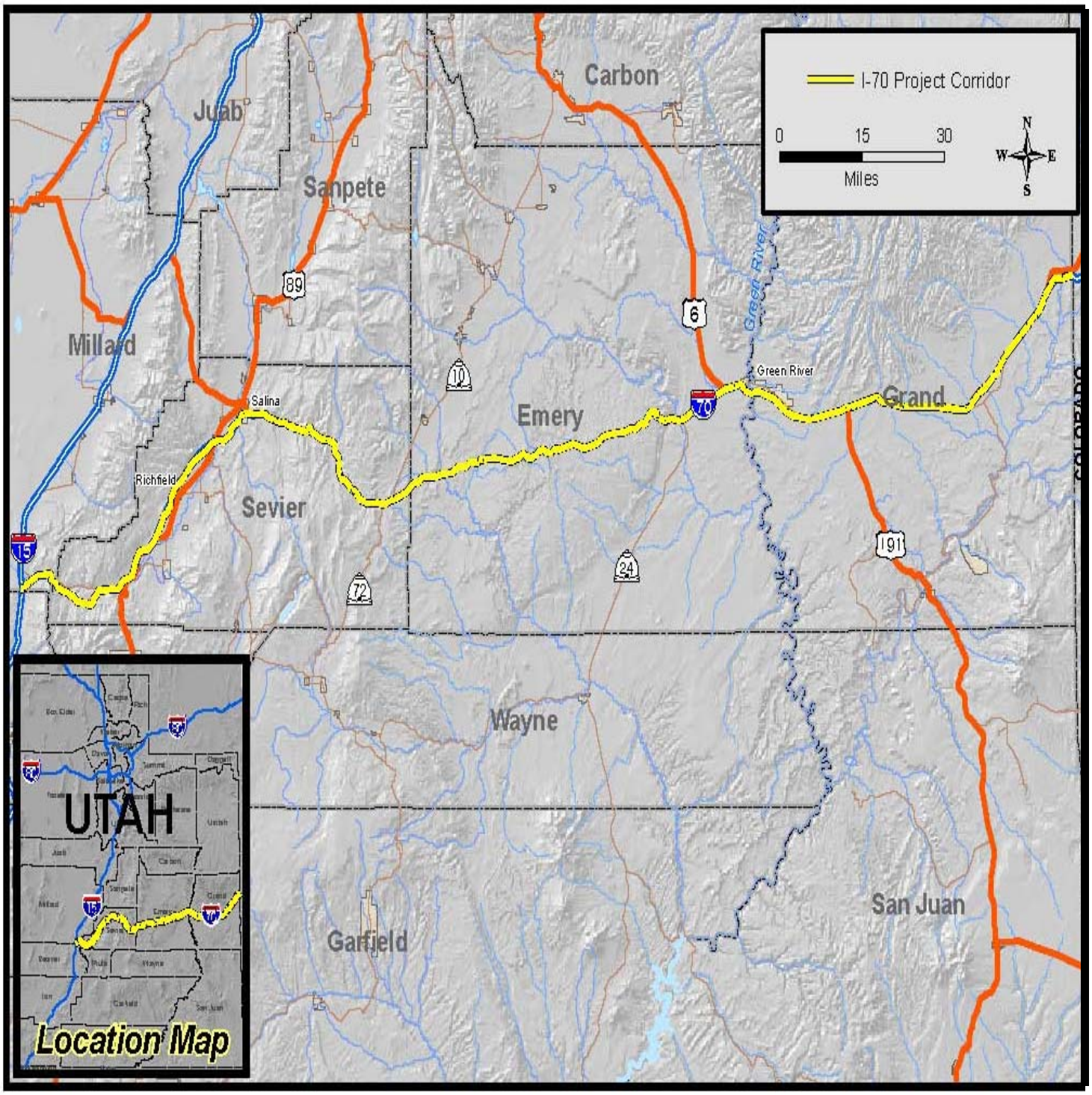


Figure 1. General Location Map—I-70

Going east from Fremont Junction, habitat changes to arid, rolling hills and desert. This habitat is markedly different from the mountainous portion with different habitats and animal associations. Desert bighorn sheep occupy the rugged, rocky desert ranges as do mule deer, mountain lion, badger, coyote, and bobcats. Antelope occupy the lower elevation and more gentle terrain in the eastern and western desert portions.

From the San Rafael River eastward, habitat is characterized by flat desert. There are a number of species unique to this portion such as white-tailed prairie dogs. The Crescent Junction to Cisco wildlife habitat linkage has a concentration of white-tailed prairie dogs and is a potential recovery site for black-footed ferrets. Other species found include antelope, mule deer, badger, coyotes, raccoon, and kit fox. Raptors such as the golden eagle and ferruginous hawk are also present.

THE PURPOSES FOR ASSESSING WILDLIFE HABITAT LINKAGES: HIGHWAY SAFETY, HABITAT FRAGMENTATION, AND WILDLIFE MORTALITY

There are several important ecological and human safety reasons to assess wildlife habitat linkages. As noted above, wildlife/vehicle collisions are a serious cause of accidents on I-70, particularly the Cove Creek and Spring Canyon to Fremont Junction wildlife habitat linkages. The collision rate involving elk is estimated to be approximately 40 accidents per year in the Cove Creek area and about 100 per year in the Spring Canyon to Fremont Junction wildlife habitat linkages. The cost to motorists hitting large animals can be high, including vehicle repair costs, medical related costs, lost work-time, and even human fatalities. One of the primary objectives of assessing wildlife habitat linkages is to determine where collisions with animals are common and use this information to determine if wildlife crossings, or other mitigation measures, could reduce the occurrence of animals on the highway surface.

Photo 2. This truck was involved in a collision with an elk on I-70 near Richfield, Utah. Elk on the highway present a serious accident risk for drivers. Photo by Richfield Reeper Newspaper.

Highways can also be significant barriers to wildlife movement. The barrier effect of highways to wildlife is called "habitat fragmentation." Wildlife must cross highways for a variety of reasons including access to food, water, or minerals; access to seasonal habitats like winter or summer range; reproduction; and dispersal of young animals. Some animals may avoid crossing highways due to human disturbance and other may attempt to cross and are killed or injured (Forman and Alexander 1998, Spellerburg 1998, Trombulak and Frisell 2000, Rondini and Doncaster 2002). Migratory big game animals like mule deer and elk often must cross highways to access winter range in late fall. The passage of fish and other aquatic animals can be blocked at road crossings by improperly designed or maintained culverts or other structures. (Furnis et al. 1991, Thomas 1998). Habitat fragmentation caused by highways can result in isolating small populations of wildlife, which are more vulnerable to extirpation (Reh and Seitz 1990).

Last, highways often result in mortality to many wildlife species. Some species like mule deer, elk, moose, and antelope are important for hunting as well as wildlife watching. These species have direct economic value and wildlife and land management agencies spend considerable funds to maintain these species. Other non-game wildlife is important to biodiversity. Many smaller species of wildlife are vulnerable to highway mortality including snakes, salamanders, lizards, small mammals, and birds. In some cases, highway mortality can eventually result in loss or severe declines of local wildlife species.

DESCRIPTION OF THE PROCESS USED TO ASSESS WILDLIFE HABITAT LINKAGES

The process used to assess wildlife and fish habitat linkages is described in "A Rapid Assessment Process for Determining Potential Wildlife, Fish and Plant Linkages for Highways" (Ruediger et al 2003) and "An Assessment of Wildlife and Fish Habitat Linkages on Highway 93 – Western Montana (Ruediger et al 2004). This process uses explicit, computerized data contained within a Geographic Information System (GIS). GIS data was collected by HDR, Inc in Salt Lake City, Utah (see Appendix A). The GIS layers were compiled from Utah Division of Wildlife Resources, Utah Natural Heritage Program, Utah Department of Transportation, US 6 EIS, Utah GAP, and Utah's Automated Geographic Reference Center.

HDR, Inc compiled GIS information based on species known to occur along I-70. This information was supplemented and confirmed by discussions with resource agency personnel by the principle author. The GIS coverage spanned two miles on either side of I-70 and included such wide-ranging species as elk, moose, mule deer, antelope, black bear, and mountain lion. Coverage also included range or point data on a number of other mammals, fish, reptiles, and amphibians. Data on rare plants and animals was provided by Utah Natural Heritage. Information of reported collisions on I-70 with deer, elk , and other large animals was provided by Utah Department of Transportation and Utah Division of Wildlife Resources.

After developing the GIS data layers, a group of technical experts were selected to review the data and select the most appropriate linkages along I-70. The members were selected from agencies that manage transportation, wildlife, fish, or plants or habitat or others having knowledge of species or habitats within the I-70 corridor.

The expert team (see list of participants) started at the intersection of I-70 with I-15 (near Cove Fort) and worked eastward to the Utah-Colorado border. Rigid criteria were not established for the selection of potential wildlife or fish habitat linkages. Instead, wildlife or fish habitat linkages were based on discussion of the GIS data and team member's experience working in the segment under review. After some initial discussions and questioning, the team was able to rapidly decide which segments were suitable for wildlife or fish habitat linkages, and for which species it was important.

An unusual aspect of the group discussions about wildlife habitat linkages on I-70 was that the session was used as a training program for professionals from throughout Utah and elsewhere. The session provided transportation and wildlife professionals with a chance to learn how the process works as well as experience an actual wildlife habitat

linkages assessment in progress. Using the session for training, a broader group is thought to be a first time occurrence.

Once the 15 Wildlife Habitat Linkages were defined for all of I-70 within Utah, the team went back and assigned a "priority rating" based on how important the linkages were to agencies. These were based on factors such as the number of animals using the linkage, the number of collisions, the need for animals to cross the highway, and the presence of rare, threatened or endangered (T&E) species. The requirement to cross the highway was based on factors such as potential highway barriers between winter or summer habitats, or access to water. In the category of rare or T&E species, desert big-horn sheep, white-tailed prairie dogs, and a potential black-footed ferret recovery site were specific examples in the I-70 corridor.

The priority rating for a Wildlife Habitat Linkage may be used to determine the type and relative cost of wildlife crossings. In the situation of the Spring Canyon to Fremont Junction Wildlife Habitat Linkage, it was assigned a "priority 1" (high) priority rating due to concerns about loss of migratory elk and mule deer herds, high collision occurrences, and fish passage issues. It is recommended that limited agency funding and personnel time should be focused on priority 1 (high), including wildlife crossings and other mitigation measures of higher relative cost and effectiveness. The priority 2 (moderate) areas also have important issues, but the species and occurrences of those species were estimated of less concern than the priority 1 areas. The priority 3 (low) areas generally had lower collision rates, species that could be mitigated with relatively less funding and effort, or were areas where existing highway mitigations measures were deemed adequate and they do not require costly future mitigation. Many sections along I-70 received no priority rating and in these cases wildlife habitat connectivity, wildlife mortality, and collisions with wildlife are considered minimally important.

The following table displays a compilation of I-70 Wildlife Habitat Linkages and their respective numbers, percentages, and miles:

Table 1. I-70 Wildlife Habitat Linkages.

Priority Rank	Number of Linkages	Percent of Linkages	Miles/ Category	Percent of Miles/ Category*
HIGH (1)	3	20%	31	13.3
MODERATE (2)	4	27%	56	17.3
LOW (3)	8	53%	80	24.0

*NOTE: There are 232 miles in the Utah I-70 corridor . Not all of these miles are identified as wildlife habitat linkages (65 miles are not considered in a linkage). Due to this factor the category (% of Miles/Category) does not add up to 100%.

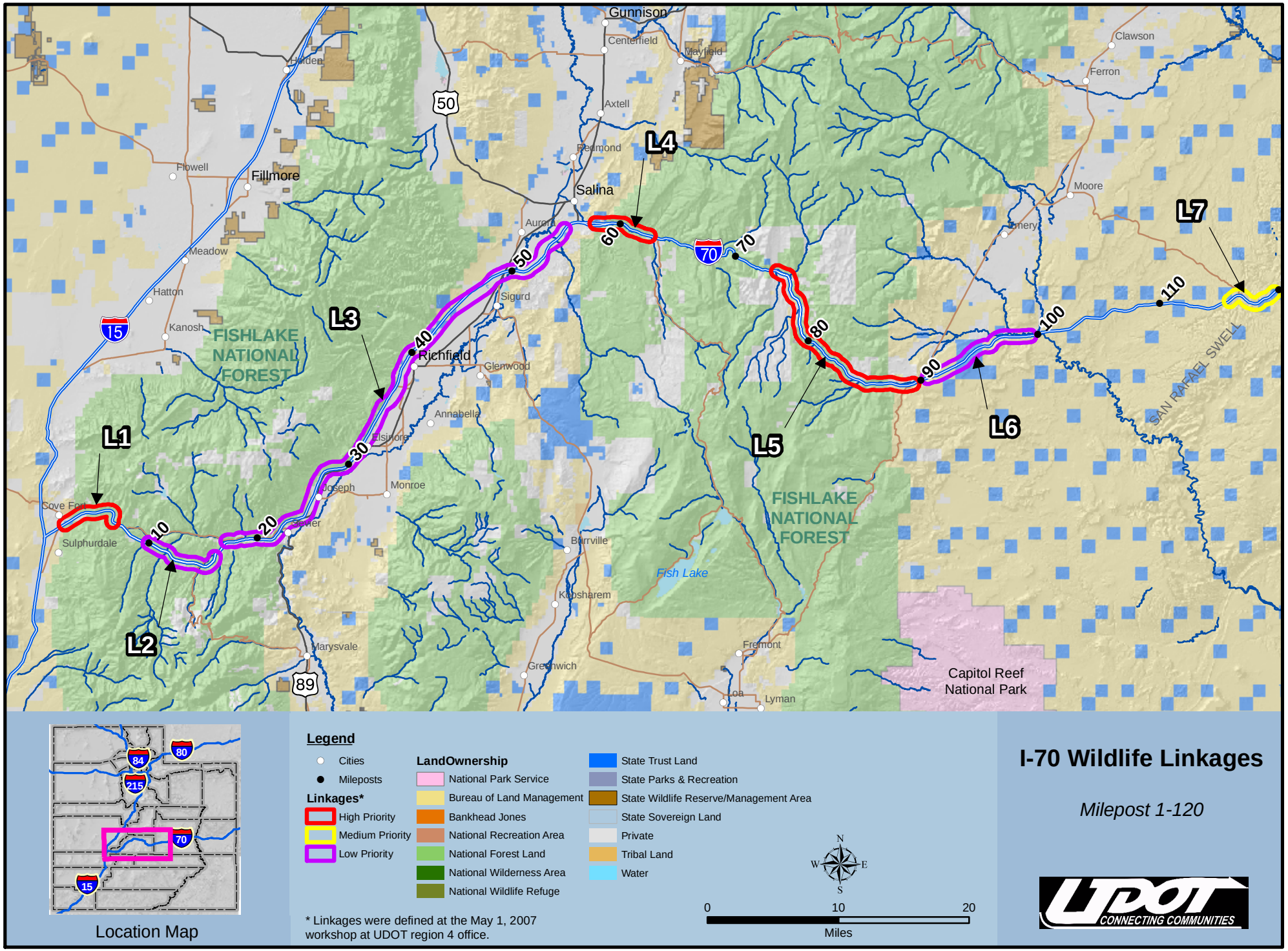
Although most of I-70 crosses relatively important wildlife habitats in Utah, only a relatively small percentage of the entire length is considered "high" priority. Parts of I-70 were not considered for any priority rating, so the actual percentage of highway miles of I-70 considered high priority is approximately 31 miles (of the 232 mile corridor) or 13.3%. This is where a large amount of the total wildlife and fish mitigation for I-70 should likely be directed. The other portions in I-70 that are moderate (17.3%) or low (24.9%) should require less mitigation, or have already received significant mitigation measures. This should be of interest to both UDOT and its resource agency partners.

In the moderate and low priority areas wildlife crossing improvements can often be accomplished with little cost when performed with other road work. Advanced planning is crucial in realizing these opportunities.

WILDLIFE HABITAT LINKAGES FOR INTERSTATE 70

The following 15 Wildlife Habitat Linkages were identified by participants of the May 1, 2007, meeting in Richfield, Utah. Figures 2 and 3 provide a map of Wildlife Habitat Linkages for I-70. It should be noted that the Wildlife Habitat Linkages defined for I-70 are based on broad scale GIS data and more refined, site-specific information may be determined necessary on some of the proposed linkages. The determination of what eventually is implemented to facilitate wildlife movement, to reduce wildlife mortality, and to potentially reduce collisions with wildlife will be made by Utah Department of Transportation and the cooperating agencies involved in the specific Wildlife Habitat Linkage. Implementation may take a decade, or more, to accomplish.

1. Cove Creek. Milepost 1.2 to 7.0. Habitat in the Cove Creek wildlife habitat linkage is characterized by pinion, juniper, and oak over story. From MP 1-5 the terrain is gently rolling, however, after MP 5 the topography quickly becomes steep and mountainous. Mule deer, elk, cougar, and black bear are the primary large species. Coyote, bobcat, raccoon, and badger are common mid-sized carnivores. A single lynx was reported in the area and probably came from trans-located animals in Colorado. Most migration of mule deer and elk is parallel to I-70; however, animals commonly cross this section of the highway and collision rates are high. The gently sloping terrain in most of the linkage area facilitates animal movement in all directions. I-70 creates a barrier between the Beaver Range to the south and the Pahvant Range to the north. Approximately 40 elk are hit per year, as well as numerous deer, making this portion of I-70 one of highest animal collision areas in Utah. Land ownership is a combination of BLM, Fishlake National Forest, state, and private. The Cove Creek wildlife habitat linkage is considered "Priority 1" (high) because of the high collision rate and migratory herds that use the area.



Location Map

Legend

Cities
Mileposts

Linkages*
High Priority
Medium Priority
Low Priority

LandOwnership
National Park Service
Bureau of Land Management
Bankhead Jones
National Recreation Area
National Forest Land
National Wilderness Area
National Wildlife Refuge
State Trust Land
State Parks & Recreation
State Wildlife Reserve/Management Area
State Sovereign Land
Private
Tribal Land
Water

N
W E
S

0 10 20
Miles

* Linkages were defined at the May 1, 2007 workshop at UDOT region 4 office.

I-70 Wildlife Linkages

Milepost 1-120

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Figure 2. I-70 Wildlife Linkages--Milepost 1-120

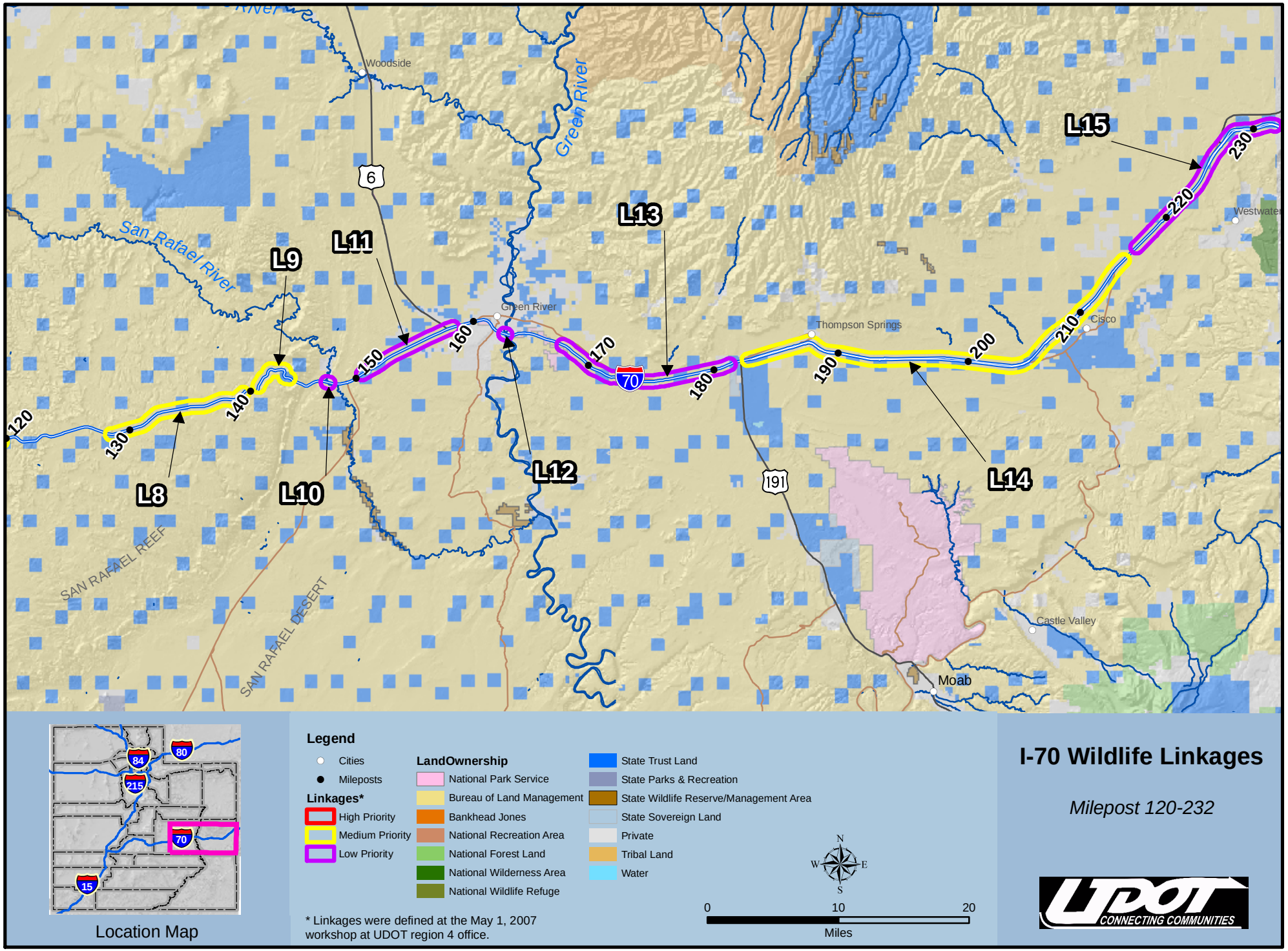

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Figure 3. I-70 Wildlife Linkages--Milepost 120-232

Photo 3. Mule deer are often hit in the Cove Creek wildlife habitat linkage, as are elk.

2. Clear Creek Basin. Milepost 9.5 to 17. The area is steep, mountainous terrain covered with pinion-juniper. The species present are mule deer, elk, cougar, and black bear. Deer and elk are mostly resident animals. There is not significant highway mortality or accidents because the entire section has wildlife fencing.

Photo 4. Elk are common in the Clear Creek Basin .

There are three large existing structures for animals to cross I-70. Land ownership is Fishlake National Forest. Due to the existing fencing and crossing structures, this section of I-70 is Priority 3 (low). A wildlife/highway need that was identified is that jump-out ramps are recommended so animals that find their way inside the highway wildlife fencing can safely get out.

3. Sevier Valley. Milepost 17 to 56. This is the valley bottom near Richfield, Utah. Habitat is sage-steppe, rolling hills on the northwest side of I-70, with farm and ranch lands on the southeast side. The area already has wildlife fencing. Mule deer are the primary large species using the adjacent lands. Deer often find their way onto the highway and can not escape. There should be jump-out ramps built to allow deer to leave the right-of-way (ROW) safely. Deer use some of the existing livestock tunnels and drainage structures to cross the highway. The Sevier Valley wildlife habitat linkage is rated as Priority 3 (low) due to the existing wildlife fencing and minimal need for wildlife crossings.

4. Rattlesnake. Milepost 57.5 to 63. Habitat in this wildlife habitat linkage is pinion-juniper. The terrain varies from gently rolling to steep and rugged mountains. Elk, mule deer, and cougar are the primary large species using adjacent habitat. The highway has wildlife fencing, but should have wildlife crossings at approximately MPs 58 and 62.

Photo 5. The Rattlesnake wildlife habitat linkage has existing fencing, but would benefit from having at least two wildlife crossings built. There presently are no crossings for wildlife. This crossing is on Highway 93, Montana.

Deer and elk must cross the highway to access south facing slopes in winter. Many of the animals using the area are migratory. There are also fish concerns (trout and speckled dace) in Salina Creek. Land ownership is BLM, Fishlake National Forest, and private. The Rattlesnake wildlife habitat linkage was rated as Priority 1 because the highway and current fencing fragment significant deer and elk populations. Several wildlife crossings are recommended in this Wildlife Habitat Linkage.

5. Spring Canyon to Fremont Junction. Milepost 72 to 93. Species present include mule deer, elk, moose, cougar, black bear, raccoon, ringtail, and beaver. Salina and Yogo Creeks have trout and speckled dace. This is one of the most important wildlife habitat linkages between the Manti and Fishlake regions. Collisions with deer and elk are a common and a serious highway safety issue. Deer and elk collisions are common between MP 72-79. Land ownership patterns are Fishlake National Forest and private. The priority rating for this linkage is "1" due to important north-south habitat connectivity concerns, potential loss of historic migration patterns, fish passage, and high collision occurrences.

6. Fremont Junction to Miller Canyon. Milepost 93 to 100. The habitat in this linkage area is characterized by high desert pinion and juniper. Species of concern are mule deer, elk, black bear, and coyote. Mule deer are most prevalent. Native fish include leatherside chub, speckled dace, and mottled sculpin. There is not a significant vehicle collision problem compared to other wildlife habitat linkages on I-70. This section has a 3 (low) priority rating.

7. West San Rafael. Milepost 115 to 120. Habitat is characterized by high desert breaks and canyons. Mule deer and desert bighorn are the primary species of concern. There is not a significant problem with vehicle collisions. Land ownership is BLM. The priority rating is 2 (moderate), primarily due to the presence of desert bighorn sheep.

Photo 6. Habitat near West San Rafael. Species include bighorn sheep.

8. San Rafael Desert. Milepost 128 to 140. Habitat is high desert and is largely flat. Species present include desert bighorn, antelope, kit fox, coyote, wild burros, and wild horse. Animals are local and not migratory. There is concern about genetic isolation of desert bighorn sheep, partly due to the habitat fragmentation I-70 creates. There is not a high concern for vehicle collisions with wildlife. Land ownership is BLM and state. The priority rating is 2 (moderate) based primarily on the concern about bighorn sheep genetic isolation.

9. San Rafael Reef. Milepost 140 to 145. Is different from the San Rafael desert wildlife habitat linkage because of the rocky reef formation. The primary species is desert bighorn sheep. As with other desert bighorn sheep areas, there is a concern about these sheep becoming isolated and loss of genetic diversity. There are other species such as coyote,

Photo 7. Jagged rocks that comprise the San Rafael Reef.

bobcat, and some antelope. Animals are local. Highway mortality is a limited concern, as is safety. Land ownership is BLM. The priority rating is 2 (moderate) due to the concern for bighorn sheep.

10. San Rafael River. Milepost 147 to 148. This is a riparian zone in the desert along the San Rafael River. This in itself is a limited and unique habitat. Species present are mule deer, raccoon, coyote, and badger, plus many bird species associated with riparian habitat. Fish include bluehead sucker and roundtail chub, which are state sensitive species. Most animals are resident. There are a significant number of road-killed animals near the current bridge including mule deer and small animals like raccoons. The bridge is of adequate size for wildlife passage, however, fencing should be considered. The landownership is BLM and private. The priority rating is 3 (low) because the structure in-place is adequate.

Photo 8. Road-killed raccoon.

11. San Rafael - Green River. Milepost 150 to 159. Salt desert, mostly flat. Species present are antelope, white-tailed prairie dogs, kit fox, gray fox, and coyote. Animals are resident. There are not many collisions with wildlife in this section. Landownership is mostly BLM with a small percentage of private land. The priority rating is 3 (low).

12. Green River. Milepost 163. A large river riparian area, not common in the general desert biome. There is a high density and diversity of animals including mule deer, raccoon, coyote, badger, corn snakes, and western toads. The significance of the wildlife habitat linkage is local and regional. Most animals are local. There are a high number of road-kills with small animals like raccoon. The existing bridge is adequate for wildlife passage, however, fencing should be considered. Most of the landownership is private. The priority rating is low (3) because the existing structure is adequate.

13. Green River to Crescent Junction. Milepost 167 to 182. Salt desert and greasewood habitat. Wildlife species include white-tailed prairie dogs, antelope, coyote, kit fox, and gray fox. The whitetail prairie dog is a species of state concern. Animals are local. There is significant road mortality of white-tailed prairie dogs and other small animals. Most of the landownership is a mixture of BLM and private. The priority rating is 3 (low).

14. Crescent Junction to Cisco. Milepost 182 to 216. Habitat is characterized by salt desert and greasewood. Species present include antelope, whitetail prairie dog, coyotes, gray fox, and kit fox. This area has been designated as a potential site for the reintroduction of black-footed (BF) ferret, a species listed as endangered by the US Fish and Wildlife Service. It also has one of the highest densities of whitetail prairie dogs in Utah. Whitetail prairie dogs are commonly run over by vehicles on I-70.

Photo 9. White-tailed prairie dogs occupy much of the desert habitat in the eastern I-70 corridor.

There is a similar potential that BF ferrets also would be road-killed if reintroduced. Also because of the high whitetail prairie dog number, raptors are also abundant in the Crescent to Cisco wildlife habitat linkage, including golden eagles and ferruginous hawks. Land ownership is a mixture of BLM, state, and private lands. The priority rating is 2 presently (moderate), but would be upgraded to 1 (high) if BF ferrets were reintroduced. The current rating is based on the potential for reintroduction of BF ferrets.

Photo 10. Big Horn Sheep are present on BLM lands in the rugged desert sections of Interstate 70.

15. Cisco to the Colorado Border. Milepost 216 to 232. Habitat is a mixture of salt desert and greasewood in the western section, with pinion-juniper near the Colorado border. Species present include mule deer, antelope, whitetail prairie dogs, kit fox, and ferret. There are no T&E or species of special concern in this habitat linkage. Some mule deer are killed on the highway, but not in high numbers. Land ownership is BLM and private. The priority rating is 3 (low).

Photo 11. Badgers are common along Interstate 70.

DISCUSSION

The wildlife habitat linkage process used on I-70 provides a template for how future highway mitigation for wildlife should be approached. This process was also used successfully on US 6, another Utah highway with serious wildlife/highway concerns (see Ruediger et al 2007). The assessment provided for a corridor-length wildlife habitat linkage analysis and review. As such, the approach avoids project-by-project level assessments that may result in expensive mitigation measured applied to low priority wildlife situations.

The wildlife habitat linkage assessment was followed immediately with specific recommendations for types and sizes of wildlife crossings, at least for the western section of I-70 on the Fishlake National Forest. Having the entire Utah portion of I-70 assessment completed before reviewing specific wildlife crossing sites was critical to understanding each of the proposed wildlife crossings relative importance. The priority ratings assigned directly contributed to the decisions as to the types and numbers of structures recommended.

Both the I-70 wildlife habitat linkage assessment and the wildlife crossing workshop were conducted as real-life reviews of serious highway/wildlife conflicts. Both sessions had participants from elsewhere in Utah and other states that attended to learn how the process works so it could be applied to other situations. The combined assessment/wildlife crossing/training approach had never been tried before and carried with it certain risks. No one knew beforehand what would be recommended in either session, or if resolution was possible. However, both the wildlife habitat linkage and wildlife crossing workshop sessions worked well and the outside participants both learned how to coordinate views and to rapidly determine wildlife habitat linkages. It was an experience that was fun and added to the participants overall highway coordination skills.

Highway planning is a complex process that often requires major mitigation measures, such as wildlife underpasses, overpasses , and fencing to be identified long before construction projects are implemented (in most cases 7-10 years prior project implementation). It is often infeasible and costly to add major structures to existing construction plans late in the planning process. Fitting expensive, unplanned wildlife mitigation into construction plans in the late stages is expensive, delays highway projects, or results in important (and sometimes easy) wildlife mitigation measures being lost.

Road ecology is a young science and there are many unknown factors. These include precise knowledge of the size and type of structure wildlife will use in various situations, fencing effects on wildlife, traffic effects on wildlife, and many other parameters. Wildlife and land management agencies cannot wait for the science to provide better answers. Highways must be reconstructed and improved now for safety and traffic capacity reasons. This results in agencies having to address wildlife connectivity, mortality, and

human safety without all the knowledge they would like to possess. Most people will agree it is better to apply the best science now and address these issues as best we can than to forgo potential options that benefit wildlife and people. Much of the learning process and science we have today is a result of biologists and engineers getting together, pooling their expertise, and applying the best options in a given situation. There is always risk, but the failures have been few.

Agencies, engineers, and biologists become more knowledgeable with each wildlife crossing built. Most existing wildlife crossings have had post-project monitoring that provides information on wildlife use. Occasionally, based on the monitoring, a certain target species will not use a structure. Usually, improvements in target species use can be attained by careful review of the factors that influence a species use such as cover, noise dampening, fencing, or even reducing bright metal or concrete surfaces. Attractants such as food or water can also be used to encourage wildlife use. Species use of wildlife crossings often increases with time, as animals become more familiar with the crossings. In some cases, use has increased steadily for over ten years.

Photo 12. Antelope are present in parts of the eastern desert bisected by I-70 .

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APPENDIX A

GIS LAYERS USED IN THE ANALYSIS PROCESS

1. Strike data 2001 to 2005 – Collision data on vehicle/wildlife crashes - UDOT
2. Mileposts - UDOT
3. Utah Natural Heritage Exact Points - UNHP
4. Streams_Utah – AGRC (Utah's automated geographic reference center)
5. Contours 500 – AGRC
6. SGID500 Watershed – AGRC
7. ut_landcover (vegetation) – Utah GAP (USU)
8. Black Bear Habitat – Division of Wildlife Resources (DWR)
9. Moose Habitat - DWR
10. Mule Deer Habitat - DWR
11. Pronghorn Habitat - DWR
12. Rocky Mountain Bighorn Sheep Habitat – DWR
13. Elk Habitat – DWR
14. Sage Grouse Brooding Habitat – DWR
15. Sage Grouse Wintering Habitat – DWR
16. Threatened and Endangered Species – DWR
17. Wetlands (formally delineated)
18. Municipalities (Boundary) – AGRC
19. Land Ownership – AGRC
20. Aerial Photos 2003 and 2004 Images – AGRC

APPENDIX B

WILDLIFE AND FISH SPECIES INCLUDED IN THE I-70 VICINITY

1. Colorado pikeminnow	*Ptychocheilius lucius*
2. Colorado River cutthroat trout	*Oncorhyncchus clarki pleuriticus*
3 Bonneville cutthroat trout	*Oncorhyncchus clarki utah*
4. Bluehead sucker	*Catostomus discobolus*
5. Flannelmouth sucker	*Catostomus latipinnis*
6. Roundtail chub	*Gila robusta*
7. Spotted frog	*Rana pretiosa*
8. Western boreal toad	*Bufo boreas boreas*
9. Western fence lizard	*Sceloporus occidentalis*
10. Utah milk snake	*Lampropeltis triangulum taylori*
11. Greater sage grouse	*Centrocercus urophasianus*
12. Canadian lynx	*Lynx canadensis*
13. Black bear	*Ursus americanus*
14. Mountain lion	*Felis concolor*
15. Kit fox	*Vulpes macrotis*
16. Raccoon	*Procyon lotor*
17. Skunk	*Mephitis mephitis*
18. Mule deer	*Odocoileus hemionus*
19. Rocky Mountain elk	*Cervus elaphus*
20. Desert bighorn sheep	*Ovis canadensis*
21. Moose	*Alces alces*
22. Pronghorn antelope	*Antilocarpra Americana*
23. White-tailed prairie dog	*Cynomys leucurus*
24. American badger	*Taxidea taxus*
25. Coyote	*Canis latrans*
26. Bobcat	*Lynx rufus*
27. Black-footed ferret	*Mustela nigripes*
28. Golden eagle	*Aquila chrysaetos*
29. Ferruginous hawk	*Buteo regalis*