

**AWPF Grant Award Contract #06-139WPF
Titled
Coal Mine Fence**

**Final Report
Submitted by the Arizona Game and Fish Department
November 2010
Task 5**

Coal Mine Canyon is located east of the San Cayetano Mountains and south of the Santa Rita Mountains in Santa Cruz County. The Arizona Game and Fish Department (AZGFD) bought the Coal Mine Canyon property in 2004 (see property boundary in Figure 1). This property is managed cooperatively with Arizona State Parks (ASP) as part of the Sonoita Creek State Natural Area. In 2005, AZGFD was awarded a grant from the Arizona Water Protection Fund to fence the Coal Mine Spring property to exclude cattle grazing and improve the riparian habitat and to conduct baseline monitoring of birds, fish, and vegetation.

Fence Construction

Because of the steep terrain the entire property boundary could not be fenced; rather gap fencing was constructed in the areas where cattle might reasonably be able to access the property. Steep areas were left unfenced, with the steep areas providing their own “virtual” fence. In some areas, the exclusion fence was placed off the property line, inside the AZGFD property, at a lower elevation, because it was impossible to build the fence on the steeper cliffs. The southern property line was already fenced. The gap fence has now been completed (Figures 1 and 2).

Fence construction began on May 21, 2007.

In December 2007, we reported on 7280 feet of fence that had been completed. On April 15, 2008, we reported on completion of an additional 7,100 feet of fence, for a grand total to date of 14380 feet. On April 29, 2009, we reported on completion of an additional 8,321 feet of fence, for a grand total to date of 22,701 feet (4.3 miles) of fence.

On January 7, 2010, we submitted the Final Fence Construction Report. We reported on completion of the final 8,558 feet of fence, for a final total construction of 31,259 feet (5.92 mi) of fence.

Photos of the fence construction are shown in Appendix A.

Figure 1. Map of Coal Mine property. Blue line is AZGFD property line. Red line is completed Coal Mine gap fence (31,259 feet). For clarity, see Figure 2 for map of completed fence without property line.

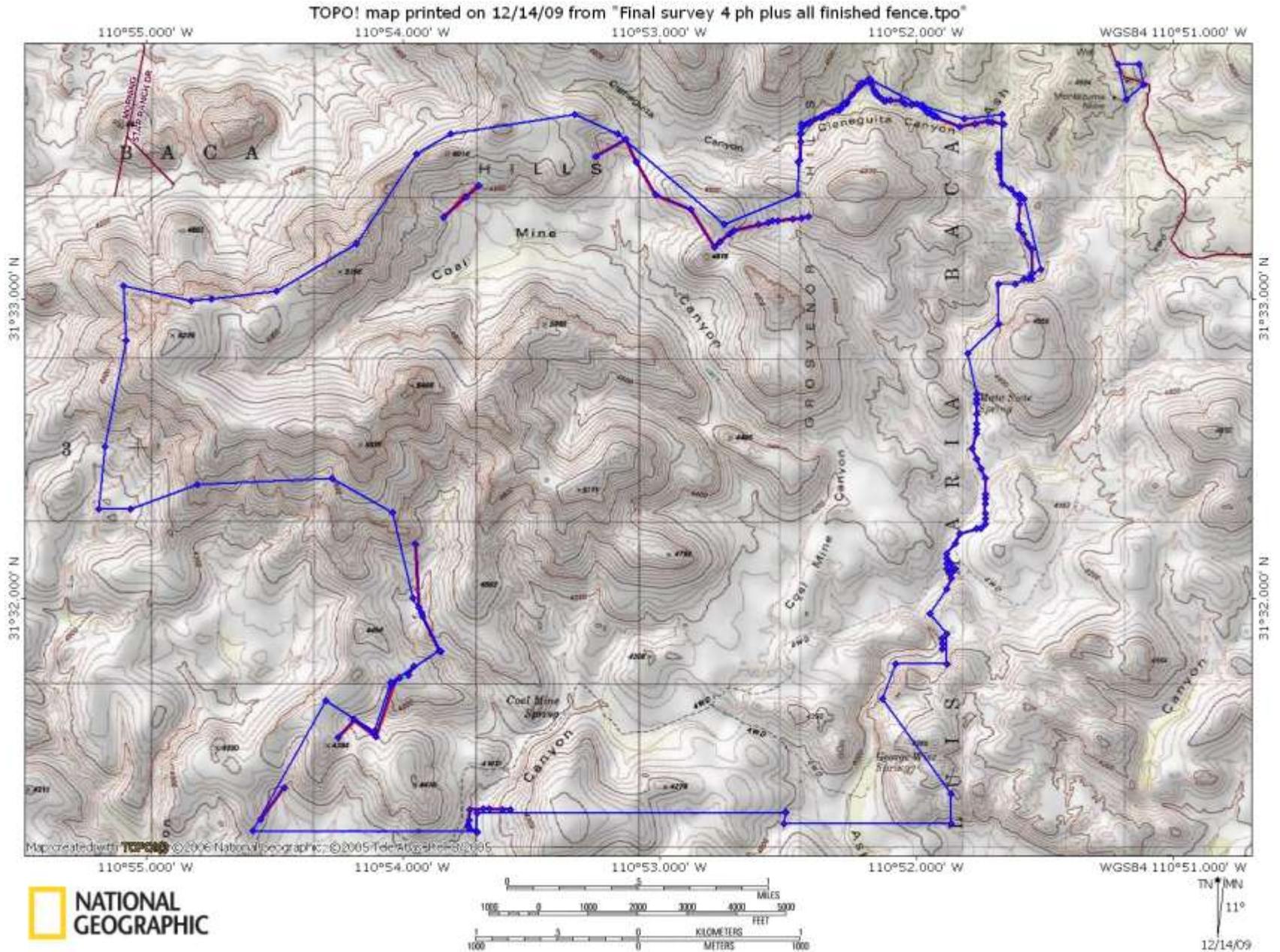
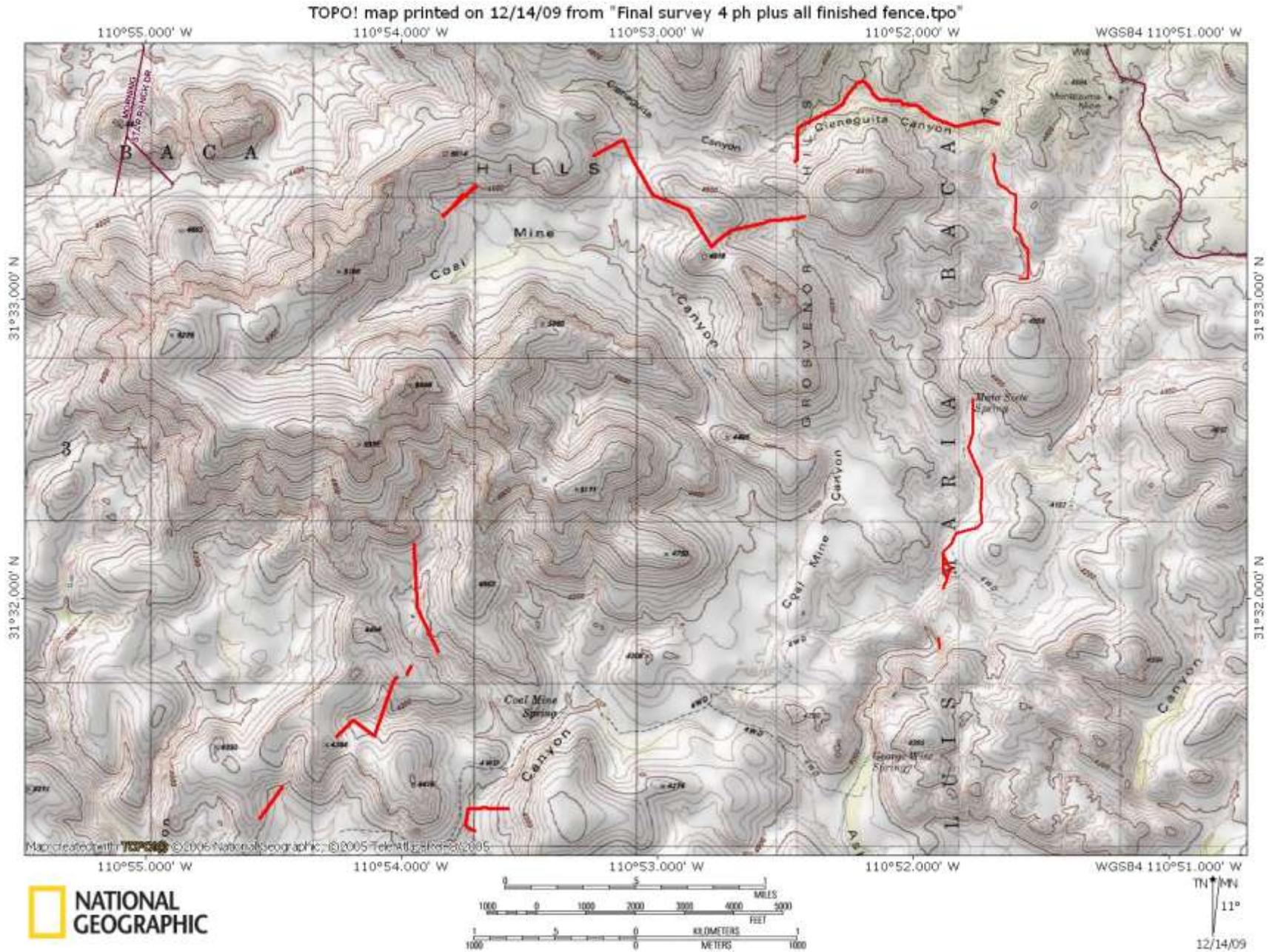


Figure 2. Map of completed Coal Mine gap fence.



Songbird and Vegetation Monitoring

Avian Point Counts

Birds were surveyed using a systematic sampling approach of point counts along a linear transect following methods described in Buckland et al (2001). Fixed survey points were established in August 2007 (Figure 3). The survey transect is located along the Coal Mine Canyon riparian corridor and contains variable-width points spaced approximately 200 m apart. Points were located with Universal Transverse Mercator (UTM) coordinates and a Global Positioning System (GPS; Garmin 3+) receiver.

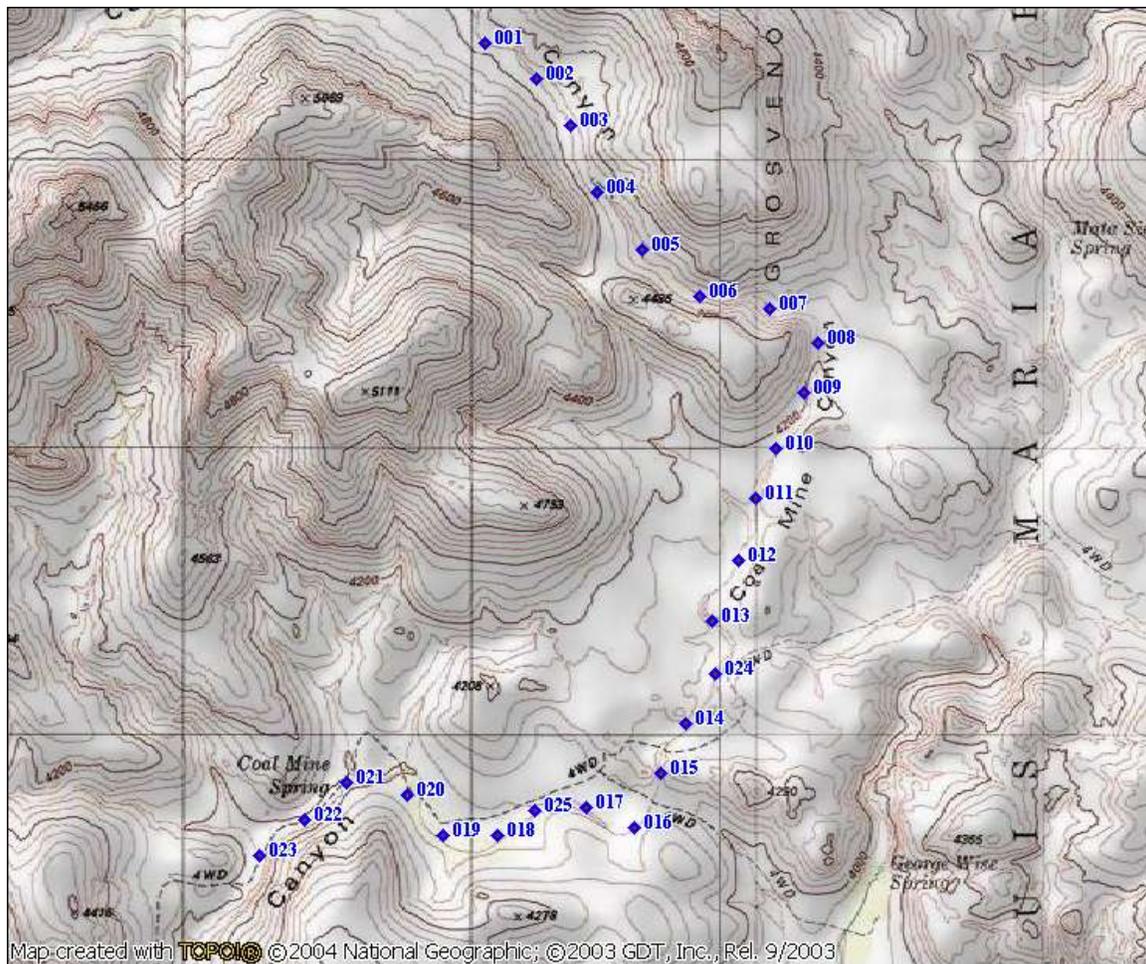


Figure 3. Bird survey and permanent vegetation photo-point monitoring locations along Coal Mine Canyon.

Point counts were conducted semiannually for 3 years: August 17-18 2007, April 11-12 2008, August 15 and 18 2008, April 9-10 2009, August 20-21 2009, and April 13-14 2010. All surveys were conducted within 3 hours post-sunrise by a single observer to minimize disturbance and observer bias (Leukering et al., 2006). At each point the

observer remained silent for one minute to prevent bird movement in direct response to the presence of the observer. Subsequent to the one-minute waiting period, the observer then began recording any birds seen or heard for the next five minutes. All auditory detections that were not visually acquired were estimated by placing the species into distance categories (10-20m, 20-50m, 50-100m, 100-200m, 200m+). Visual bird detections were recorded concurrently with their respective distances (measured with laser rangefinders to minimize estimation errors).

Assessing species richness and composition using point count data requires compiling a list of species detected in the survey area for each plot and each survey pass. Two indices of richness and diversity can be calculated from the species lists generated from all plots: the Margalef's index can be computed for comparison with other published bird literature in addition to the species richness index suggested by Bibby et al., (2000).

Margalef's Index
 $DMG = (S-1)/\ln N$

Species Richness Index
 $SR = S + N_1 / (2 * N_2)$

where,

S= number of species

N= number of individuals, and N_1 =number of species recorded only once,

\ln =natural log, N_2 =number of species recorded at least twice

Table 1 shows species list and total detections from 3 years of semiannual bird surveys conducted from August 2007 to April 2010.

Table 1. Species list and total detections observed at Coal Mine Canyon from Aug 2007 through April 2010.

Common Name	Scientific Name	Aug. 2007	April 2008	Aug. 2008	April 2009	Aug. 2009	April 2010
Abert's Towhee	<i>Pipilo aberti</i>	0	0	1	0	0	0
Acorn Woodpecker	<i>Melanerpes formicivorus</i>	0	0	0	0	1	0
American Kestral	<i>Falco sparverius</i>	0	0	0	0	1	0
American Robin	<i>Turdus migratorius</i>	0	0	1	0	0	0
Ash-throated Flycatcher	<i>Myiarchus cinerascens</i>	0	14	0	11	0	7
Bell's Vireo	<i>Vireo belli</i>	2	0	0	0	0	0
Belted Kingfisher	<i>Ceryle alcyon</i>	0	0	0	1	0	0
Bewick's Wren	<i>Thryomanes bewickii</i>	7	7	1	6	1	0
Black-chinned Hummingbird	<i>Archilochus alexandri</i>	0	0	0	3	3	2
Black-chinned sparrow	<i>Spizella atrogularis</i>	0	1	0	0	0	0
Black-headed Grosbeak	<i>Pheucticus melanocephalus</i>	2	0	5	1	5	0
Black-tailed Gnatcatcher	<i>Polioptera melanura</i>	0	0	0	0	3	2
Black Phoebe	<i>Sayornis nigricans</i>	2	0	2	0	1	0
Black-throated Gray Warbler	<i>Dendroica nigrescens</i>	3	0	0	1	0	1
Black-throated Sparrow	<i>Amphispiza bilineata</i>	13	5	15	8	17	4
Blue Grosbeak	<i>Passerina caerulea</i>	29	0	21	0	24	0
Blue-gray Gnatcatcher	<i>Polioptila caerulea</i>	0	0	0	6	1	0
Bridled Titmouse	<i>Baeolophus wollweberi</i>	0	2	0	3	0	0
Broad-billed Hummingbird	<i>Selasphorus platycercus</i>	3	6	3	9	2	1
Broad-tailed Hummingbird	<i>Selasphorus platycercus</i>	0	0	1	1	0	0
Brown-headed Cowbird	<i>Molothrus ater</i>	2	0	0	0	0	0
Bullock's Oriole	<i>Icterus bullockii</i>	22	0	3	0	9	0
Bushtit	<i>Psaltiriparus minimus</i>	0	0	0	0	0	3
Cactus Wren	<i>Campylorhynchus brunneicapillus</i>	19	12	17	9	20	3
Canyon Wren	<i>Catherpes mexicanus</i>	7	3	5	6	4	2
Canyon Towhee	<i>Pipilo fuscus</i>	3	5	0	22	11	8
Cassin's Kingbird	<i>Tyrannus vociferans</i>	8	4	0	1	7	5

Table 1 (cont.). Species list and total detections observed at Coal Mine Canyon from Aug 2007 through April 2010.

Common Name	Scientific Name	Aug. 2007	April 2008	Aug. 2008	April 2009	Aug. 2009	April 2010
Cassin's Sparrow	<i>Aimophila cassinii</i>	0	0	0	0	2	0
Chipping Sparrow	<i>Spizella passerina</i>	0	32	0	7	0	0
Common Raven	<i>Corvus corax</i>	1	1	0	0	0	0
Cooper's Hawk	<i>Accipiter cooperii</i>	0	2	0	0	1	0
Costa's Hummingbird	<i>Calypte costae</i>	0	1	0	3	0	3
Crissal's Thrasher	<i>Toxostoma crissale</i>	1	0	0	0	0	0
Curve-billed Thrasher	<i>Toxostoma curvirostre</i>	4	0	0	2	1	1
Dusky Flycatcher	<i>Empidonax oberholseri</i>	0	0	0	0	0	2
Gila Woodpecker	<i>Melanerpes uropygialis</i>	1	5	0	3	2	3
Golden Eagle	<i>Aquila chrysaetos</i>	0	2	0	0	0	1
Gray Flycatcher	<i>Empidonax wrightii</i>	3	3	0	5	3	5
Gray Hawk	<i>Asturina nitida</i>	0	0	0	1	0	0
Greater Roadrunner	<i>Geococcyx californius</i>	1	0	4	3	4	0
Green-tailed Towhee	<i>Pipilo chlorurus</i>	0	2	0	2	0	3
Hammond's Flycatcher	<i>Empidonax hammondii</i>	0	0	0	0	2	3
Hermit Warbler	<i>Dendroica occidentalis</i>	0	0	0	0	0	1
House Finch	<i>Carpodacus mexicanus</i>	0	2	0	4	0	6
House Wren	<i>Troglodytes aedon</i>	0	0	2	3	0	1
Hutton's Vireo	<i>Vireo huttoni</i>	0	1	0	0	0	0
Ladder-backed Woodpecker	<i>Picoides scalaris</i>	1	4	1	7	3	2
Lark Sparrow	<i>Chondestes grammacus</i>	1	1	0	3	0	3
Lazuli Bunting	<i>Passerina amoena</i>	0	0	2	0	11	14
Lesser Goldfinch	<i>Carduelis psaltria</i>	2	0	0	3	0	2
Loggerhead Shrike	<i>Lanius ludovicianus</i>	0	0	1	0	4	0
Lucy's Warbler	<i>Vermivora luciae</i>	0	23	0	19	0	10
MacGillivray's warbler	<i>Oporornis tolmiei</i>	0	0	2	0	1	0
Mexican Jay	<i>Aphelocoma ultramarina</i>	2	0	2	6	0	0
Montezuma Quail	<i>Cyrtonyx montezumae</i>	1	9	0	12	6	12
Mountain Chickadee	<i>Poecile gambeli</i>	0	0	2	0	0	0

Table 1 (cont.). Species list and total detections observed at Coal Mine Canyon from Aug 2007 through April 2010.

Common Name	Scientific Name	Aug. 2007	April 2008	Aug. 2008	April 2009	Aug. 2009	April 2010
Mourning Dove	<i>Zenaida macroura</i>	5	2	1	3	0	0
Nashville Warbler	<i>Vermivora ruficapilla</i>	2	0	0	1	0	0
Northern Beardless Tyrannulet	<i>Camptostoma imberbe</i>	0	0	0	0	0	1
Northern Cardinal	<i>Cardinalis cardinalis</i>	0	0	0	0	0	1
Northern Flicker	<i>Colaptes auratus</i>	0	0	0	0	0	1
Northern Mockingbird	<i>Mimus polyglottos</i>	5	1	0	0	0	0
Orange-crowned Warbler	<i>Vermivora celata</i>	0	1	0	4	0	0
Osprey	<i>Pandion haliaetus</i>	0	1	0	0	0	0
Pacific-slope Flycatcher	<i>Empidonax difficilis</i>	1	0	3	0	0	0
Plumbeous Vireo	<i>Vireo plumbeus</i>	0	1	0	0	0	0
Prairie Falcon	<i>Falco mexicanus</i>	0	1	0	0	0	0
Pyrrhuloxia	<i>Cardinalis sinuatus</i>	0	1	1	2	0	0
Red-tailed Hawk	<i>Buteo jamaicensis</i>	0	0	0	0	1	0
Rock Wren	<i>Salpinctes obsoletus</i>	21	7	5	1	7	8
Ruby-crowned Kinglet	<i>Regulus calendula</i>	0	0	0	1	0	4
Rufous-crowned Sparrow	<i>Aimophila ruficeps</i>	0	1	18	0	4	2
Rufous Hummingbird	<i>Selasphorus rufus</i>	0	1	0	1	0	0
Scott's Oriole	<i>Icterus parisorum</i>	0	0	0	5	2	2
Song Sparrow	<i>Melospiza melodia</i>	1	0	0	0	0	0
Southwestern Willow Flycatcher	<i>Empidonax traillii extimus</i>	0	0	0	0	1	0
Spotted Sandpiper	<i>Actitis macularia</i>	0	0	1	0	0	0
Streak-backed Oriole	<i>Icterus pustulatus</i>	0	0	0	0	0	1
Summer Tanager	<i>Piranga rubra</i>	2	0	3	0	9	1
Townsend's Solitaire	<i>Myadestes townsendi</i>	2	0	0	0	2	0
Turkey Vulture	<i>Cathartes aura</i>	0	12	2	3	0	1
Varied Bunting	<i>Passerina versicolor</i>	3	0	3	0	23	0
Verdin	<i>Auriparus flaviceps</i>	1	5	6	9	4	0
Vermillion Flycatcher	<i>Pyrocephalus rubinus</i>	0	0	1	0	1	0

Table 1 (cont.). Species list and total detections observed at Coal Mine Canyon from Aug 2007 through April 2010.

Common Name	Scientific Name	Aug. 2007	April 2008	Aug. 2008	April 2009	Aug. 2009	April 2010
Violet-green Swallow	<i>Tachycineta thalassina</i>	0	1	0	0	2	2
Virginia's Warbler	<i>Vermivora virginiae</i>	6	0	2	0	0	0
Warbling Vireo	<i>Vireo gilvus</i>	0	0	1	0	1	0
Western Kingbird	<i>Tyrannus verticalis</i>	5	0	10	4	1	1
Western Tanager	<i>Piranga ludoviciana</i>	2	0	1	0	0	0
Western Wood-pewee	<i>Contopus sordidulus</i>	0	0	3	0	2	0
White-breasted Nuthatch	<i>Sitta carolinensis</i>	0	0	0	0	1	0
White-crowned Sparrow	<i>Zonotrichia leucophrys</i>	0	0	0	2	0	0
White-throated Swift	<i>Aeronautes saxatalis</i>	0	2	0	0	0	0
White-winged Dove	<i>Zenaida asiatica</i>	5	1	5	0	4	7
Wilson's Snipe	<i>Gallinago gallinago</i>	0	1	0	0	0	0
Wilson's Warbler	<i>Wilsonia pusilla</i>	1	0	0	0	0	0
Yellow Warbler	<i>Dendroica petechia</i>	0	0	1	0	2	0
Yellow-billed Cuckoo	<i>Coccyzus americanus</i>	1	0	0	0	2	0
Yellow-rumped Warbler	<i>Dendroica coronata</i>	1	1	0	1	0	0

The Margalef's Index and the Species Richness Index for the survey periods are reported in Table 2. Generally, these indices remain fairly similar despite changes in the species detected during the survey passes.

Table 2. Number of birds and species observed and indices of richness and diversity for the survey periods.

Year	April				August			
	# of indiv birds obs	# of species obs	Margalef's Index	Species Richness Index	# of indiv birds obs	# of species obs	Margalef's Index	Species Richness Index
2007					204	42	7.7	0.95
2008	190	42	7.80	1.18	158	38	7.51	1.02
2009	208	44	8.06	0.83	219	46	8.35	0.94
2010	128	40	8.04	0.98				

August 2007

The August 2007 bird surveys detected a total of 204 individuals comprising 42 species (Table 2). Many species that do not breed on the project site were detected in August (e.g., Nashville warbler, yellow-rumped warbler, Pacific-slope flycatcher), and migrants probably inflated the total numbers for the breeding species. One yellow-billed cuckoo was heard from point number 13 (Figure 3) and another was heard calling briefly from a canyon at the start of the two-track within Salero Ranch (second bird was incidental and not recorded as part of survey). Numerous Bullock's orioles were observed along the channel along with other migrating warblers and flycatchers (Nashville warbler, Wilson's warbler, grey flycatcher and Pacific-slope flycatcher). Additionally, many blue grosbeaks were detected along the entire reach surveyed; this species is one of the latest arrivals to their breeding grounds, timed to maximize the benefits of post-monsoon. Varied Buntings were also detected along the reach, a species that is fairly common, but local in southern Arizona.

Additional species were detected before or after surveys, including a northern goshawk soaring over Coal Mine Spring. Other incidental observations included Abert's towhee, Townsend's warbler, Codillera flycatcher, warbling vireo, western screech owl, barn owl, turkey vulture and red-tailed hawk. Numerous tadpoles were discovered throughout the channel, and a Sonoran mud turtle was observed, indicating their occupation of the larger pools in the drainage.

April 2008

In April 2008, many bird species were detected as the observation period corresponded with the spring migration season. A total of 190 individuals were detected comprising 42 species, however, three individuals were silent *Empidonax* flycatchers. An osprey was detected on both mornings (4/11-4/12) from different points and was probably the same individual. Two golden eagles were observed soaring near point 19 and a prairie falcon was seen briefly near point 23. A black-chinned sparrow was observed at point 14 along with a Hutton's vireo and violet-green

swallow; all three species were also firsts for these surveys. Another interesting observation was of a single Wilson's snipe at point 21.

Coal Mine Canyon was very dry compared to the August 2007 surveys; however, several pools downstream of point 23 contained many longfin dace again this year. Two Sonoran mud turtles were incidentally observed in two larger pools further upstream.

August 2008

A total of 158 individuals were detected comprising 38 species. Many rufous-crowned sparrows were detected during the August 2008 surveys (N=18) compared to the April 2008 surveys (N=1) and none were detected in August 2007. Another interesting point is that no Lucy's warblers were detected during the August 2008 surveys despite 23 detections during the April visit. Similarly, no blue grosbeaks were detected in April, however 29 individuals were detected in August 2007 and 21 individuals were detected in August 2008. This variation in detection is undoubtedly the result of seasonal shifts in use for several bird species that breed in Arizona (Corman and Wise-Gervais 2005). A spotted sandpiper provided a first species detection for these surveys in Coal Mine Canyon. Species detected only once during the August 2008 surveys included: Abert's towhee, American robin, Bewick's wren, broad-tailed hummingbird, ladder-backed woodpecker, loggerhead shrike, mourning dove, pyrrhuloxia, spotted sandpiper, vermilion flycatcher, warbling vireo, western tanager and yellow warbler (Table 1). Additional species were observed incidentally between point stations and while acquiring vegetation photographs; these species included: Cooper's hawk, red-tailed hawk, Montezuma quail, canyon towhee and Gila woodpecker. It is interesting to note that some of the more common species were only recorded incidentally.

As in August 2007, Coal Mine Canyon was very wet in August 2008 containing extensive and deep pools and surface flow throughout most of the drainage. Two yearling Sonoran mud turtles were incidentally observed in two larger pools further upstream and several longfin dace continued in large pools throughout the system.

April 2009

A total of 208 individuals were detected comprising 44 species in April 2009. Similar to April 2008, no blue grosbeaks were detected in April 2009 as compared to 29 individuals detected in August 2007 and 21 individuals detected in August 2008. Several Lucy's warblers were detected in both April 2008 and 2009 (23 and 19 respectively) as compared to zero detections for both August 2007 and 2008. No varied buntings were detected during any April visit to date compared to 3 detections in both August 2008 and August 2009. This variation in detection in species detections between April and August is undoubtedly the result of disparate seasonal arrival times for several bird species that breed in Arizona (Corman and Wise-Gervais 2005). Total ladder-backed woodpecker detections increased from 4 in April 2008 to 7 individuals in April 2009. Total Montezuma quail detections also increased from 9 individuals in April 2008 to 12 in April 2009. The largest increase in detections was observed in the canyon towhee from 5 individuals in April 2008 to 22 detections in April 2009. Chipping sparrow total detections decreased from 32 in April 2008 to 7 in April 2009. However, this species can often be found in large flocks as was the case in April 2008. Species not detected on any prior Coal Mine Spring survey included: belted kingfisher, blue-gray gnatcatcher, Scott's oriole, ruby-crowned kinglet

and gray hawk. Species detected only once during the April 2009 surveys included: belted kingfisher, black-headed grosbeak, black-throated gray warbler, broad-tailed hummingbird, Cassin's kingbird, gray hawk, Nashville warbler, ruby-crowned kinglet, rock wren, rufous hummingbird and yellow-rumped warbler. Additional species were observed incidentally between point stations and while acquiring vegetation photographs; these species included: Cooper's hawk, red-tailed hawk, merlin, Bullock's oriole, Abert's towhee, white-winged dove, common raven and rufous-crowned sparrow.

As in April 2008, Coal Mine Canyon was dry throughout most of the reach except in areas containing deep pools. Several Sonoran mud turtles were incidentally observed in the larger pools downstream from the road crossing.

August 2009

A total of 219 individuals were detected comprising 46 species. The most notable observations were a yellow-billed cuckoo at points 8 and 4. A singing southwestern willow flycatcher was also observed at point 4. Similar to the past August visits, blue grosbeaks were fairly common; the August 2009 visit detected 24 blue grosbeaks as compared to 29 individuals detected in August 2007 and 21 individuals detected in August 2008. Several Lucy's warblers were detected in both April 2008 and 2009 (23 and 19 respectively) as compared to zero detections for all August visits to date (2007-2009). No varied buntings have been detected during any April visit to date as compared to 3 detections in both August 2008 and August 2009; the August 2009 surveys have produced the most varied buntings detections (N=23). Variation in species detections between April and August is the result of disparate seasonal arrival times for several bird species that breed in Arizona (Corman and Wise-Gervais 2005). Total ladder-backed woodpecker detections increased from 4 in April 2008 to 7 individuals in April 2009; however, only three ladder-backed woodpeckers were detected in August 2009. Total Montezuma quail detections also increased from 9 individuals in April 2008 to 12 in April 2009, but then decreased to 6 detections in August 2009. The largest increase in detections was observed in the canyon towhee from 5 individuals in April 2008 to 22 detections in April 2009; however, this species detection count also dropped to 11 in August 2009. Species observed in August 2009 that were not detected on any prior Coal Mine Canyon survey included: Hammond's flycatcher, southwestern willow flycatcher, and white-breasted nuthatch. Species detected only once during the August 2009 surveys included: American kestrel, acorn woodpecker, Bewick's wren, blue-gray gnatcatcher, black phoebe, curve-billed thrasher, Cooper's hawk, MacGillavery's warbler, red-tailed hawk, southwestern willow flycatcher, vermilion flycatcher, warbling vireo, white-breasted nuthatch, and western kingbird.

Unlike the previous two August visits (2007-2008), the August 2009 survey along Coal Mine Canyon was dry throughout most of the reach except in areas containing deep pools. When the past two August surveys were conducted, Coal Mine Canyon was flowing, and the dammed portion of the reach (near point 4) contained water. Coal Mine Canyon during the August 2009 visit more closely resembled the April visits in 2007 and 2008 than the previous August visits. Several Sonoran mud turtles were incidentally observed in the larger pools and black-necked gartersnakes (*Thamnophis cyrtopsis*) were observed at point 16 and point 25. Another interesting incidental detection was of a ring-necked snake at point 17. Another southwestern willow flycatcher was observed incidentally at the nearby George Wise spring.

April 2010

A total of 128 individuals were detected comprising 40 species in April 2010. Similar to April 2008 and 2009, no blue grosbeaks were detected in April 2010 as compared to 29 individuals detected in August 2007, 21 individuals detected in August 2008, and 24 individuals in August 2009. Several Lucy's warblers were detected in April 2008, 2009 and 2010 (23, 19, and 10 respectively) as compared to zero detections for August 2007, 2008, and 2009. No varied buntings were detected during any April visit compared to 3 detections in both August 2007 and August 2008 and an astounding 23 individuals in August 2009. This variation in detection in species detections between April and August is undoubtedly the result of disparate seasonal arrival times for several bird species that breed in Arizona (Corman and Wise-Gervais 2005). An adult golden eagle was detected soaring near Coal Mine Springs where a pair had been detected on previous surveys. This most likely indicates the presence of nearby nesting.

Species not detected on any prior Coal Mine Spring survey included: dusky flycatcher, northern beardless tyrannulet and streak-backed oriole. All of these species are uncommon to rare in Arizona. The dusky flycatcher is an uncommon breeder in northern Arizona usually along perennial creeks with a heavy deciduous component, and birds detected in Coal Mine Canyon are undoubtedly migrants. The northern beardless tyrannulet is an uncommon breeder in southeastern Arizona, although it is a little surprising that this was the only detection. The streak-backed oriole detection occurred at point 4 by the dam creating a large pond in the wetter months. This species occurs so infrequently in Arizona that it is under review by the American Ornithologists Union. The streak-backed oriole detection was probably not a breeding individual but a bird that strayed north from Mexico where they breed in abundance beginning approximately 200-300 miles south of the international border. Although probably not breeding, the streak-backed oriole detection further highlights the importance of the Coal Mine Canyon area to an avian community that includes a heavy Mexican representation that occurs only in the southeastern region of the state.

As in previous April surveys, Coal Mine Canyon was dry in April 2010 throughout most of the reach except in areas containing deep pools. Several Sonoran mud turtles were incidentally observed in the larger pools downstream from the road crossing. Gila topminnow were observed in the larger pools approaching Coal Mine Spring, including several black males in the shallows.

Vegetation Photo-points

We established 23 permanent photo points (see Table 3 for UTM locations) in August 2007 to monitor change in vegetation. T-posts were placed near every bird survey point to a height of 1.5 m (Figure 3). Each T-post was placed off the main channel (on the bank) and parallel to the bird point station. T-posts were not placed in the main channel, but were located as proximal to each bird point as possible. At each point four photos were taken 1.5 m above the ground (i.e., resting on top of the T-post) in each cardinal direction. Vegetation photographs were recorded at the photopoints semiannually for 3 years, August 2007 to April 2010. Two additional photopoints and bird plots were established in August 2008 and have been included in the UTM list (Table 3) and study area map (Figure 3).

Vegetation photographs for the 6 survey periods are provided in Appendix B.

Table 3. Vegetation photopoint locations. Locations are in WGS 84, and Direction refers to the azimuth that the photos were taken (clockwise beginning at North and ending at West).

Point	Easting	Northing	Direction
1	511031	3490615	NESW
2	511117	3490490	NESW
3	511315	3490284	NESW
4	511389	3490089	NESW
5	511515	3489912	NESW
6	511688	3489753	NESW
7	511870	3489719	NESW
8	512043	3489673	NESW
9	512137	3489590	NESW
10	512086	3489306	NESW
11	512000	3489171	NESW
12	511942	3488943	NESW
13	511790	3488685	NESW
24	511798	3488576	NESW
14	511760	3488359	NESW
15	511648	3488170	NESW
16	511582	3487979	NESW
17	511468	3487831	NESW
25	511310	3487946	NESW
18	511123	3487899	NESW
19	510889	3487780	NESW
20	510746	3488012	NESW
21	510553	3488019	NESW
22	510345	3487895	NESW
23	510244	3487721	NESW

Photo-point Narratives

Vegetation observed in the 6 sets of photos (August 2007, April 2008, August 2008, April 2009, August 2009 and April 2010) is typical for riparian and canyon bottom in semi-desert grassland and oak woodland areas. Vegetation diversity consists of mesquite, live oak, ash, netleaf hackberry, desert broom, yucca, agave, ocotillo, and prickly pear. All the photos show that the vegetation is in good condition, with tall native grasses standing even in April. As grazing had not yet been excluded from the property by the time of the last survey, these photos represent a baseline condition. The following is a brief narrative description of each survey point within the Coal Mine Canyon study area.

Point 1

Dry channel with young ash saplings (10-15 m) and seep willow scattered in channel. Hillsides contain small to mid-sized oaks and mesquite. There is also scattered desert broom on the north slope. The amount of annual vegetation and bunchgrass growth varied with the amount of rain. August 2008 and 2009 had visibly less growth than August 2007. August 2007 was the wettest

year of the three, determined by the presence of flowing water in the channel that year and water restricted only to large pools in the subsequent years. Although surveys were not conducted in August 2010, it is very likely that August 2010 resembled August 2007 based upon the amount of in-channel flow and vegetation growth in nearby areas (bird surveys conducted by Scott Blackman along Sonoita Creek in 2010).

Point 2

Dry channel with small 2-3 m tall mesquite along the channel along with an approximately 3 m tall alligator juniper. Dense bunchgrass and annual vegetation also characterize this point, along with scattered mid-sized oaks to 15 m tall. The bunchgrass within and along the channel in the photos appear to have grown considerably when comparing April 2008 to April 2010. The yucca next to the oak has grown taller than the crotch in the oak in the last couple of years. Oaks growing on the hillsides are more abundant than on hillsides surrounding many of the other plots owing to the geography being more conducive to oak survival. Three ash trees are also present (10-15 m tall) along with some seep willow. Dead and downed material has also been present at this point since the inception of photo-points in 2007. April 2010 was again dry, as has been consistently the case with previous visits during this month. However, the larger tinaja-like pools that accumulate water appeared to be very full when compared to previous April visits.

Point 3

Dry with large boulders lining the channel along with scattered oaks and mesquite to 10 m tall. Ash recruitment along the main channel is 0.5-2 m tall. Yucca and dense bunchgrass exists on the slopes. Much more annual growth was present in August 2007 and 2008 than 2009. The vegetation from 2007 to 2010 has not changed appreciably, however the small oak in the foreground is noticeably taller, and the larger yucca in the north angle appears to be more voluminous.

Point 4

In August 2009 the pond above the old dam was nearly dry, but had been full in the previous two August visits. A small pool still exists just above and below the dam in April 2010; both were dry in 2008. Four approximately 15 m tall Goodding willows line the pond containing lush growth and one small (8-10 m tall) and large (15-20 m tall) willow exist at the base of the dam along with more smaller willow saplings. These trees have grown appreciably since 2007, revealed by comparing the terminal ends of the branches compared to the hill in the background (north angle) and the boulder near the dam (east angle) between the years. The August 2007 photos reveal how much water the pond can potentially retain in wet years. Conversely, the April photos reveal how dry the pond can become during drought periods.

Point 5

Dry channel with scattered ash recruitment and low mesquite to 2 m tall and a 2-3 m alligator juniper. Large boulders align the north bank over which large oaks and mesquite to 20 m tall grow with a large canopy. Small ocotillo to 3 m tall approach the channel and oaks and mesquite exist in both upland slopes. The bunchgrass appears to have become more dense in the last 2.5 years as there appears to be more bare ground exposure in earlier photographs. There also appears to have been a concomitant increase in bunchgrass cover as the boulder beneath the

juniper in the south photo appears to be more obstructed from view by bunchgrass than previous years.

Point 6

Dry channel with several desert broom to 1.5 m and many large oaks to 20-25 m tall. Small mesquite between 2-3 m tall and two small mesquite snags are near plot center that is also below a large ash tree to 20-25 m tall. Dead and downed material has been present at this point since the inception of photo-points in 2007. This plot has not changed appreciably since 2007. However, the bunchgrass does appear to be denser and the desert broom has grown taller since 2007. Additionally, the small ash in the foreground of the east photo angle appears to be more voluminous with respect to canopy cover in relation to the large tree in the background.

Point 7

Dry channel within bottleneck slot canyon containing ash recruitment to 5 m tall and oaks to 15 m tall. Small mesquite 0.5-10 m tall growing above large boulders on the north bank along with yucca, prickly pear, coral bean and bunchgrass. This plot has changed little in the last few years; the ash recruitment remains in the channel and has grown slightly along with the yucca at the base of the small oak in the north photo angle. The fact that the ash recruitment remains suggests that flash flooding is not that extreme through this slot canyon.

Point 8

Dry boulder-strewn channel with ash recruitment to 4 m tall. Large oaks to 25 m tall predominate the north bank along with Arizona cotton and ocotillo. Small mesquite grows on both banks. This plot appears to have changed little since the inception of repeat photography, even the annual and bunchgrass appears very similar in 2010 to that depicted in the photos from 2007. In 2010, the bunchgrass and annual cover appears to resemble the amounts observed initially in 2007 and 2008. Additionally, the oak and mesquite cover and size appear similar to that of 2007 and 2008.

Point 9

Dry channel beneath large oak 20-25 m tall and smaller oaks 15-20 m tall scattered around plot center. Arizona cotton shrub layer along with beargrass and coral bean. Ash recruitment in boulder-strewn wash to 4 m tall with lush ocotillo beneath large oak. The most prominent change for this plot between 2007 and 2010 is the height of the ash saplings in the channel as is reflected in the west photo angle. The heights of the ash trees can be compared by using the rock band in the background as a comparison between years. Additionally, the small shrubs in the background of the north angle have grown taller in the 2.5 year span between repeat photography.

Point 10

Small remnant pools with small ash recruitment and mesquite between 2-8 m tall. Coral bean and lush bunchgrass are present in the undergrowth and ocotillo line the small escarpment on the east slope. This plot also appears to have changed little throughout the years. The most notable change is the young ash tree in the east photo angle apparently died back since 2008 and has resprouted in 2010, yet another example of ebb and flow of life in response to oscillating wet and

dry years. The bunchgrass and annual cover appear similar and correspondingly, the amount of bare ground appears similar in 2010 to the initial photo years of 2007 and 2008.

Point 11

Dry boulder-strewn channel containing oak to 15 m tall and mesquite to 8 m tall. Additional species including yucca, Arizona cotton, beargrass and bunchgrass comprise the understory. Some dead and downed material also exists near plot center and ocotillo inhabits the uplands. This photo point had to be relocated as it apparently washed out in flood event at some point. Thus, photos are difficult to compare between the years. However, the bunchgrass and annual cover appear to have changed little where photos are comparable.

Point 12

Dry at confluence, however, a large pool still contains water just upstream within the main channel. In August 2009, the mesquite was not as leafed out as in past August visits, and there was less annual cover. Small hopbush, mesquite, desert hackberry, and yucca comprise the understory beneath mid-sized oaks (10-15 m tall) in the main channel as well as on the banks. The bare ground appears to have decreased along with the increase in bunchgrass canopy cover in 2010 compared to 2007 and 2008. The remaining trees appeared to have changed very little since the initial years of repeat photography.

Point 13

This plot is in the upland. The channel is dry and contains numerous ash saplings from 0.5-7 m tall. Two large oaks near the channel to 20-25 m tall and mesquite to 4 m tall appear drought-stressed. Beargrass, bunchgrass and shin-dagger are locally dense. The bunchgrass, yucca and desert broom appear to have increased in size between 2007 and 2010. Most notably, the young ash trees in the channel have appeared to increase substantially between these years as is apparent using the hills in the background for comparison of size change from year to year.

Point 14

In August 2009, a small pool remained in channel, but it was considerably smaller than the previous two August surveys. Small oak 3-4 m tall are on the boulder outcrop. A large mesquite tree still contains green but the annual growth is sparse. Small mesquite trees around plot center are approximately 5 m, and a large decadent mesquite is beginning to senesce. The bunchgrass growth appears to have increased in basal and canopy cover by April 2010. The water level in April 2010 was much higher than in previous years.

Point 15

Dry channel with large oaks approximately 15 m tall and ash recruitment to 10-15 m tall. Mesquite 1-6 m tall and dense bunchgrass. As throughout the rest of the study area, the amount of annual growth during August 2007-2008 was much higher than August 2009. This plot appears to have changed little with respect to the bunchgrass cover and height. The oaks have similarly appeared to change little, although oaks are slow growing and difficult to judge using repeat photography unless photographed over long periods of time. The largest ash in the west photo angle is much more voluminous in 2010 than in previous photos; in April 2008, this tree appeared drought-stressed and has responded vigorously with growth by April 2010.

Point 16

Dry channel with a small oak approximately 10 m tall and ocotillo scattered through the uplands. Mesquite bosque on the west bank contains trees up to approximately 15 m tall. Hopbush, Arizona cotton and dense bunchgrass comprise the understory vegetation within the channel and nearby banks. This plot has appeared to change little from 2007-2010. The bunchgrass contains slightly more basal and canopy cover, and the abundant prickly pear has grown but is harder to validate in the photos.

Point 17

Dry channel with small walnut tree (2.5 m tall) and ash recruitment. Coral bean and Arizona cotton exist in the understory along with mesquite to 10 m. Large ash to 10-15 m tall are upstream from the plot within the channel. The young ash tree in the background is noticeably taller in 2010 than in the initial years of photography. The bunchgrasses are slightly larger (taller with more canopy cover and basal area) and the prickly pear and mesquite appear only slightly larger.

Point 18

Dry channel with ash recruitment up to 4 m and mesquite on the north and west banks to 20 m. There is a large oak upstream from plot center that is approximately 25 m tall. In August 2007 and 2008 there was much more standing water depth in the channel concurrent with much higher annual growth when compared to August 2009. The bunchgrasses appear to be about the same height and density in 2010 as in 2007-2009. The larger trees also appear about the same size and height except for the ash in the north angle, which has grown taller. There is also a snag in the channel that fell and remains in the channel as down.

Point 19

Dry channel containing large walnut tree approximately 20 m tall that appears to be slowly senescing. Ash saplings are in the channel. Mesquite bosque north of channel containing tree heights to 15 m and large oaks upstream approximately 20 m tall. The ash tree in the foreground in the north camera angle appears to have grown several feet in the last 2.5 years. This is evident by this tree's height above the mountain horizon in the background. The bunchgrass and bare ground appear to have changed little during the years this plot was photographed.

Point 20

Large walnut tree approximately 20 m is almost a snag but still contains some green leaves (similar amounts of growth in August 2007-2010). Large desert broom on the banks and mesquite to 10-15 m. There are also ash trees north and east of plot center and ash saplings in the channel. All of the walnut trees are drought-stressed to some degree with branch die-back and dead wood comprising most of the mass. The desert broom appears to be about the same size as in previous years, and bunchgrass and bare ground appear to be about the same as in 2007-2009.

Point 21

Small pools in a boulder strewn channel containing ash saplings and bunchgrass. In August 2009 the pools are much smaller than in the previous two August visits (2007-2008). Rock outcrops with shin-dagger surround plot center with scattered oaks to 10-15 m tall and some ash

recruitment in the channel. The bunchgrass appears to have grown taller and denser in 2010 than in the previous years of repeat photography. There is also more water in the channel during April 2010 than in the previous two April visits in 2008 and 2009.

Point 22

Small pools in channel with large stand of ash 20-25 m tall. Small mesquite trees to 5 m tall are scattered throughout the uplands. Oak to approximately 8 meters tall and agave occur in the foothills. The upland vegetation remains effectively the same, including the bunchgrass component that appears heavily grazed. However, the ash trees in the channel, particularly the young ash trees in the east and south photo angles, have grown taller.

Point 23

Spring fed small pools percolate through boulders along the main channel. Growing along the banks are 10-15 m tall ash. A rock outcrop dominates the east bank. Desert broom and mesquite in the foreground range between 1 and 4 m tall. Bunchgrass is fairly dense along the channel banks. This plot has changed little since repeat photography commenced in 2007.

Point 24

Dry channel with a few ash saplings to 5m tall. Mesquite between 1-4 m tall and containing a grazed understory allowing sparse bunchgrass growth; mostly annual growth during wet periods. Large oaks downstream up to 15-20 m tall.

Point 25

This point contains a tinaja that usually has a large amount of water with longfin dace, bullfrogs and Sonoran mud turtles. There are several large boulders around the tinaja and a few scattered oaks from 5-10 m tall. Several larger oaks from 10-15 m in height exist downstream and are apparent in the west photo angle. Small mesquite from 5-10 m in height also exist in the surrounding foothills. Bunchgrasses are relatively dense, growing along the channel and the surrounding foothills. Yucca, prickly pear, desert broom and a diverse array of annuals also comprise this point.

Conclusion of Songbird and Vegetation Monitoring

Southeastern Arizona contains one of the most diverse avian assemblages in the United States due principally to the state's shared border with Mexico. This proximity to Mexico has allowed Arizona to support an infusion of neotropical species at the northern limits of their distribution, many of which have expanded northward within the last century. The Coal Mine Canyon property is in the heart of southeastern Arizona and therefore benefits from this Mexican influence in not just bird species, but several plants, mammals, fish and herpetofauna also. Not only is Coal Mine Canyon in some of the richest country within Arizona, it is ultimately a tributary of Sonoita Creek that is arguably the richest wildlife region in southeastern Arizona. This wealth of diversity is manifested by several observations from these surveys conducted within Coal Mine Canyon including: Gila topminnow, northern beardless tyrannulet, yellow-billed cuckoo, southwestern willow flycatcher (non-breeding) and a streak-backed oriole. Between August 2007 and April 2010, a total of 98 bird species were detected on surveys conducted within Coal Mine Canyon. However, these surveys only provided a snapshot in time and have thus, only scratched the surface of the potential for what actually exists in the region.

The majority of Coal Mine Canyon is ephemeral and only contains permanent water in a few small springs and tinajas scattered throughout the drainage. As the repeat photography demonstrates, the weather at Coal Mine Canyon is strongly influenced by bimodal episodic events during the monsoon and prolonged winter rains. The August visits (with in-stream flow) were predominately far wetter than those in April (predominately dry channel), indicating that monsoon probably has a strong if not stronger influence than the winter storms. The repeat photography was conducted over a brief period of time (August 2007-April 2010) and is not enough to draw large conclusions. However, it is apparent that most of the young ash trees have increased in height and canopy cover, and the bunchgrasses have generally increased in basal area and canopy cover, with a concomitant decrease in bare ground. This pattern of increasing perennial grass cover should continue with the exclusion of cattle grazing that will start this year.

The Species Richness and Margalef's Indices provide value to analyzing the bird data. For the months and years surveyed in Coal Mine Canyon, both of the index values changed slightly but not significantly. This could indicate a relatively stable system. However, caution is emphasized when interpreting data collected over a short duration. Especially for bird data, long-term data on the magnitude of 20-30 years (minimum) is required to make significant inferences. Furthermore, birds are very difficult to study because of their dynamic nature as defined by multiple brooding, nest failures, migrating individuals and their reliance on monsoon activity in southeastern Arizona (to name a few).

Nevertheless, the avian community of the Coal Mine Canyon property is probably stable in part because of the remote location and minimal anthropogenic impacts. During 2.5 years of April and August visits to the property, no illegal immigrant activity was documented, and minimal evidence for their use was observed. Similarly, during surveys on adjacent Sonoita Creek in 2010, neither illegal immigrants nor their sign were observed, suggesting that the Coal Mine Canyon vicinity sees minimal immigrant use. Whereas Sonoita Creek is exposed to relatively high recreationist use due to its proximity to Rio Rico, Coal Mine Canyon is much more remote to public use and provides a less disturbed area for wildlife to exist.

Fish Monitoring

Coal Mine Canyon is deemed important habitat for the recovery of the endangered Gila topminnow *Poeciliopsis occidentalis* (POOC) and is also habitat for the unlisted native longfin dace *Agosia chrysogaster* (AGCH). Both species currently persist in isolated locations in the lower portions of the drainage.

Occupied fish habitat is expected to improve over time as the property is fenced and grazing is eliminated, and fish may expand into previously unoccupied areas, either naturally or with management assistance. To gather baseline data for future evaluations of improvements, AZGFD conducted a three-year biannual fish population-monitoring project to evaluate the numbers and location of the existing fish populations.

Methods

Coal Mine Canyon was surveyed from the headwaters downstream to the boundary with the Sonoita Creek State Natural Area. Known perennial, potentially perennial, and some ephemeral waters were selected as fixed sites to monitor beginning in October 2007 (Figure 4).

In known and potential perennial pools 1/4 inch and 1/16 inch mesh minnow traps were baited with Aquamax pellet fish food and set to capture all age classes of fish species present. Sites were photographed with a Canon Powershot A550 digital camera and mapped with a Garmin GPSmap76S. Width and length of wetted habitat were measured using a range finder. Average depth of wetted habitats was measured, except that depth was estimated at Coal Mine Spring (photo point 2) because it was greater than could be measured with available equipment. Percent canopy cover, when present, was determined using a densiometer. Estimates were made of percent shoreline vegetation and percent aquatic vegetation. Species of shoreline vegetation were identified. Up to three types of dominant substrates were identified at each photo point.

Fish sampling in April 2007 was completed using a backpack electro-shocker, minnow traps, and a beach seine. Given the variety of habitats encountered, minnow traps were the most suitable method for collection of fish in Coal Mine Canyon. Thus, starting in October 2007, we standardized the fish sampling to only use minnow traps. Therefore the April 2007 fish sampling dataset is not comparable to later surveys. In April 2008, some of the traps at photo points 1-3 were set near the surface and some were completely submerged. In October 2007, October 2008, April 2009, and October 2009 all traps were set near the surface of the water column. All fish captured were counted and identified.

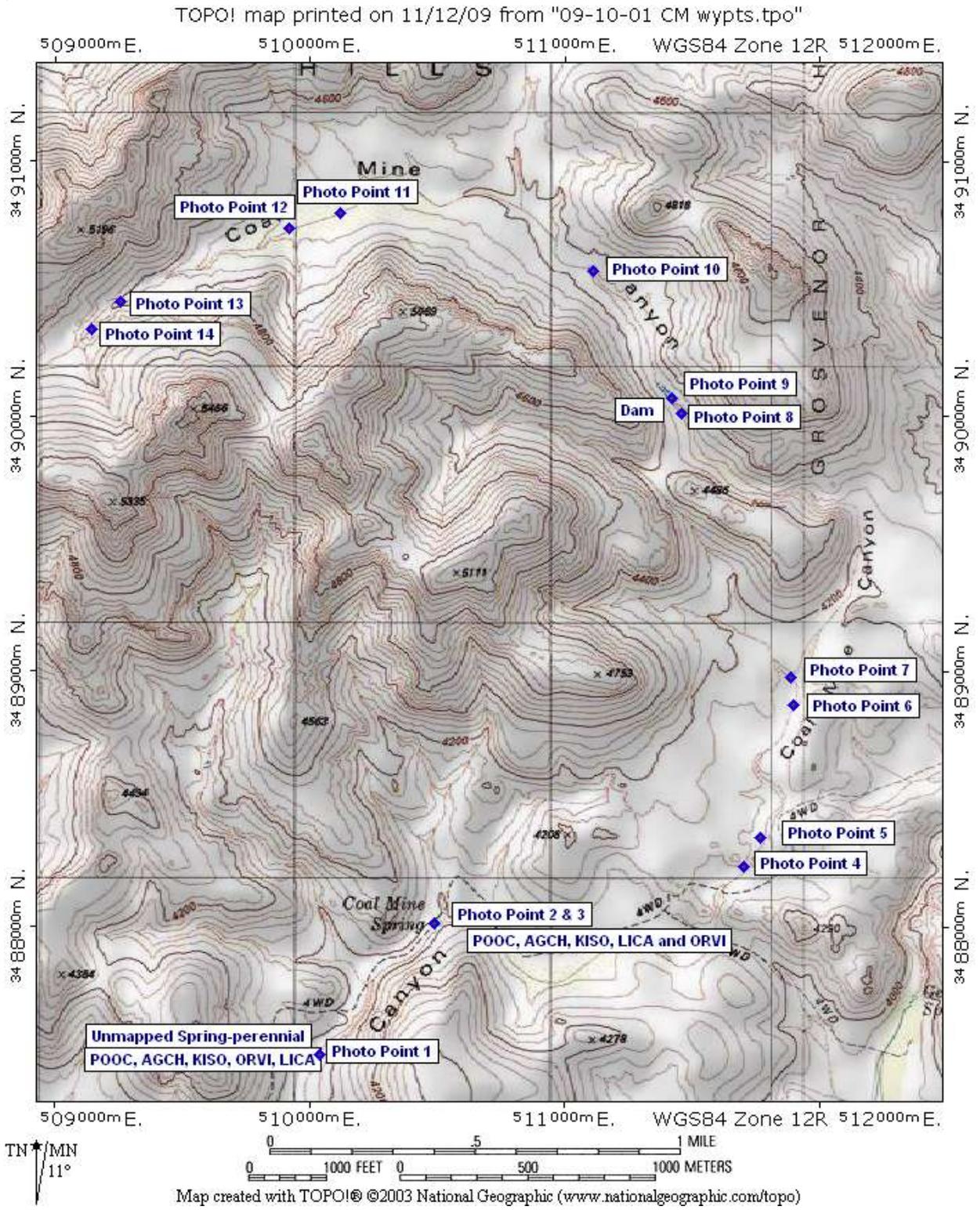


Figure 4. Fish monitoring sites in Coal Mine Canyon.

Because data from the first survey period was not comparable to later survey periods, the Arizona Water Protection Fund allowed AZGFD to survey an additional season. During May 1 and 2, 2010 personnel from the Department's Nongame Branch out of Phoenix conducted follow up fish surveys of Coal Mine Canyon. Protocols established during previous surveys were followed. However, data sheets produced during that survey period were lost. Although no data on fish numbers are available, employees that conducted the surveys report that Gila topminnow remained abundant in May 2010 in all locations previously occupied. Longfin dace also remained abundant at Coal Mine Spring as well. Employees were able to provide some pictures of previously documented photo points from the May 2010 survey, and those photos have been included in this document.

Non-native northern crayfish *Oronectes virilis* (ORVI) and bullfrogs *Lithobates catesbiana* (LICA) were enumerated on shore and removed from the system. All Sonora mud turtles *Kinosternon sonoriense* (KISO) were counted and released where they were captured. Aquatic and interesting animal species sightings were also recorded.

Relative abundance was measured using catch per unit effort (CPUE) which is the number of fish, crayfish, and turtles captured per trap divided by the number of hours the trap was set.

Water quality data were collected during earlier surveys at the unmapped spring downstream of Coal Mine Spring (photo point 1), at Coal Mine Spring (photo point 2), and above the dam (photo point 9). A pH & EC combo probe was used to record pH and temperature. Water quality was not measured at the unmapped spring in April 2009 due to equipment malfunction. Due to equipment failure no water quality data were collected in October 2009.

Precipitation data was recorded from National Oceanic and Atmospheric Administration (NOAA) records for Patagonia, which is the closest recorded site.

Results and discussion of fish monitoring

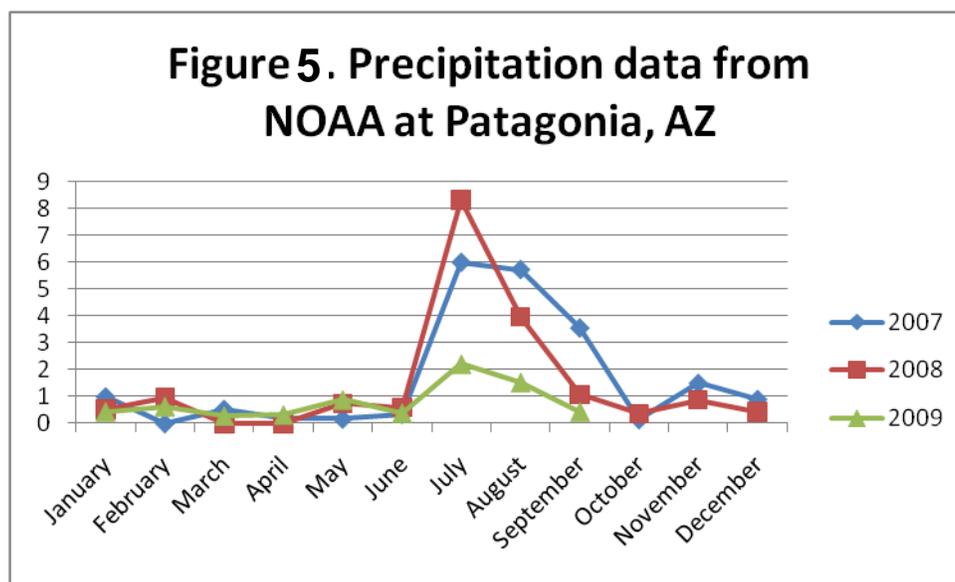
Pools of water exist throughout the Coal Mine canyon drainage, but during dry times standing water does not generally persist above photo point 3. Although no water remained behind the dam at photo point 9 in dry times, a small puddle or seep of water below the dam at photo point 8 persisted in all survey periods. This may indicate that water occurs just below the surface of the stream in this area.

Photos that document the fish habitat are provided in Appendix C.

Water temperature and pH appear normal for a desert stream (Table 4).

Date	Location	Time	Temperature (°C)	pH
04/08	Photo Point 1	1130	16.7	7.90
10/08		1540	24.5	7.36
10/07	Photo Point 2	0900	16.9	8.76
04/08		0934	15.0	9.30
10/08		1348	26.1	8.42
04/09		1033	20.0	9.04
10/07	Photo Point 9	0900	12.7	7.95

Habitat data for all watered areas are shown in Table 5. No trend was observed in water levels during the survey period. Rather, seasonal and annual water levels related to respective precipitation (see precipitation data from NOAA in Figure 5). October 2008 had the most surface water compared to other survey periods due to abundant late summer rains during the summer monsoon season of 2008. April 2009 had the least surface water, when 9 of the 14 monitored sites were completely dry. This may be the result of slightly decreased rainfall during the winter of 2008-2009. Conditions did not improve very much from April 2009 to October 2009 due to reduced summer rains.



Willows, ash, oaks, junipers, desert broom, and deer grass were common throughout the drainage. Aquatic vegetation, canopy cover, and shoreline vegetation was related to the amount of water present. There was more vegetation present during the October 2008 survey in comparison to all other survey periods. This difference is most likely associated with the abundance of water associated with the summer rains in 2008. Primary, secondary, and tertiary substrates (where present) of wetted habitats were recorded in Table 5. Amounts of vegetative cover and types of substrate may be valuable to compare with post-fence surveys to see if changes have occurred.

Table 5. Watered habitat data collected at fixed monitoring sites in Coal Mine Canyon.

Photo Point	Date	Easting	Northing	Survey Method	Fish Present	Length (m)	Width (m)	Avg. Depth (m)	% Aquatic Vegetation	% Canopy Cover	% Shoreline Vegetation	1° Substrate	2° Substrate ¹	3° Substrate ¹
1	04/07	510043	3487495	Visual	Yes	34.9	6.3	0.5	0	55	75	Sand/Fine	Bedrock	-
	10/07			39.6		6.6	1.0	<1	52	50	Cobble	Bedrock	Sand	
	04/08			39.1		7.9	0.6	<1	50	50	Gravel	Cobble	Bedrock	
	10/08			41.5		7	0.67	<1	56	87	Gravel	Cobble	Bedrock	
	04/09			30		7	0.6	0	42	50	Gravel	Bedrock	Cobble	
	10/09			19		4	0.3	<1	37	0	Gravel	Cobble	Bedrock	
2	04/07	510490	3488014	Trap	Yes	14.8	12.2	>2	0	<1	<1	Sand/Fine	Bedrock	-
	10/07					18	15	>3	0	<1	0	Sand	Bedrock	-
	04/08					18.1	14.6	>2	0	<1	0	Gravel	Bedrock	-
	10/08					21.5	18.8	>2	0	<1	10	Gravel	Bedrock	-
	04/09					19	15	>2	0	<5	0	Gravel	Bedrock	-
	10/09					16	13	>2	0	<1	0	Gravel	Bedrock	-
3	04/07	510541	3488074	Seine	Yes	6.3	3.3	0.75	0	40	3	Sand/Fine	Bedrock	-
	10/07			22		12	>2	0	<1	0	Sand	-	-	
	04/08			12.9		11	0.6	0	<1	0	Gravel	Cobble	Bedrock	
	10/08			29.2		5.3	1+	0	<1	5	Gravel	Cobble	Bedrock	
	04/09			23		10	0.6	0	<5	0	Gravel	Bedrock	-	
	10/09			21		5	0.6	0	<1	0	Gravel	Bedrock	-	
4	10/07	511702	3488287	Trap	No	18	6.2	0.75	0	0	0	Sand	Bedrock	-
	04/08			16.6		4.5	0.5	35	0	0	Gravel	Bedrock	-	
	10/08			32.6		2.7	0.7	3	0	2	Gravel	Cobble	Bedrock	
	04/09			Dry Site				0	0	Bedrock	Gravel	Cobble		
	10/09			10		5	0.2	30	0	1	Gravel	Bedrock	-	
5	10/07	511769	3488350	Visual	No	11	2.5	0.3	50	0	0	Sand	Bedrock	-
	04/08					Dry Site				0	0	Gravel	Cobble	Bedrock
	10/08					37.2	4.3	0.6	8	0	5	Gravel	Cobble	Bedrock
	04/09					Dry Site				0	0	Gravel	Bedrock	Cobble
	10/09					Dry Site				0	0	Gravel	Cobble	-
6	10/07	511896	3488870	Visual	No	5	3	0.2	0	0	0	Bedrock	Cobble	Organics
	04/08					4	2	0.1	45	<1	0	Bedrock	Cobble	-
	10/08					27	3.4	0.4	10	<1	8	Bedrock	Gravel	Cobble

Table 5. Watered habitat data collected at fixed monitoring sites in Coal Mine Canyon.

Photo Point	Date	Easting	Northing	Survey Method	Fish Present	Length (m)	Width (m)	Avg. Depth (m)	% Aquatic Vegetation	% Canopy Cover	% Shoreline Vegetation	1° Substrate	2° Substrate ¹	3° Substrate ¹
	04/09					Dry Site				0	0	Gravel	Cobble	Bedrock
	10/09					Dry site				20	0	Bedrock	Silt/fine	Cobble
7	10/07	511887	3488979	Visual	No	5	2	0.2	50	0	0	Organics	Bedrock	Cobble
	04/08					9	2	0.2	0	0	Silt/fine	Cobble	-	
	10/08					18.4	2	0.5	45	0	20	Bedrock	Cobble	Gravel
	04/09					Dry Site				0	0	Bedrock	Gravel	Cobble
	10/09					Dry Site				0	0	Silt/fine	Bedrock	-
8	10/07	511455	3490012	Trap	No	8	2	0.3	90	8	0	Sand	Bedrock	Cobble
	04/08					5	5	0.5	100	10	0	Silt/fine	-	-
	10/08					17	8	1.3	5	10	45	Silt/fine	Cobble	-
	04/09					2	1	0.1	100	10	0	Bedrock	Cobble	Silt/Fine
	10/09					8	1	0.1	100	30	0	Bedrock	Cobble	Silt/Fine
9	10/07	511421	3490069	Trap	No	75	15	1	80	0	0	Organics	Sand	-
	04/08					12	4	0.4	5	0	0	Silt/Fine	-	-
	10/08					60.2	20.3	*	100	0	9	Silt/Fine	-	-
	04/09					Dry Site				0	0	Silt/Fine	-	-
	10/09					Dry Site				0	0	Silt/Fine	-	-
10	10/07	511108	3490572	Visual	No	2.5	1	0.35	0	0	0	Bedrock	-	-
	04/08					3	2	0.2	30	0	0	Bedrock	-	-
	10/08					18.7	8.4	0.3	20	0	7	Bedrock	Cobble	-
	04/09					Dry Site				0	0	Bedrock	Cobble	-
	10/09					2	1	0.1	0	<1	0	Bedrock	Gravel	-
11	10/07	510116	3490797	Visual	No	1.5	0.5	0.10	0	0	0	Bedrock	-	-
	04/08					20.5	2	0.17	20	0	0	Bedrock	-	-
	10/08					24.7	3.2	0.3	5	0	25	Bedrock	Cobble	-
	4/09					Dry Site				0	0	Bedrock	-	-
	10/09					2.5	2	0.1	20	0	0	Bedrock	-	-
12	10/07	509915	3490735	Visual	No	4	1	0.10	0	0	0	Bedrock	-	-
	04/08					17	3	0.1	30	0	0	Bedrock	-	-
	10/08					25.9	2.7	0.2	30	0	60	Bedrock	-	-
	04/09					Dry Site				0	0	Bedrock	-	-

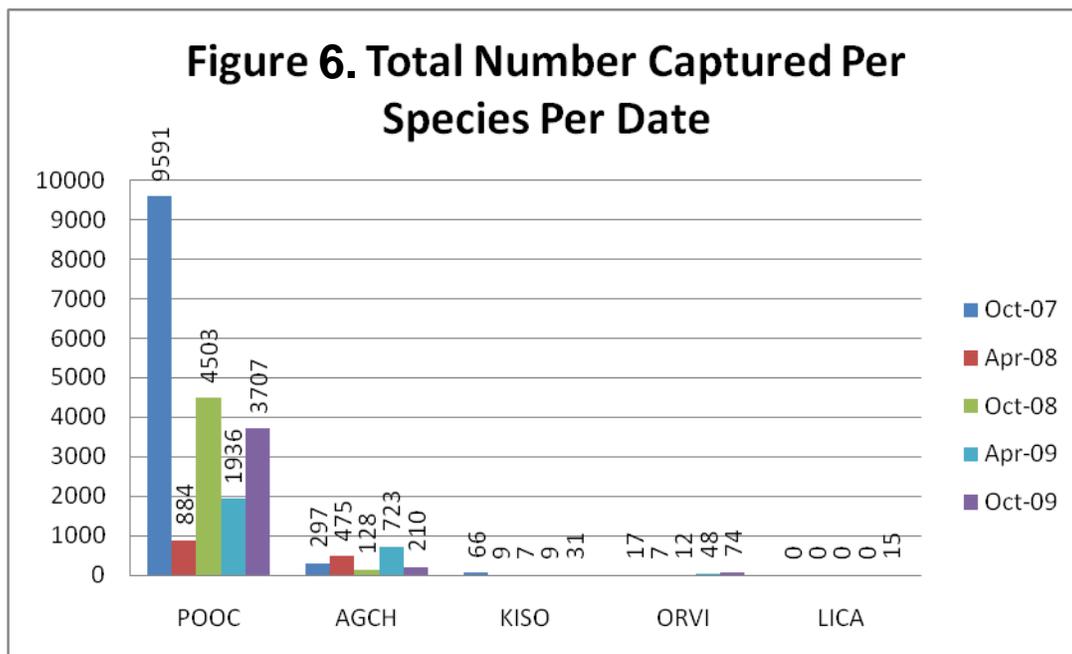
Photo Point	Date	Easting	Northing	Survey Method	Fish Present	Length (m)	Width (m)	Avg. Depth (m)	% Aquatic Vegetation	% Canopy Cover	% Shoreline Vegetation	1° Substrate	2° Substrate ¹	3° Substrate ¹
	10/09					7 ²	2	0.1	0	0	0	Bedrock	-	-
13	10/07	509256	3490448	Visual	No	2	1	0.25	0	0	0	Bedrock	-	-
	04/08					5	3	0.2	10	0	0	Bedrock	-	-
	10/08					8.3	2.3	0.2	15	0	0	Bedrock	Cobble	-
	04/09					1.75	1.3	0.1	10	0	0	Bedrock	-	-
	10/09					7	3	0.2	0	0	0	Bedrock	-	-
	10/07					509140	3490340	Visual	No	2	0.5	0.20	0	0
04/08	2	0.5	0.1	15	0					0	Bedrock	-	-	
10/08	2.8	0.7	0.1	4	0					0	Bedrock	-	-	
04/09	Dry Site				0					0	0	Bedrock	-	-
10/09	2	0.75	0.1	0	0					0	Bedrock	-	-	

¹ A dash denotes no other substrate type was identified

²Site was divided into 2 pools; second pool was smaller in dimensions

* Depth unknown due to inability to adequately measure or visually estimate

Figure 6 and Tables 6 and 7 show the numbers of aquatic species captured. Gila topminnows have been present in abundance at Coal Mine Spring (photo point 2) and at the unmapped spring further downstream (photo point 1) for all 6 survey periods. Gila topminnows were not captured at the pool above Coal Mine Spring (photo point 3) in April 2008 and April 2009, but were abundant at this location in all other survey periods. Gila topminnow was the most abundantly caught aquatic species. No exotic fish species were captured in the canyon.



*April 2007 data is not included in this figure because the methods used to sample for fish are not comparable to later survey periods and therefore the data is not comparable to later datasets

Longfin dace persist at the unmapped spring downstream of Coal Mine Spring (photo point 1), Coal Mine Spring (photo point 2), and the pool above Coal Mine Spring (photo point 3). Overall, they appear to be more abundant at the unmapped spring (photo point 1) and Coal Mine Spring (photo point 2).

During all surveys, both Gila topminnow and longfin dace were in breeding condition; gravid female topminnows and male longfin dace with tubercles were documented from all 6 survey periods.

Until October 2009, no bullfrogs were captured and only a few adult bullfrogs were sighted during each survey. This changed in October 2009. Seven bullfrog tadpoles were captured in the pool above Coal Mine Spring (photo point 3) and 8 tadpoles were captured in the unmapped spring (photo point 1). Bullfrog tadpoles have been documented by ASP personnel in the Coal Mine drainage at the unmapped spring (photo point 1) and further downstream (pers. comm. Steve Haas 11/12/09). Tadpoles have not yet been documented at Coal Mine Spring.

Table 6. Capture data from 1/16-inch mesh traps in Coal Mine Canyon											
Location	Date	# of Traps	Total Trap Hours	Total # POOC	Total # AGCH	Total # KISO	Total # ORVI	CPUE			
								POOC	AGCH	KISO	ORVI
Photo Point 1 Spring below Coal Mine	*04/07	0 ¹	0	200+	200+	0	0	-	-	-	-
	10/07	6	35.56	5414	10	12	1	152.24	0.28	0.34	0.03
	4/08	6	22.20	864	256	0	0	38.91	11.53	0	0
	10/08	6	25.43	1744	1	1	8	68.58	0.04	0.04	0.31
	04/09	6	17.95	1196	88	2	43	66.63	4.90	0.11	2.40
Photo Point 2 Coal Mine Spring	*04/07	11 ²	39.39	487	99	5	0	12.36	2.51	0.13	0
	10/07	5	30.10	3476	273	14	0	105.72	8.71	0.33	0
	4/08	5	19.10	20	200	1	4	1.05	10.47	0.05	0.2
	10/08	5	21.26	1937	97	1	0	91.11	4.56	0.05	0
	04/09	5	17	740	528	2	0	43.52	31.05	0.12	0
Photo Point 3 Pool above Coal Mine	*04/07	0 ³	0	307	356	0	16	15.5 ³	17.98	0	0.81
	10/07	2	12.40	700	10	0	0	56.43	0.81	0	0
	4/08	2	9.50	0	19	2	0	0	2.00	0.21	0
	10/08	2	3.50	717	17	0	0	204.86	4.85	0	0
	04/09	2	10.33	0	85	0	1	0	8.22	0	0.01
Photo Point 8 Below Dam	10/07	2	38.34	0	0	3	0	0	0	0	0
	4/08	2	7.80	0	0	3	0	0	0	0.38	0
	10/08	2	6.76	0	0	0	0	0	0	0	0
	04/09	Site too shallow to trap									
	10/09	Site too shallow to trap									
Photo Point 9 Above Dam	10/07	3	** Capture Data from 1/4-inch and 1/16-inch mesh traps were pooled at this site. KISO only captured.								
	4/08	3	12.0	0	0	0	0	0	0	0	0
	10/08	3	11.75	0	0	0	0	0	0	0	0
	04/09	Dry site									
	10/09	Dry site									

* Highlighted areas indicate April 2007 dataset when different methods were utilized in fish sampling. Data are not comparable to other sampling periods.

¹ Fish sampling was accomplished by observation only.

² Fish sampling was accomplished by 1/16 inch mesh trap.

³ Fish sampling was accomplished using a seine with 1/8-inch mesh size, and CPUE was calculated by dividing the number of fish over the area (m²) sampled.

**Only 16 KISO were captured over 174.48 hours in October 2007 at site 9. These numbers are the pooled data for October 2007 at site 9 for 1/4 -inch and 1/16-inch traps. No other species were captured at this site.

Table 7. Capture data from 1/4-inch mesh traps in Coal Mine Canyon

Location	Date	# of Traps	Total Trap Hours	Total # POOC	Total # AGCH	Total # KISO	Total # ORVI	CPUE			
								POOC	AGCH	KISO	ORVI
Photo Point 1 Spring below Coal Mine	10/07	2	12.14	1	2	16	2	0.08	0.16	1.32	0.16
	4/08	2	9.20	0	0	0	0	0	0	0	0
	10/08	2	8.56	1	0	0	4	0.12	0	0	0.47
	04/09	2	5.98	0	0	1	2	0	0	0.20	0.33
	10/09	2	9.58	0	6	2	8	0	0.63	0.21	0.84
Photo Point 2 Coal Mine Spring	10/07	3	17.75	0	2	5	14	0	0.11	0.28	0.78
	4/08	3	11.4	0	0	4	3	0	0	0.35	0.26
	10/08	3	12.87	104	13	1	0	8.08	1.01	0.08	0
	04/09	3	10.4	0	22	4	2	0	2.12	0.38	0.19
	10/09	3	10.07	2	2	6	0	0.20	0.20	0.60	0
Photo Point 9 Above Dam	10/07	6	**Capture Data from 1/4-inch and 1/16-inch mesh traps were pooled at this site. KISO only captured.								
	4/08	6	23.2	0	0	2	0	0	0	0.09	0
	10/08	6	23.6	0	0	4	0	0	0	0.17	0
	04/09	Dry Site									
	10/09	Dry Site									

**Only 16 KISO were captured over 174.48 hours in October 2007 at site 9. These numbers are the pooled data for October 2007 at site 9 for 1/4 -inch and 1/16-inch traps. No other species were captured at this site.

A total of sixty-six Sonora mud turtles *Kinosternon sonoriense* (KISO) were captured in Coal Mine Canyon in October 2007. Since then numbers of turtles captured have been much lower.

A black-necked gartersnake *Thamnophis cyrtopsis* (THCY) was observed at Coal Mine Spring in three of the surveys.

Cattle and cattle sign were observed on all surveys, but overall the riparian area was not heavily impacted by cattle.

Conclusion of fish monitoring

The fence at Coal Mine Canyon has just been completed. These pre-fence fish surveys provide baseline data which can be used in the future to compare with post-fence fish monitoring data.

Data indicate that there are no invasive fish present in Coal Mine Canyon, which is important to continue documenting.

Gila topminnow and longfin dace are abundant in Coal Mine Canyon. Surveys over the last 3 years show that the Gila topminnow and longfin dace are persistent at Coal Mine Spring (photo point 2) and below, and that both occasionally occupy the pool above Coal Mine (photo point 3). No fish (native or exotic) have been documented up-canyon from the pool above Coal Mine Spring (none above photo point 3), indicating that fish have not expanded upstream above this location.

Gila topminnow numbers are highly variable. The difference in the number of fish caught between seasons and years may indicate: 1) differences in actual fish numbers present, 2) sampling differences due to different depths which some of the traps were placed, 3) sampling differences due to differences in the amount of water present during sampling periods.

Based on data and observations by AZGFD and ASP personnel, bullfrog abundance continues throughout wetted reaches of the watershed. Steve Haas, a ranger with ASP, has observed bullfrog tadpoles in Coal Mine Canyon, though not in abundance until summer of 2009. Since then ASP has seen an increase in bullfrog abundance.

Crayfish are abundant in Coal Mine Canyon. Since 2007 ASP has been working with the help of boy scouts to trap for crayfish in autumn each year. They documented little depletion in crayfish numbers after multiple trappings, indicating that trapping did not significantly reduce numbers of crayfish. Their traps were placed at the bottom of the water column. We have not captured many crayfish during our surveys, probably because our traps were set at the surface or in the middle of the water column rather than at the bottom.

Based on the dry conditions in much of Coal Mine Canyon in 2009, we are concerned about the persistence of wetted habitat in the canyon. Continued drought conditions could have a negative effect on native fish populations in Coal Mine Canyon.

Although data sheets were misplaced from the May 2010 survey, surveyors remember that native fish were still abundant in the same locations as previous survey periods. Photos do not show any significant difference in water availability in May 2010.

The Arizona Water Protection Fund Commission has funded a portion of this Project. The views or findings presented are the Grantee's and do not necessarily represent those of the Commission, the State, or the Arizona Department of Water Resources.

References

- Bibby, C. J., Burgess, N. D., Hill, D. A. and Mustoe, S. H. 2000. Bird Census Techniques, Second Edition. Academic Press, San Diego. 302 pp.
- Blackman, S. T, and D. D. Grandmaison. 2007. Avian density and diversity on Camp Navajo, Arizona: 2006 Progress Report. Research Branch, Arizona Game and Fish Department, Phoenix.
- Buckland S.T., Anderson, D. R., Burnham, K. P. and Laake, J. L. 2001. Distance Sampling: Estimating Abundance of Biological Populations. Chapman and Hall, London. 446pp.
- Corman, T. E. and Wise-Gervais, C. 2005. Arizona Breeding Bird Atlas. University of New Mexico Press, Albuquerque, NM.
- Leukering, T., Carter, M., Panjabi, A., Faulkner, D., and Leivad, R. 1998. Rocky Mountain Bird Observatory Point Transect Protocol: Revised May 2006. Rocky Mountain Bird Observatory, Brighton, CO, 113 pp.
- Wilson, D. E., Cole, R. F., Nichols, J. D., Rudran, R. and Foster, M. S. 1996. Measuring and Monitoring Biological Diversity: Standard Methods for Mammals (Biological Diversity Handbook Series). Smithsonian Institution Press.

Appendix A

Photos of Fence Construction

Photos of Coal Mine Fence December 2007



Photo #1



Photo #2



Photo #3



Photo #4



Photo #5



Photo #6



Photo #7



Photo #8



Photo #9



Photo #10



Photo #11



Photo #12



Photo #13

Photo #14

Photos of Coal Mine Fence April 2009



Photo #1



Photo #2



Photo #3



Photo #4



Photo #5



Photo #6



Photo #7

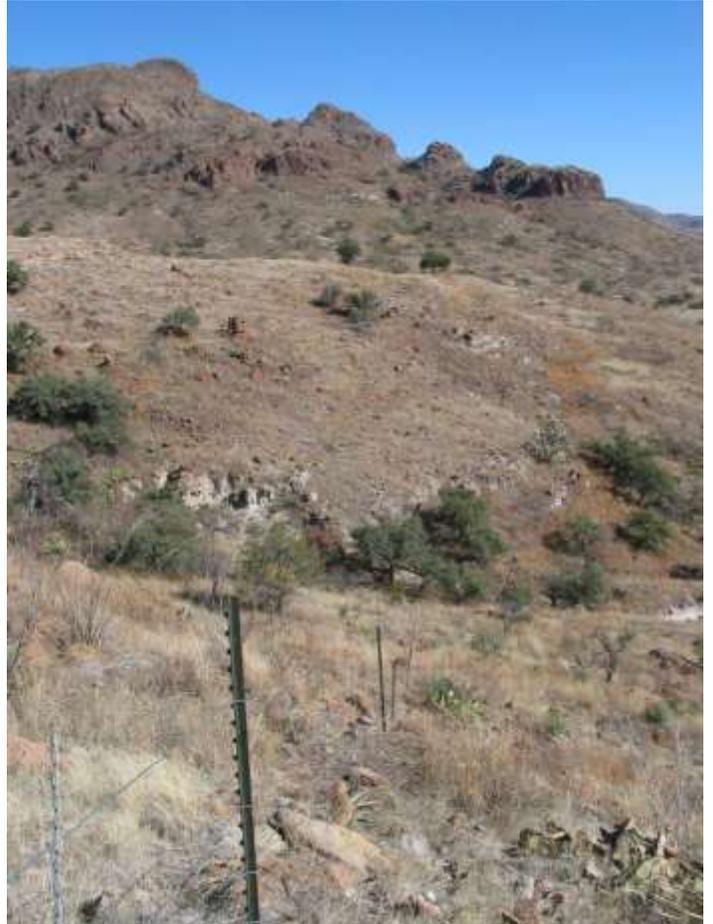


Photo #8



Photo #9

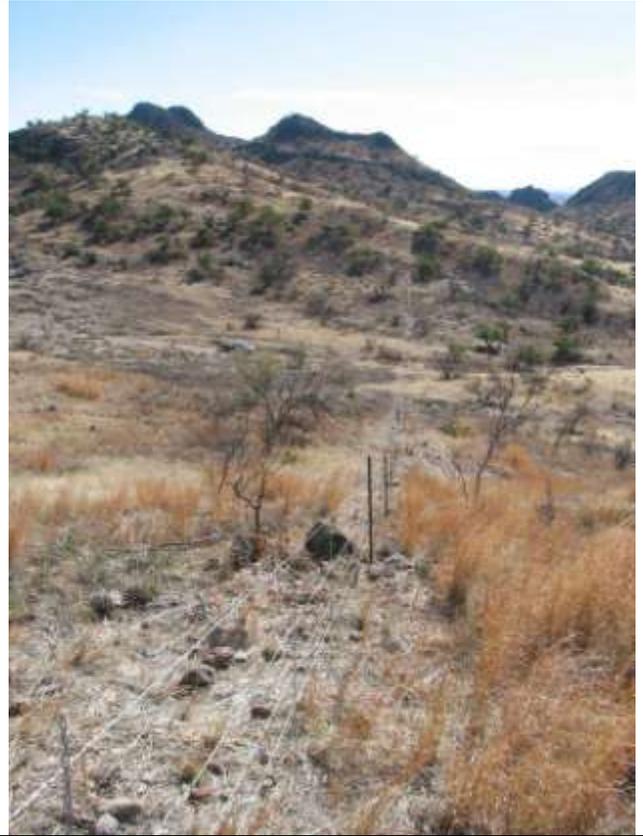


Photo #10



Photo #11



Photo #12



Photo #13

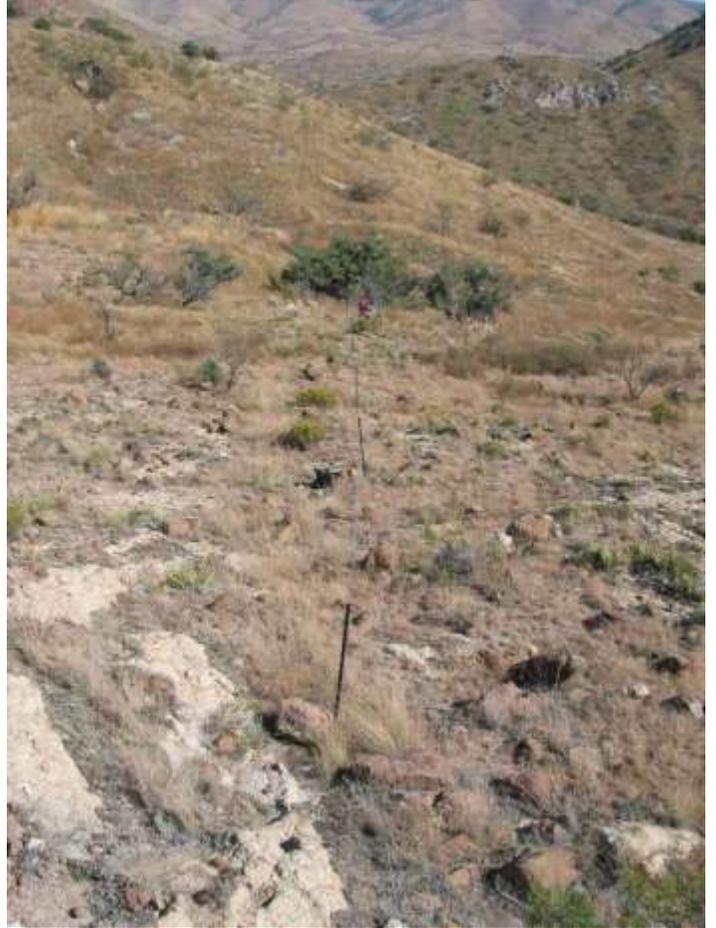


Photo #14



Photo #15



Photo #16



Photo #17



Photo #18



Photo #19



Photo #20



Photo #21



Photo #22



Photo #23



Photo #24



Photo #25



Photo #26



Photo #27



Photo #28



Photo #29



Photo #30



Photo #31



Photo #32



Photo #33



Photo #34

Photos of Coal Mine Fence Construction December 2009



Photo #1



Photo #2



Photo #3



Photo #4



Photo #5



Photo #6



Photo #7



Photo #8



Photo #9



Photo #10



Photo #11



Photo #12



Photo #13



Photo #14



Photo #15



Photo #16



Photo #17



Photo #18



Photo #19



Photo #20



Photo #21



Photo #22



Photo #23



Photo #24



Photo #25



Photo #26



Photo #27



Photo #28



Photo #29



Photo #30



Photo #31



Photo #32



Photo #33



Photo #34



Photo #35



Photo #36



Photo #37



Photo #38



Photo #39



Photo #40



Photo #41



Photo #42



Photo #43



Photo #44



Photo #45



Photo #46



Photo #47



Photo #48



Photo #49



Photo #50



Photo #51



Photo #52



Photo #53



Photo #54



Photo #55



Photo #56



Photo #57



Photo #58



Photo #59



Photo #60



Photo #61



Photo #62



Photo #63



Photo #64

Appendix B
Photos of Vegetation

**Photos of Coal Mine Vegetation Monitoring
8/17/007
Photopoint 1**



CM1 North



CM1 East



CM1 South



CM1 West

**Photos of Coal Mine Vegetation Monitoring
8/17/007
Photopoint 2**



CM2 North



CM2 East



CM2 South



CM2 West

**Photos of Coal Mine Vegetation Monitoring
8/17/007
Photopoint 3**



CM3 North



CM3 East



CM3 South



CM3 West

**Photos of Coal Mine Vegetation Monitoring
8/17/007
Photopoint 4**



CM4 North



CM4 East



CM4 South



CM4 West

**Photos of Coal Mine Vegetation Monitoring
8/17/07
Photopoint 5**



CM5 North



CM5 East



CM5 South



CM5 West

**Photos of Coal Mine Vegetation Monitoring
8/17/007
Photopoint 6**



CM6 North



CM6 East



CM6 South



CM6 West

**Photos of Coal Mine Vegetation Monitoring
8/17/007
Photopoint 7**



CM7 North



CM7 East



CM7 South



CM7 West

**Photos of Coal Mine Vegetation Monitoring
8/17/007
Photopoint 8**



CM8 North



CM8 East



CM8 South



CM8 West

**Photos of Coal Mine Vegetation Monitoring
8/17/007
Photopoint 9**



CM9 North



CM9 East



CM9 South



CM9 West

**Photos of Coal Mine Vegetation Monitoring
8/17/007
Photopoint 10**



CM10 North



CM10 East



CM10 South



CM10 West

**Photos of Coal Mine Vegetation Monitoring
8/17/007
Photopoint 11**

<p>No Photo</p>	<p>No Photo</p>
<p>CM11 North</p>	<p>CM11 East</p>
<p>No Photo</p>	<p>No Photo</p>
<p>CM11 South</p>	<p>CM11 West</p>

**Photos of Coal Mine Vegetation Monitoring
8/17/007
Photopoint 12**



CM12 North



CM12 East



CM12 South



CM12 West

**Photos of Coal Mine Vegetation Monitoring
8/17/07
Photopoint 13**



CM13 North



CM13 East



CM13 South



CM13 West

**Photos of Coal Mine Vegetation Monitoring
8/17/007
Photopoint 14**



CM14 North



CM14 East



CM14 South



CM14 West

**Photos of Coal Mine Vegetation Monitoring
8/17/007
Photopoint 15**



CM15 North



CM15 East



CM15 South



CM15 West

**Photos of Coal Mine Vegetation Monitoring
8/17/007
Photopoint 16**



CM16 North



CM16 East

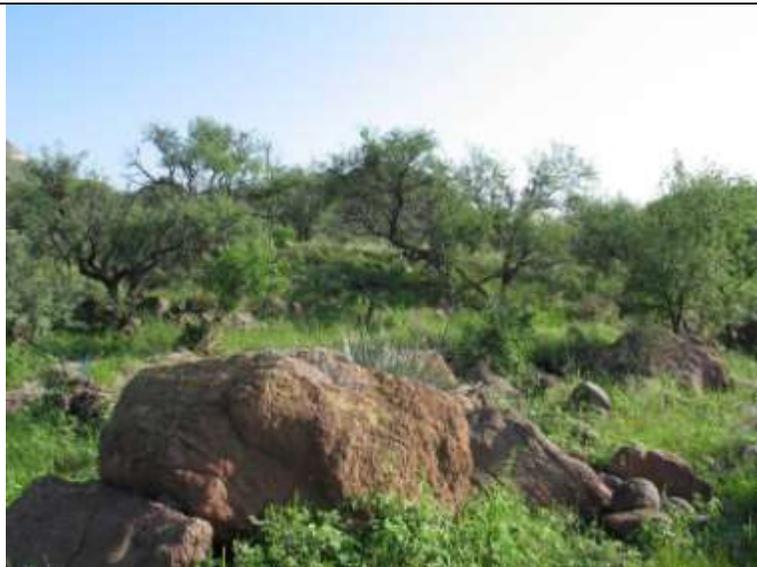


CM16 South



CM16 West

**Photos of Coal Mine Vegetation Monitoring
8/17/007
Photopoint 17**



CM17 North



CM17 East



CM17 South



CM17 West

**Photos of Coal Mine Vegetation Monitoring
8/17/007
Photopoint 18**



CM18 North



CM18 East



CM18 South



CM18 West

**Photos of Coal Mine Vegetation Monitoring
8/17/007
Photopoint 19**



CM19 North



CM19 East



CM19 South



CM19 West

**Photos of Coal Mine Vegetation Monitoring
8/17/007
Photopoint 20**



CM20 North



CM20 East



CM20 South



CM20 West

**Photos of Coal Mine Vegetation Monitoring
8/17/007
Photopoint 21**



CM21 North



CM21 East



CM21 South



CM21 West

**Photos of Coal Mine Vegetation Monitoring
8/17/007
Photopoint 22**



CM22 North



CM22 East



CM22 South



CM22 West

**Photos of Coal Mine Vegetation Monitoring
8/17/007
Photopoint 23**



CM23 North



CM23 East



CM23 South



CM23 West

**Photos of Coal Mine Vegetation Monitoring
4/12/08
Photopoint 1**



CM1 North



CM1 East



CM1 South



CM1 West

**Photos of Coal Mine Vegetation Monitoring
4/12/08
Photopoint 2**



CM2 North



CM2 East



CM2 South



CM2 West

**Photos of Coal Mine Vegetation Monitoring
4/12/08
Photopoint 3**



CM3 North



CM3 East



CM3 South



CM3 West

**Photos of Coal Mine Vegetation Monitoring
4/12/08
Photopoint 4**



CM4 North



CM4 East



CM4 South



CM4 West

**Photos of Coal Mine Vegetation Monitoring
4/12/08
Photopoint 5**



CM5 North



CM5 East



CM5 South



CM5 West

**Photos of Coal Mine Vegetation Monitoring
4/12/08
Photopoint 6**



CM6 North



CM6 East



CM6 South



CM6 West

**Photos of Coal Mine Vegetation Monitoring
4/12/08
Photopoint 7**



CM7 North



CM7 East



CM7 South



CM7 West

**Photos of Coal Mine Vegetation Monitoring
4/12/08
Photopoint 8**



CM8 North



CM8 East



CM8 South



CM8 West

**Photos of Coal Mine Vegetation Monitoring
4/12/08
Photopoint 9**



CM9 North



CM9 East



CM9 South



CM9 West

**Photos of Coal Mine Vegetation Monitoring
4/12/08
Photopoint 10**



CM10 North



CM10 East



CM10 South



CM10 West

**Photos of Coal Mine Vegetation Monitoring
4/12/08
Photopoint 11**



CM11 North



CM11 East



CM11 South



CM11 West

**Photos of Coal Mine Vegetation Monitoring
4/12/08
Photopoint 12**



CM12 North



CM12 East



CM12 South



CM12 West

**Photos of Coal Mine Vegetation Monitoring
4/12/08
Photopoint 13**



CM13 North



CM13 East



CM13 South



CM13 West

**Photos of Coal Mine Vegetation Monitoring
4/12/08
Photopoint 14**



CM14 North



CM14 East



CM14 South



CM14 West

**Photos of Coal Mine Vegetation Monitoring
4/12/08
Photopoint 15**



CM15 North



CM15 East



CM15 South



CM15 West

**Photos of Coal Mine Vegetation Monitoring
4/12/08
Photopoint 16**



CM16 North



CM16 East



CM16 South



CM16 West

**Photos of Coal Mine Vegetation Monitoring
4/12/08
Photopoint 17**



CM17 North



CM17 East



CM17 South



CM17 West

**Photos of Coal Mine Vegetation Monitoring
4/12/08
Photopoint 18**



CM18 North



CM18 East



CM18 South



CM18 West

**Photos of Coal Mine Vegetation Monitoring
4/12/08
Photopoint 19**



CM19 North



CM19 East



CM19 South



CM19 West

**Photos of Coal Mine Vegetation Monitoring
4/12/08
Photopoint 20**



CM20 North



CM20 East



CM20 South



CM20 West

**Photos of Coal Mine Vegetation Monitoring
4/12/08
Photopoint 21**



CM21 North



CM21 East



CM21 South



CM21 West

**Photos of Coal Mine Vegetation Monitoring
4/12/08
Photopoint 22**



CM22 North



CM22 East



CM22 South



CM22 West

**Photos of Coal Mine Vegetation Monitoring
4/12/08
Photopoint 23**



CM23 North



CM23 East



CM23 South



CM23 West

**Photos of Coal Mine Vegetation Monitoring
8/15/08
Photopoint 1**



CM1 North



CM1 East



CM1 South



CM1 West

**Photos of Coal Mine Vegetation Monitoring
8/15/08
Photopoint 2**



CM2 North



CM2 East



CM2 South



CM2 West

**Photos of Coal Mine Vegetation Monitoring
8/15/08
Photopoint 3**



CM3 North



CM3 East



CM3 South



CM3 West

**Photos of Coal Mine Vegetation Monitoring
8/15/08
Photopoint 4**



CM4 North



CM4 East



CM4 South



CM4 West

**Photos of Coal Mine Vegetation Monitoring
8/15/08
Photopoint 5**



CM5 North



CM5 East



CM5 South



CM5 West

**Photos of Coal Mine Vegetation Monitoring
8/15/08
Photopoint 6**



CM6 North



CM6 East



CM6 South



CM6 West

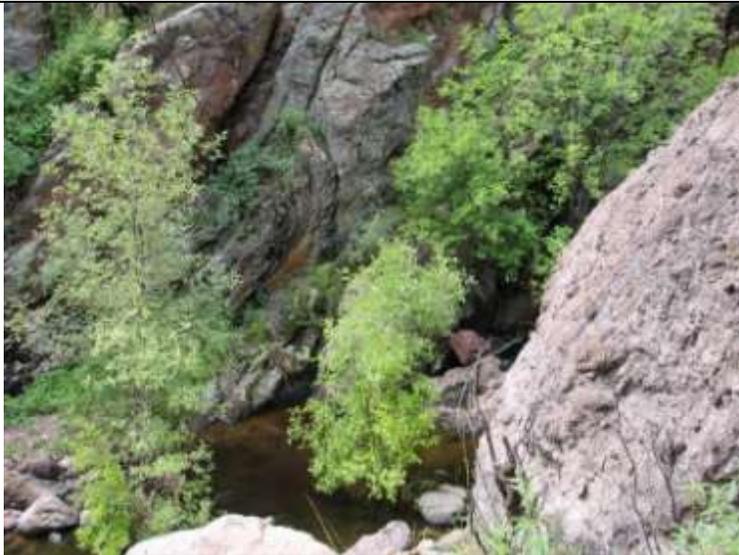
**Photos of Coal Mine Vegetation Monitoring
8/15/08
Photopoint 7**



CM7 North



CM7 East

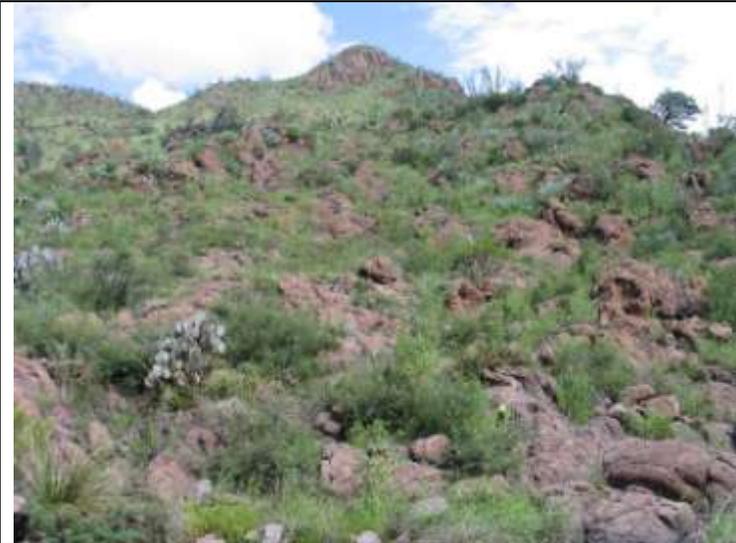


CM7 South



CM7 West

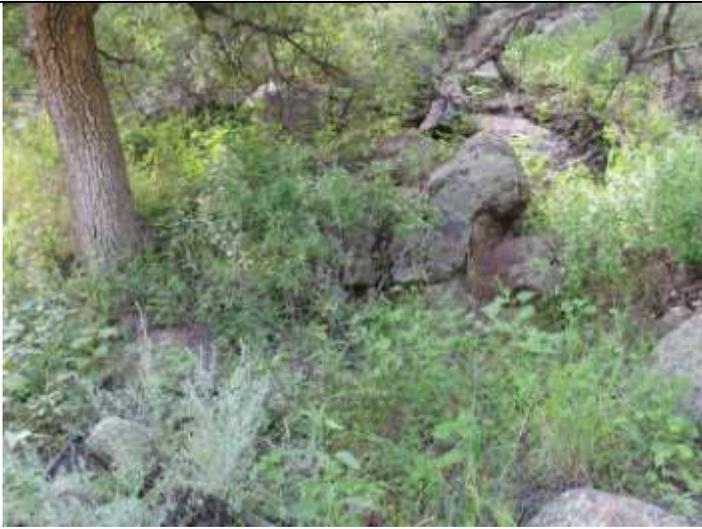
**Photos of Coal Mine Vegetation Monitoring
8/15/08
Photopoint 8**



CM8 North



CM8 East



CM8 South



CM8 West

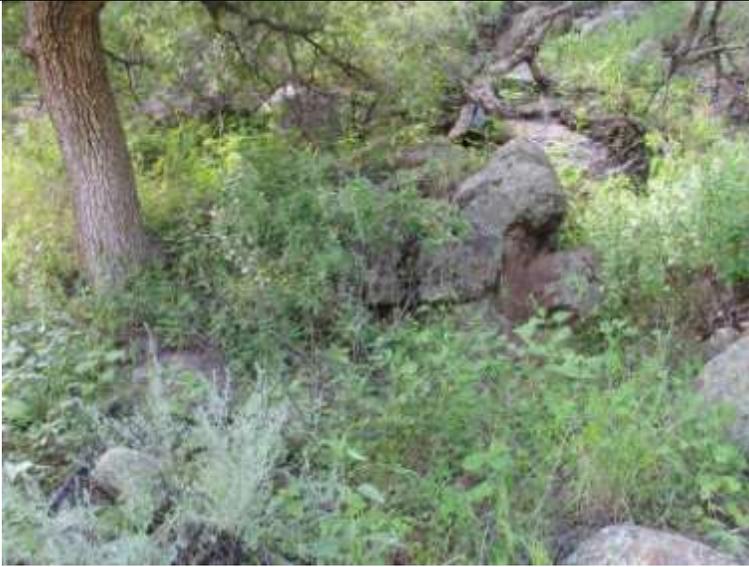
**Photos of Coal Mine Vegetation Monitoring
8/15/08
Photopoint 9**



CM9 North



CM9 East



CM9 South



CM9 West

**Photos of Coal Mine Vegetation Monitoring
8/15/08
Photopoint 10**



CM10 North



CM10 East



CM10 South



CM10 West

**Photos of Coal Mine Vegetation Monitoring
8/15/08
Photopoint 11**



CM11 North



CM11 East



CM11 South



CM11 West

**Photos of Coal Mine Vegetation Monitoring
8/15/08
Photopoint 12**



CM12 North



CM12 East



CM12 South



CM12 West

**Photos of Coal Mine Vegetation Monitoring
8/15/08
Photopoint 13**



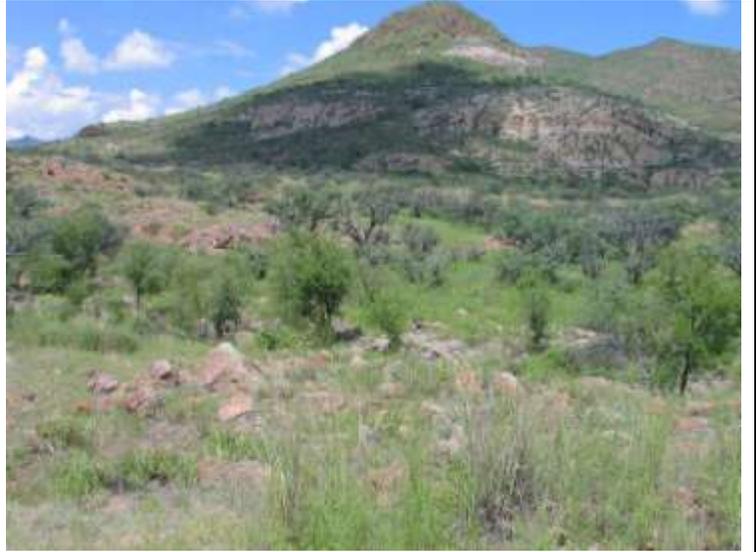
CM13 North



CM13 East



CM13 South



CM13 West

**Photos of Coal Mine Vegetation Monitoring
8/15/08
Photopoint 14**



CM14 North



CM14 East



CM14 South



CM14 West

**Photos of Coal Mine Vegetation Monitoring
8/15/08
Photopoint 15**



CM15 North



CM15 East



CM15 South



CM15 West

**Photos of Coal Mine Vegetation Monitoring
8/15/08
Photopoint 16**



CM16 North



CM16 East



CM16 South



CM16 West

**Photos of Coal Mine Vegetation Monitoring
8/15/08
Photopoint 17**



CM17 North



CM17 East



CM17 South



CM17 West

**Photos of Coal Mine Vegetation Monitoring
8/15/08
Photopoint 18**



CM18 North



CM18 East



CM18 South



CM18 West

**Photos of Coal Mine Vegetation Monitoring
8/15/08
Photopoint 19**



CM19 North



CM19 East



CM19 South



CM19 West

**Photos of Coal Mine Vegetation Monitoring
8/15/08
Photopoint 20**



CM20 North



CM20 East



CM20 South



CM20 West

**Photos of Coal Mine Vegetation Monitoring
8/15/08
Photopoint 21**



CM21 North



CM21 East



CM21 South



CM21 West

**Photos of Coal Mine Vegetation Monitoring
8/15/08
Photopoint 22**



CM22 North



CM22 East



CM22 South



CM22 West

**Photos of Coal Mine Vegetation Monitoring
8/15/08
Photopoint 23**



CM23 North



CM23 East



CM23 South



CM23 West

**Photos of Coal Mine Vegetation Monitoring
8/15/08
Photopoint 24**



CM24 North



CM24 East



CM24 South



CM24 West

**Photos of Coal Mine Vegetation Monitoring
8/15/08
Photopoint 25**



CM25 North



CM25 East

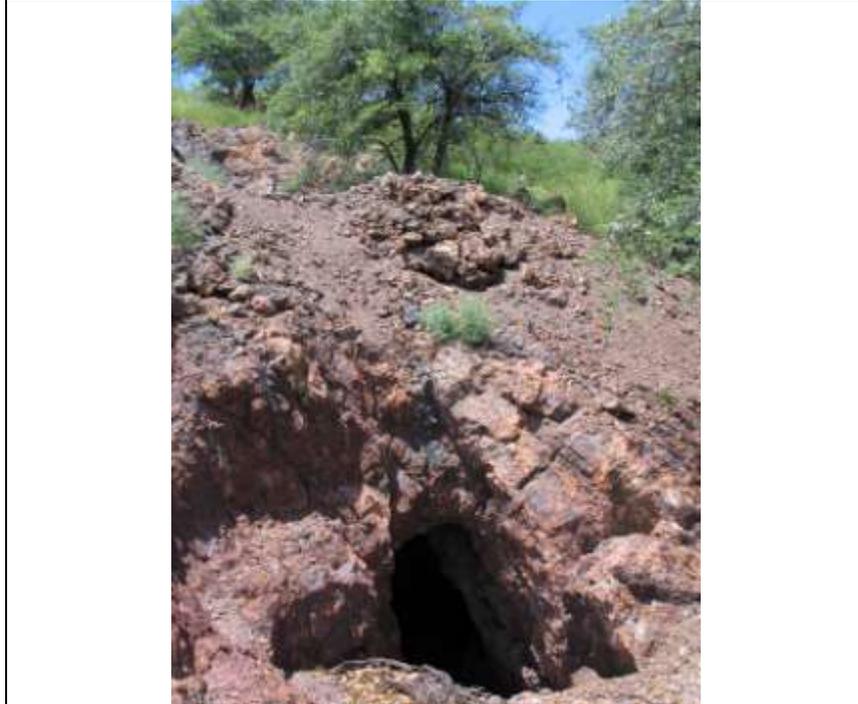


CM25 South



CM25 West

**Photos of Coal Mine Vegetation Monitoring
8/15/08
Other photos**



Lesser long-nosed bat roost



Sonora mud turtle

**Photos of Coal Mine Vegetation Monitoring
4/9/09
Photopoint 1**



CM1 North



CM1 East



CM1 South



CM1 West

**Photos of Coal Mine Vegetation Monitoring
4/9/09
Photopoint 2**



CM2 North



CM2 East



CM2 South



CM2 West

**Photos of Coal Mine Vegetation Monitoring
4/9/09
Photopoint 3**



CM3 North



CM3 East



CM3 South



CM3 West

Photos of Coal Mine Vegetation Monitoring
4/9/09
Photopoint 4



CM4 North



CM4 East



CM4 South



CM4 West

**Photos of Coal Mine Vegetation Monitoring
4/9/09
Photopoint 5**



CM5 North



CM5 East



CM5 South



CM5 West

**Photos of Coal Mine Vegetation Monitoring
4/9/09
Photopoint 6**



CM6 North



CM6 East



CM6 South



CM6 West

**Photos of Coal Mine Vegetation Monitoring
4/9/09
Photopoint 7**



CM7 North



CM7 East



CM7 South



CM7 West

Photos of Coal Mine Vegetation Monitoring
4/9/09
Photopoint 8



CM8 North



CM8 East



CM8 South



CM8 West

**Photos of Coal Mine Vegetation Monitoring
4/9/09
Photopoint 9**



CM9 North



CM9 East



CM9 South



CM9 West

**Photos of Coal Mine Vegetation Monitoring
4/9/09
Photopoint 10**



CM10 North



CM10 East



CM10 South



CM10 West

**Photos of Coal Mine Vegetation Monitoring
4/9/09
Photopoint 11**



CM11 North



CM11 East



CM11 South



CM11 West

**Photos of Coal Mine Vegetation Monitoring
4/9/09
Photopoint 12**



CM12North



CM12 East



CM12 South



CM12 West

Photos of Coal Mine Vegetation Monitoring
4/9/09
Photopoint 13



CM13 North



CM13 East



CM13 South



CM13 West

**Photos of Coal Mine Vegetation Monitoring
4/10/09
Photopoint 14**



CM14 North



CM14 East



CM14 South



CM14 West

Photos of Coal Mine Vegetation Monitoring
4/10/09
Photopoint 15



CM15 North



CM15 East



CM15 South



CM15 West

Photos of Coal Mine Vegetation Monitoring
4/10/09
Photopoint 16



CM16 North



CM16 East



CM16 South



CM16 West

Photos of Coal Mine Vegetation Monitoring
4/10/09
Photopoint 17



CM17 North



CM17 East



CM17 South



CM17 West

Photos of Coal Mine Vegetation Monitoring
4/10/09
Photopoint 18



CM18 North



CM18 East



CM18 South



CM18 West

**Photos of Coal Mine Vegetation Monitoring
4/10/09
Photopoint 19**



CM19 North



CM19 East



CM19 South



CM19 West

**Photos of Coal Mine Vegetation Monitoring
4/10/09
Photopoint 20**



CM20 North



CM20 East



CM20 South



CM20 West

**Photos of Coal Mine Vegetation Monitoring
4/10/09
Photopoint 21**



CM21 North



CM21 East



CM21 South



CM21 West

**Photos of Coal Mine Vegetation Monitoring
4/10/09
Photopoint 22**



CM22 North



CM22 East



CM22 South



CM22 West

**Photos of Coal Mine Vegetation Monitoring
4/10/09
Photopoint 23**



CM23 North



CM23 East



CM23 South



CM23 West

Photos of Coal Mine Vegetation Monitoring
4/10/09
Photopoint 24



CM24 North



CM24 East



CM24 South



CM24 West

**Photos of Coal Mine Vegetation Monitoring
4/10/09
Photopoint 25**



CM25 North



CM25 East



CM25 South



CM25 West

**Photos of Coal Mine Vegetation Monitoring
8/19/09
Photopoint 1**



CM1 North



CM1 East



CM1 South



CM1 West

**Photos of Coal Mine Vegetation Monitoring
8/19/09
Photopoint 2**



CM2 North



CM2 East



CM2 South



CM2 West

**Photos of Coal Mine Vegetation Monitoring
8/19/09
Photopoint 3**



CM3 North



CM3 East



CM3 South



CM3 West

**Photos of Coal Mine Vegetation Monitoring
8/19/09
Photopoint 4**



CM4 North



CM4 East



CM4 South



CM4 West

**Photos of Coal Mine Vegetation Monitoring
8/19/09
Photopoint 5**



CM5 North



CM5 East



CM5 South



CM5 West

**Photos of Coal Mine Vegetation Monitoring
8/19/09
Photopoint 6**



CM6 North



CM6 East



CM6 South



CM6 West

**Photos of Coal Mine Vegetation Monitoring
8/19/09
Photopoint 7**



CM7 North



CM7 East



CM7 South



CM7 West

**Photos of Coal Mine Vegetation Monitoring
8/19/09
Photopoint 8**



CM8 North



CM8 East



CM8 South



CM8 West

**Photos of Coal Mine Vegetation Monitoring
8/19/09
Photopoint 9**



CM9 North



CM9 East



CM9 South



CM9 West

**Photos of Coal Mine Vegetation Monitoring
8/19/09
Photopoint 10**



CM10 North



CM10 East



CM10 South



CM10 West

**Photos of Coal Mine Vegetation Monitoring
8/19/09
Photopoint 11**



CM11 North



CM11 East



CM11 South



CM11 West

**Photos of Coal Mine Vegetation Monitoring
8/19/09
Photopoint 12**



CM12 North



CM12 East



CM12 South



CM12 West

**Photos of Coal Mine Vegetation Monitoring
8/19/09
Photopoint 13**



CM13 North



CM13 East



CM13 South



CM13 West

**Photos of Coal Mine Vegetation Monitoring
8/19/09
Photopoint 14**



CM14 North



CM14 East



CM14 South



CM14 West

**Photos of Coal Mine Vegetation Monitoring
8/19/09
Photopoint 15**



CM15 North



CM15 East



CM15 South



CM15 West

**Photos of Coal Mine Vegetation Monitoring
8/19/09
Photopoint 16**



CM16 North



CM16 East



CM16 South



CM16 West

**Photos of Coal Mine Vegetation Monitoring
8/19/09
Photopoint 17**



CM17 North



CM17 East



CM17 South



CM17 West

**Photos of Coal Mine Vegetation Monitoring
8/19/09
Photopoint 18**



CM18 North



CM18 East



CM18 South



CM18 West

**Photos of Coal Mine Vegetation Monitoring
8/19/09
Photopoint 19**



CM19 North



CM19 East



CM19 South



CM19 West

**Photos of Coal Mine Vegetation Monitoring
8/19/09
Photopoint 20**



CM20 North



CM20 East



CM20 South



CM20 West

**Photos of Coal Mine Vegetation Monitoring
8/19/09
Photopoint 21**



CM21 North



CM21 East



CM21 South



CM21 West

**Photos of Coal Mine Vegetation Monitoring
8/19/09
Photopoint 22**



CM22 North



CM22 East



CM22 South



CM22 West

**Photos of Coal Mine Vegetation Monitoring
8/19/09
Photopoint 23**



CM23 North



CM23 East



CM23 South



CM23 West

**Photos of Coal Mine Vegetation Monitoring
8/19/09
Photopoint 24**



CM24 North



CM24 East



CM24 South



CM24 West

**Photos of Coal Mine Vegetation Monitoring
8/19/09
Photopoint 25**



CM25 North



CM25 East



CM25 South



CM25 West

**Photos of Coal Mine Vegetation Monitoring
4/2010
Photopoint 1**



CM1 North



CM1 East



CM1 South



CM1 West

**Photos of Coal Mine Vegetation Monitoring
4/2010
Photopoint 2**



CM2 North



CM2 East



CM2 South



CM2 West

Photos of Coal Mine Vegetation Monitoring
4/10
Photopoint 3



CM3 North



CM3 East



CM3 South



CM3 West

**Photos of Coal Mine Vegetation Monitoring
4/2010
Photopoint 4**



CM4 North



CM4 East



CM4 South



CM4 West

**Photos of Coal Mine Vegetation Monitoring
4/2010
Photopoint 5**



CM5 North



CM5 East



CM5 South



CM5 West

**Photos of Coal Mine Vegetation Monitoring
4/2010
Photopoint 6**



CM6 North



CM6 East



CM6 South



CM6 West

**Photos of Coal Mine Vegetation Monitoring
4/2010
Photopoint 7**



CM7 North



CM7 East



CM7 South



CM7 West

**Photos of Coal Mine Vegetation Monitoring
4/2010
Photopoint 8**



CM8 North



CM8 East



CM8 South



CM8 West

**Photos of Coal Mine Vegetation Monitoring
4/2010
Photopoint 9**



CM9 North



CM9 East



CM9 South



CM9 West

**Photos of Coal Mine Vegetation Monitoring
4/2010
Photopoint 10**



CM10 North



CM10 East



CM10 South



CM10 West

**Photos of Coal Mine Vegetation Monitoring
4/2010
Photopoint 11**



CM11 North



CM11 East



CM11 South



CM11 West

**Photos of Coal Mine Vegetation Monitoring
4/2010
Photopoint 12**



CM12North



CM12 East



CM12 South



CM12 West

**Photos of Coal Mine Vegetation Monitoring
4/2010
Photopoint 13**



CM13 North



CM13 East



CM13 South



CM13 West

**Photos of Coal Mine Vegetation Monitoring
4/2010
Photopoint 14**



CM14 North



CM14 East



CM14 South



CM14 West

**Photos of Coal Mine Vegetation Monitoring
4/2010
Photopoint 15**



CM15 North



CM15 East



CM15 South



CM15 West

**Photos of Coal Mine Vegetation Monitoring
4/2010
Photopoint 16**



CM16 North



CM16 East



CM16 South



CM16 West

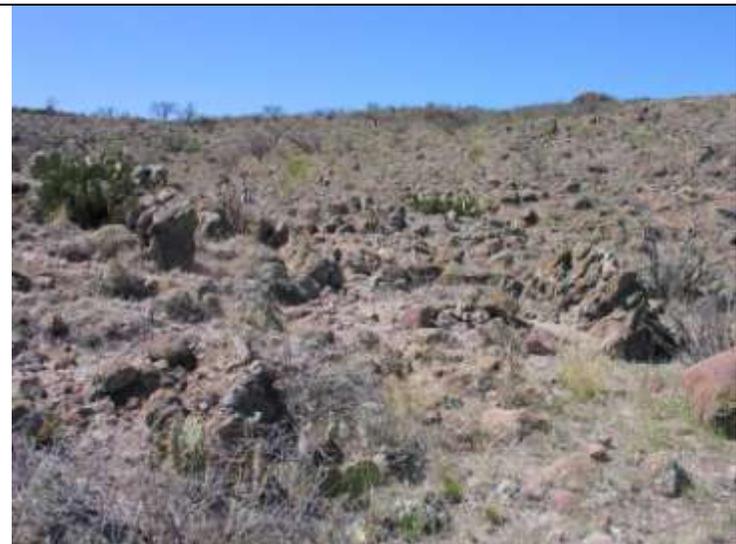
**Photos of Coal Mine Vegetation Monitoring
4/2010
Photopoint 17**



CM17 North



CM17 East



CM17 South



CM17 West

**Photos of Coal Mine Vegetation Monitoring
4/2010
Photopoint 18**



CM18 North



CM18 East



CM18 South



CM18 West

**Photos of Coal Mine Vegetation Monitoring
4/2010
Photopoint 19**



CM19 North



CM19 East



CM19South



CM19 West

**Photos of Coal Mine Vegetation Monitoring
4/2010
Photopoint 20**



CM20 North



CM20 East



CM20 South



CM20 West

**Photos of Coal Mine Vegetation Monitoring
4/2010
Photopoint 21**



CM21 North



CM21 East



CM21 South



CM21 West

**Photos of Coal Mine Vegetation Monitoring
4/2010
Photopoint 22**



CM22 North



CM22 East



CM22 South



CM22 West

**Photos of Coal Mine Vegetation Monitoring
4/2010
Photopoint 23**



CM23 North



CM23 East



CM23 South



CM23 West

**Photos of Coal Mine Vegetation Monitoring
4/2010
Photopoint 24**



CM24 North



CM24 East



CM24 South



CM24 West

**Photos of Coal Mine Vegetation Monitoring
4/2010
Photopoint 25**



CM25 North



CM25 East



CM25 South



CM25 West

Appendix C

Photographs of Fish Habitat

**FISH SURVEY
PHOTOGRAPHS OF COAL MINE CANYON**

Photo Point 1a – Unmapped Spring facing upstream

No Photo



Date: 04-07

Date: 10-07



Date: 04-08

Date: 10-08



Date: 04-09

Date: 10-09



Date: 05-10

Photo Point 1b- Unmapped Spring facing downstream



Date: 04-07

No Photo

Date: 10-07



Date: 04-08



Date: 10-08



Date: 04-09



Date: 10-09

Photo Point 2- Coal Mine Spring facing upstream



Date: 04-07



Date: 10-07



Date: 04-08



Date: 10-08



Date: 04-09



Date: 10-09



Date: 05-10

Photo Point 3-Pool above Coal Mine Spring facing downstream

No photo

No photo

Date: 04-07

Date: 10-07



Date: 04-08

Date: 10-08



Date: 04-09

Date: 10-09



Date: 05-10

Photo Point 3-Pool above Coal Mine Spring facing upstream



Date: 04-07



Date: 10-07



Date: 04-08



Date: 10-08



Date: 04-09



Date: 10-09

Photo Point 4- facing upstream

No Photo

No Photo

Date: 04-07

Date: 10-07



Date: 04-08

Date: 10-08



Date: 04-09

Date: 10-09

Photo Point 5

No Photo



Date: 04-07

Date: 10-07 facing east



Date: 04-08 facing upstream



Date: 10-08 facing upstream



Date: 04-09 facing upstream



Date: 10-09 facing upstream

Photo Point 6	
No Photo	
Date: 04-07	Date: 10-07 facing northeast
	
Date: 04-08 facing upstream	Date: 10-08 facing upstream
	
Date: 04-09 facing upstream	Date: 10-09 facing upstream
	
Date: 05-10 facing upstream	

Photo Point 7

No Photo



Date: 04-07

Date: 10-07 facing east



Date: 04-08 facing northeast

Date: 10-08 facing upstream



Date: 04-09 facing upstream

Date: 10-09 facing upstream



Date: 05-10 facing east

Photo Point 8 - Below the dam facing across

No Photo



Date: 04-07

Date: 10-07



Date: 04-08

Date: 10-08



Date: 04-09

Date: 10-09



Date: 05-10

Photo Point 9 – Above the dam

No Photo



Date: 04-07

Date: 10-07 facing downstream



Date: 04-08 facing upstream



Date: 10-08 facing upstream



Date: 04-09 facing upstream



Date: 10-09 facing upstream

Photo Point 9- Above the dam facing across

No Photo

No Photo

Date: 04-07

Date: 10-07



Date: 04-08

Date: 10-08



Date: 04-09

Date: 10-09



Date: 05-10



Photo Point 10- facing upstream

No Photo



Date: 04-07

Date: 10-07



Date: 04-08

Date: 10-08



Date: 04-09

Date: 10-09



Date: 05-10

Photo Point 11

No Photo



Date: 04-07

Date: 10-07 facing north northeast



Date: 04-08 facing upstream

Date: 10-08 facing upstream



Date: 04-09 facing upsteam

Date: 10-09 facing upstream

Photo Point 12	
<p>No Photo</p>	
<p>Date: 04-07</p>	<p>Date: 10-07 facing north</p>
	
<p>Date: 04-08 facing upstream</p>	<p>Date: 10-08 facing upstream</p>
	
<p>Date: 04-09 facing upstream</p>	<p>Date: 10-09 facing upstream</p>
	
<p>Date: 05-10 facing upstream</p>	

Photo Point 13- facing upstream

No Photo



Date: 04-07

Date: 10-07



Date: 04-08

Date: 10-08



Date: 04-09

Date: 10-09



Date: 05-10

Photo Point 14

No Photo



Date: 04-07

Date: 10-07 facing east



Date: 04-08



Date: 10-08 facing upstream



Date: 04-09 facing upstream



Date: 10-09 facing upstream