FINAL REPORT

As Required by

THE ENDANGERED SPECIES PROGRAM

TEXAS

Grant No. TX E-91-R
(F08AP00137)

Endangered and Threatened Species Conservation

Biological Monitoring of the Repatriation Efforts for the Endangered Rio Grande silvery minnow (*Hybognathus amarus*) in Texas

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28 June 2013

FIANL REPORT

STATE: Texas **GRANT NUMBER:** TX E – 91-R

GRANT TITLE: Biological Monitoring of the Repatriation Efforts for the Endangered Rio Grande silvery minnow (*Hybognathus amarus*) in Texas

REPORTING PERIOD: 6 Sep 2007 to 31 Mar 2013

OBJECTIVE(S):

To monitor the status of repatriated Rio Grande silvery minnows (*Hybognathus amarus*) in the Big Bend region of Texas over three years.

Segment Objectives:

Oct - Dec 2008. Obtain from USFWS Rio Grande silvery minnow raised from eggs collected in the wild (preferred) or spawned in captivity.

Jan 2009. Stock fish in selected sites in Big Bend reach of Rio Grande identified as those in Big Bend Ranch State Park (Colorado Canyon, Madera or Grassy Banks or, Contrabando Canyon) and in Big Bend National Park (Mouth of Terlingua Creek, Santa Elena River Access, Hot Springs in BBNP or, the entrance to Boquillas Canyon).

2009-2010. Post Release Monitoring of Rio Grande silvery minnow populations in Big Bend reach of Rio Grande at time of introduction.

2010-2011. Monitoring of Rio Grande silvery minnow populations. Assessment of fish community structure and habitats where Rio Grande silvery minnows are found and a preliminary assessment of the habitat characteristics of areas where the species is not found for use in adaptive management of the restocking efforts.

Significant Deviation: None.

Summary Of Progress: See Attachment A.

Location: Brewster County, TX

Cost: Costs were not available at time of this report.

Prepared by: Craig Farquhar **Date:** 28 June 2013

Approved by: _____ **Date:** 28 June 2013
C. Craig Farquhar

Abstract

The Rio Grande silvery minnow (*Hybognathus amarus*) is one of the most endangered fishes in North America and was first federally listed in 1994. Originally inhabiting the Rio Grande from Española, New Mexico to the mouth of the river near Brownsville, the species is currently found in approximately 5% of its former range in central New Mexico. The Recovery Plan for the species recommended that it be reintroduced into portions of its former range. The first experimental reintroductions of the species was approved and undertaken in December 2008. More than 2,000,000 minnows have been released in the Big Bend region in the past 5 years. The reintroduced fish have shown at least some survival at each of the sites and have been found considerable distances away from the reintroduction sites. Rio Grande silvery minnow eggs have been collected from two of the monitoring sites in 2010 and in August 2010, a 37 mm standard length juvenile Rio Grande silvery minnow was taken at one site, indicating some successful reproduction

Introduction

The historical distribution of the federally Endangered Rio Grande silvery minnow, *Hybognathus amarus,* included the Rio Grande from Española, New Mexico, through the Big Bend reach to the Gulf of Mexico, and the Pecos River from near Santa Rosa, New Mexico, to the confluence with the Rio Grande. Seven collections made between 1938 and 1960 documented that Rio Grande silvery minnow was among the most common fishes of the Big Bend reach. Despite several sampling events from 1977 to the present, the species has not been found in the area and there are no records of the silvery minnow in the Río Conchos of Mexico in either historic or recent collections (U.S. Fish and Wildlife Service 1999, 2006).

The reasons for the species' extirpation in the Rio Grande in Texas are uncertain, but are believed to have been due to drought and diversions, in combination with water pollution. However, the continued presence of other native members of the pelagic spawning guild to which the species belongs (e.g., speckled chub and Rio Grande shiner) is evidence that the Big Bend reach may support the reestablishment of Rio Grande silvery minnow. But, a natural repopulation of the Rio Grande silvery minnow to the Big Bend reach of the Rio Grande was not possible without human assistance (U.S. Fish and Wildlife Service 1999, 2006).

Based on the presence of suitable habitat, the presence of fish species that have similar habitat requirements, the recommendations of the Rio Grande Silvery Minnow Recovery Team's reach-by-reach analysis of the entire Rio Grande basin, and the results of a feasibility study (U.S. Fish and Wildlife Service 1999, 2006; Edwards 2005), the area in which silvery minnow are most likely to become reestablished after potential reintroduction in the Rio Grande is from Mulato Dam near Presidio, Texas to Foster's Weir near the Terrell/Val Verde County line. The U.S. Fish and Wildlife Service is finalized its NEPA and rulemaking process and Federal Register rule for the reestablishment of the Rio Grande silvery minnow into its historic habitat in the Big Bend reach of the Rio Grande in Texas in December, 2008. This monitoring study was a cooperative endeavor involving the U.S. Fish and Wildlife, the National Park Service, the Texas Parks and Wildlife Department and U.S. Geologic Survey. The reestablished fish have a 10(j)

status, meaning that it is classified as a nonessential experimental population (NEP) under the federal Endangered Species Act provisions.

Objective

It was the purpose of this study to monitor the stocked Rio Grande silvery minnow populations in the Big Bend region to determine whether the stocking was successful, to determine various life history parameters, such as habitat occupation, time of reproduction, movements and interactions with other species, and to be able to provide timely data on the species' status in its environment to adaptively manage the multiple year restocking efforts in order to maximize the potential for the successful reestablishment of the species. A further objective was to establish baseline of data to be able to compare various of the species life history parameters with those found in the Rio Grande silvery minnow source populations in New Mexico.

The aim of the reestablishment of the Rio Grande silvery minnow into the Big Bend region is to create a self-sustaining population of the species in part of its historic range and to partially fulfill one of the recovery goals of the Recovery Plan which, when other goals are also satisfied, would ultimately lead to the downlisting of the species. The draft revised Recovery Plan defines a self-sustaining population as one that can sustain a minimum of 500,000 unmarked fish, for five consecutive years without augmentation from captive-bred fish (U.S. Fish and Wildlife Service 2006).

Materials and Methods

The initial stocking effort occurred in December 2008 from stocks raised at Dexter, New Mexico (at the Southwestern Native Aquatic Resources & Recovery Center, formerly Dexter National Fish Hatchery and Technology Center) and the Albuquerque BioPark. These were approximately equally divided among four established sites that were identified in the Big Bend region. The stockings sites, chosen, in part, due to their ease of access for the stocking vehicles were at Grassy Banks (Big Bend Ranch State Park), the mouth of Terlingua Creek and the boat ramp at Rio Grande Village (Big Bend National Park) and at Adams Ranch (owned by CEMEX). The dates of stocking are shown in Table 1.

Date	Number Stocked
December 2008	431,000
October 2009	509,000
October 2010	500,000
October 2011	267,000
October 2012	120,000
Total	1,827,000

Table 1. Stocking history of Rio Grande silvery minnows at the four sites in the Big Bend region. Shown for each date is the approximate total number of Rio Grande silvery minnows stocked.

The dates of the monitoring sampling are shown in Table 2.

Monitoring Date
May 11-13, 2009
July 3-5, 2009
October 28-29, 2009
February 10-12, 2010
May 19-21, 2010
August 2-4, 2010
October 19-20, 2010
February 1-3, 2011
June 12-24, 2011
October 23-24, 2011
February 21-23, 2012
May 22-23, 2012
October 25, 2012

Table 2. Dates for monitoring of reintroduced *Hybognathus amarus* in the Big Bend region.

Fishes were monitored by seining in all habitats in the relative proportion in which they occurred using seines that were (usually) 10' and 15' long with 1/8" mesh. Occasionally a 20' or 30' long seine with 1/4" mesh was used. The following physical measurements were recorded: time of each collection, stream temperature, stream width, stream depth, stream flow, substrate characteristics, vegetation density, dissolved oxygen (DO), conductivity or salinity, and pH. For the most part, captured specimens were preserved in 10% formalin and separated and counted by species in the laboratory at the University of Texas-Pan American (Appendix A). Occasionally, some captured fishes were too large to fit into our container and their lengths were estimated and they were returned alive to their site of capture. Most of the Rio Grande silvery minnows were kept alive and processed for parasites, viruses and general health, including breeding condition, by personnel from the Southwestern Native Aquatic Resources & Recovery Center. At various times, egg collections were made by personnel from the New Mexico Fish and Wildlife Conservation Office in Albuquerque, NM. Collections sites were chosen to correspond to or near the sites of stocking. In addition, various other sites in the region were also sampled on a more or less regular basis. Each of these sites along with their GPS coordinates are also found in Appendix A.

In addition, all curated collections of Rio Grande silvery minnows from the Texas Natural History Collections at the University of Texas at Austin were examined. For each lot, all specimens were measured (standard length) except in several large samples where a subset of at least 30 individuals was measured. These lengths are shown in Appendix B.

Results and Discussion

In all, 29 species and 1 hybrid combination were taken during our collections. A total of 113,402 specimens were captured of which, Rio Grande silvery minnows accounted for 297 specimens (Appendix 1). Rio Grande silvery minnow captures were not uniform. In most years,

the greatest numbers of silvery minnows were taken in the months following their stocking with few minnows remaining by the next stocking event (Fig. 1).

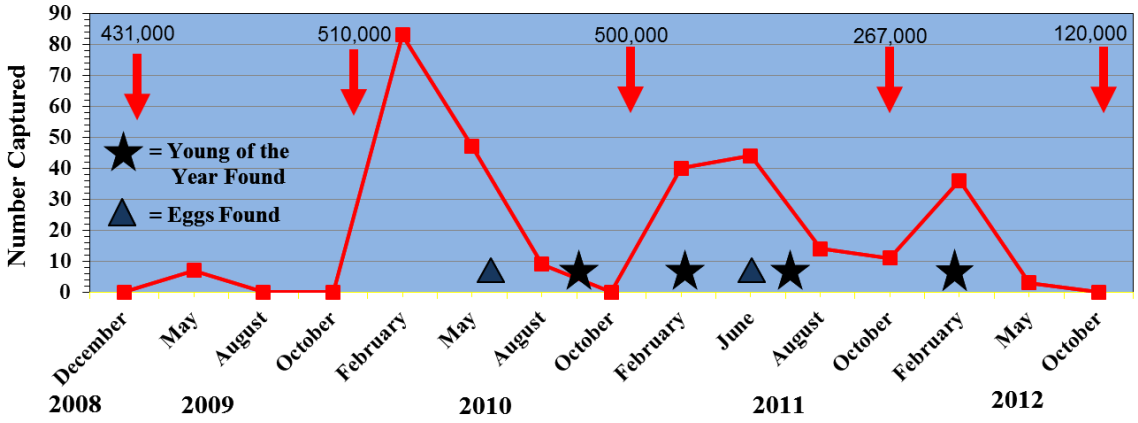


Fig. 1. Captures of *Hybognathus amarus* by date. Also shown are the number of individuals stocked (above red arrows) and when young-of-year or eggs were found.

The number of Rio Grande silvery minnows also varied by collection site with the greatest number being taken at the Terlingua Creek/Santa Elena Canyon mouth site and lesser, but approximately equal numbers being taken at the Boquilla Overlook, Adams Ranch, and Rio Grande Village collection sites (Fig. 2).

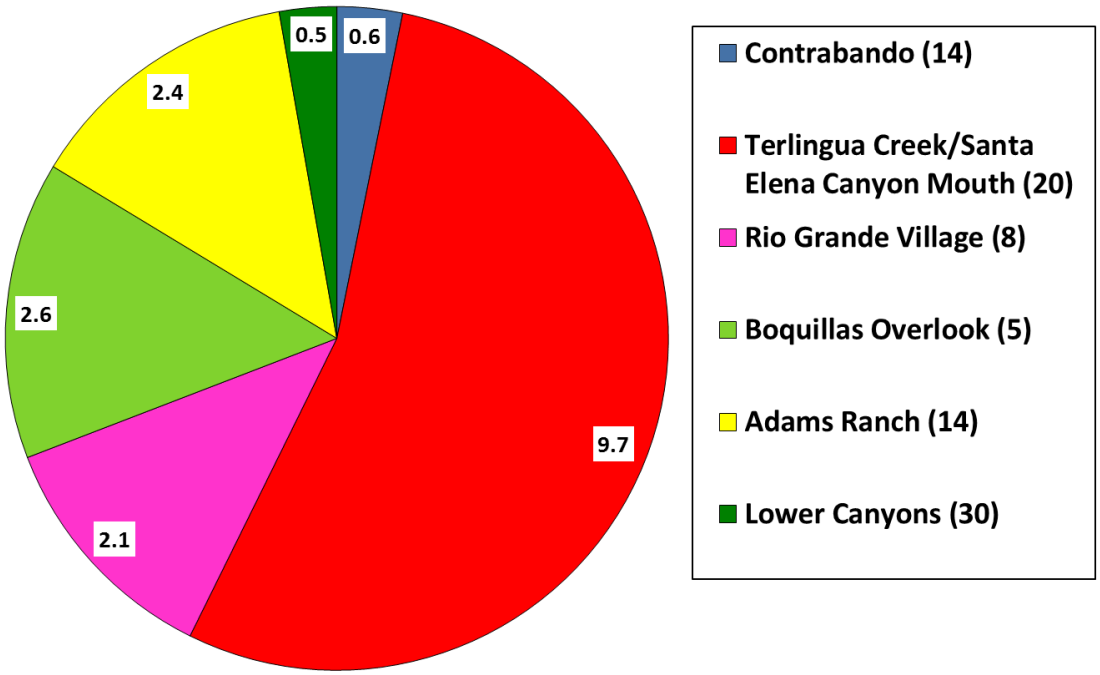


Fig. 2. Distribution of the mean number of *Hybognathus amarus* per collection taken at various collections sites in the Big Bend region. Numbers in parentheses are the number of collections for each site.

The substrates used by *H. amarus* is shown in Figure 3. Most individuals were captured over relatively fine substrates, especially sand and mud. While most sample localities were heterogenous with respect to substrates types, few *H. amarus* individuals were captured in riffles; most were captured in either backwater environments, along the margins of cut-banks with slow-moving flow or in relatively fine-graveled runs with moderate currents. While some habitats such as the areas strewn with large cobbles to boulders may be inhabited by *H. amarus*, seining was a particularly inefficient capture means in these areas.

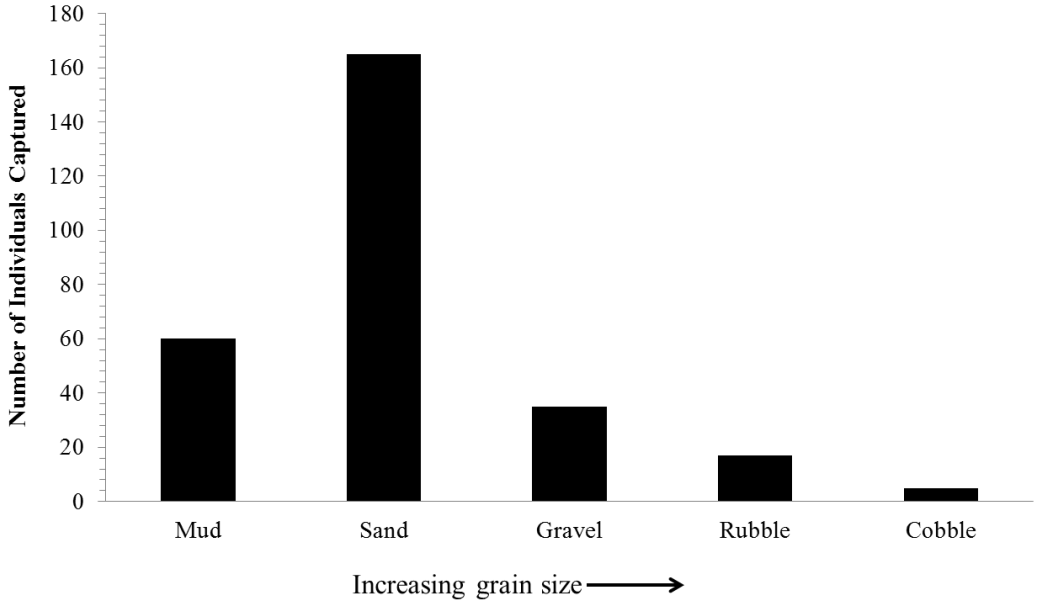


Figure 3. Substrate composition where *Hybognathus amarus* were captured.

The depth distributions of captured *H. amarus* are shown in Fig. 4. These represent the maximum depth of the water column at each site where fish were captured and not necessarily the depth where the fish were swimming.

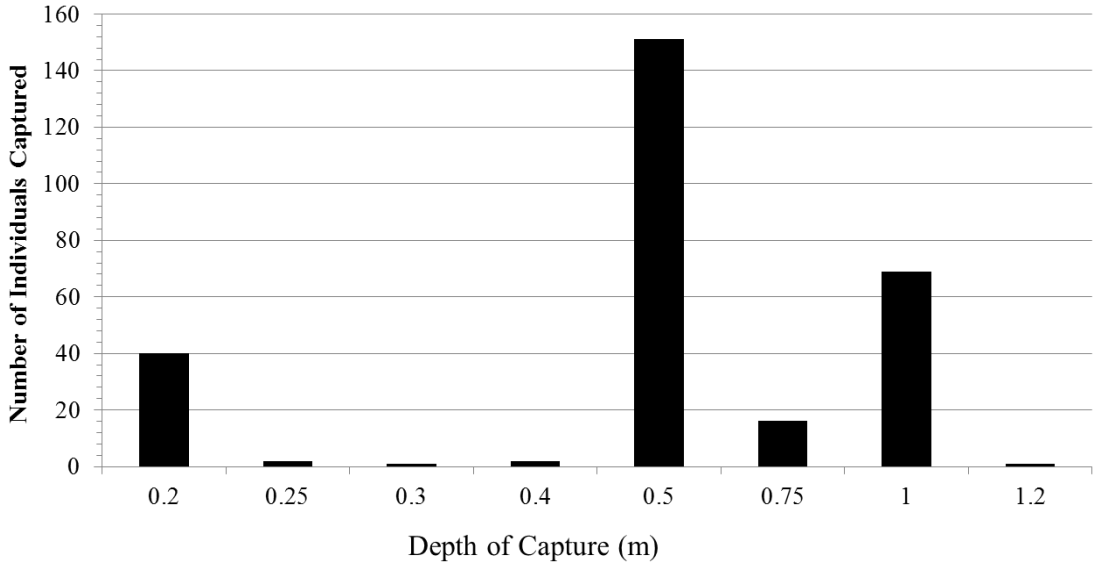


Fig. 4. Depth of water column in samples where H. amarus were captured.

The species composition at sites where *H. amarus* were captured were compared with sites that did not yield *H. amarus* (Table 3). While species composition for this comparison were similar for this comparison, *H. amarus* were more often taken in sites that had greater abundances of Tamaulipas shiners (*Notropis braytoni*) and river carpsuckers (*Carpiodes carpio*) and a lesser abundance of red shiners (*Cyprinella lutrensis*).

Table 3. Relative abundances of fishes in collections where Rio Grande silvery minnows were found (With %) compared to collections in which Rio Grande silvery minnows were not taken (Without %).

Common name	Species	With %	Without %
longnose gar	*Lepisosteus osseus*	0.130	0.044
gizzard shad	*Dorosoma cepedianum*	0.385	0.390
Mexican stoneroller	*Campostoma ornatum*	0.239	0.452
Rio Grande silvery minnow	*Hybognathus amarus*	0.635	0.000
speckled chub	*Macrhybopsis aestivalis*	0.659	0.531
red shiner	*Cyprinella lutrensis*	63.252	70.761
blacktail shiner	*Cyprinella venusta*	0.009	0.032
red x blacktail shiner hybrid	*C. lutrensis x venusta hybrid*	0.004	0.002
longnose dace	*Rhinichthys cataractae*	0.443	0.137
Chihuahua shiner	*Notropis chihuahua*	0.639	0.282
Tamaulipas shiner	*Notropis braytoni*	18.745	14.597
Rio Grande shiner	*Notropis jemezanus*	0.017	0.005
bullhead minnow	*Pimephales vigilax*	0.165	0.008
common carp	*Cyprinus carpio*	1.407	0.683

river carpsucker	*Carpiodes carpio*		2.932	1.261
blue sucker	*Cycleptus elongatus*		0.062	0.009
Mexican tetra	*Astyanax mexicanus*		1.069	0.905
blue catfish	*Ictalurus furcatus*		0.081	0.204
channel catfish	*Ictalurus punctatus*		0.716	0.416
flathead catfish	*Pylodictis olivaris*		0.026	0.047
inland silverside	*Menidia beryllina*		0.017	0.039
plains killifish	*Fundulus kansae*		1.022	1.790
western mosquitofish	*Gambusia affinis*		6.875	6.726
largemouth bass	*Micropterus salmoides*		0.002	0.006
green sunfish	*Lepomis cyanellus*		0.015	0.000
bluegill	*Lepomis macrochirus*		0.011	0.015
longear sunfish	*Lepomis megalotis*		0.436	0.618
freshwater drum	*Aplodinotus grunniens*		0.004	0.003
blue tilapia	*Oreochromis aureus*		0.002	0.039
Rio Grande cichlid	*Cichlasoma cyanoguttatum*		0.000	0.002
		Total Captures	46765	66637

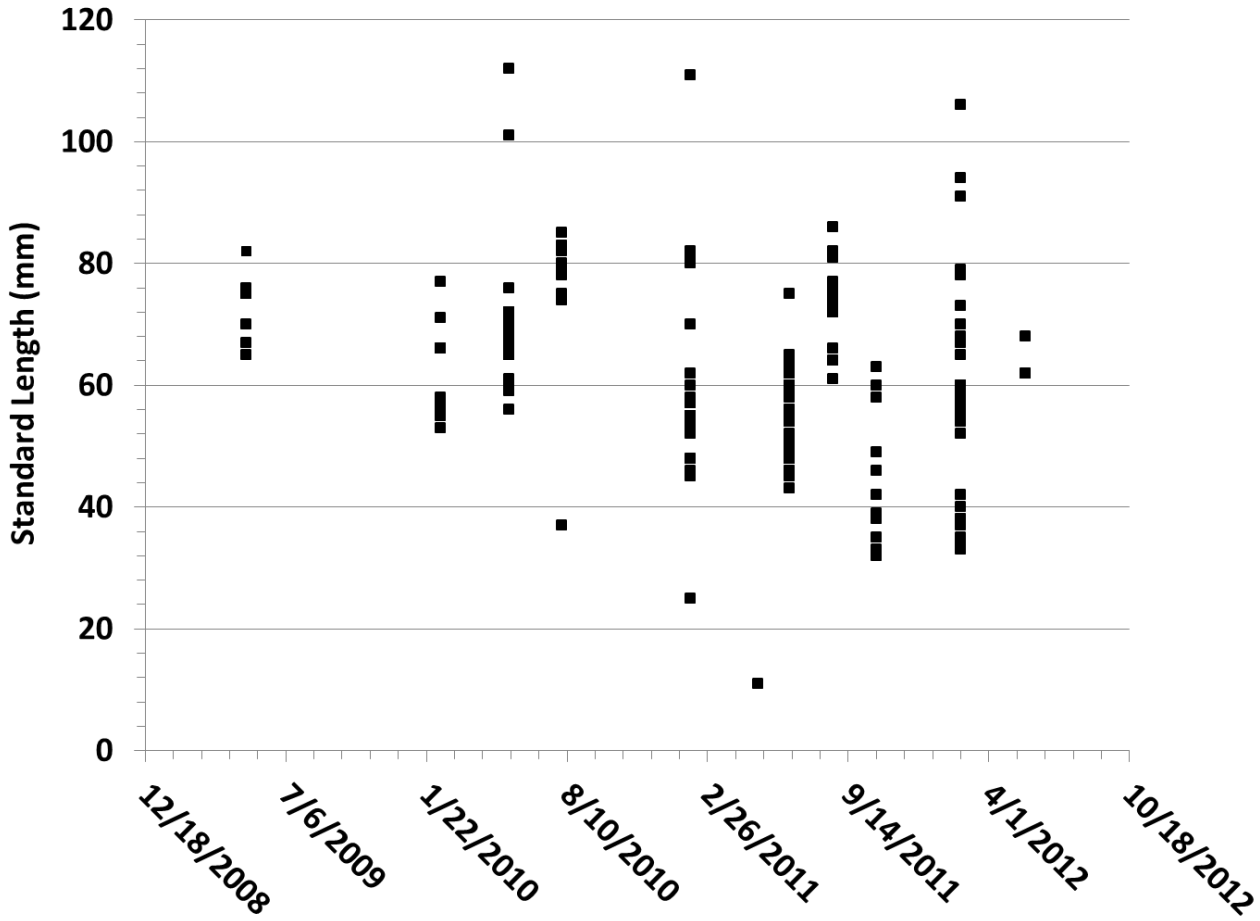
Table 4. Reproductive status of Rio Grande silvery minnows captured in various months. Data was processed by personnel from the Southwestern Native Aquatic Resources & Recovery Center. Shown is the percentage of specimens whose ovaries or testes were in a given reproductive state as listed on the datasheets.

Month of Collection	Not Reproductive	Developing ovaries/testes	Ripe ovaries/testes	Reabsorbing ova/regressing testes	N
February	4.9	78.0	14.6	2.4	39
May	12.5	25.0	56.3	6.3	28
August	18.2	13.6	40.9	27.3	22

The reproductive status of captured fishes was assessed from the data gathered and reported by the Southwestern Native Aquatic Resources & Recovery Center (Table 4). It appears that most specimens were developing their ovaries and testes in February and that most contained ripe ovaries and testes in May and August, suggesting a late spring through summer breeding season. An examination of all historical collections Rio Grande silvery minnows from the Texas Natural History collections indicate that young (less than 20 mm SL) were taken in June near the Hot Springs, in July near Dryden and in August near Boquillas Canyon and at a Ranch in Webb County and in late December in the Lower Rio Grande Valley (Appendix 2).

Young juvenile Rio Grande silvery minnows were taken infrequently. The smallest specimen (10.9 mm SL) was taken at the Adams Ranch site in May 2011 and other juveniles were taken in August 2010 at Adams Ranch, in February 2011 in Terlingua Creek near its mouth, in October 2011 at Adams Ranch, and in February 2012 at confluence of Terlingua Creek with the Rio Grande and at Adams Ranch (Fig. 5). The distribution of sizes of Rio Grande silvery minnows among the collection dates indicate that stocked fish not only survive, but grow as well, as many fish captured were larger than the sizes of *H. amarus* stocked.

Fig. 5. Size distribution of collected *H. amarus*. Each data point represents one or more individuals of a given standard length (in mm).



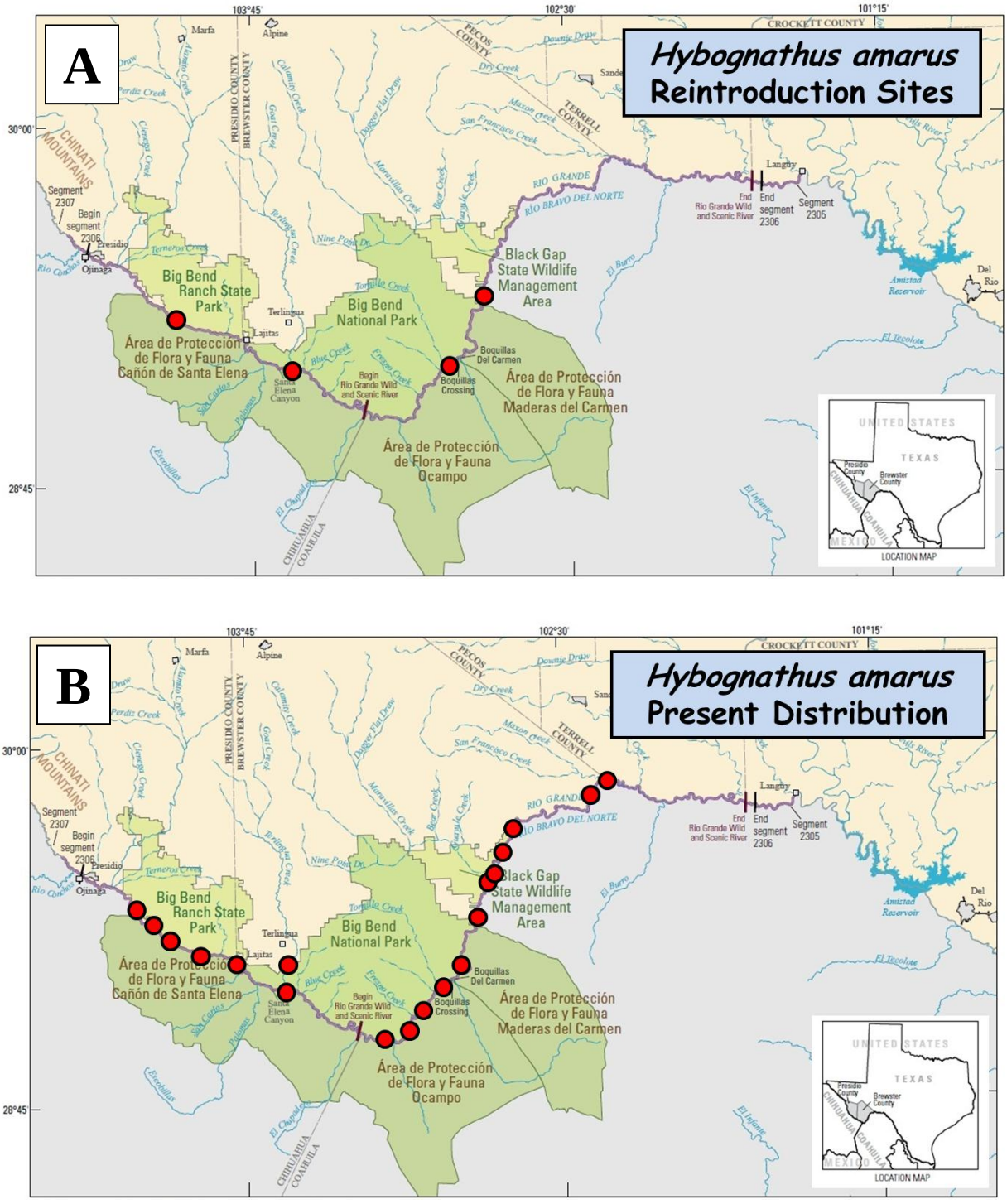


Fig. 6. The map sites where Rio Grande silvery minnows were stocked (A) and the distribution of Rio Grande silvery minnows taken during the June 2011 sampling period (B).

Conclusions and Recommendations

From the sampling beginning in May 2009 through 2012, the present range of the Rio Grande silvery minnow may be inferred from the results of the extensive sampling undertaken in June 2011 which sampled from near Presidio downstream through the Lower Canyon stretch (Fig. 6). Rio Grande silvery minnows were found throughout, suggesting that not only is there significant survival, but also both upstream and downstream dispersion. Reproduction is apparently limited which may be that the proper conditions for optimal reproduction do not occur with regularity and that further stockings should be carried out for a further 5-year period. Monitoring could be more limited to attempt to target sampling to when the juveniles are more likely to be captured.

Acknowledgments

Funding for this project came from Section 6 Funds provided by the Texas Parks and Wildlife Department and I thank them for their funding. We would like to thank the following departments, agencies and individuals: Big Bend National Park, Raymond Skiles, Jeff Bennett; Big Bend Ranch State Park, Mark Lockwood; Southwestern Native Aquatic Resources & Recovery Center, Manuel Ulibarri, Catherine Sykes, Teresa Lewis; Albuquerque Biological Park, Chris Altenbach; U.S. Fish and Wildlife Service, Aimee Roberson, Jason Remshardt, Jim Brooks; Texas Parks and Wildlife Department, David Wilson, Niki Ragan, Stephanie Shelton, Megan Bean, Paul Fleming; Texas Water Development Board, Ray Mathews; Middle Rio Grande Endangered Species Collaborative Program; CEMEX El Carmen/Adams Ranch, Bonnie McKinney; Texas Commission on Environmental Quality; Texas Department of Agriculture; Texas Farm Bureau; World Wildlife Fund; The Nature Conservancy; University of Texas-Pan American; U.S. Geological Survey, Bruce Moring; International Boundary and Water Commission, Comisión Nacional de Areas Naturales Protegidas, Departmento de Restauración Ecologia, and Instituto Nacional Ecologia and many others who have helped with our sampling.

Literature Cited

Federal Register. 2008. Final Rule: Establishment of a Nonessential Experimental Population of Rio Grande Silvery Minnow in the Big Bend Reach of the Rio Grande in Texas. Vol. 73 (236):74358-74372, December 8, 2008.

U. S. Fish and Wildlife Service. 2007a. Draft Revised Rio Grande Silvery Minnow Recovery Plan. Albuquerque, New Mexico. 174 pp.

U. S. Fish and Wildlife Service. 2008. Environmental Assessment. Reestablishment of the Rio Grande silvery minnow in the Big Bend reach of the Rio Grande in Texas. Final assessment prepared by USFWS, November 21, 2008.

Appendix A. Specimens of each species collected for each sample site and date.

		Grassy Banks	Santa Elena/ Terlingua	Rio Grande Village	Adams Ranch	Grassy Banks	Contrabando Movie Set	Adams Ranch	Grassy Banks	Santa Elena/ Terlingua
	Latitude	29° 16'53.46" N	29° 09'54.34" N	29° 10'46.67" N	29° 24'31.43" N	29° 16'53.46" N	29°16'44.91"N	29° 24'31.43" N	29° 16'53.46" N	29° 09'54.34" N
	Longitude	103°53'07.56" W	103°36'38.45" W	102°57'38.95" W	102°49'58.07" W	103°53'07.56" W	103° 50'28.27"W	102°49'58.07" W	103°53'07.56" W	103°36'38.45" W
	Date	5/11/2009	5/13/2009	5/12/2009	5/12/2009	8/3/2009	8/3/2009	8/5/2009	10/29/2009	10/28/2009
Common name	Species									
longnose gar	*Lepisosteus osseus*	12	6	2	6					
gizzard shad	*Dorosoma cepedianum*	3			17				10	104
Mexican stoneroller	*Campostoma ornatum*									
Rio Grande silvery minnow	*Hybognathus amarus*	1	1	1	4					
speckled chub	*Macrhybopsis aestivalis*	5		51	14	6		8	19	3
red shiner	*Cyprinella lutrensis*	20	113	638	60	58	4	70	374	1064
blacktail shiner	*Cyprinella venusta*									
red x blacktail shiner hybrid	*C. lutrensis x venusta hybrid*									
longnose dace	*Rhinichthys cataractae*		14	4	28	10				1
Chihuahua shiner	*Notropis chihuahua*		3							
Tamaulipas shiner	*Notropis braytoni*		25	98	8			2	10	347
Rio Grande shiner	*Notropis jemezanus*									
bullhead minnow	*Pimephales vigilax*									
common carp	*Cyprinus carpio*	111	296	6	4					
river carpsucker	*Carpiodes carpio*	149	49	102	16	3		3		74
blue sucker	*Cycleptus elongatus*	1	2	4	1					
Mexican tetra	*Astyanax mexicanus*	2	10	2	4				5	18
blue catfish	*Ictalurus furcatus*		4	3		35	13	9	14	18
channel catfish	*Ictalurus punctatus*			2			3		11	12
flathead catfish	*Pylodictis olivaris*						1			
inland silverside	*Menidia beryllina*				5					2
plains killifish	*Fundulus kansae*		16	4						1
western mosquitofish	*Gambusia affinis*	41	18	51	9	46		1	12	1
largemouth bass	*Micropterus salmoides*									
green sunfish	*Lepomis cyanellus*									
bluegill	*Lepomis macrochirus*	1	1						1	
longear sunfish	*Lepomis megalotis*								1	
freshwater drum	*Aplodinotus grunniens*				1					
blue tilapia	*Oreochromis aureus*									
Rio Grande cichlid	*Cichlasoma cyanoguttatum*									
	Number of Fishes Captured	346	558	968	177	158	21	93	457	1645
	N Species	11	14	14	14	6	4	6	10	12
	Temperature	28	25.4	28.7	30.3		27.5	30	15.9	20.8
	Dissolved Oxygen						6.88	7.7		11.04
	Conductivity						1491	1494	1333	1171
	pH						7.92	8.06		8.46
	Salinity (ppt)	4.60	1.20	1.60	1.20					

		Rio Grande Village	Adams Ranch	Contrabando Movie Set	Santa Elena/ Terlingua	Rio Grande at Tornillo Cr. mouth	Rio Grande Village	Adams Ranch	Contrabando Movie Set	Lajitas Boat Ramp
	Latitude	29° 10'46.67" N	29° 24'31.43" N	29° 16'44.91"N	29° 09'54.34" N	29° 10' 39" N	29° 10'46.67" N	29° 24'31.43" N	29°16'44.91"N	29°15'55.81"N
	Longitude	102°57'38.95" W	102°49'58.07" W	103° 50'28.27"W	103°36'38.45" W	102°59'49" W	102°57'38.95" W	102°49'58.07" W	103° 50'28.27"W	103° 46'56.43"W
	Date	10/28/2009	10/29/2009	2/10/2010	2/11/2010	2/11/2010	2/11/2010	2/12/2010	5/19/2010	5/19/2010
Common name	Species									
longnose gar	*Lepisosteus osseus*									9
gizzard shad	*Dorosoma cepedianum*				2	3	1			
Mexican stoneroller	*Campostoma ornatum*									
Rio Grande silvery minnow	*Hybognathus amarus*			1	80		2			
speckled chub	*Macrhybopsis aestivalis*	4	17		16		4	9	5	
red shiner	*Cyprinella lutrensis*	304	231	297	445	416	1560	720	244	159
blacktail shiner	*Cyprinella venusta*									
red x blacktail shiner hybrid	*C. lutrensis x venusta hybrid*									
longnose dace	*Rhinichthys cataractae*		2		2	5	30	26	13	1
Chihuahua shiner	*Notropis chihuahua*									
Tamaulipas shiner	*Notropis braytoni*	14	66	9	1045	15	156	187	15	
Rio Grande shiner	*Notropis jemezanus*						5	2		
bullhead minnow	*Pimephales vigilax*									
common carp	*Cyprinus carpio*									10
river carpsucker	*Carpiodes carpio*		2				49		2	
blue sucker	*Cycleptus elongatus*									
Mexican tetra	*Astyanax mexicanus*					9	2		1	
blue catfish	*Ictalurus furcatus*	1	1					1		
channel catfish	*Ictalurus punctatus*	12	12	4	1	2	2	2	1	
flathead catfish	*Pylodictis olivaris*						1		1	
inland silverside	*Menidia beryllina*									2
plains killifish	*Fundulus kansae*				3	32	1			
western mosquitofish	*Gambusia affinis*	2	2	11	12	36		4	41	31
largemouth bass	*Micropterus salmoides*									
green sunfish	*Lepomis cyanellus*									
bluegill	*Lepomis macrochirus*									
longear sunfish	*Lepomis megalotis*				1					1
freshwater drum	*Aplodinotus grunniens*									
blue tilapia	*Oreochromis aureus*									
Rio Grande cichlid	*Cichlasoma cyanoguttatum*									
	Number of Fishes Captured	337	333	322	1607	518	1813	951	323	213
	N Species	6	8	5	10	8	12	8	9	7
	Temperature	20.3	18.6	12.1	11.3	21	14.7	12.6	28.9	30
	Dissolved Oxygen	11.12	11.03						9.56	10.68
	Conductivity	1268	1215	2288	2816	1126	2728	2494	3956	4080
	pH	8.32	8.4						8.48	8.47
	Salinity (ppt)				1.5			1.3		

		Santa Elena/ Terlingua	Rio Grande at Tornillo Cr. mouth	Rio Grande Village	Adams Ranch	Contrabando Movie Set	Lajitas Boat Ramp	Santa Elena/ Terlingua	Terlingua Cr. at Terlingua Abajo	Rio Grande at Tornillo Cr. mouth
	Latitude	29° 09'54.34" N	29° 10' 39" N	29° 10'46.67" N	29° 24'31.43" N	29°16'44.91"N	29°15'55.81"N	29° 09'54.34" N	29°12'5.70"N	29° 10' 39" N
	Longitude	103°36'38.45" W	102°59'49" W	102°57'38.95" W	102°49'58.07" W	103° 50'28.27"W	103° 46'56.43"W	103°36'38.45" W	103°36'00.63"W	102°59'49" W
	Date	5/20/2010	5/20/2010	5/20/2010	5/21/2010	8/3/2010	8/3/2010	8/3/2010	8/3/2010	8/4/2010
Common name	Species									
longnose gar	*Lepisosteus osseus*		1	20	2					
gizzard shad	*Dorosoma cepedianum*	1						76		
Mexican stoneroller	*Campostoma ornatum*									
Rio Grande silvery minnow	*Hybognathus amarus*	36		11				1	7	
speckled chub	*Macrhybopsis aestivalis*	21	1	48	1	13	6	9		6
red shiner	*Cyprinella lutrensis*	1224	186	501	423	33	17	1572	390	356
blacktail shiner	*Cyprinella venusta*									
red x blacktail shiner hybrid	*C. lutrensis x venusta hybrid*									
longnose dace	*Rhinichthys cataractae*	108			3	4		2	13	
Chihuahua shiner	*Notropis chihuahua*	25						5	53	
Tamaulipas shiner	*Notropis braytoni*	101	81	211	78	26	2	442	211	105
Rio Grande shiner	*Notropis jemezanus*	2								
bullhead minnow	*Pimephales vigilax*									
common carp	*Cyprinus carpio*	1	1		1			1		
river carpsucker	*Carpiodes carpio*	118	1	64	4	3		30	94	6
blue sucker	*Cycleptus elongatus*	4		4						
Mexican tetra	*Astyanax mexicanus*		5		1	3		4	2	21
blue catfish	*Ictalurus furcatus*			1			3		4	7
channel catfish	*Ictalurus punctatus*	55	2			48	24	74	67	7
flathead catfish	*Pylodictis olivaris*			2						
inland silverside	*Menidia beryllina*							1		
plains killifish	*Fundulus kansae*	27						3	16	
western mosquitofish	*Gambusia affinis*		7	115	42			5		2
largemouth bass	*Micropterus salmoides*									
green sunfish	*Lepomis cyanellus*	1								
bluegill	*Lepomis macrochirus*							1		
longear sunfish	*Lepomis megalotis*			3		1		4		
freshwater drum	*Aplodinotus grunniens*									
blue tilapia	*Oreochromis aureus*									
Rio Grande cichlid	*Cichlasoma cyanoguttatum*									
	Number of Fishes Captured	1724	285	980	555	131	52	2230	857	510
	N Species	14	9	11	9	8	5	16	10	8
	Temperature	26	32.5	31.8	27.9	28.41	28.96	27.2	26.42	28.86
	Dissolved Oxygen	6.28	8.47	7.99	7.57	6.79	6.8	6.71	7.34	6.19
	Conductivity	3773	1285	2922	2448	1352	1278	147	1.321	1208
	pH	8.47	8.03	8.41	8.57	8.47	8.44	8.28	8.4	8.37
	Salinity (ppt)									

		Rio Grande Village	Adams Ranch	Contrabando Movie Set	Santa Elena/ Terlingua	Rio Grande Village	Adams Ranch	Contrabando Movie Set	Rio Grande at Santa Elena	Terlingua Cr. near mouth
	Latitude	29° 10'46.67" N	29° 24'31.43" N	29°16'44.91"N	29° 09'54.34" N	29° 10'46.67" N	29° 24'31.43" N	29°16'44.91"N	29° 09'54.34" N	29.166984°
	Longitude	102°57'38.95" W	102°49'58.07" W	103° 50'28.27"W	103°36'38.45" W	102°57'38.95" W	102°49'58.07" W	103° 50'28.27"W	103°36'38.45" W	-103.612598°
	Date	8/4/2010	8/2/2010	10/20/2010	10/20/2010	10/20/2010	10/19/2010	2/2/2011	2/2/2011	2/2/2011
Common name	Species									
longnose gar	*Lepisosteus osseus*	1								
gizzard shad	*Dorosoma cepedianum*				14		5			5
Mexican stoneroller	*Campostoma ornatum*									
Rio Grande silvery minnow	*Hybognathus amarus*	1								37
speckled chub	*Macrhybopsis aestivalis*	13	18		4	13	6		5	2
red shiner	*Cyprinella lutrensis*	444	252	110	742	24	98	132	8	129
blacktail shiner	*Cyprinella venusta*									
red x blacktail shiner hybrid	*C. lutrensis x venusta hybrid*									
longnose dace	*Rhinichthys cataractae*				4					
Chihuahua shiner	*Notropis chihuahua*									
Tamaulipas shiner	*Notropis braytoni*	393	85	8	806	9	90	2	199	1
Rio Grande shiner	*Notropis jemezanus*									
bullhead minnow	*Pimephales vigilax*									
common carp	*Cyprinus carpio*				14					
river carpsucker	*Carpiodes carpio*	15			24				1	2
blue sucker	*Cycleptus elongatus*									
Mexican tetra	*Astyanax mexicanus*	4			12	1				
blue catfish	*Ictalurus furcatus*	22	8	1	1	7	4			
channel catfish	*Ictalurus punctatus*	50	27	1	3	6	9			
flathead catfish	*Pylodictis olivaris*	2	13	1			2			
inland silverside	*Menidia beryllina*				13		2			
plains killifish	*Fundulus kansae*				7					1
western mosquitofish	*Gambusia affinis*	2	3		41		6		1	
largemouth bass	*Micropterus salmoides*									
green sunfish	*Lepomis cyanellus*									
bluegill	*Lepomis macrochirus*									
longear sunfish	*Lepomis megalotis*	10	1							
freshwater drum	*Aplodinotus grunniens*									
blue tilapia	*Oreochromis aureus*				1					
Rio Grande cichlid	*Cichlasoma cyanoguttatum*									
	Number of Fishes Captured	957	407	121	1685	60	222	134	214	177
	N Species	12	8	5	13	6	9	2	5	7
	Temperature	28.2	31.25	22.8	22	23.9	25.1	8.8	6.5	0.5
	Dissolved Oxygen	6.34	6.24					17.03	12.9	16.3
	Conductivity	1166	979	1324	1417	1721	1592	2460	2272	694
	pH	8.36	8.18					8.85	8.45	8.77
	Salinity (ppt)			0.7	0.7	0.9	0.8			

		Terlingua Cr. at Terlingua Abajo	Terlingua Cr. at Terlingua	Rio Grande at Tornillo Cr. mouth	Adams Ranch	Redford	Big Bend Ranch State Park Site 4	Colorado Canyon	Madera Put-in	Madera Access
	Latitude	29°12'5.70"N	29°19'45.30"N	29° 10' 39" N	29° 24'31.43" N	29°26'8.89"N	29° 20.657'N	29° 20.198'N	29°17'31.38"N	29°17'50.70"N
	Longitude	103°36'00.63"W	103°33'19.92"W	102°59'49" W	102°49'58.07" W	104°11'34.84"W	104° 04.225'W	104° 03.354'W	103°55'16.02"W	103°57'20.82"W
	Date	2/2/2011	2/2/2011	2/3/2011	2/1/2011	6/22/2011	6/22/2011	6/22/2011	6/22/2011	6/22/2011
Common name	Species									
longnose gar	*Lepisosteus osseus*									2
gizzard shad	*Dorosoma cepedianum*									
Mexican stoneroller	*Campostoma ornatum*	111	35							
Rio Grande silvery minnow	*Hybognathus amarus*	2		1			1		1	
speckled chub	*Macrhybopsis aestivalis*	1			13		2	2	4	
red shiner	*Cyprinella lutrensis*	105	391	40	63	3617	1967	1341	1852	296
blacktail shiner	*Cyprinella venusta*									
red x blacktail shiner hybrid	*C. lutrensis x venusta hybrid*									
longnose dace	*Rhinichthys cataractae*					1				
Chihuahua shiner	*Notropis chihuahua*	33	51							
Tamaulipas shiner	*Notropis braytoni*	19		205	20	139	89	109	22	19
Rio Grande shiner	*Notropis jemezanus*									
bullhead minnow	*Pimephales vigilax*									
common carp	*Cyprinus carpio*					12	2	14	4	82
river carpsucker	*Carpiodes carpio*	4	11	24	2	4		2		2
blue sucker	*Cycleptus elongatus*					1				
Mexican tetra	*Astyanax mexicanus*			84		4	3	2	4	16
blue catfish	*Ictalurus furcatus*									
channel catfish	*Ictalurus punctatus*	13								
flathead catfish	*Pylodictis olivaris*				1	1				
inland silverside	*Menidia beryllina*									
plains killifish	*Fundulus kansae*	48	87					1		
western mosquitofish	*Gambusia affinis*			73	3		19	10	11	29
largemouth bass	*Micropterus salmoides*									
green sunfish	*Lepomis cyanellus*									
bluegill	*Lepomis macrochirus*									
longear sunfish	*Lepomis megalotis*					1				
freshwater drum	*Aplodinotus grunniens*									
blue tilapia	*Oreochromis aureus*									
Rio Grande cichlid	*Cichlasoma cyanoguttatum*									
	Number of Fishes Captured	336	575	427	102	3780	2083	1481	1898	446
	N Species	9	5	6	6	9	7	8	7	7
	Temperature	6.9	9	7.2	15.5	26.7	26.1	25.7	27.6	28
	Dissolved Oxygen	13.61	13.8	12.1	12.2	7.04	5.41	7	6.71	5.8
	Conductivity	849	1229	1914	2134	3559	3166	3129	3049	2820
	pH	8.66	8.55	8.18	8.33	7.81	7.88	7.99	8.01	7.73
	Salinity (ppt)									

		Big Bend Ranch State Park Site 2	Big Bend State Ranch Site 8	Contrabando Movie Set	Lajitas Resort	Terlingua Cr. at Terlingua	Terlingua Cr. at Terlingua	Terlingua Cr. at Terlingua Abajo	Rio Grande at Santa Elena	Rio Grande at Castolon pullout
	Latitude	29° 17.119'N	29° 17.052'N	29°16'44.91"N	29°15'13.0"N	29.327298° N	29°19'45.30"N	29°12'5.70"N	29° 09'54.34" N	29° 9' 18"
	Longitude	10°3 52.847'W	10°3 52.717'W	103° 50'28.27"W	103° 46'21.9"W	-103.553543°	103°33'19.92"W	103°36'00.63"W	103°36'38.45"W	103° 35' 52.80"
	Date	6/21/2011	6/22/2011	6/22/2011	6/21/2011	6/22/2011	6/21/2011	6/21/2011	6/21/2011	6/21/2011
Common name	Species									
longnose gar	*Lepisosteus osseus*			1	6					
gizzard shad	*Dorosoma cepedianum*									
Mexican stoneroller	*Campostoma ornatum*					178	9	79		
Rio Grande silvery minnow	*Hybognathus amarus*				2				13	
speckled chub	*Macrhybopsis aestivalis*	5	3	4	8				25	1
red shiner	*Cyprinella lutrensis*	3589	1766	2048	4369	286	1222	223	1101	963
blacktail shiner	*Cyprinella venusta*									
red x blacktail shiner hybrid	*C. lutrensis x venusta hybrid*									
longnose dace	*Rhinichthys cataractae*				1					
Chihuahua shiner	*Notropis chihuahua*					53	3	81		
Tamaulipas shiner	*Notropis braytoni*	58	20	83	88	165	239	456	132	211
Rio Grande shiner	*Notropis jemezanus*								1	
bullhead minnow	*Pimephales vigilax*									
common carp	*Cyprinus carpio*	8	6	3	12				19	4
river carpsucker	*Carpiodes carpio*	10	8	1	10		27	10	5	21
blue sucker	*Cycleptus elongatus*								4	
Mexican tetra	*Astyanax mexicanus*	23	12	6	36	17	3	8	11	1
blue catfish	*Ictalurus furcatus*									
channel catfish	*Ictalurus punctatus*								1	
flathead catfish	*Pylodictis olivaris*								5	
inland silverside	*Menidia beryllina*									
plains killifish	*Fundulus kansae*				1	630	267	79	1	
western mosquitofish	*Gambusia affinis*	65	21	10	225			10	6	44
largemouth bass	*Micropterus salmoides*									
green sunfish	*Lepomis cyanellus*									
bluegill	*Lepomis macrochirus*									
longear sunfish	*Lepomis megalotis*	1							2	
freshwater drum	*Aplodinotus grunniens*									
blue tilapia	*Oreochromis aureus*									
Rio Grande cichlid	*Cichlasoma cyanoguttatum*									
	Number of Fishes Captured	3759	1836	2156	4758	1329	1770	946	1326	1245
	N Species	8	7	8	11	6	7	8	14	7
	Temperature	32.7	31.3	30.5	33.4	29.5	34.7	25.3	27.3	29.74
	Dissolved Oxygen	7	7.27	5.78	7.4	5.04				7.44
	Conductivity	3164	3108	2926	2937	2613	1699	1308	2388	2478
	pH	8.11	8.1	8.13	8.15	7.66				8.07
	Salinity (ppt)						0.8	0.7	1.2	

		Rio Grande imm.Up from Alamo Creek	Cottonwood Campground	West River Road Gaging Station	West River Road Woodsons	West River Road Rio Grande at Smokey Creek	Gravel Pit	Solis	La Clocha	Talley
	Latitude	29° 9' 28.8"	29° 8' 13.2"	29° 2' 2.40"	29° 0' 18.0"	29° 9' 28.8"	29.151167°	29.043933°	29.147983°	28.983150°
	Longitude	103° 33' 10.80"	103° 31' 30"	103° 23' 16.8"	103° 17' 42"	103° 33' 10.8"	-103.002033°	-103.105367°	-103.008083°	-103.185167°
	Date	6/21/2011	6/21/2011	6/22/2011	6/22/2011	6/22/2011	6/23/2011	6/22/2011	6/23/2011	6/22/2011
Common name	Species									
longnose gar	*Lepisosteus osseus*							2		
gizzard shad	*Dorosoma cepedianum*	2					16		15	5
Mexican stoneroller	*Campostoma ornatum*									
Rio Grande silvery minnow	*Hybognathus amarus*				3			3		1
speckled chub	*Macrhybopsis aestivalis*		3	1	2		1		8	26
red shiner	*Cyprinella lutrensis*	1128	1882	1195	893	733	1823	993	1719	1565
blacktail shiner	*Cyprinella venusta*									
red x blacktail shiner hybrid	*C. lutrensis x venusta hybrid*									
longnose dace	*Rhinichthys cataractae*									
Chihuahua shiner	*Notropis chihuahua*									
Tamaulipas shiner	*Notropis braytoni*	75	71	88	180	35	74	65	323	230
Rio Grande shiner	*Notropis jemezanus*									
bullhead minnow	*Pimephales vigilax*									
common carp	*Cyprinus carpio*	22	8	3	12	6	5	1	16	9
river carpsucker	*Carpiodes carpio*	48	98	26	56	41	18	3	62	15
blue sucker	*Cycleptus elongatus*								1	1
Mexican tetra	*Astyanax mexicanus*	7	5	2	4	8	3	9	1	2
blue catfish	*Ictalurus furcatus*						1			1
channel catfish	*Ictalurus punctatus*				4	1		1		26
flathead catfish	*Pylodictis olivaris*									1
inland silverside	*Menidia beryllina*						2	1	4	1
plains killifish	*Fundulus kansae*	1	2		2				2	
western mosquitofish	*Gambusia affinis*	30	25	95	108	115	95	145	315	197
largemouth bass	*Micropterus salmoides*									
green sunfish	*Lepomis cyanellus*									
bluegill	*Lepomis macrochirus*									1
longear sunfish	*Lepomis megalotis*		1	5	3	7	20	6	22	14
freshwater drum	*Aplodinotus grunniens*								1	1
blue tilapia	*Oreochromis aureus*									
Rio Grande cichlid	*Cichlasoma cyanoguttatum*									
	Number of Fishes Captured	1313	2095	1415	1267	946	2058	1229	2489	2096
	N Species	8	9	8	11	8	11	11	13	17
	Temperature	30.66	33.36	30.73	29.67	26.87	27.2	22	26.3	19.3
	Dissolved Oxygen	8.09	7.86	6.88	2.87	6.14				
	Conductivity	2485	8.1	2472	1100	2575	2166	403.65	2220	390.6
	pH	8.06	2520	4.6	6.02	5.34				
	Salinity (ppt)						1.1	0.2	1.1	0.2

		Rio Grande at Tornillo Cr. mouth	Rio Grande Village Boatramp	Beaver Pond	Boquillas Overlook	Lower Canyon - WJR-988 Site 1 - Horse Canyon	Lower Canyon - WJR11-989 Site 2 Driftwood Canyon	Lower Canyon - WJR11-990 Site 3 Temple Canyon	Lower Canyon - WJR11-991 Site 4 1 mi upstr Maravillas Canyon	Lower Canyon - WJR11-992 Site 5 1 mi below Maravillas Canyon
	Latitude	29° 10' 39" N	29.179635°	29.178517°	29.199333°	29.47114839	29.49560032	29.53303809	29.54731482	29.57689567
	Longitude	102°59'49" W	-102.960940°	-102.953683°	-102.917417°	-102.8159501	-102.8068789	-102.7921864	-102.7733937	-102.7635267
	Date	6/23/2011	6/24/2011	6/24/2011	6/24/2011	6/12/2011	6/12/2011	6/12/2011	6/13/2011	6/13/2011
Common name	Species									
longnose gar	*Lepisosteus osseus*		1			1	1	1		
gizzard shad	*Dorosoma cepedianum*	12	2		25	39	4	1	3	
Mexican stoneroller	*Campostoma ornatum*									
Rio Grande silvery minnow	*Hybognathus amarus*				5	1	6			
speckled chub	*Macrhybopsis aestivalis*	1	2		6		2	2		5
red shiner	*Cyprinella lutrensis*	700	2489	52	259	11	13	23	34	5
blacktail shiner	*Cyprinella venusta*									
red x blacktail shiner hybrid	*C. lutrensis x venusta hybrid*									
longnose dace	*Rhinichthys cataractae*						1			
Chihuahua shiner	*Notropis chihuahua*									
Tamaulipas shiner	*Notropis braytoni*	170	138		167	214	448	208	80	187
Rio Grande shiner	*Notropis jemezanus*									
bullhead minnow	*Pimephales vigilax*									
common carp	*Cyprinus carpio*	2	18		37	48	51	48	59	62
river carpsucker	*Carpiodes carpio*	36	33		37	53	44	14	25	10
blue sucker	*Cycleptus elongatus*		1		1					1
Mexican tetra	*Astyanax mexicanus*	16	8	2	24	6	4	4	16	4
blue catfish	*Ictalurus furcatus*				1				1	1
channel catfish	*Ictalurus punctatus*		3		1	1				2
flathead catfish	*Pylodictis olivaris*									1
inland silverside	*Menidia beryllina*									
plains killifish	*Fundulus kansae*	3	1		2					
western mosquitofish	*Gambusia affinis*	130	337	16	776	99	27	83	43	349
largemouth bass	*Micropterus salmoides*						1	1		
green sunfish	*Lepomis cyanellus*									
bluegill	*Lepomis macrochirus*			9						
longear sunfish	*Lepomis megalotis*		99		62	12	13	27	17	6
freshwater drum	*Aplodinotus grunniens*									
blue tilapia	*Oreochromis aureus*			25						
Rio Grande cichlid	*Cichlasoma cyanoguttatum*									
	Number of Fishes Captured	1070	3132	104	1403	485	615	412	278	633
	N Species	9	13	5	14	11	13	11	9	12
	Temperature	29	29.8	30	27.5	29.53	31.27	31.93	28.34	28.78
	Dissolved Oxygen					6.42	7.38	7.55	6.1	6.88
	Conductivity	2195	1722	1317	1965	1513	1521	1527	1522	1515
	pH					8.03	8.11	8.16	7.97	8.01
	Salinity (ppt)	1.1	0.9	0.7	1					

		Lower Canyon - WJR11-993 Site 6	Lower Canyon - WJR11-994 Site 7	Lower Canyon - WJR11-995 Site 8 upstrm fro Taylor's Farm	Lower Canyon - WJR11-997 Site 10 below Taylor's Farm	Lower Canyon - WJR11-998 Site 11 Reagan Canyon	Lower Canyon - WJR11-999 Site 12 Dwnstrm fro El Recodo Rapid	Lower Canyon - WJR11-1000 Site 13 El Reliz	Lower Canyon - WJR11-1001 Site 14 Oso Canyon	Lower Canyon - WJR11-1002 Site 15 Las Yeguas, upstrm from Silber Canyon
	Latitude	29.59782459	29.6285134	29.65173759	29.6819852	29.72723135	29.73476496	29.73427851	29.74833094	29.76716721
	Longitude	-102.7568309	-102.7409514	-102.7224469	-102.6963797	-102.6841805	-102.6509884	-102.6308525	-102.6075105	-102.5738593
	Date	6/13/2011	6/13/2011	6/13/2011	6/14/2011	6/14/2011	6/14/2011	6/15/2011	6/15/2011	6/15/2011
Common name	Species									
longnose gar	*Lepisosteus osseus*					1	1			1
gizzard shad	*Dorosoma cepedianum*									
Mexican stoneroller	*Campostoma ornatum*									
Rio Grande silvery minnow	*Hybognathus amarus*	1		4						
speckled chub	*Macrhybopsis aestivalis*	6	1		1		1	1	1	1
red shiner	*Cyprinella lutrensis*	34	15		10		64	22	41	77
blacktail shiner	*Cyprinella venusta*						1			
red x blacktail shiner hybrid	*C. lutrensis x venusta hybrid*									
longnose dace	*Rhinichthys cataractae*		2	3			1	1		
Chihuahua shiner	*Notropis chihuahua*									
Tamaulipas shiner	*Notropis braytoni*	313	27	62	422	212	119	251	92	139
Rio Grande shiner	*Notropis jemezanus*									
bullhead minnow	*Pimephales vigilax*									
common carp	*Cyprinus carpio*	25		10	2	9	2			9
river carpsucker	*Carpiodes carpio*	4		3	5	24		1	1	3
blue sucker	*Cycleptus elongatus*	7								
Mexican tetra	*Astyanax mexicanus*	6	65	81	19	61	22	9	4	9
blue catfish	*Ictalurus furcatus*					1				
channel catfish	*Ictalurus punctatus*					1				
flathead catfish	*Pylodictis olivaris*		1							
inland silverside	*Menidia beryllina*									
plains killifish	*Fundulus kansae*									
western mosquitofish	*Gambusia affinis*	12	17	346	44	93	62	10	100	12
largemouth bass	*Micropterus salmoides*		2							1
green sunfish	*Lepomis cyanellus*									
bluegill	*Lepomis macrochirus*									
longear sunfish	*Lepomis megalotis*	3	5	2	4	35	2	14	2	10
freshwater drum	*Aplodinotus grunniens*									
blue tilapia	*Oreochromis aureus*									
Rio Grande cichlid	*Cichlasoma cyanoguttatum*									
	Number of Fishes Captured	411	135	511	507	437	275	309	241	262
	N Species	10	9	8	8	9	10	8	7	10
	Temperature	30.68	31.64	32.05	28.58	30.64	31.64	28.59	29.46	30.55
	Dissolved Oxygen	7.67	8.38	7.72	7.83	9.63	7.74	5.62	5.80	6.92
	Conductivity	1450	1408	1319	1287	1273	1277	1241	1252	1246
	pH	7.66	7.87	7.51	8.07	8.17	7.76	8.09	8.11	7.69
	Salinity (ppt)									

		Lower Canyon - WJR11-1003 Site 16 Spring pool, Asa Jones	Lower Canyon - WJR11-1004 Site 17 Below Bullis Fold	Lower Canyon - WJR11-1005 Site 18 Downstrm from Las Palmas	Lower Canyon - WJR11-1006 Site 19 Downstrm from Huisache Camp	Lower Canyon - WJR11-1007 Site 20 Rodeo Rapids	Lower Canyon - WJR11-1008 Site 21 Upstrm from Madison Falls	Lower Canyon - WJR11-1009 Site 22 Below Madison Falls	Lower Canyon - WJR11-1010 Site 23 Smuggler's Canyon	Lower Canyon - WJR11-1011 Site 24 Juan Botas, Many Tinajas Canyon
	Latitude	29.7671533	29.78117336	29.78129462	29.77612332	29.77730017	29.77345351	29.79795192	29.80743187	29.86287212
	Longitude	-102.562864	-102.5188959	-102.4993831	-102.4747201	-102.4467899	-102.427985	-102.3775784	-102.3736154	-102.3296039
	Date	6/15/2011	6/16/2011	6/16/2011	6/16/2011	6/16/2011	6/16/2011	6/17/2011	6/17/2011	6/17/2011
Common name	Species									
longnose gar	*Lepisosteus osseus*		1				1			
gizzard shad	*Dorosoma cepedianum*		39		2		20		1	
Mexican stoneroller	*Campostoma ornatum*									
Rio Grande silvery minnow	*Hybognathus amarus*									1
speckled chub	*Macrhybopsis aestivalis*		1	1		2				1
red shiner	*Cyprinella lutrensis*	219	21	57	37	23	24	164	42	335
blacktail shiner	*Cyprinella venusta*		1					5	3	
red x blacktail shiner hybrid	*C. lutrensis x venusta hybrid*	1								
longnose dace	*Rhinichthys cataractae*			3	1					
Chihuahua shiner	*Notropis chihuahua*									
Tamaulipas shiner	*Notropis braytoni*	6	26	120	140	322	121	44	3	362
Rio Grande shiner	*Notropis jemezanus*									
bullhead minnow	*Pimephales vigilax*									70
common carp	*Cyprinus carpio*	3			1	5				3
river carpsucker	*Carpiodes carpio*		17	4	7	19	7	2		23
blue sucker	*Cycleptus elongatus*							1		
Mexican tetra	*Astyanax mexicanus*	16	9	4	6	7	14	2	2	20
blue catfish	*Ictalurus furcatus*		1							
channel catfish	*Ictalurus punctatus*	1						1	1	
flathead catfish	*Pylodictis olivaris*									
inland silverside	*Menidia beryllina*									
plains killifish	*Fundulus kansae*									
western mosquitofish	*Gambusia affinis*	459	87	30	33	11	33	1	1	147
largemouth bass	*Micropterus salmoides*									
green sunfish	*Lepomis cyanellus*									5
bluegill	*Lepomis macrochirus*									
longear sunfish	*Lepomis megalotis*	3	8		5	3	12	3	1	16
freshwater drum	*Aplodinotus grunniens*									
blue tilapia	*Oreochromis aureus*									
Rio Grande cichlid	*Cichlasoma cyanoguttatum*									
	Number of Fishes Captured	708	211	219	232	392	232	223	54	983
	N Species	8	11	7	9	8	8	9	8	11
	Temperature	31.27	29.27	29.56	30.08	30.74	30.76	30.19	30.22	31.02
	Dissolved Oxygen	5.87	5.71	5.74	6.78	7.39	6.73	6.65	6.62	6.96
	Conductivity	1098	1099	1103	1102	1102	1100	1056	1043	1039
	pH	7.57	7.91	7.98	8.06	8.10	8.12	8.15	8.12	8.05
	Salinity (ppt)									

		Lower Canyon - WJR11-1013 Site 26 Big Thicket Voyager's Canyon	Lower Canyon - WJR11-1014 Site 27 Downstrm of Bone Watering	Lower Canyon - WJR11-1015 Site 28 1 mi abv Middle Watering	Lower Canyon - WJR11-1016 Site 29 Dwnstrm from Middle Watering	Lower Canyon - WJR11-1017 Site 30 Red House Canyon	Lower Canyon - WJR11-1018 Site 31 Sanderson Canyon	Lower Canyon - WJR11-1019 Site 32 Dryden Crossing	Contrabando Movie Set	Rio Grande at Santa Elena
	Latitude	29.87125777	29.86137602	29.84845314	29.84043013	29.84243637	29.84718699	29.80910305	29°16'44.91"N	29° 09'54.34" N
	Longitude	-102.2870566	-102.2506023	-102.2353691	-102.2209425	-102.1937594	-102.1841083	-102.148291	103° 50'28.27"W	103°36'38.45" W
	Date	6/18/2011	6/18/2011	6/18/2011	6/18/2011	6/18/2011	6/18/2011	6/19/2011	8/24/2011	8/24/2011
Common name	Species									
longnose gar	*Lepisosteus osseus*									
gizzard shad	*Dorosoma cepedianum*						8			
Mexican stoneroller	*Campostoma ornatum*									
Rio Grande silvery minnow	*Hybognathus amarus*	2								
speckled chub	*Macrhybopsis aestivalis*	5	1	1	1					13
red shiner	*Cyprinella lutrensis*	267	258	163	101	108	111	90	138	903
blacktail shiner	*Cyprinella venusta*	3	6			1	1	3		
red x blacktail shiner hybrid	*C. lutrensis x venusta hybrid*	1								
longnose dace	*Rhinichthys cataractae*									
Chihuahua shiner	*Notropis chihuahua*									
Tamaulipas shiner	*Notropis braytoni*	128	74	71	123	14	42	27	6	98
Rio Grande shiner	*Notropis jemezanus*									
bullhead minnow	*Pimephales vigilax*	7						5		
common carp	*Cyprinus carpio*	1	3	2	2	4	1			
river carpsucker	*Carpiodes carpio*	5		10	3	2	1	2		6
blue sucker	*Cycleptus elongatus*									
Mexican tetra	*Astyanax mexicanus*	17	3	2	15	16	22	7	5	
blue catfish	*Ictalurus furcatus*					1				
channel catfish	*Ictalurus punctatus*	1		4	1	1	8			37
flathead catfish	*Pylodictis olivaris*						3			
inland silverside	*Menidia beryllina*									
plains killifish	*Fundulus kansae*		2	1		1		1		8
western mosquitofish	*Gambusia affinis*	23	40	24	5	4	4	3		12
largemouth bass	*Micropterus salmoides*									
green sunfish	*Lepomis cyanellus*									
bluegill	*Lepomis macrochirus*									
longear sunfish	*Lepomis megalotis*	4	1	10	2	5	5	5	1	
freshwater drum	*Aplodinotus grunniens*									
blue tilapia	*Oreochromis aureus*									
Rio Grande cichlid	*Cichlasoma cyanoguttatum*									
	Number of Fishes Captured	464	388	288	253	157	206	143	150	1077
	N Species	13	9	10	9	11	11	9	4	7
	Temperature	33.49	29.04	29.98	30.38	30.17	30.72	31.02	30.90	27.3
	Dissolved Oxygen	6.53	6.47	6.35	6.93	6.80	5.93	7.11	7.67	8.4
	Conductivity	1663	1028	1031	1034	1036	1039	1041	2295	1845
	pH	8.51	8.16	8.19	8.14	8.13	8.02	8.16	8.12	8.21
	Salinity (ppt)									

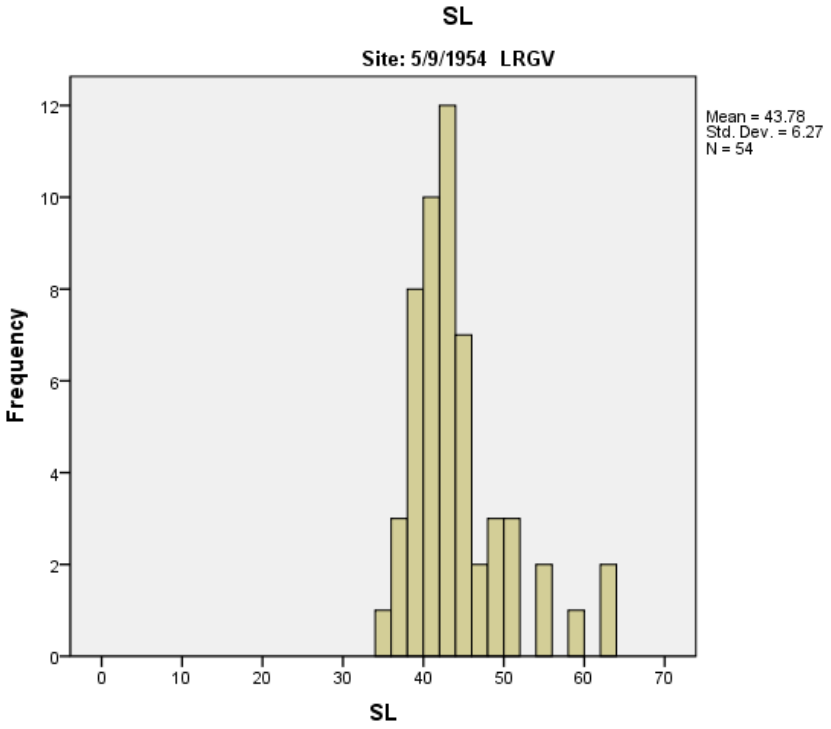
		Terlingua Cr. at Terlingua Abajo	Boquillas Overlook	Adams Ranch	Contrabando Movie Set	Rio Grande at Santa Elena	Terlingua Cr. near mouth	Boquillas Overlook	Adams Ranch	Contrabando Movie Set
	Latitude	29°12'5.70"N	29.199333°	29° 24'31.43" N	29°16'44.91"N	29° 09'54.34" N	29.166984°	29.199333°	29° 24'31.43" N	29°16'44.91"N
	Longitude	103°36'00.63"W	-102.917417°	102°49'58.07" W	103° 50'28.27"W	103°36'38.45" W	-103.612598°	-102.917417°	102°49'58.07" W	103° 50'28.27"W
	Date	8/24/2011	8/24/2011	8/23/2011	10/24/2011	10/24/2011	10/24/2011	10/24/2011	10/25/2011	2/23/2012
Common name	Species									
longnose gar	*Lepisosteus osseus*			1					3	
gizzard shad	*Dorosoma cepedianum*						2			
Mexican stoneroller	*Campostoma ornatum*	1								
Rio Grande silvery minnow	*Hybognathus amarus*	8	6				3		8	7
speckled chub	*Macrhybopsis aestivalis*		1		1	13				2
red shiner	*Cyprinella lutrensis*	118	126	295	666	736	1191	1184	946	1780
blacktail shiner	*Cyprinella venusta*									
red x blacktail shiner hybrid	*C. lutrensis x venusta hybrid*									
longnose dace	*Rhinichthys cataractae*					3				
Chihuahua shiner	*Notropis chihuahua*	34								
Tamaulipas shiner	*Notropis braytoni*	100	33	13	18	105	74	195	35	193
Rio Grande shiner	*Notropis jemezanus*									
bullhead minnow	*Pimephales vigilax*									
common carp	*Cyprinus carpio*	2								
river carpsucker	*Carpiodes carpio*	22	20	1			92	32		
blue sucker	*Cycleptus elongatus*									
Mexican tetra	*Astyanax mexicanus*	1	15	2	1		9	16	11	
blue catfish	*Ictalurus furcatus*						1			1
channel catfish	*Ictalurus punctatus*	9	1		2		9	1	1	
flathead catfish	*Pylodictis olivaris*									
inland silverside	*Menidia beryllina*									
plains killifish	*Fundulus kansae*	45				2	2			
western mosquitofish	*Gambusia affinis*		41	182	3	131	22	118	77	2
largemouth bass	*Micropterus salmoides*									
green sunfish	*Lepomis cyanellus*						1			
bluegill	*Lepomis macrochirus*									1
longear sunfish	*Lepomis megalotis*		19	10			4	4	9	1
freshwater drum	*Aplodinotus grunniens*									
blue tilapia	*Oreochromis aureus*						1			
Rio Grande cichlid	*Cichlasoma cyanoguttatum*									
	Number of Fishes Captured	340	262	504	691	990	1411	1550	1090	1987
	N Species	10	9	7	6	6	13	7	8	8
	Temperature	33.9	29.5	31.5				28.6	22	13.2
	Dissolved Oxygen	7.64	6	8.19						9.63
	Conductivity	1537	1775	2373				1363	1470	2491
	pH	8.06	7.88	8.14						8.32
	Salinity (ppt)							1.4	0.7	

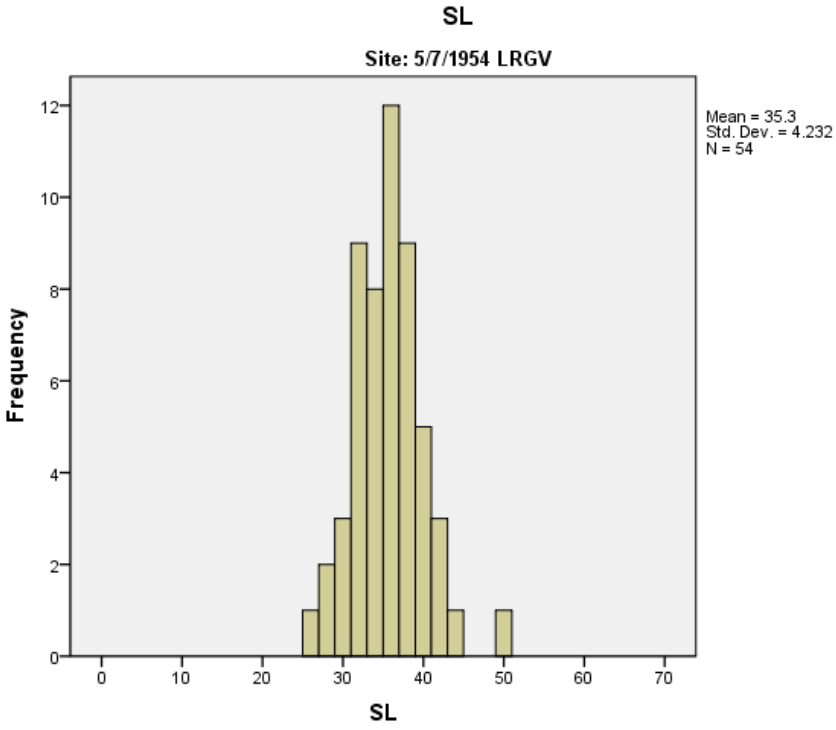
		Rio Grande at Santa Elena	Rio Grande at Castolon pullout	Terlingua Cr. at Terlingua Abajo	Rio Grande at Tornillo Cr. mouth	Rio Grande Village boatramp	Boquillas Overlook	Adams Ranch	Adams Ranch downstream at Castle	Contrabando Movie Set
	Latitude	29° 09'54.34" N	29° 9'21.11"N	29°12'5.70"N	29° 10' 39" N	29° 10'46.67" N	29.199333°	29° 24'31.43" N	29°24'17.75"N	29°16'44.91"N
	Longitude	103°36'38.45" W	103°35'57.08"W	103°36'00.63"W	102°59'49" W	102°57'38.95" W	-102.917417°	102°49'58.07" W	102°49'33.08"W	103° 50'28.27"W
	Date	2/22/2012	2/22/2012	2/22/2012	2/22/2012	2/22/2012	2/22/2012	2/21/2012	2/21/2012	5/22/2012
Common name	Species									
longnose gar	*Lepisosteus osseus*						1			
gizzard shad	*Dorosoma cepedianum*									1
Mexican stoneroller	*Campostoma ornatum*									
Rio Grande silvery minnow	*Hybognathus amarus*	3		2		3	2	1	21	
speckled chub	*Macrhybopsis aestivalis*	7	23		1	9	9	2	5	9
red shiner	*Cyprinella lutrensis*	1102	1689	581	975	280	611	823	355	607
blacktail shiner	*Cyprinella venusta*								1	
red x blacktail shiner hybrid	*C. lutrensis x venusta hybrid*								1	
longnose dace	*Rhinichthys cataractae*		10							
Chihuahua shiner	*Notropis chihuahua*			146						
Tamaulipas shiner	*Notropis braytoni*	307	846	329	242	416	394	525	754	9
Rio Grande shiner	*Notropis jemezanus*									
bullhead minnow	*Pimephales vigilax*									
common carp	*Cyprinus carpio*						1			4
river carpsucker	*Carpiodes carpio*	31		152	1	4	42		4	1
blue sucker	*Cycleptus elongatus*									
Mexican tetra	*Astyanax mexicanus*			102	2	10	4		7	
blue catfish	*Ictalurus furcatus*									
channel catfish	*Ictalurus punctatus*	1		9	1	1	1			1
flathead catfish	*Pylodictis olivaris*	1								
inland silverside	*Menidia beryllina*									
plains killifish	*Fundulus kansae*	2	2	303	41					
western mosquitofish	*Gambusia affinis*	1	5		81	1	354	232		11
largemouth bass	*Micropterus salmoides*									
green sunfish	*Lepomis cyanellus*									
bluegill	*Lepomis macrochirus*									
longear sunfish	*Lepomis megalotis*	1			6		8	1	5	2
freshwater drum	*Aplodinotus grunniens*									
blue tilapia	*Oreochromis aureus*									
Rio Grande cichlid	*Cichlasoma cyanoguttatum*									
	Number of Fishes Captured	1456	2575	1624	1350	724	1427	1584	1153	645
	N Species	10	6	8	9	8	11	6	9	9
	Temperature	10.4	9.9		24.9		25.6	19		24
	Dissolved Oxygen	10.6	11.52		6.99		9.09	18.62		7.19
	Conductivity	2308	2278		1836		1796	1439		690
	pH	8.38	8.37		7.6		8.02	8.39		8.03
	Salinity (ppt)									

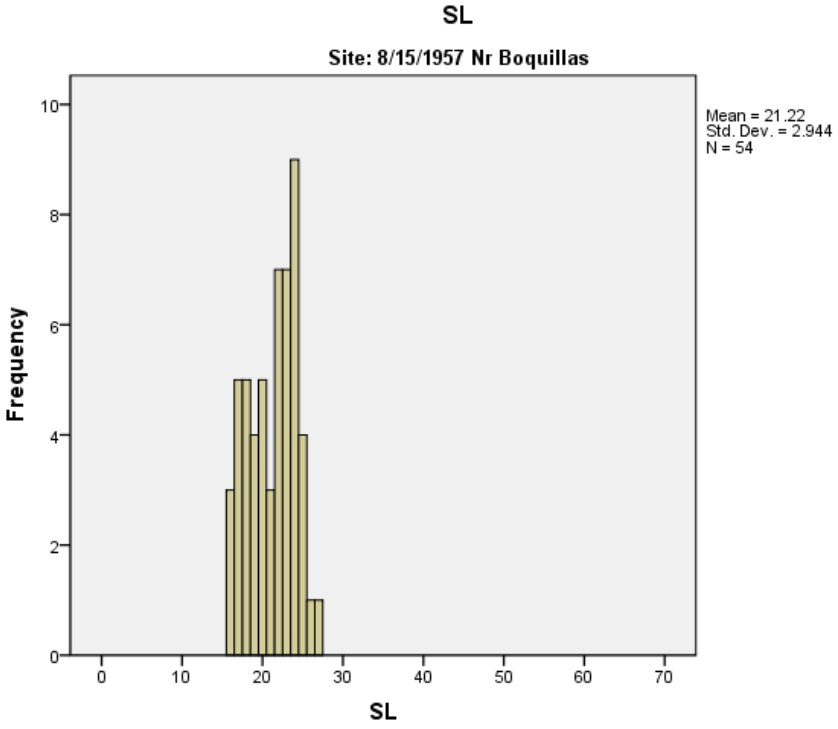
		Rio Grande at Santa Elena	Terlingua Creek mouth Isolated Pool	Rio Grande at Castolon pullout	Rio Grande at Gravel Pit	Boquillas Overlook	Adams Ranch	Adams Ranch downstream at Castle	Contrabando Movie Set	Rio Grande at Santa Elena
	Latitude	29° 09’54.34” N	29° 09’54.35” N	29° 9'21.11"N	29.151167° N	29.199333°	29° 24’31.43” N	29°24'17.75"N	29°16’44.91”N	29° 09’54.34” N
	Longitude	103°36’38.45” W	103°36’38.45” W	103°35'57.08"W	-103.002033° W	-102.917417°	102°49’58.07” W	102°49'33.08"W	103° 50’28.27”W	103°36’38.45” W
	Date	5/23/2012	5/23/2012	5/23/2012	5/23/2012	5/23/2012	5/22/2012	5/22/2012	10/25/2012	10/25/2012
Common name	Species									
longnose gar	*Lepisosteus osseus*				2	1	2		1	
gizzard shad	*Dorosoma cepedianum*	1		1						
Mexican stoneroller	*Campostoma ornatum*									
Rio Grande silvery minnow	*Hybognathus amarus*		3							
speckled chub	*Macrhybopsis aestivalis*	11	2	13	20	2	1			33
red shiner	*Cyprinella lutrensis*	1462	470	999	481	289	189	114	523	194
blacktail shiner	*Cyprinella venusta*									
red x blacktail shiner hybrid	*C. lutrensis x venusta hybrid*									
longnose dace	*Rhinichthys cataractae*		1							
Chihuahua shiner	*Notropis chihuahua*									
Tamaulipas shiner	*Notropis braytoni*	219	182	217	148	36	11	2	7	4
Rio Grande shiner	*Notropis jemezanus*						1			
bullhead minnow	*Pimephales vigilax*									
common carp	*Cyprinus carpio*		2	1	1	2				
river carpsucker	*Carpiodes carpio*	9	30	6	16	10			2	8
blue sucker	*Cycleptus elongatus*						1			
Mexican tetra	*Astyanax mexicanus*					3	12	1		2
blue catfish	*Ictalurus furcatus*			1			1	1		
channel catfish	*Ictalurus punctatus*			3	12	11	1	1		1
flathead catfish	*Pylodictis olivaris*			1	1	1		1		
inland silverside	*Menidia beryllina*								1	
plains killifish	*Fundulus kansae*	6	1	4		1				11
western mosquitofish	*Gambusia affinis*	3	7	2	5	362	331	50	3	
largemouth bass	*Micropterus salmoides*									
green sunfish	*Lepomis cyanellus*									
bluegill	*Lepomis macrochirus*									
longear sunfish	*Lepomis megalotis*		1		11	24	5	2	2	
freshwater drum	*Aplodinotus grunniens*				1					
blue tilapia	*Oreochromis aureus*									
Rio Grande cichlid	*Cichlasoma cyanoguttatum*						1			
	Number of Fishes Captured	1711	699	1248	698	742	555	172	539	253
	N Species	7	10	11	11	12	11	8	8	8
	Temperature		21.8	26	30.2	29.7	30.1	30.03	23.4	21.2
	Dissolved Oxygen		8.05	7.89	7.54	7.41			9.3	7.83
	Conductivity		1056	1846	1425	1337	1333	1353	2794	2223
	pH		8.55	8.24	8.11	7.93			8.16	7.88
	Salinity (ppt)						0.7	0.7		

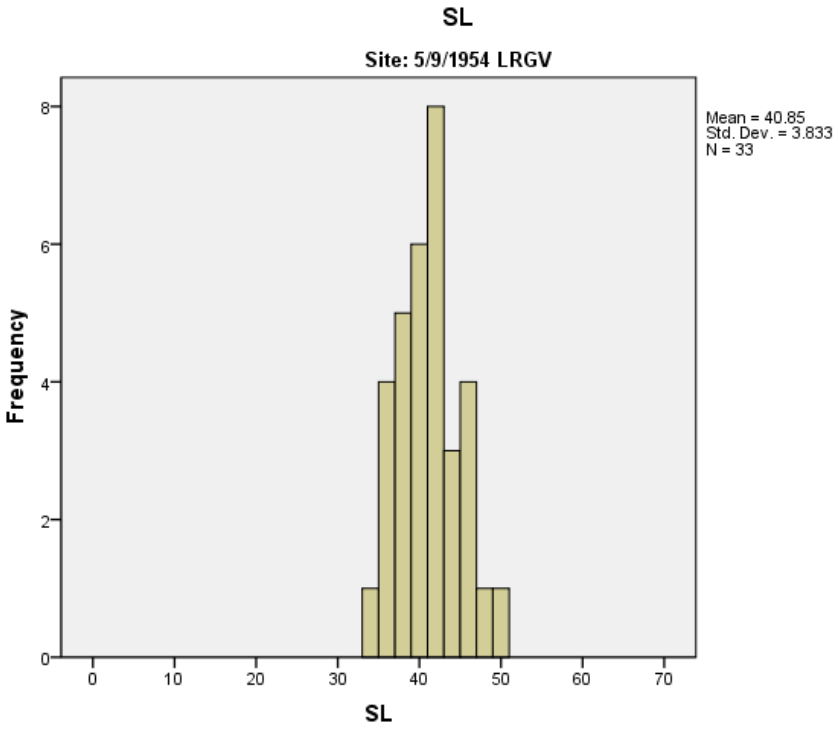
		Terlingua Creek mouth Isolated Pool	Rio Grande at Castolon pullout	Rio Grande at Tornillo Cr. mouth	Rio Grande at RGV Boat Ramp	Boquillas Overlook	Adams Ranch	Adams Ranch downstream at Castle
	Latitude	29° 09’54.35” N	29° 9'21.11"N	29° 10’ 39” N	29° 10’46.67” N	29.199333°	29° 24’31.43” N	29°24'17.75"N
	Longitude	103°36’38.45” W	103°35'57.08"W	102°59’49” W	102°57’38.95” W	-102.917417°	102°49’58.07” W	102°49'33.08"W
	Date	10/25/2012	10/25/2012	10/25/2012	10/25/2012	10/25/2012	10/25/2012	10/25/2012
Common name	Species							
longnose gar	*Lepisosteus osseus*							
gizzard shad	*Dorosoma cepedianum*							
Mexican stoneroller	*Campostoma ornatum*							
Rio Grande silvery minnow	*Hybognathus amarus*							
speckled chub	*Macrhybopsis aestivalis*			3	3			
red shiner	*Cyprinella lutrensis*	88	293	13	36	2	7	10
blacktail shiner	*Cyprinella venusta*							
red x blacktail shiner hybrid	*C. lutrensis x venusta hybrid*							
longnose dace	*Rhinichthys cataractae*							
Chihuahua shiner	*Notropis chihuahua*							
Tamaulipas shiner	*Notropis braytoni*	11	10	3	5	4	2	6
Rio Grande shiner	*Notropis jemezanus*							
bullhead minnow	*Pimephales vigilax*							
common carp	*Cyprinus carpio*							
river carpsucker	*Carpiodes carpio*	1	2		2	3		
blue sucker	*Cycleptus elongatus*							
Mexican tetra	*Astyanax mexicanus*		1					
blue catfish	*Ictalurus furcatus*						4	
channel catfish	*Ictalurus punctatus*							
flathead catfish	*Pylodictis olivaris*						2	
inland silverside	*Menidia beryllina*							
plains killifish	*Fundulus kansae*							
western mosquitofish	*Gambusia affinis*			1	1	1	3	1
largemouth bass	*Micropterus salmoides*							
green sunfish	*Lepomis cyanellus*							
bluegill	*Lepomis macrochirus*							
longear sunfish	*Lepomis megalotis*							
freshwater drum	*Aplodinotus grunniens*							
blue tilapia	*Oreochromis aureus*							
Rio Grande cichlid	*Cichlasoma cyanoguttatum*							
	Number of Fishes Captured	100	306	20	47	10	18	17
	N Species	4	5	5	6	5	6	4
	Temperature	19.5	22.2	29.2	30	29.8	25.2	25.3
	Dissolved Oxygen	6.8	7.9	6.26	6.13	6.48	6.13	6.83
	Conductivity	1502	2262	1589	1550	1421	1186	1194
	pH	8.06	8.03	8.07	8.07	8.31	8.17	8.29
	Salinity (ppt)							

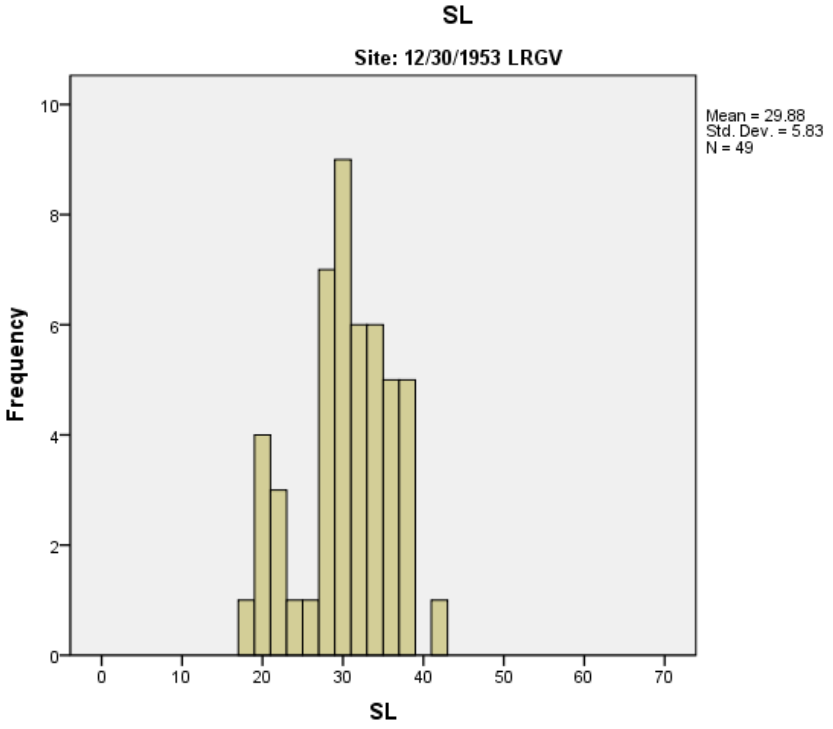
Appendix B. Length (mm SL) distribution of Rio Grande silvery minnows from the Texas Natural History Collections.

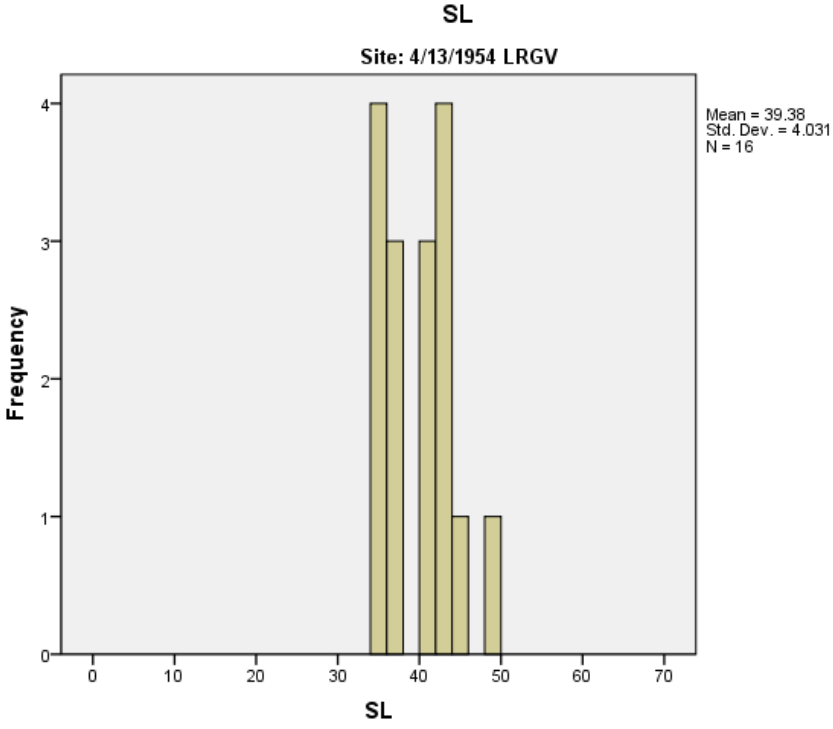

SL
Site: 5/9/1954 LRGV
Mean = 43.78
Std. Dev. = 6.27
N = 54
Frequency
SL

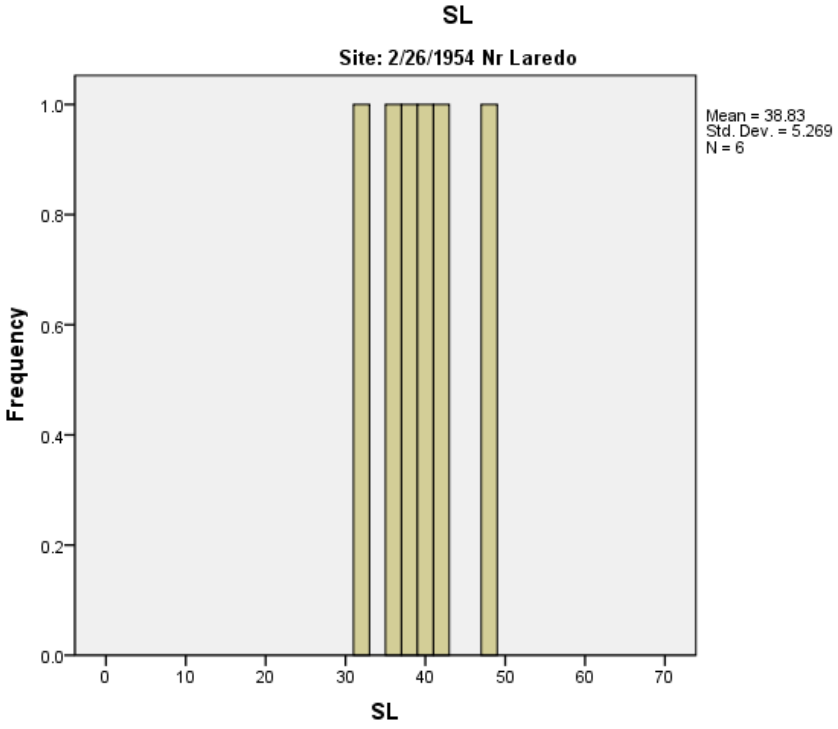

SL
Site: 5/7/1954 LRGV
Mean = 35.3
Std. Dev. = 4.232
N = 54
Frequency
SL

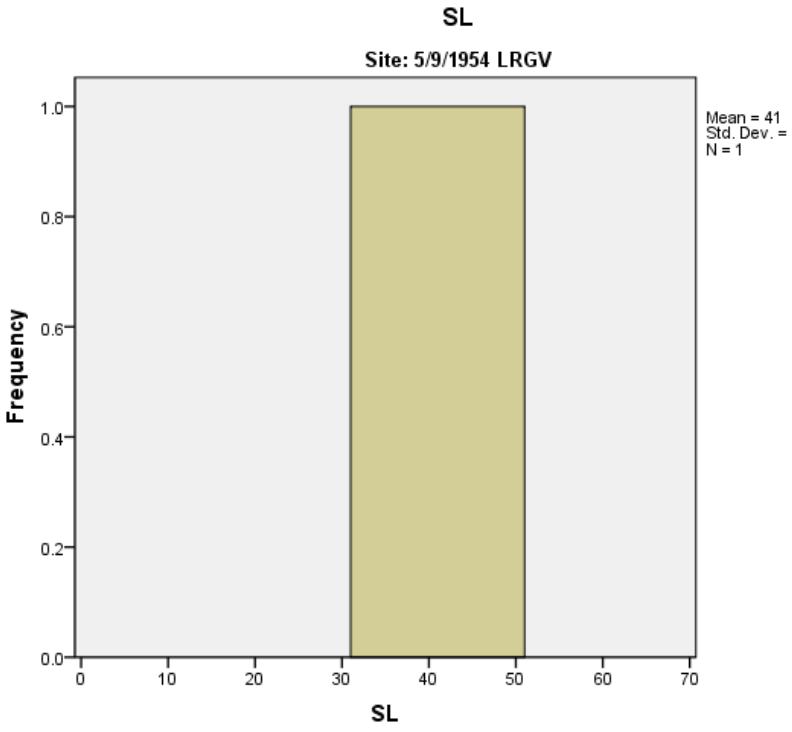

SL
Site: 8/15/1957 Nr Boquillas
Mean = 21.22
Std. Dev. = 2.944
N = 54
Frequency
SL

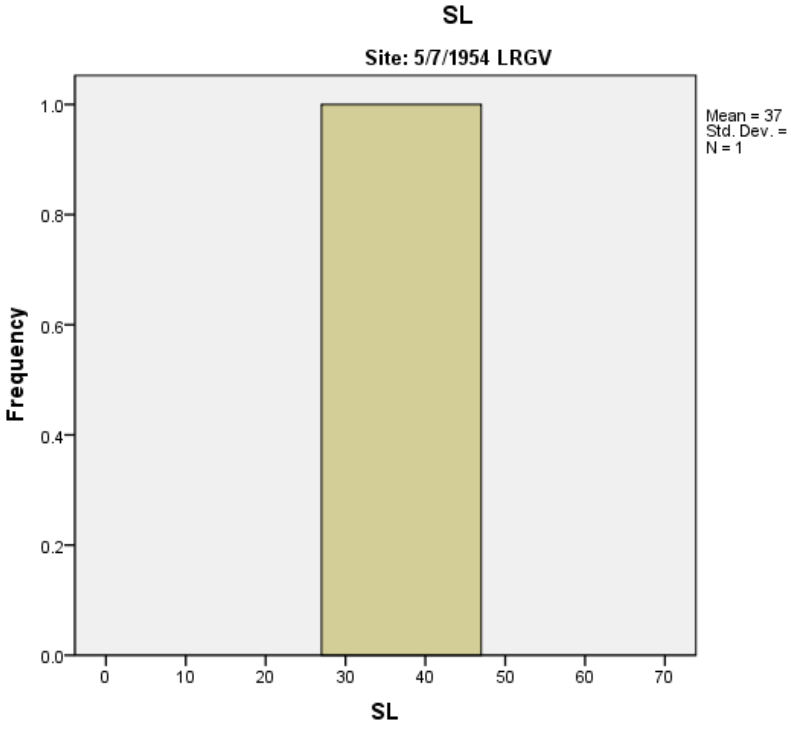

SL
Site: 5/9/1954 LRGV
Mean = 40.85
Std. Dev. = 3.833
N = 33
Frequency
SL

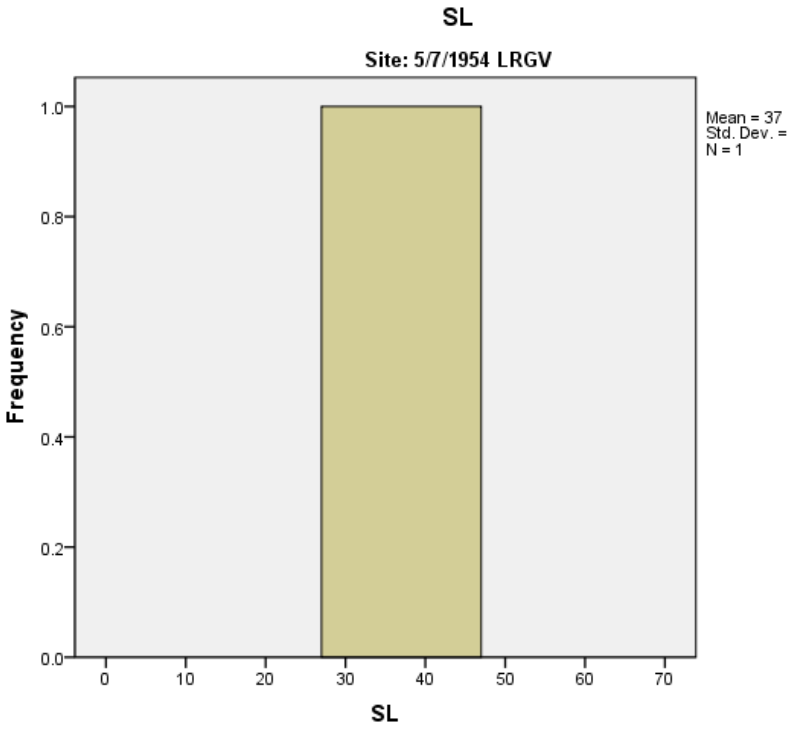

SL
Site: 12/30/1953 LRGV
Mean = 29.88
Std. Dev. = 5.83
N = 49
Frequency
SL

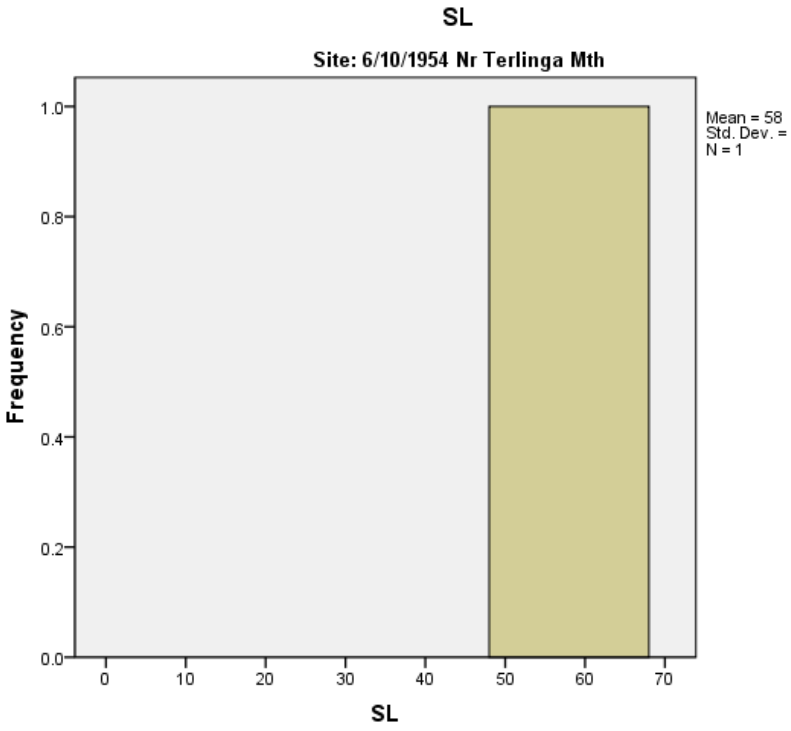

SL
Site: 4/13/1954 LRGV
Mean = 39.38
Std. Dev. = 4.031
N = 16
Frequency
SL

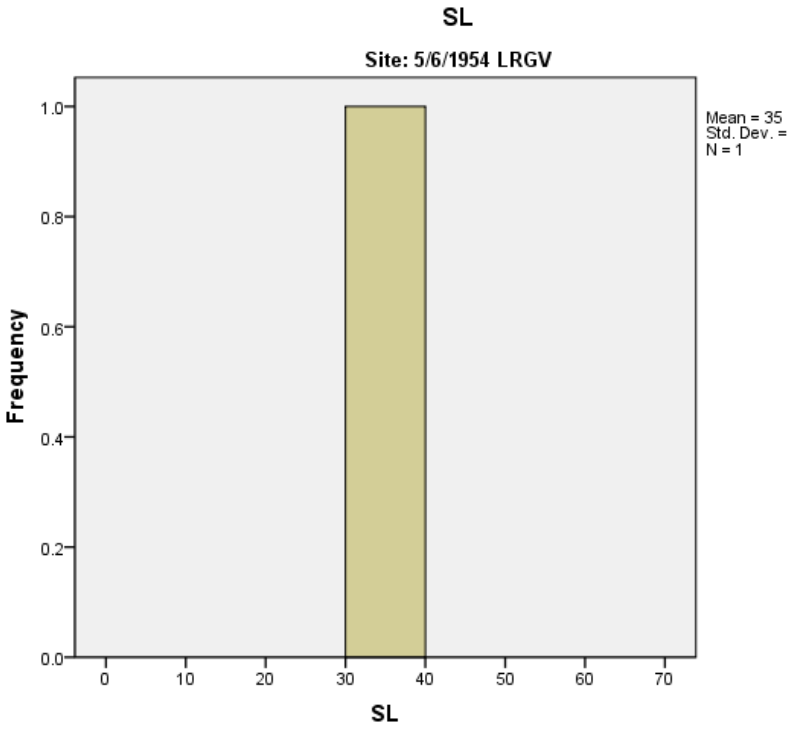

SL
Site: 2/26/1954 Nr Laredo
Mean = 38.83
Std. Dev. = 5.269
N = 6
Frequency
1.0
0.8
0.6
0.4
0.2
0.0
0
10
20
30
40
50
60
70
SL

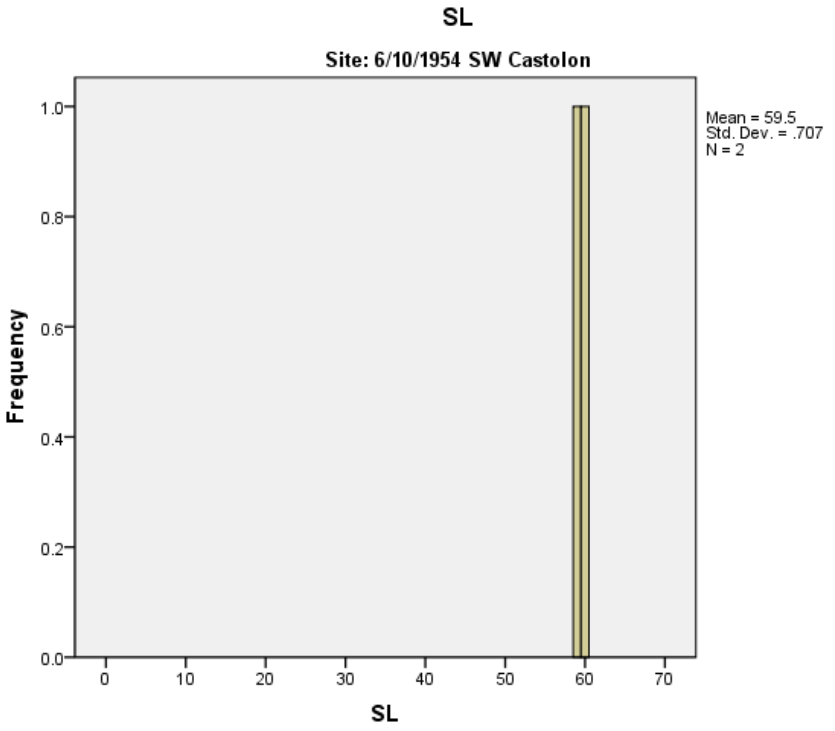

SL
Site: 5/9/1954 LRGV
Mean = 41
Std. Dev. =
N = 1
Frequency
1.0
0.8
0.6
0.4
0.2
0.0
0
10
20
30
40
50
60
70
SL

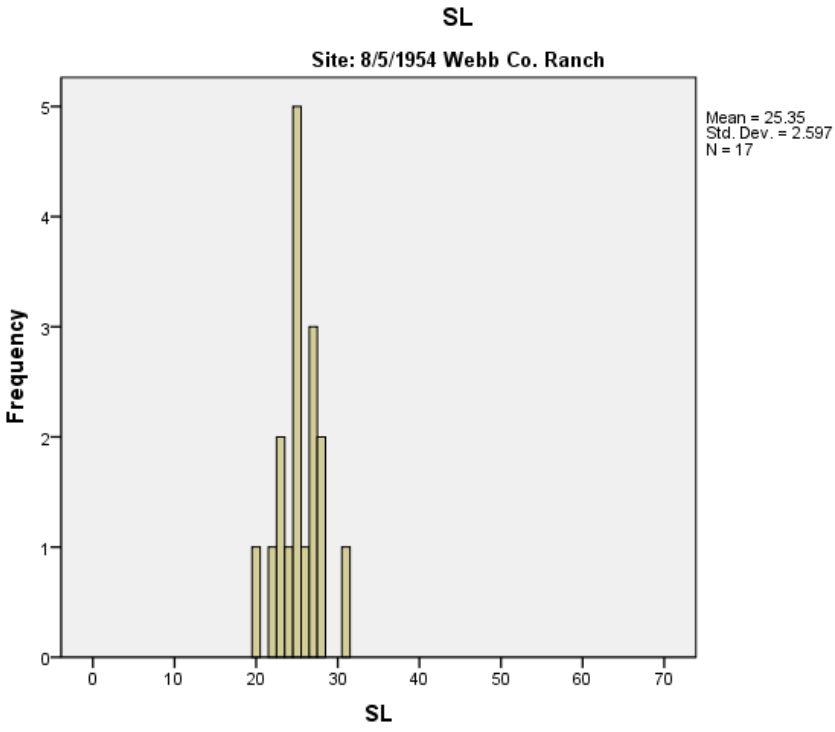

SL
Site: 5/7/1954 LRGV
Mean = 37
Std. Dev. =
N = 1
Frequency
1.0
0.8
0.6
0.4
0.2
0.0
0
10
20
30
40
50
60
70
SL

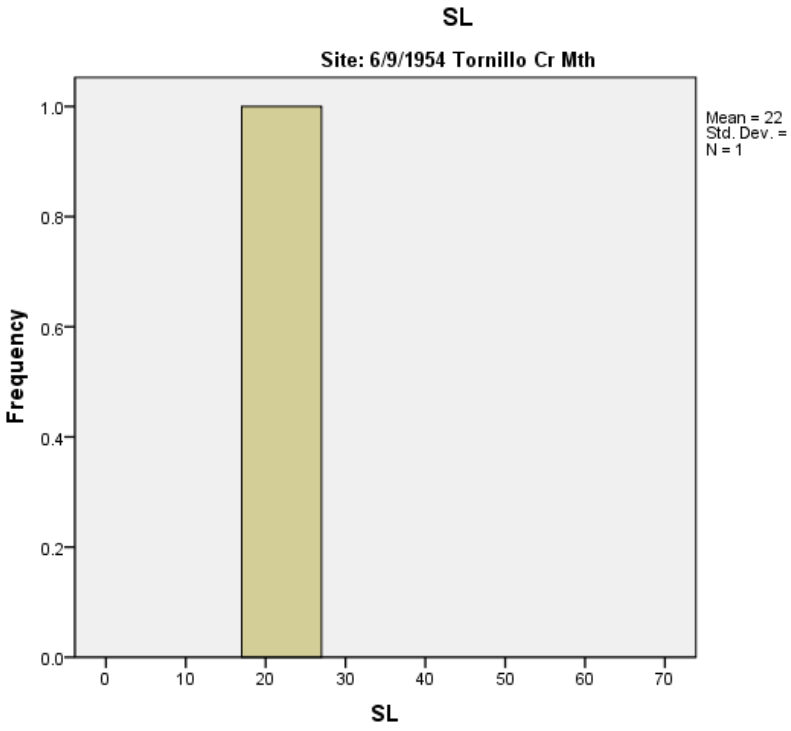

SL
Site: 5/7/1954 LRGV
Mean = 37
Std. Dev. =
N = 1
Frequency
1.0
0.8
0.6
0.4
0.2
0.0
0
10
20
30
40
50
60
70
SL

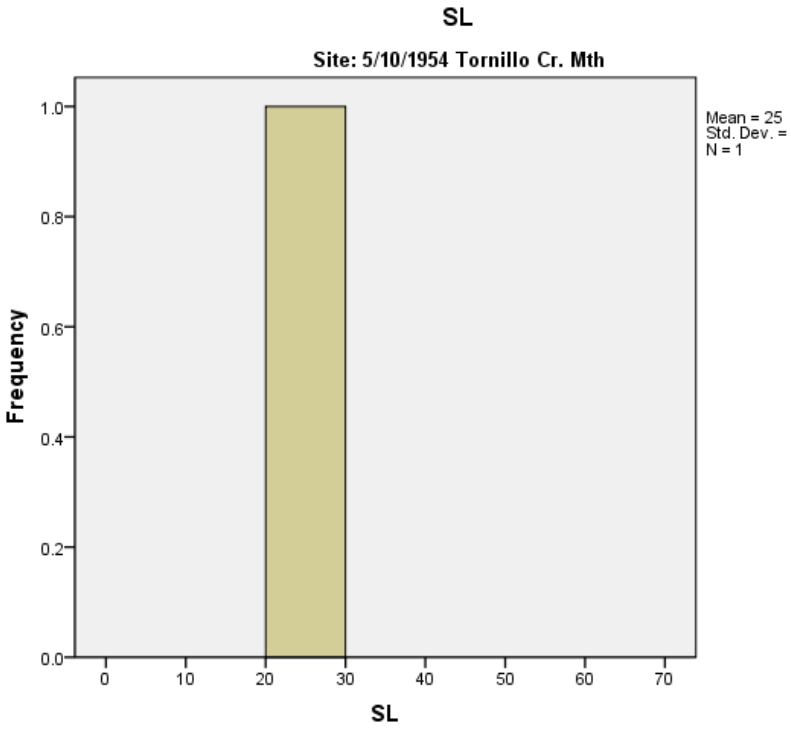

SL
Site: 6/10/1954 Nr Terlinga Mth
Mean = 58
Std. Dev. =
N = 1
Frequency
1.0
0.8
0.6
0.4
0.2
0.0
0
10
20
30
40
50
60
70
SL

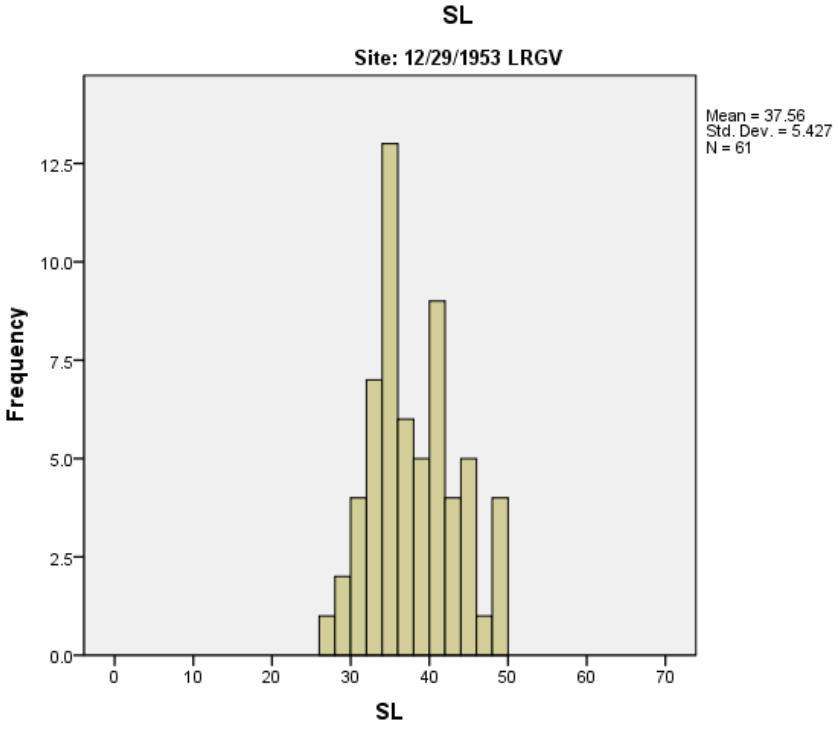

SL
Site: 5/6/1954 LRGV
Mean = 35
Std. Dev. =
N = 1
Frequency
1.0
0.8
0.6
0.4
0.2
0.0
0
10
20
30
40
50
60
70
SL

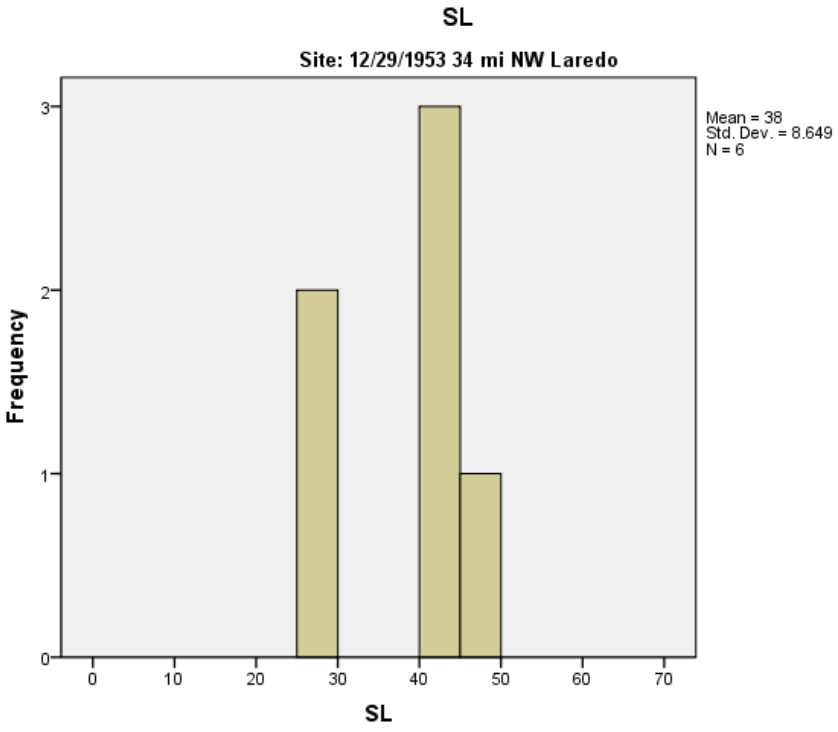

SL
Site: 6/10/1954 SW Castolon
Mean = 59.5
Std. Dev. = .707
N = 2
Frequency
SL

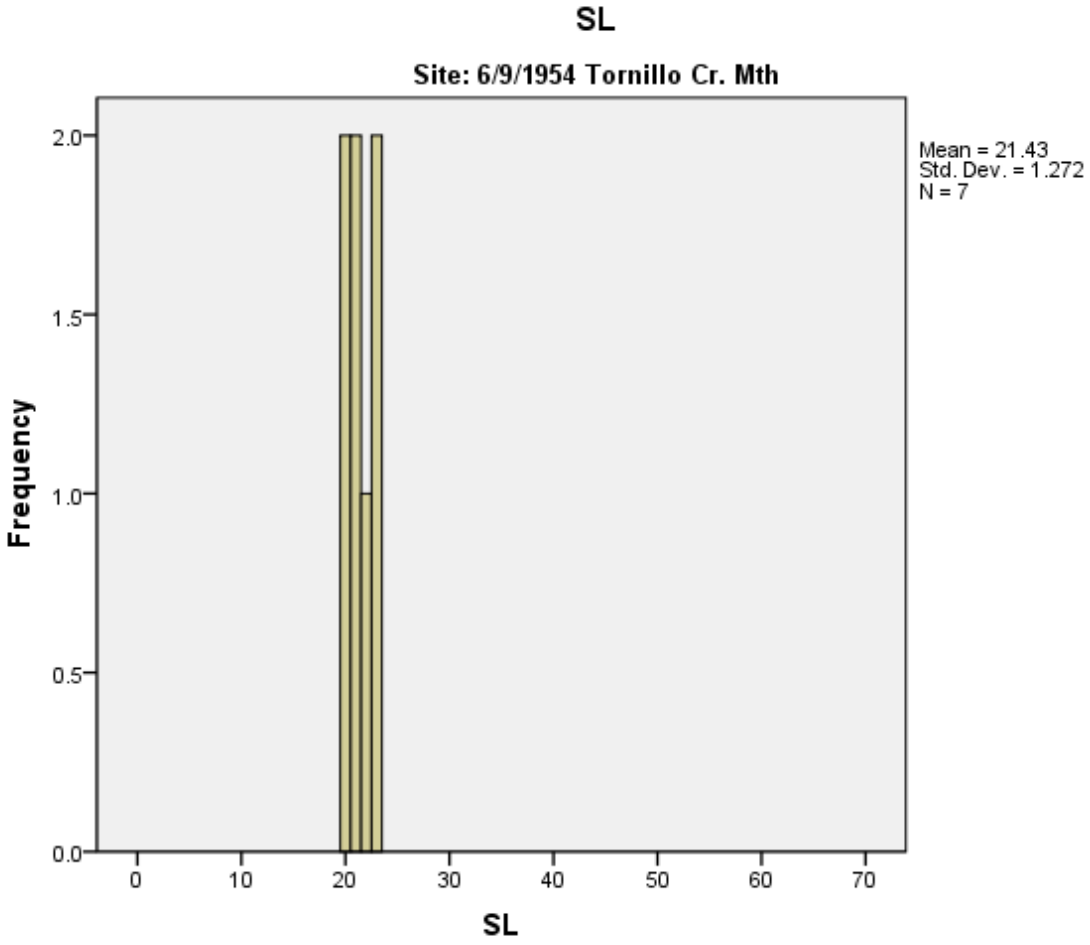

SL
Site: 8/5/1954 Webb Co. Ranch
Mean = 25.35
Std. Dev. = 2.597
N = 17
Frequency
SL

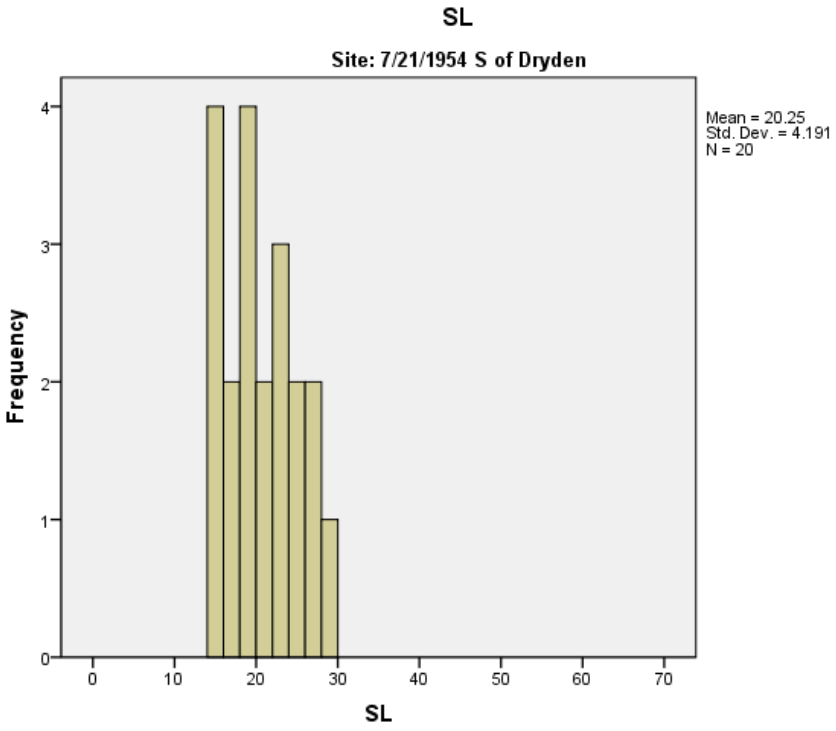

SL
Site: 6/9/1954 Tornillo Cr Mth
Mean = 22
Std. Dev. =
N = 1
Frequency
1.0
0.8
0.6
0.4
0.2
0.0
0
10
20
30
40
50
60
70
SL


SL
Site: 5/10/1954 Tornillo Cr. Mth
Mean = 25
Std. Dev. =
N = 1
Frequency
1.0
0.8
0.6
0.4
0.2
0.0
0
10
20
30
40
50
60
70
SL


SL
Site: 12/29/1953 LRGV
Mean = 37.56
Std. Dev. = 5.427
N = 61
Frequency
SL


SL
Site: 12/29/1953 34 mi NW Laredo
Mean = 38
Std. Dev. = 8.649
N = 6
Frequency
SL


SL
Site: 6/9/1954 Tornillo Cr. Mth
Mean = 21.43
Std. Dev. = 1.272
N = 7
Frequency
2.0
1.5
1.0
0.5
0.0
0
10
20
30
40
50
60
70
SL


SL
Site: 7/21/1954 S of Dryden
Mean = 20.25
Std. Dev. = 4.191
N = 20
Frequency
0
1
2
3
4
0
10
20
30
40
50
60
70
SL