Devils Canyon Drainage Stock Tank Surveys During 2010 and 2011

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December 20, 2011

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ACKNOWLEDGMENTS

The surveys conducted in the Devils Canyon and Mineral Creek drainages in 2010 and 2011 occurred with the assistance of multiple agency personnel and private citizens. These surveys were funded through an agreement with U.S. Fish and Wildlife Service as part of the Central Arizona Project (CAP) Gila River Basin Native Fishes Conservation Program. Involved in the 2010 surveys were individuals from Arizona Game and Fish Department (Tony Robinson, Clay Crowder, Natalie Robb, Danny Rodriguez, Steve Prager, Abi Medina and Kent Mosher). Additionally, the 2011 surveys included personnel from Arizona Game and Fish Department (Clay Crowder, Tony Robinson, Kent Mosher, Andrea Steffen and Kyle Yarush). Access to lower Devils Canyon was granted by ASARCO Ray Mine and escort provided by Ray Mine personnel (Keith Warren and Brian Munson), likewise access through Resolution Copper's JI Ranch was provided by the property caretakers.

Recommended Citation:

Crowder, C.D. and A.T. Robinson. 2011. Devils Canyon drainage stock tank surveys during 2010 and 2011. Arizona Game and Fish Department, Phoenix. 9pp.

INTRODUCTION

Gila chub *Gila intermedia* was federally listed as endangered with critical habitat in 2005 (Federal Register 2005). Upper Mineral Creek, the watershed immediately upstream of the ASARCO Ray Mine Big Box Dam, was designated as critical habitat for Gila chub at the time of listing. According to Robinson (2008a), Gila chub were last documented in upper Mineral Creek in 2000. Subsequent surveys completed in 2002, 2006 and 2008 were not able to document the presence of Gila chub, and the species is considered extirpated from upper Mineral Creek (Robinson 2008a).

Robinson (2008a) recommended repatriation of Gila chub in upper Mineral Creek, as well as additional surveys of the drainage; namely the ~650 meter reach of Mineral Creek below Big Box Dam and the ASARCO Ray Mine tunnel, and the Devils Canyon drainage, to ascertain the possibility of Gila chub existing outside the upper Mineral Creek reach (Robinson 2008a). Mineral Creek lineage chub would be the preferred lineage for repatriation of chub into upper Mineral Creek (Robinson 2008a). In 2008, Robinson (2008b) performed aerial helicopter surveys to identify perennial reaches and stock tanks within the Devils Canyon drainage.

In 2009, Arizona Game and Fish Department (AGFD) conducted fish surveys in Mineral Creek from Big Box Dam to ASARCO Ray Mine tunnel, in Devils Canyon and in Rawhide Canyon, a sub-drainage of Devils Canyon located approx. 2.65 km upstream of Devils Canyon and Mineral Creek confluence (Robinson et al. 2010). No Gila chub or other native fish were observed or captured during the surveys. However, nonnative Green sunfish *Lepomis cyanellus*, fathead minnow *Pimephales promelas* and mosquitofish *Gambusia affinis* were detected. These nonnative species were previously detected in Devils Canyon (Schwemm 2002; AGFD unpublished data) and Mineral Creek, below Big Box Dam (Andrews and King 1997). Robinson et al. (2010) suggested that nonnative fish species within Devils Canyon and lower Mineral Creek could have originated from: 1) upstream migration from the Gila River to Mineral Creek prior to the construction of the ASARCO Big Box Dam, 2) illegally stockings or 3) downstream migration into Devils Canyon from stock tanks within the watershed. Robinson (2008b) recommended that all tanks in the Devils Canyon drainage be surveyed prior to any renovation effort to restore Gila chub to the Devils Canyon, Big Box Dam reservoir and lower Mineral Creek.

The objective of the surveys conducted in 2010 and 2011 was to complete the inventory of perennial waters (streams reaches and tanks) in the Devils Canyon drainage to document the presence and distribution of Gila chub and other fish and aquatic vertebrate species within the drainage. The inventory was also done to identify source populations of nonnative fish (i.e. stock ponds). Fish distribution information is needed if Gila chub are repatriated to upper Mineral Creek and if the watershed above Big Box Dam is renovated and managed for native fishes (Robinson 2008a).

STUDY SITE

Devils Canyon is a tributary to Mineral Creek, which is a tributary to the Gila River in Pinal County Arizona. Devils Canyon joins Mineral Creek approximately 14 km upstream of the Mineral Creek and Gila River confluence, on the southwestern edge of the Pinal Mountains (Figure 1). Devils Canyon begins at an elevation of approximately 685 m and runs in a north-to-south direction, bisecting U.S. Highway 60 in the uppermost 5.6 km of the canyon. Devils

Canyon has five main sub-tributaries; the three minor tributaries entering Devils Canyon from the west are Rancho Rio Creek, Hackberry Creek and Oak Creek. The largest tributary, Rawhide Canyon, runs in a northeast-to-south direction. Rawhide Canyon's confluence with Devils Canyon lies approximately 10.8 km downstream of Devils Canyon and US Highway junction. Another tributary is Iron Canyon, which drains the Top of the World area and then parallels U.S. Highway 60 before meeting Devils Canyon. The Devils Canyon drainage covers an area of about 92.35 km^2. More than 20 tanks are known to occur throughout the drainage (Robinson 2008b).

METHODS

Stock Tank Surveys

Using a combination of data collected from Robinson's (2008b) aerial survey of Devils Canyon drainage (Figure 3), TOPO! 4® software and aerial images from Google Earth®, 29 stock tanks within Devils Canyon drainage were identified. An additional three tanks were discovered during the surveys. Personnel from AGFD surveyed the stock tanks on July 6-8, 2010 and May 3, 4 and 16, 2011. Three stock tanks were not visited, two of which (Iron Flat tank and an unnamed tank identified as Tank 32 within Table 1) were reported (Robert Johnston, local landowner, personal communication, May 17, 2011) to go dry during the year and have limited access because roads were behind deeded or locked gates. The third unvisited tank (Tank 23) had incorrect GPS coordinates so was not found, but was later determined to exist based on examination of satellite photographs.

Stock tanks were surveyed using bag seines (9 m wide, 1.2 m high with 6 mm mesh), and dip nets (Duraframe Dipnet® electro intermediate hex trap net, 37 cm wide at the base, 12 cm wide at the apex and 41 cm long with 3mm mesh and 1.5 m pole). Ropes (~approximately 45 m long each) were attached to the seine brails to facilitate pulling the seine across the tanks. The bag seine was pulled through each tank three times, each time through a different portion of the tank, unless the tank was 1) dry, 2) small enough to be surveyed by one or two seine hauls, or 3) too shallow or small in which case dip nets were used. Data recorded for each sampling effort included: site name, site location (GPS coordinates), date, time, participants, effort (length and width of area surveyed via bag seine or dip net sweep), area of tank (length and width of wetted area), species captured and number of individuals.

Stream Surveys

A 1 km reach of upper Rawhide Canyon was visually surveyed on May 3, 2011 because bedrock tinajas were observed in that reach by Robinson (2008b). Wetted reaches, which were pools, were visually inspected and seined or dip netted if enough water was present. In addition, a 1-km portion of Devils Canyon was surveyed on June 2, 2011. This reach was previously surveyed (Robinson et al. 2010), however an Audubon Arizona employee reported a 'chub-like' fish in the reach and verification of the report was needed. The one reach of Devils Canyon targeted was surveyed using Smith-Root model LR24 backpack electrofisher with one probe and rattail. Sections were shocked in an upstream direction and fish were captured using dip nets. Survey length and duration shocked was variable. Data recorded for each effort included: site name, site location, species captured, number of fish of each species captured and seconds electrofished.

Deeper pools were sampled with Promar® collapsible mini-hoop nets (0.85 m long, 0.3 m diameter circular hoops, with 9 mm mesh) baited with Gravy Train® dog food. Nets were set for a minimum of 2 hours during daylight. Data recorded for each trap included: date and time net was set and pulled, GPS location, species captured and numbers of individuals captured.

Physical Environment
Water quality parameters; pH, conductivity (µS), salinity (ppm), total dissolved solutes (mg/L) and water temperature (˚C), were measured using an EXTECH Instruments Inc. ExStik EC500 meter. Dissolved oxygen (mg/L) was measured using an EXTECH Instruments Inc. ExStik DO600 meter.

RESULTS

Stock Tank Surveys
Of the 31 stock tanks that were surveyed; only two (Headquarter tank and East Fork tank) had fish (Table 2). Mosquitofish were the only fish species captured in East Fork tank. Mosquitofish and bluegill *Lepomis macrochirus* were captured in Headquarter tank, with bluegill being more abundant; this is the first time that bluegill has been documented in Devils Canyon drainage. A slider, likely a red-eared slider *Trachemys scripta* and a large female spiny soft-shell turtle *Apalone spinifera* were also observed at Headquarter tank. Eleven of the stock tanks had tiger salamander *Ambystoma tigrinum* in varying stages of development (ie. egg, brachial larvae, adult). Two tanks had northern crayfish *Orconectes virilis*, three had lowland leopard frog *Rana yavapaiensis*, and one had black-necked gartersnake *Thamnophis cyrtopsis* (Table 1).

Stream Sampling
No Gila chub were in Devils Canyon. Green sunfish and northern crayfish were captured during electrofishing. Only Green sunfish were captured in the mini-hoop nets (Table 2). Both adult and juvenile Green sunfish were captured in the traps.

Very little water was found in Rawhide Canyon. Most water was in three relatively small (about 2, 4, and 6 m^2) tinaja pools; the larger tinajas observed by Robinson (2008b) were dry. No fish were observed (the water was clear in all pools found) or captured in dip net sweeps (the number of dip net sweeps was not recorded).

DISCUSSION

Only nonnative fishes were found during our survey of stock tanks and two stream segments in the Devils Canyon drainage. We did not capture green sunfish in any of the stock tanks, so cannot conclude that the stock tanks were sources of dispersal of the species into Devils Canyon and upper Mineral Creek. However as Robinson et al. (2010) discussed, perhaps these fish were illegally stocked in the stream system in the past or moved downstream from a stock tank where they were previously stocked but no longer persist. The three stock tanks that were not surveyed are not likely a source of nonnatives fishes because two of them (Iron Flat tank and Tank 32) are reported (Robert Johnston, personal communication, May 17, 2011) to annually go dry, and the third, Tank 23, is upstream of Tank 22 and Tank 22 was fishless. Arizona Game and Fish Department Region VI office did not have stocking records or copies of a Wildlife Holding Permit for Headquarter tank (Chris Cantrell, AGFD Region VI Fish Program Manager, personal communication, December 05, 2011). Likewise, AGFD could not locate any stocking records or Wildlife Holding Permits for tiger salamanders, which were found in nine stock tanks in the

Devils Canyon drainage, indicating that there has been illegal movement of aquatic species within the drainage.
Gila chub have not been found in any surveys in any Mineral Creek or Devils Canyon since 2000 (Robinson 2007; Robinson 2008a; Robinson et al. 2010). Some of the perennial stream sections in Devils Canyon (e.g., from Rio Rancho Creek down to Five Pools) have only been surveyed once, but in multiple surveys of the lowest section of Devils Canyon, Gila chub have never been captured. Therefore, Gila chub can probably be considered extirpated from the Mineral Creek drainage.

RECOMMENDATIONS

Efforts to reestablish Gila chub into upper Mineral Creek and in suitable portions of Devils Canyon should be continued. Following recommendations from Robinson et al. (2010), the three best choices of lineages to use would be Redfield Canyon, Hot Springs Canyon or Bonita Creek. If the entire Mineral Creek and Devils Canyon drainage above Big Box dam is to be managed for Gila chub and other native fish, then the stock tanks in the drainage containing nonnative fishes as well as the perennial portions of Devils Canyon and upper Mineral Creek (Big Box Dam to series of small natural water falls) and Big Box Dam reservoir should be renovated to prevent the reinvasion of nonnatives into the system.

Prior to the completion of the renovation, stock tanks within the Mineral Creek drainage should be surveyed and assessed for nonnative fish presence. Likewise, the three remaining stock tanks in Devils Canyon drainage should be surveyed to completely rule them out as potential sources of nonnative fishes. Headquarter tank could be further evaluated to determine if other nonnative fish (i.e., bullhead or catfish) are also present.

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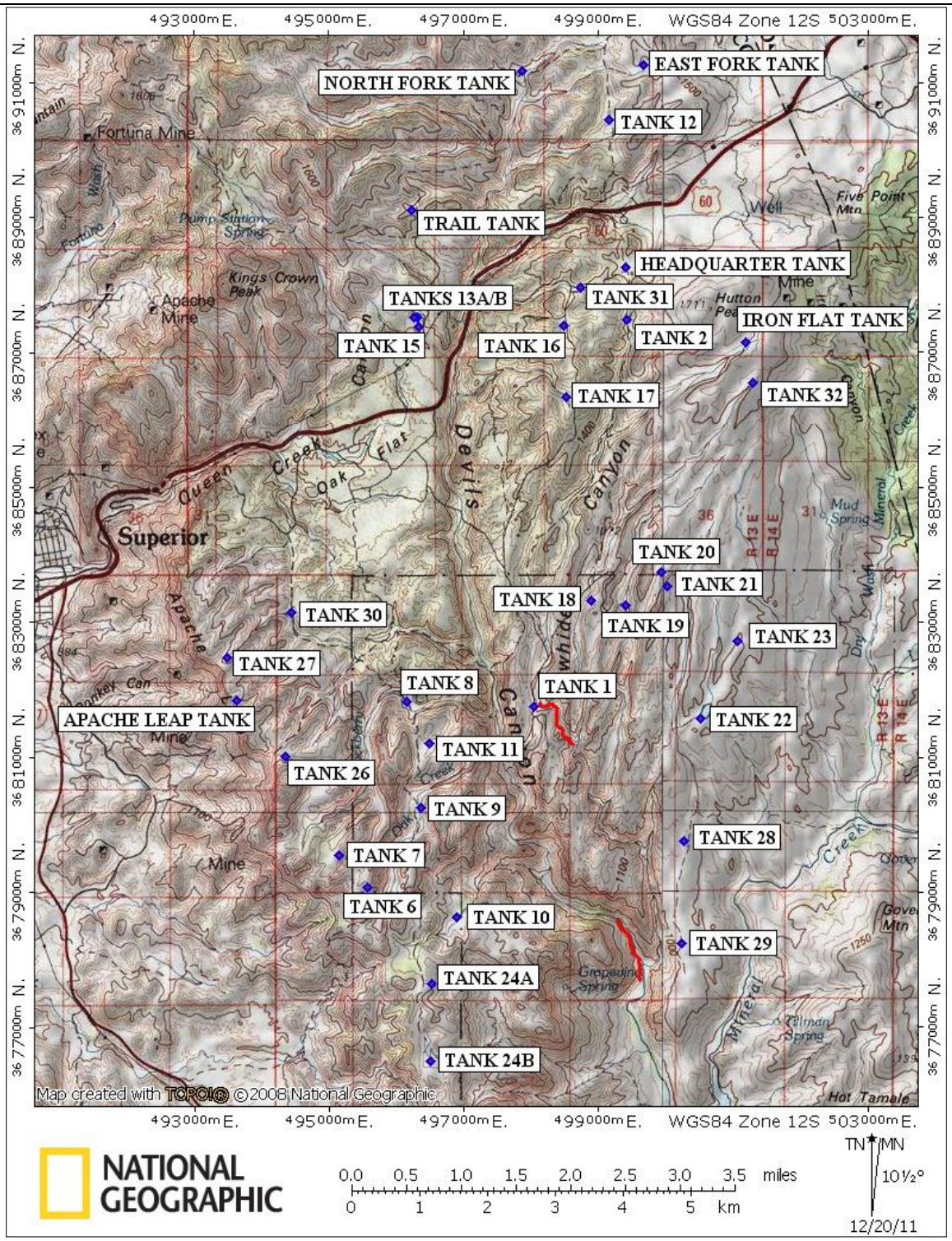

Figure 1. Map showing locations of stock tanks (blue triangles) in Devils Canyon drainage. The tanks were surveyed in 2010 and 2011. The red line located below Tank 1 in the central portion of the map is the 1 km portion of Rawhide Canyon that was surveyed on May 3, 2011. The red line in the lower right-hand portion of the map is the 1 km portion of Devils Canyon that was surveyed on June 2, 2011.

Figure 2. Photographs taken during Devils Canyon drainage stock tank surveys, 2010 and 2011. Top left: a large brachial larvae of tiger salamander. Top right: photo of Apache Trail tank, a typical stock tank. Bottom left: survey crew beginning a seine haul. Bottom right: bluegill, mosquitofish, and crayfish captured in a bag seine haul at Headquarter tank.

Table 1. Stock tank locations in Devils Canyon drainage, methods of survey, and species detected during 2010-2011. GPS coordinates are NAD83. Species codes are as follows: *Ambystoma tigrinum* AMTI, *Apalone spinifera* APSP, *Gambusia affinis* GAAF, *Lepomis macrochirus* LEMA, *Rana yavapaiensis* LIYA, *Orconectes virilis* ORVI, *Thamnophis cyrtopsis* THCY, *Trachemys scripta* TRSC.

Tank name	UTM Zone	UTM Easting	UTM Northing	Date visited	Gear/ comments	Species detected
Apache Leap tank	12S	493631	3681849	May 4, 2011	Bag seine	-
East Fork tank	12S	499668	3691252	May 16, 2011	Bag seine	GAAF, AMTI
Headquarter tank	12S	499403	3688286	May 17, 2011	Bag seine	LEMA, GAAF, ORVI, TRSC, APSP
Trail tank	12S	496227	3689116	May 3, 2011	Bag seine	AMTI
North Fork tank	12S	497862	3691181	May 16, 2011	Bag seine	-
Iron Flat tank	12S	501180	3687142	NA	Not surveyed	NA
Tank 1	12S	498048	3681746	May 3, 2011	Bag seine	-
Tank 2	12S	499420	3687490	May 4, 2011	Bag seine	-
Tank 6	12S	495572	3679069	May 4, 2011	Dipnet	-
Tank 7	12S	495145	3679552	May 4, 2011	Bag seine	-
Tank 8	12S	496149	3681830	May 4, 2011	Bag seine	-
Tank 9	12S	496371	3680246	May 4, 2011	Bag seine	AMTI
Tank 10	12S	496892	3678627	May 3, 2011	Dry	-
Tank 11	12S	496491	3681201	May 4, 2011	Bag seine	AMTI
Tank 12	12S	499160	3690444	May 16, 2011	Bag seine	AMTI
Tank 13A	12S	496304	3687523	May 3, 2011	Bag seine	AMTI
Tank 13B	12S	496258	3687512	May 3, 2011	Bag seine	AMTI
Tank 15	12S	496332	3687388	May 3, 2011	Dry	-
Tank 16	12S	498479	3687404	May 3, 2011	Bag seine	AMTI
Tank 17	12S	498512	3686340	May 3, 2011	Bag seine	AMTI, RAYA
Tank 18	12S	498891	3683325	July 6, 2010	Bag seine	AMTI
Tank 19	12S	499390	3683248	July 6, 2010	Bag seine	-
Tank 20	12S	499922	3683748	July 7, 2010	Dry	-
Tank 21	12S	500008	3683540	July 7, 2010	Bag seine	THCY
Tank 22	12S	500506	3681580	July 7, 2010	Bag seine	RAYA
Tank 23	12S	501051	3682713	NA	Not surveyed	NA
Tank 24A	12S	495145	3677638	July 6, 2010	Dry	-
Tank 24B	12S	496504	3676501	July 7, 2010	Dry	-
Tank 26	12S	494346	3681014	July 8, 2010	Bag seine	-
Tank 27	12S	493482	3682478	May 4, 2011	Bag seine	-
Tank 28	12S	500262	3679749	July 7, 2010	Bag seine	RAYA
Tank 29	12S	500229	3678238	July 7, 2010	Bag seine	-
Tank 30	12S	494440	3683152	May 4, 2011	Bag seine	-
Tank 31	12S	498734	3687969	May 4, 2011	Bag seine	ORVI, AMTI
Tank 32	12S	501289	3686552	NA	Not surveyed	NA

Table 2. Summary of fish captured and catch rates during the June 2, 2011 fish survey of Devils Canyon, Arizona, showing for each gear type: total number of individuals captured, number of sampling efforts, mean catch-per-unit-effort, and standard error of the mean catch rate. Catch rates for the electrofishing are the number of individuals (Ind) captured per minute electrofished and for trapping are the number of individuals captured per hour.

Gear type	Statistic	Green sunfish	Crayfish	Total
Electrofishing	#Individuals	137	1	138
	#Efforts	3	3	3
	Mean #Ind/min	22.05	-	22.05
	SE±	(6.23)	-	
Mini hoop	#Individuals	139	-	139
	#Efforts	6	6	6
	Mean #Ind/h	10.19	-	10.19
	SE±	(1.23)	-	(1.23)
Table Total	#Individuals	276	1	277

Table 3. Summary of results of the stock tanks containing fish and crayfish during the 2010 and 2011 stock tank in Devils Canyon drainage, Arizona.

Stock tank	Gear type	Statistic	Bluegill	Mosquitofish	Total Fish	Crayfish
East Fork tank	Bag seine	#Individuals	-	2094	2094	-
		#Efforts	-	3	3	
		Mean #Ind/m²	-	6.71	6.71	
		SE±	-	(1.23)	(1.23)	
Headquarter tank	Bag seine	#Individuals	2207	488	2695	45
		#Efforts	3	3	3	3
		Mean #Ind/m²	3.17	0.79	3.96	0.06
		SE±	(1.01)	(0.52)	(1.04)	(0.03)
Tank 31	Bag seine	#Individuals	-	-	-	1
		#Efforts	-	-	-	1

Table 4. Water quality characteristics measured in the two stock tanks that contained fish in Devils Canyon drainage, 2010-2011.

Site name	Date	Water temp. (C)	Dissolved oxygen (mg/L)	pH	Conductivity (µS)	Total dissolved solids (mg/L)	Salinity (ppm)
East Fork Tank	05/04/2011	21.9	5.57	7.33	83.5	81.8	58.8
Headquarter Tank	05/16/2011	22.8	11.18	8.45	66.1	47.8	31.8