

Annual Report to Bureau of Land Management for
2010 CWP-UA NATIVE FROG CONSERVATION,
LAS CIENEGAS NATIONAL CONSERVATION AREA (LCNCA)

Philip C. Rosen, Research Scientist
School of Natural Resources & the Environment
University of Arizona, Tucson, AZ 85721
pcrosen@u.arizona.edu

1 February 2010

Summary:

Bullfrog eradication is proceeding in the Empire Valley region, and may be completed in 2011 or 2012 if intensive removals in an upper reach of Cienega Creek are successful. Bullfrogs are in Babocomari Cienega and several ponds north of Elgin in the Babocomari drainage near the divide into the Cienega Creek basin. Crayfish in Empire Valley are confined to Clyne Pond, in the valley's southeast extreme, and intensive removal efforts are being ramped up to eradicate this nearly intractable infestation (crayfish are also in Babocomari as well as in Post Canyon and O'Donnell Cienega on and near Audubon Research Ranch). At least 9 non-native fish species were documented in Empire Valley region in 2010, including several potentially harmful to native aquatic vertebrates. Breeding populations of the Chiricahua Leopard Frog are persisting at Empire Gulch Spring and at least two sites in Santa Rita Mountains; this frog may be locally increasing in this region. The Lowland Leopard Frog is restricted to a small population in Wakefield Canyon (Whetstone Mountains) and Road Canyon Tank in upper Empire Valley (where it may be introduced; and from which it dispersed in summer 2010 to 10 other sites). The Mexican Gartersnake is persisting at low abundance in Cienega Creek: intensive surveys of its population and those of other aquatic species in the creek will be conducted in 2011.

Non-Native Aquatic Invasive Species Removals:

Bullfrog removals were intensified in 2010 under continuing funding with assistance from additional funding under a NFWF grant for Chiricahua Leopard Frog conservation. For this reason in part, a greater number of bullfrogs were removed than in any previous year of our work at LCNCA (Table 1). Further, we initiated intensive removals of bullfrogs from the Cienega Creek mainstem in 2010 (to be intensified in 2011 with a goal of complete eradication). Results in Cienega Creek mainstem, while numerically impressive, only 10 adults and 1 juvenile bullfrog were collected, with intensive trapping and dipnetting yielding 608 tadpoles. Elsewhere at Las Cienegas, only 2 bullfrogs at Cinco Ponds, and 65 at Clyne Ranch, were observed. Our removals appear to have completely eliminated the bullfrog from Clyne Ranch. If removals in the mainstem Gardner Canyon to Headwaters reach are successful in 2011, it may be possible to eradicate the species from the Empire Valley landscape. *Bd* is known in the bullfrogs at LCNCA.

Crayfish elimination at Clyne Pond was attempted in Spring 2010 for the third year running. Sampling revealed that the Northern Crayfish (*Orconectes virilis*) population still persisted in the pond despite rotenone treatment and dry-season pond drying, and intensive trapping. Digging and observations indicated that crayfish persisted in the spring located just above the pond, and these may be the source of repopulation of the pond following the removal treatments: crayfish

burrowed into pond-bank soil may also be involved. Although crayfish numbers have been kept below the extremes expected, the threat is persisting.

Therefore, we pumped the pond dry in November 2010 and plan to keep it free of water - by re-pumping if necessary - through June 2011. We also plan to trap and dig out crayfish from the spring, and then temporarily cover the spring with gravel to eliminate it as habitat. Meanwhile, plans are being completed to install a drain at Clyne Pond to permit drying whenever needed for control of non-native species.

Table 1. Bullfrogs observed and removed at Las Cienegas NCA 2002-2010.

		2002	2003	2004	2005	2006	2007	2008	2009	2010	Total
Cienega Cr	No. Removed	3									3
Mattie reach	No. Observed	3									3
Cienega Cr	No. Removed	14	5	0	0	2	0	0	0	0	21
Springwater reach	No. Observed	41	13	0	6	2	0	0	0	0	62
Cienega Cr	No. Removed	1	34	7	10	4	2		4	618	680
Gardner reach	No. Observed	13	78	17	13	4	2		11	618	756
Cienega Cr	No. Removed		17	0	7	0	0		0	0	24
Headwaters reach	No. Observed		34	0	10	0	0		0	0	44
Cinco Ponds	No. Removed	36	61	49	18	0	2	0	0	2	168
	No. Observed	93	64	134	24	1	2	8	1	2	329
Clyne Ranch	No. Removed					0	57	0	5	65	127
	No. Observed					32	362	1	5	67	467
LCNCA Uplands	No. Removed			2	0	0	0	0	0	0	2
	No. Observed			3	1	0	0	0	0	0	4
Sonoita	No. Removed									0	0
Grasslands / Elgin	No. Observed									c.1000	c.1000
Mustang Mts	No. Removed									1	1
	No. Observed									4	4
Total Removed		54	117	58	35	6	61	0	9	686	c.1026
Total Observed		150	189	154	54	39	366	9	17	c.1688	c.2666

Non-Native Fishes Detected in the Watershed:

Intensive surveys throughout all public and some of the private lands in the upper Cienega Creek drainage basin in 2010 revealed a total of 19 populations of 7 introduced fish species captured at 9 sites (Table 2). Of these, the mosquitofish found in a single site in the Cienega Creek drainage and numerous ponds north of Elgin in Babocomari drainage. Mosquitofish are expected to be found much more widely distributed in the Elgin-Sonoita area, including just below the grassland divide to the upper Cienega Creek basin. Two additional species, for a total of 9 exotic fish species, were observed but not handled: koi (*Cyprinus carpio*, an ornamental form of the common carp; three sites) and a catfish that appeared to be the channel catfish (*Ictalurus*

punctatus; two sites). Additional populations of exotic fishes are likely to be located on private lands during 2011 surveys. Exotic species removals and negotiations with private landowners to facilitate exotics removal have been initiated.

Table 2. Non-native fishes recorded in the upper Cienega Creek watershed during 2010. Catfish and koi were also seen.

Region, Site Name	Mosquito-fish (<i>Gambusia affinis</i>)	Green Sunfish (<i>Lepomis cyanellus</i>)	Pumpkin-seed Sunfish (<i>Lepomis gibbosus</i>)	Bluegill Sunfish (<i>Lepomis macrochirus</i>)	Largemouth Bass (<i>Micropterus salmoides</i>)	Common Goldfish (<i>Carassius auratus</i>)	Grass Carp (<i>Ctenopharyngodon idella</i>)	Site Totals
Davidson Canyon		2		2	2			6
Duck Tank		1						
The Lake				1				
Twin Tanks				1	1			
Unnamed tank		1			1			
Elgin-Sonoita	5		1				1	7
Barnes Pond	1							
Breke Pond	1							
Homestead Pond	1							
Kalso Pond	1							
Masek Pond			1				1	
Ryan pond	1							
Mustang Mt.s					1			1
Jack Daniels Dam					1			
Santa Rita Mts				1	1	2		5
Haber Pond				1	1			
Haber Koi Pond	1							
Sweetwater Tank						2		
Species Totals	6	2	1	3	4	2	1	19

Exotic Fish Issues Discussion. Of the 9 non-native fish species detected thus far, the mosquitofish poses a severe and unmistakable threat to the native aquatic system: should its spread continue, it will reach Cienega Creek and eliminate the Gila Topminnow population, which represents by far the largest and most robust population of this endangered species in the United States. Two of the other non-native fish detected also pose a significant threat to native fishes in Cienega Creek: the green sunfish would possibly extirpate the endangered Gila chub and the topminnow in Cienega Creek; and the koi could wreak havoc in the creek should it become established there. The other non-native fishes are poorly adapted to cienega-stream conditions and would be less likely to produce significant impacts if they reached the creek.

It is difficult to foresee means by which the spread of exotic fishes harmful to the unique native fish fauna of Cienega Creek can be forestalled for long. Although almost all owners of the private lands, which support all the non-native fish populations we detected, were receptive to discussion with the FROG Project team conducting this survey, it is highly unlikely they would

remove the exotic fishes, or will fail to host more exotic fish species and populations, without an offer of satisfactory native replacements. Offer of native topminnows for mosquito control and desert pupfish as ornamentals under the statewide Safe Harbor Agreement program; and native Gila chubs, razorback suckers, and giant Colorado pikeminnows, as experimental non-essential populations would be appealing to fish-lovers and would likely thrive in the pools and ponds they have created for fish. Failing that, successful colonization of Cienega Creek by non-native fishes seems virtually inevitable over time. The most common question a pond owner interested in cooperating asks is, "Can I get native fish instead?" This may be a viable avenue to a conservation culture that will protect native aquatic vertebrates in the Southwest.

Chiricahua Leopard Frog (CLF) Monitoring:

The last Chiricahua Leopard Frogs observed in Cienega Creek were in Oct. 2004 (see Table 3). Metamorph CLFs (n=3) were found in Cinco Ponds in 2003, possibly the first breeding recorded there since the 1980's, but larval CLFs have not been found at LCNCA except at Empire Gulch Spring during our 21st century surveys. At least one adult male leopard frog was observed calling in Cinco Ponds in September of 2008, and two individuals were present in 2010. The CLF is also present in the Santa Rita Mountains at low and moderate elevations (Table 4).

Table 3. Average number of Chiricahua Leopard Frogs per visit when leopard frogs were seen.

	2002	2003	2004	2005	2006	2007	2008	2009	2010
Cinco Ponds		1.7					1.0		1.0
Empire Gulch	6.7	4.9	6.9	7.6	14.5	17.0	19.0	36.0	40.0
Gardner Cyn/Cienega Cr	2.3	1.0	1.0						
Headwaters, Cienega Cr		1.0							

The CLF population at Empire Gulch Spring remained remarkably stable at a low level, consisting of an apparent handful of individuals (probably between 6 and 20 total adults) between 1997 and 2004 or 2005 (Fig. 1). Population increase began in 2005 for unknown reasons, and has continued at least through 2009, resulting in an estimated increase of 6-fold. Although few counts are available for 2007-2010, high frog densities have been obvious during numerous other activities at the site.

The causes of the CLF increase at Empire Gulch Spring are not known. Other CLF populations (in the Pajarito Mountains) increased during this period, which was relatively arid and warm regionally. During 2005-2006, we collected a number of predatory aquatic invertebrates from the site for experimental use, which could have somewhat reduced tadpole mortality temporarily, although high densities of predatory aquatic insects have persisted at the site. It is also possible the CLF population has developed some immunity to the *Bd* chytrid fungus, which is confirmed present but has not produced evidence of mass mortality. Empire Gulch Spring is the warmest-water site at LCNCA, especially in winter: high water temperatures are associated with low observed *Bd* impacts on native ranid frogs in the Southwest. The mechanism for this is not known, but may involve frog immune response, protective skin microorganisms, and/or adaptation to the pathogen over time or in warm, low-virulence environments. Swab samples looking for *J. (Janthinobacterium) lividum*, a bacterium that confers protection against *Bd* in amphibians, have been collected, but results are not available yet.

Table 4. Observations of *Rana chiricahuensis* in the Empire Valley region, David Hall, 2010

Region, Site Name	Individuals Observed	No. Seen / Survey
Canelo Hills	2	2.0
Double Tank	2	2.0
Las Cienegas	9	4.5
Cinco Pond #5	1	1.0
Empire Gulch Spring	8	8.0
Santa Rita Mts	176	14.7
East Tank	3	3.0
Granite Tank	20	10.0
Greaterville Tank	64	32.0
Louisiana Gulch Corrals	25	25.0
Morningstar Tank	1	1.0
Unknown Tank	1	1.0
Upper Enzenberg Tank	1	1.0
West Tank	61	20.3
Grand Total	187	12.5

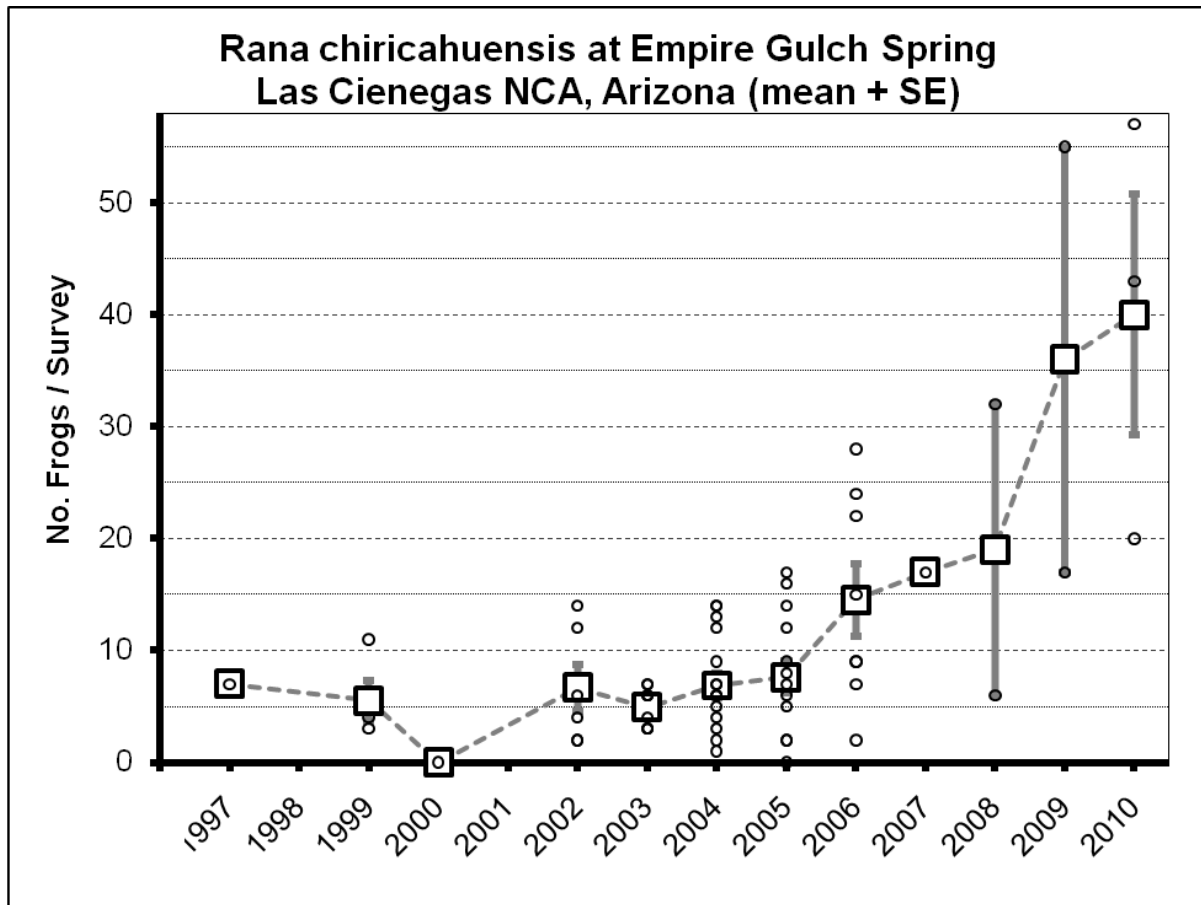


Figure 1. FROG Project monitoring data for the CLF. Individual surveys are hollow circles; means and SE are the large hollow squares with gray error bars. Detailed discussion is in text.

Empire Gulch Spring is unusual in southern Arizona in supporting a consistent number of individual leopard frogs, contrasting with more usual observations of fluctuation and collapse. The frogs are also remarkably localized within 50-m of the spring source, which is the most thermally stable area; it is uncommon to find them over 150-m downstream, and they are rarely found even 500-m downstream even though suitable habitat for leopard frogs is widespread. While tadpoles are consistently seen, and metamorphs appear as expected, massive flushes of these earlier age classes - often seen in other ranid frog populations - have not been observed as expected in a population with numerous large adult frogs.

Whether the Empire Gulch Spring CLF population has produced immigrants to the currently substantial Santa Rita Mountains populations (Table 4), where the CLF was not observed for several years prior to 2007-8; or to upper Cienega Creek and Cinco Ponds, where occasional individuals are observed, is not known. The Empire Gulch CLFs appear unusually sedentary, but metamorphs or even occasional adults could disperse.

Lowland Leopard Frog (LLF) Monitoring:

The LLF has been rarely observed at LCNCA since the 1970's, when John Frost (unpublished field notes) found both CLF and LLF present and syntopic in central Empire Valley; and especially since the 1980's, when Jeff Simms (personal communications) found the LLF in low numbers but not infrequently in the lower Empire Valley portion of Cienega Creek. Since then, only occasional individuals of the LLF have been seen in The Narrows (1994; Phil Rosen, unpublished) and near Stevenson Canyon (2007; David Kahrs, personal communication). A small population near Little Nogales Spring has been reported intermittently from the 1980's (Rosen, interview notes), and has never been reported extirpated. Lower Cienega Creek in the Pima County Natural Preserve, north of I-10, the LLF was very abundant during 1986-1993 (Rosen, field notes); but it has declined there markedly and maintained a sparse, small population since then (Dennis Caldwell, unpublished) following the discovery of *Bd*-related morbidity and mortality there in 1997-8. Lowermost Davidson Canyon, adjoining and in the county preserve, often has LLFs, though these may be individuals or migrants from the creek. The LLF was formerly abundant in the southeast quadrant of Santa Rita Mountains, in the mid-1970's (John Frost, unpublished field notes; Adobe Canyon), but currently it is known only from the southern extreme in one or more localized springs (emails from AGFD, 2005).

Elsewhere in southeastern Arizona, the LLF is found in isolated, mostly very small populations in the Pajarito, Rincon, and Santa Catalina mountains. A single robust metapopulation of the LLF occurs naturally in the lower San Pedro River and adjoining canyons (especially Aravaipa and Redfield canyons in the Galiuro Mountains). The only natural population not confirmed with the *Bd* pathogen is in the Tumacacori Mountains, and this population may be extirpated based on 2009-2011 surveys (Anna Savage, personal communications). The LLF is thus a species of concern in southeastern Arizona, although some captive outdoor populations in the Tucson basin are doing well (Caldwell, Rosen, Schwalbe, unpublished data).

The current known distribution of the LLF in the Empire Valley region is shown in Table 5. The only known reproducing populations are at Wakefield Canyon and Road Canyon Tank. The Wakefield Canyon population is small, localized, and isolated. The LLF population at Road Canyon Tank appeared in 2007, shortly after the tank was renovated by bullfrog elimination and installation of a solar-powered well and a cattle enclosure around one of the two small ponds there. Based on its isolation at ca. 11 straight-line miles from the nearest known potential

sources, this LLF population is thought to be introduced. It has persisted without evidence of mortality episodes, growing to a large size of scores of adults and hundreds of metamorphs in summer 2010 (although the high counts are not reflected in Table 5). During heavy rains in summer 2010, dispersing LLFs from Road Canyon Tank reached 10 sites within a 5-mile radius of the tank, accounting for all populations in Table 5 except the tank itself and Wakefield Canyon. Persistence and reproduction of the LLF at the new sites will not be known until surveys in 2011. The LLF at Road Canyon Tank has been sampled for genetic evidence of origin, *Bd* prevalence, and *J. lividum* presence, but results are not available yet.

Table 5. Observations of *Rana yavapaiensis* in the Empire Valley region, David Hall, 2010

Region, Site Name	Individuals Observed	No. Seen / Survey
Clyne Ranch	53	10.6
Clyne Pond	4	1.3
Hospital Tank	49	24.5
Elgin-Sonoita	2	2.0
Unknown	2	2.0
Las Cienegas	123	12.3
Cienega Cr Headwaters	4	4.0
Hummel Tank	4	4.0
Lower Johnson Tank	1	1.0
Oil Well Tank	1	1.0
Regge Tank	1	1.0
Road Canyon Tank	84	28.0
Upper Road Canyon Tank	11	11.0
Walker Pond	17	17.0
Whetstone Mts	25	12.5
Wakefield Canyon	25	12.5
Grand Total	203	11.3

Gartersnake Status at Las Cienegas NCA

The Mexican Gartersnake is less abundant at LCNCA than when the population was discovered (near the Mattie Canyon confluence in Cienega Creek) in 1985. However, it is persisting in low numbers (Table 6). The Checkered Gartersnake and Black-necked Gartersnake, which were not recorded in the Empire Cienega lowlands prior to the 21st century, are regularly observed now, and may be increasing. These species are less confined to perennial water habitat that exposes them to bullfrog predation, and less dependent on ranid frogs as a dietary staple than the Mexican Gartersnake, and may be predicted to increase as it declines. Bullfrog removals, in the absence of leopard frog recovery in Cienega Creek, may be contributing to the decline of the Mexican Gartersnake: adult bullfrogs are not abundant enough at LCNCA to outweigh the dietary benefits of tadpoles and metamorphs for the snake.

Table 6. Gartersnakes observed in the Empire Valley region, Arizona, 2010 on FROG Project work. DJC and PCR refer to Caldwell and Rosen, respectively.

Date	Location	No. Observed	Obs. Type	Observer	Notes
<u>Mexican Gartersnake (<i>Thamnophis eques</i>)</u>					
27-Sep-2009	Gardner Cyn/Cienega Cr	1	visual	DJC	collected for recovery team
8-Jul-2010	Gardner Cyn/Cienega Cr	2	trap	DJC	collected for recovery team
20-Jul-2010	Gardner Cyn/Cienega Cr	1	hand	DJC	at bullfrog larva area
21-Jul-2010	Gardner Cyn/Cienega Cr	1	visual	DJC	night
4-Aug-2010	Cienega Cr Headwaters	1	visual	Hall	Adult, Female
22-Sep-2010	Cienega Cr Headwaters	1	visual	Hall	Adult, Female
3-Oct-2010	Cienega Cr Headwaters	1	visual	DJC	Agency field trip
3-Nov-2010	Cienega Cr Headwaters	1	visual	PCR	Adult
<u>Checkered Gartersnake (<i>Thamnophis marcianus</i>)</u>					
3-Oct-2010	Clyne Ranch, Sue's Pond	1	visual	Hall	Adult, Male
<u>Black-necked Gartersnake (<i>Thamnophis cyrtopsis</i>)</u>					
21-Sep-2010	Clyne Pond	2	visual	Hall	Adult, 1 Male, 1 Female
3-Nov-2010	Road Canyon Tank	1	visual	PCR	Adult

Under guidance of the state and federal Gartersnake Working Group, a captive-breeding program has been established for the Mexican Gartersnake in Arizona: individuals from populations in San Raphael Valley and Cienega Creek, which are genetically indistinguishable based on existing analysis, are being maintained at Arizona-Sonora Desert Museum. In January 2011, the Gartersnake Working Group authorized introduction of captive-born or wild-collected Mexican Gartersnakes from Cienega Creek at Road Canyon Tank in 2011.

Aquatic Sampling at Cinco Ponds

Standardized protocols for sampling aquatic invertebrates and vertebrates were carried out in 2010 in the fenced-unfenced cattle grazing experimental area at Cinco Ponds in 2010. Emergent vegetation in the fenced portion of the largest pond, which supports most of the perennial open water found in marshy depression in the lowlands surrounding Cienega Creek, has proliferated extensively since cattle enclosure, and could result in closing off the open water. The Gila Topminnow arrived in this large pond during summer 2010, apparently during overbank flooding of nearby Cienega Creek. A small number of schools of this fish were observed, and some were seen in another wetted depression on the floodplain terrace nearby. Analysis of aquatic animal samples from Cinco Ponds is scheduled for completion in winter-spring 2011.

Continuing Intensive Conservation - 2011-2012

Using funding from National Fish and Wildlife Foundation (the "FROG Project") and continuing support from BLM, aquatic sampling, monitoring, research, and propagation; habitat renovation; exotic species control and eradication; native species population establishment; public education; and citizen science participation will be aggressively pursued in the upper Empire Valley watershed and frog-shed, including Babocomari and Research Ranch, in 2011-2012.

Appendix I. Location gazetteer for Empire Valley region aquatic vertebrate survey, 2010 FROG Project

SITE NAME	zone	Easting	Northing	SITE TYPE	County
<u>Canelo Hills</u>					
Double Tank	12R	535990	3496679	stock tank	Santa Cruz
<u>Clyne Ranch</u>					
Clyne Pond	12R	546706	3514459	stock tank	Pima
Hospital Tank	12R	547208	3514089	stock tank	Pima
Sue's Pond	12R	547694	3514089	stock tank	Pima
<u>Davidson Cyn</u>					
Duck Tank	12R	531128	3537462	stock tank	Pima
Missile Tank	12R	531495	3535908	stock tank	Pima
The Lake	12R	529212	3530674	stock tank	Pima
Twin Tanks	12R	531419	3530631	stock tank	Pima
Unnamed tank	12R	530026	3524251	stock tank	Pima
<u>Elgin-Sonoita</u>					
Barnes Pond	12R	541657	3504509	private pond	Santa Cruz
Breke Pond	12R	541355	3504381	stock tank	Santa Cruz
Homestead Lane Pond	12R	541939	3503455	private pond	Santa Cruz
Kalso pond	12R	541321	3505849	private pond	Santa Cruz
Masek Pond	12R	534302	3509090	artificial pond	Santa Cruz
Ryan Pond	12R	541348	3504419	private pond	Santa Cruz
Slatum Pond	12R	540593	3505283	private pond	Santa Cruz
Unknown	12R	544047	3506693	stock tank	Santa Cruz
<u>Las Cienegas NCA</u>					
Hummel Tank	12R	538767	3512947	stock tank	Pima
Lower Johnson Tank	12R	537989	3510977	stock tank	Pima
Missile Tank	12R	531495	3535908	stock tank	Pima
Mud Spring	12R	545516	3513895	seep	Pima
Oil Well Tank	12R	538000	3514179	stock tank	Pima
Regge Tank	12R	535746	3512307	stock tank	Pima
Road Canyon Tank	12R	540859	3511407	stock tank	Pima
Upper Road Cyn Tank	12R	543023	3511766	stock tank	Santa Cruz
Walker Pond	12R	534325	3507194	artificial pond	Santa Cruz
<u>Mustang Mts</u>					
Jack Daniels Dam	12R	548003	3505152	stock tank	Santa Cruz
<u>Santa Rita Mts</u>					
East Tank	12R	523238	3516882	stock tank	Pima
Fish Canyon Dam	12R	520819	3512727	small cyn stream	Pima
Fish Canyon Tank	12R	519822	3513061	stock tank	Pima
Granite Tank	12R	521076	3514228	stock tank	Pima
Greaterville Tank	12R	522733	3514676	stock tank	Pima
Haber Pond	12R	529800	3511406	artificial pond	Santa Cruz

(continued)

Appendix I. Location gazetteer
(continued)

Santa Rita Mts (continued)

Louisiana Gulch Corrals	12R	525810	3512587	small metal tanks	Santa Cruz
Morningstar Tank	12R	522681	3513982	stock tank	Pima
Perfect Tank	12R	520719	3510928	stock tank	Santa Cruz
Sweetwater Tank	12R	519220	3508791	stock tank	Santa Cruz
Unknown Tank	12R	524337	3510216	stock tank	Santa Cruz
Upper Enzenberg Tank	12R	520577	3514774	stock tank	Pima
West Tank	12R	554700	3493324	stock tank	Santa Cruz

Whetstone Mts

Wakefield Canyon	12R	549641	3529108	spring run	Pima
------------------	-----	--------	---------	------------	------
