BUREAU OF RECLAMATION

2019 Middle Rio Grande Southwestern Willow Flycatcher Study Results

Selected Sites along the Rio Grande from San Acacia Diversion Dam to Elephant Butte Reservoir, New Mexico

U.S. Department of the Interior

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Selected Sites along the Rio Grande from San Acacia Diversion Dam to Elephant Butte Reservoir, New Mexico

Report # ENV-2020-024

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Cover photo: Debris dam in Elephant Butte Reservoir Delta adjacent to occupied SWFL habitat (Reclamation/Dave Moore)

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Executive Summary

Overview

During the summer of 2019, the Bureau of Reclamation (Reclamation) conducted surveys and nest monitoring of the Federally-listed endangered Southwestern Willow Flycatcher (SWFL). The surveys were completed in five distinct reaches along approximately 80 river miles of the Rio Grande in New Mexico between San Acacia Diversion Dam and Elephant Butte Reservoir. Surveys were performed to contribute to current baseline population data, monitor population trends, determine the current distribution of SWFLs along the Middle Rio Grande, and meet Reclamation's and the Corps of Engineers' Endangered Species Act compliance commitments. During 2019 surveys, 590 resident SWFLs were documented. These residents formed 264 pairs and established 326 territories. As in previous years, the San Marcial Reach of the Rio Grande was by far the most productive supporting 293 territories and 243 pairs. The Bosque del Apache Reach supported 24 territories. Overall, territory numbers in the Middle Rio Grande declined slightly in 2019 when compared to 2018. However, two reaches (Belen and Sevilleta/La Joya) that typically are occupied by resident SWFLs were not surveyed in 2019.

Time permitting, nest monitoring was conducted at all sites where nesting pairs were detected. Nests were monitored for success rates, productivity, depredation, abandonment and Brown-headed Cowbird parasitism. The San Marcial Reach again proved most productive, producing 280 nests and fledging 272 SWFL young. The Bosque del Apache Reach produced 7 nests for which fates were all unknown due to limited site access caused by extensive flooding. Overall nesting success was 42 percent.

Survey Results

Reclamation Albuquerque Area Office funded reaches:

San Acacia – 0 territories
Bosque del Apache (active floodplain) – 24 territories
San Marcial – 293 territories

Corps of Engineers funded reaches:

Escondida – 9 territories
Tiffany – 0 territories

Introduction

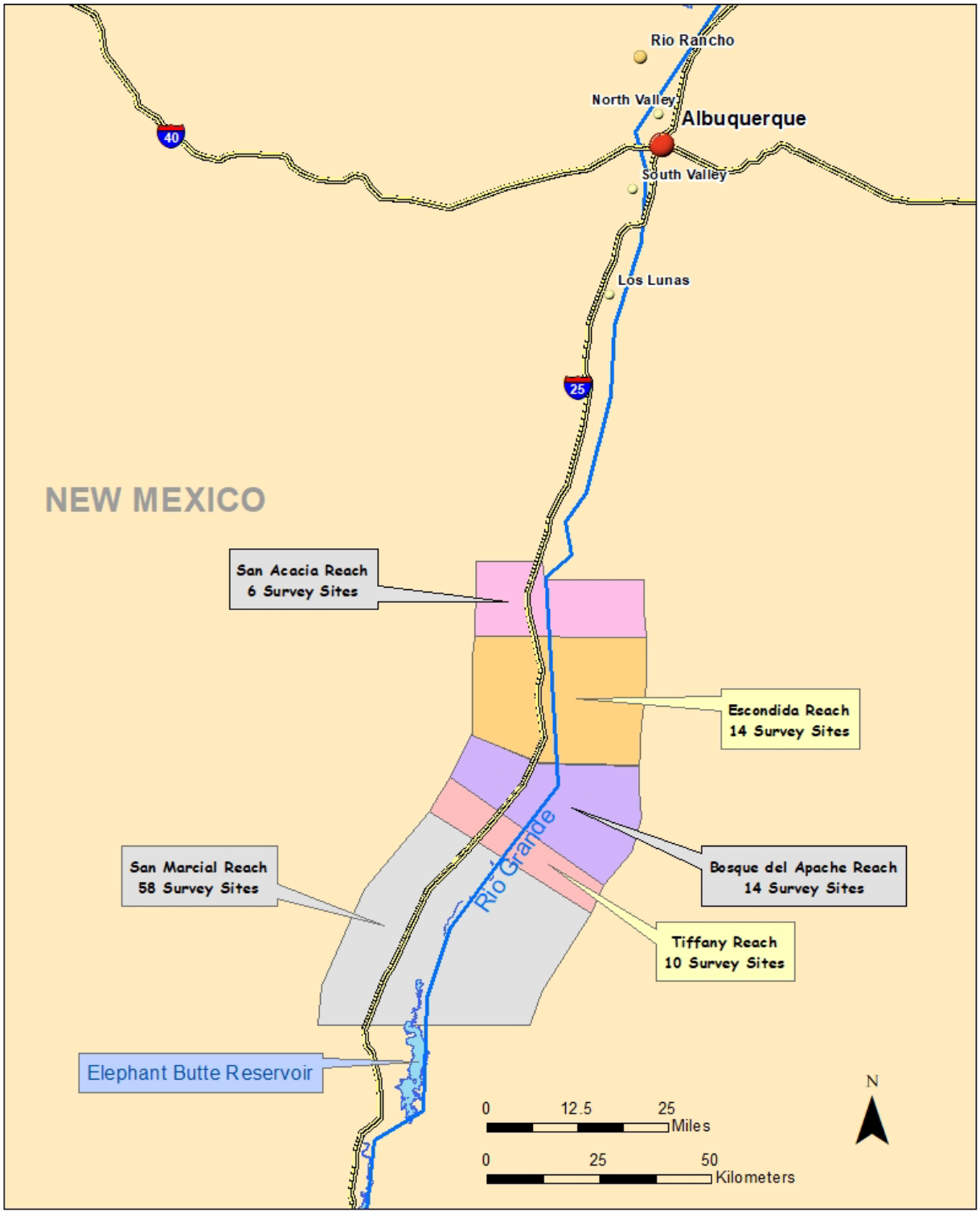
The Southwestern Willow Flycatcher (*Empidonax traillii extimus*; hereafter referred to as SWFL) is a State-listed and Federally-listed endangered subspecies of the Willow Flycatcher (*Empidonax traillii*) or WIFL. It is an insectivorous, Neotropical migrant that nests in dense riparian or wetland vegetation in the Southwestern United States (Figure 1). SWFLs typically arrive at their Middle Rio Grande breeding sites between mid-May and early June. They depart for wintering areas in Mexico, Central America, and northern South America between late July and mid-August (Sogge, Ahlers and Sferra 2010, USFWS 2002).

Due to declining populations and habitat loss, the U.S. Fish and Wildlife Service (USFWS) officially listed the SWFL as endangered in February 1995 (USFWS 1995). Subsequent studies conducted during the late-1990s and early 2000s and detailed in the SWFL Recovery Plan (USFWS 2002) confirmed the population declines. The SWFL is also listed as endangered or a species of concern by the states of Arizona, California, Colorado, Nevada, New Mexico, Texas, and Utah (Sogge, Ahlers and Sferra 2010, TPWD 2005). A recovery plan for the SWFL was finalized in August 2002. To accompany the recovery plan, a series of issue papers associated with the recovery of the endangered SWFL was prepared by the USFWS Recovery Team. These papers addressed current issues and recommended management alternatives regarding livestock grazing; water management; exotic vegetation; habitat restoration; fire management; recreational impacts; and parasitism by Brown-headed Cowbirds (*Molothrus ater*; hereafter referred to as BHCO or cowbird - USFWS 2002).

In October 2005, the USFWS designated critical habitat for the SWFL along the Middle Rio Grande in three distinct segments, separated by the Sevilleta and Bosque del Apache National Wildlife Refuges (NWR), which were excluded from the designation. The designated reaches include "from the southern boundary of the Isleta Pueblo for 44.2 miles [71.1 kilometers (km)] to the northern boundary of the Sevilleta NWR. The Middle Rio Grande segment extends for 27.3 miles (43.9 km) from the southern boundary of the Sevilleta NWR to the northern boundary of the Bosque del Apache NWR. The most southern Rio Grande segment extends for 12.5 miles (20.1 km) from the southern boundary of the Bosque del Apache NWR to the overhead powerline near Milligan Gulch…"(USFWS 2005). This designation does not include the conservation pool of Elephant Butte Reservoir. In August of 2011 the USFWS proposed a revised critical habitat designation and the final rule was issued in January of 2013. Changes to the critical habitat maps include adding the Sevilleta and Bosque del Apache NWRs and a portion of the Elephant Butte Reservoir pool to the designation.

Figure 1. Breeding range of the SWFL (adapted from Unitt 1987 and Browning 1993).

Presence/absence surveys, based on established survey protocols (Sogge, Ahlers and Sferra 2010), were conducted to determine the distribution and abundance of the endangered SWFL during the relatively brief breeding season when they become a seasonal resident of the Southwestern United States. Bureau of Reclamation (Reclamation) personnel have conducted presence/absence surveys and nest monitoring during the May to July survey season within the Rio Grande Basin since 1995. In 1994, the New Mexico Natural Heritage Program (NMNHP 1994) conducted presence/absence surveys and nest monitoring within portions of the San Marcial Reach under a contract with the U.S. Army Corps of Engineers (Corps). The 2019 presence/absence surveys for SWFLs were conducted at selected sites along the Rio Grande between San Acacia Diversion Dam and Elephant Butte Reservoir (Figure 2). Surveys were performed between May 15 and July 21, 2019.



* Please note: The length of the survey site reaches from North to South along the Rio are exact, whereas the width from West to East is exaggerated for viewing purposes. Most survey sites are within 1 mile (either east or west) of the Rio Grande. Gray shading in territory boxes represent reaches funded by BOR Albuquerque Area Office and yellow shading represents reaches funded by U.S. Army Corps of Engineers.

Figure 2. General locations of 2019 survey sites.

Nest searches and monitoring of SWFL nests were conducted by permitted biologists in conjunction with surveys.

Goals and Objectives

The primary goals of the field studies performed in 2019 were to:

- Contribute to current baseline data regarding the population status, distribution, and habitat requirements of the SWFL in the Middle Rio Grande.
- Meet Reclamation's and Corps' Endangered Species Act (ESA) compliance commitments for ongoing and proposed projects, and the monitoring of completed projects.
- Avoid or minimize any potentially adverse project-related effects to breeding SWFLs or their habitat.
- Identify key habitat parameters and incorporate suitable habitat features into restoration planning.

The specific objectives included:

- Maintain project ESA compliance in specific action areas by conducting five surveys per site.
- Determine impacts of river maintenance activities on specific sub-populations of SWFLs.
- Monitor SWFL nests to determine productivity, parasitism and depredation rates, population recruitment, and to identify limiting factors.
- Determine relationships between SWFL nesting and hydrologic parameters.

Related Studies

This study is a continuation of ongoing efforts that have grown in size and complexity since 1995. A variety of studies have been conducted over the past two decades to investigate aspects of SWFL ecology and reproduction. Below is a brief synopsis of the various related studies conducted over the last 25 years:

- Using a modified Breeding Biology Research and Monitoring Database (BBIRD) protocol (Martin et al. 1997), an avian nest monitoring study was conducted from 1999 to 2004. Potential BHCO host nests were monitored to determine the effectiveness of the 1997 through 2001 cowbird trapping and removal effort and to gain a better understanding of the effects and intensity of factors such as brood parasitism and depredation on productivity of riparian obligate species. Parasitism levels, depredation, nest success, and nest productivity of SWFLs and comparable riparian obligate species in various sites within the former trapping area were compared to those within two adjacent areas at least 7 miles from the trapping area. Neither of the adjacent areas had been subject to cowbird trapping. One of the areas supported year-round grazing, and the other did not support any livestock grazing. Results suggest that trapping cowbirds may reduce brood parasitism; however, compensatory factors such as habitat, depredation, and nest abandonment appear to offset the increased nest success resulting from decreased BHCO parasitism. Further information on this study can be found in *Riparian Obligate Nesting Success as Related to Cowbird Abundance and Vegetation Characteristics Along the Middle Rio Grande, New Mexico* (Moore 2006).

- Avian point counts were conducted between 1999 and 2008 to determine the distribution and abundance of BHCOs and host bird species within the Middle Rio Grande. Transects were established within four study areas to determine the distribution and density of BHCOs and to determine the effectiveness of the cowbird trapping program conducted between 1997 and 2001. Point count data from 1999 to 2008 showed a dramatic decline in BHCOs per point in the Sevilleta and Bosque del Apache reaches. BHCO abundance increased within the San Marcial reach and declined slightly in the San Acacia reach. Similarly, host species abundance increased markedly in the San Marcial reach while decreasing slightly in the other three reaches. Higher quality habitat in the San Marcial reach likely attracted riparian-obligate host species which, in turn, may have attracted greater numbers of BHCOs. Methods and results of this study can also be found as a component of *Riparian Obligate Nesting Success as Related to Cowbird Abundance and Vegetation Characteristics Along the Middle Rio Grande, New Mexico* (Moore 2006).

- A 12-year study to monitor and evaluate the impacts of livestock grazing on the establishment and development of riparian vegetation was concluded in 2008. This study was initiated in 1997 to determine the effects of seasonal livestock grazing on the potential future habitat of the endangered SWFL and the physical disturbance to existing occupied habitats. Data from a series of established livestock exclosures and photo stations were collected biannually and processed. The established browse threshold of 35 percent was exceeded during three different sampling periods at several exclosures. However, long-term impacts to regenerating riparian habitat were only documented at one exclosure during the study. Results are presented in *A Long-Term Assessment of Livestock Impacts on Riparian Vegetation: Elephant Butte Project Lands* (Ahlers, Reed and Siegle 2009).

- Development of a geographic information systems-based SWFL habitat suitability model was initiated in 1998 for the Middle Rio Grande. The model continues to be refined based on changes in hydrology, habitat use by SWFLs, and updated vegetation maps. Riparian vegetation in the Middle Rio Grande between Highway 60 and Elephant Butte Reservoir was classified using the Hink and Ohmart (1984) classification system. This system identifies vegetation polygons based on dominant species and structure. Plant community types are classified according to the dominant and/or codominant species in the canopy and shrub layers. During the summer and fall of 2002, as part of the Middle Rio Grande (MRG) Endangered Species Collaborative Program, Reclamation personnel updated vegetation maps from Belen to San Marcial using a combination of ground-truthing and aerial photo analysis (Callahan and White 2004). During the summer of 2004, the conservation pool of Elephant Butte Reservoir was again aerially photographed (true color) and vegetation heights were remotely-sensed using Light Detection and Ranging (LIDAR) methods. Updates to habitat maps were again completed in 2008, 2012 and, most recently, 2016. Results and interpretation of the 2016 data can be found in *Southwestern Willow Flycatcher Habitat Suitability 2016: Middle Rio Grande, New Mexico* (Siegle and Ahlers 2017).

- A study to quantify the vegetation at known SWFL breeding sites began in 2003. Data gathered included nesting height and substrate, vegetation density, height diversity, canopy cover, and hydrology. Methodologies were refined in 2004 and a formal study was initiated. Between 2004 and 2006, data were collected at 112 nests and were used to increase overall knowledge of the nesting and general habitat requirements of the species. The resulting data analysis has helped to provide guidelines for riparian restoration projects targeted for SWFL habitat. See *Vegetation Quantification of Southwestern Willow Flycatcher Nest Sites* (Moore 2007) for details of this study. In 2007, data were

gathered at 11 non-nest sites within maturing habitat in both the delta of Elephant Butte Reservoir and adjacent to the Los Lunas Restoration Site to assess the suitability of these areas for nesting SWFLs. Results of this study are available in *An Assessment of Potential Southwestern Willow Flycatcher Habitat* (Moore 2009). Most recently, this effort has been conducted at three plots within the cleared portion and three plots within the natural portion of the Los Lunas site. Results will be presented in Siegle and Moore (in press-a).

- Beginning in 2004, detailed hydrological data at each SWFL nest were recorded on each monitoring visit. Data from the 2004 through 2008 breeding seasons were compared to SWFL nest variables (success, productivity, depredation, parasitism, and distance to water) to determine what, if any, relationships exist between hydrology and nesting. For details of this hydrology monitoring study, see *A Review of Vegetation and Hydrologic Parameters Associated with the Southwestern Willow Flycatcher – 2002 to 2008: Elephant Butte Reservoir Delta* (Ahlers 2009).

- In 2005, photostations were established adjacent to developing habitat in the delta of Elephant Butte Reservoir. Permanent photopoints are visited annually in August and photos are taken at predetermined bearings to document changes in riparian vegetation. Three additional photostations were established in 2013 to document the developing habitat in the vicinity of Monticello Point. Currently, 13 sets of annual photos at each of the original 13 stations have been taken and some have documented either considerable vegetation growth and development, or habitat decline. Most recent results of this study will be presented in *Elephant Butte Reservoir Delta Photostations – 2005-2019* (Moore 2019).

- In conjunction with SWFL nest monitoring, a hydrology monitoring study was implemented in 2004 and continued through 2011. Initially, 19 hydrostations (custom-built staff gauges) were installed in proximity to the core SWFL population in the headwaters of Elephant Butte Reservoir to measure water depth at certain locations. Four additional hydrostations (20, 22, 23, and 24) were installed in newly occupied habitat in 2008 and monitoring of three others was discontinued due to difficulty of access or deterioration of habitat. Hydrostations were placed in select locations, representative of the overall site's hydrology. They were monitored during the SWFL breeding seasons from 2004 through 2011. Of the 20 hydrostations monitored in 2011, nine were never flooded, three never dried, and eight were flooded and dried during the survey season. Data were collected weekly and were used to determine the relationship between flows in the Low Flow Conveyance Channel (LFCC) and depth of water within the core SWFL breeding areas of the Elephant Butte Reservoir delta. For additional details regarding this portion of the hydrology study, see Moore and Ahlers (2012).

- During the spring and summer of 2010, a study designed to monitor the newly occupied SWFL habitat adjacent to the sediment plug in the Bosque del Apache National Wildlife Refuge (NWR) was initiated. Several alternatives to address the recurring sediment plug problem at River Mile 82 were considered and the alternative of channel realignment was chosen. The new alignment was designed to alleviate issues associated with the sediment plug while minimizing impacts to higher suitability SWFL habitat. However, impacts in the form of lower water table elevations and/or changing overbank flooding regimes are still possible. In order to establish a baseline within the project area, groundwater monitoring wells and vegetation sampling sites, including transects at well locations, nest plots at nest locations, and hemispherical photography at both, were established during the spring and summer of 2010. Additional groundwater wells and vegetation transects were

installed in habitat on the east side of the river in 2011, north of the northern refuge boundary in 2014, and adjacent to the new alignment on the east side of the refuge in 2017 and 2018. Data are collected annually and the most recent results can be found in *Bosque del Apache Sediment Plug Baseline Studies – Annual Report 2019* (Siegle and Moore, in press-b).

- A similar study designed to monitor impacts of sediment plug management in the delta of Elephant Butte Reservoir was initiated during the summer of 2011. A series of piezometers was installed, vegetation monitoring transects were established, and vegetation at six SWFL nests was quantified within survey site EB-09. An eighth year of data collection was conducted in 2018 and results can be found in Siegle, Ahlers, and Moore (2019). No data were collected in 2019 due to flooding and scouring of the study site from prolonged high flows in the Rio Grande.

- In an effort to quantify potential impacts of future reservoir elevations on suitable SWFL habitat in the exposed delta of Elephant Butte Reservoir, an assessment incorporating SWFL habitat maps and predicted reservoir elevations for five years was conducted. Suitable SWFL habitat was converted to habitat units and tallied by 5-foot contour interval and then run through a flowchart of potential scenarios to determine annual impacts from rising and falling reservoir levels. The end result was an annual estimate of habitat gains and losses per contour interval which was then extrapolated to SWFL territory abundance. This study was first conducted in 2009 based on three hydrologic scenarios – drought, average and wet - for the years 2009 through 2013. Only in the wet scenario was a displacement of SWFL territories based on reservoir levels predicted. Details of this study can be found in Bureau of Reclamation (2009). A similar 5-year assessment is currently underway for the years 2020 through 2024, which includes impacts to suitable Yellow-billed Cuckoo habitat as well (Siegle, Dillon, and Moore 2020).

- Prompted by the population expansion of the tamarisk beetle (*Diorhabda* sp.) within the Middle Rio Grande, an impact monitoring study was initiated in 2015 to determine impacts to occupied SWFL habitat. Canopy cover analysis via hemispheric photography, landscape photography and microclimate monitoring is conducted within SWFL-occupied tamarisk-dominated habitat in six different survey sites. Hemispheric photos are taken annually in early, mid- and late summer in order to document any changes to foliar density, landscape photos taken annually document visual changes to the habitat, and microclimate data reveal changes to temperature and humidity caused by tamarisk defoliation. The presence of *Diorhabda* has been documented within all study plots and defoliation has been observed within five of the six. Latest results will be presented in Dillon and Moore (in press-c).

Methods

Study Area

Survey sites were selected based on environmental compliance requirements related to Reclamation and Corps projects and a need to monitor SWFL population trends within the Middle Rio Grande. Sites consist of riparian habitat bounded by waterbodies, levees, or other physical features and are typically surveyed by one person in one day. The 2019 survey area encompassed selected sites along the Rio Grande in New Mexico between San Acacia Diversion Dam and Elephant Butte Reservoir. This stretch contained five distinct survey reaches: San Acacia, Escondida, Bosque del Apache, Tiffany, and San Marcial. Survey efforts varied among reaches and sites based on research needs, project environmental compliance, effort needed to ensure thorough coverage, and events which limited access (e.g. flooding and fire). Table 1 shows a summary of the survey effort within each reach.

Table 1. Number of sites and surveys per survey reach – Middle Rio Grande 2019

Survey reach	Number of sites	Number of surveys
San Acacia	6	3
Escondida	14	5
Bosque del Apache	14	5
Tiffany	10	With the exception of LF-26 (3 surveys), sites in Tiffany Reach not surveyed due to complete burn by Tiffany Fire.
San Marcial	61	Sites LF-10 to LF-13 completely burned and not surveyed. Remainder of sites surveyed 5 times.

Presence/Absence Surveys

All sites were surveyed using the repeated call-playback method in accordance with the protocols established in Sogge, Ahlers and Sferra (2010). Surveys in individual sites were conducted a minimum of 5 days apart; generally between 0530 and 1030 or 1100 MDT (depending on weather conditions), by trained and permitted personnel. Survey forms were completed daily for each respective site. A minimum of three surveys were conducted at sites when only general research or study needs were required. A minimum of five surveys were conducted for all project-related sites. Several sites were burned in the 2017 Tiffany Fire and were excluded from 2019 surveys due to total lack of habitat.

The first survey is conducted in late May to increase the likelihood of detection, since territorial males are more vocal when establishing territories than after nesting has begun. It was anticipated that migrant WIFLs (Willow Flycatchers that are not the *extimus* subspecies, or *extimus* subspecies that are passing through and not actively defending territories) would also be detected. For sites with only a three-survey requirement, the second and third surveys were conducted between early June and mid-July to (1) confirm the establishment of territories and/or nesting, (2) detect late-settling males, and

(3) determine which sites remained occupied throughout the breeding season. In sites with a five-survey requirement, the second and third surveys were conducted during June and the fourth and fifth surveys were conducted from late June to mid-July. The additional two surveys were initiated in 2000 to derive a greater degree of confidence regarding the breeding status, habitat association, and presence/absence of SWFLs at the selected sites. WIFLs documented on or after June 10 were typically considered resident birds (i.e., SWFLs) for reporting purposes, however several were determined to be late migrants based on their behavior and were not included as residents. Each site was surveyed as thoroughly as conditions would allow.

Nest Searches/Monitoring

Within occupied sites, nest searches were conducted by a permitted biologist and/or technician under the direct supervision of a permitted biologist upon discovery of a breeding or suspected breeding SWFL pair. Due to logistical and personnel constraints, nest searching and regular nest monitoring were not conducted in a few occupied sites. At a minimum, all territories were visited at least once during the typical nesting period to determine pairing status. Thus, for several pairs, nests were not located or nest fates were unknown. To minimize disturbance and maximize accuracy of monitoring efforts, nest searches and monitoring were conducted using methods outlined in Martin and Geupel (1993) and the *Southwestern Willow Flycatcher Nest Monitoring Protocol* (Rourke at al. 1999). Nest areas were located by observing diagnostic SWFL breeding behavior and listening for calls within the habitat patch. Once located, the nest sites were approached cautiously with minimum disturbance to vegetation. Typically, adult SWFLs did not immediately reveal nest locations. All suitable mid-story trees and shrubs in the suspected area were carefully inspected until the characteristic small, cup-shaped nest (as described in Tibbitts, Sogge and Sferra [1994]) was found. Nests were usually located within a few minutes of nest search initiation. Once located, descriptive flagging was placed at a distance from the nest (usually 8 to 10 meters) to minimize attraction of predators. On subsequent visits, time spent at the nest was minimized, dead-end trails were not made, and a variety of paths to and from the nest were used, again to minimize disturbance and reduce predator attraction.

At all nest sites, physical data required by the Willow Flycatcher Nest Record Form were recorded. Nest contents were not monitored during the nest building/egg laying stages—the period when disturbance is most likely to cause adults to abandon the nest—or as the suspected fledging date approached when nestlings are likely to be force-fledged as a result of disturbance. Nests with eggs/young were examined quickly using a mirror mounted on a telescopic pole or a straight branch. Nesting chronology was then estimated following the initial search and examination. Subsequent visits were minimized and timed so at least one inspection would be made of both eggs and nestlings. Data resulting from these inspections were recorded on the Nest Record Form.

At the conclusion of the first or early-season nesting attempts, the nesting pair was not monitored for approximately one week to minimize disturbance and allow for possible initiation of another nesting attempt. Then a re-nest/second brood search was performed. A re-nest is a nesting attempt that occurs after a nest fails while a second brood is a nesting attempt following an initial successful nesting attempt. When possible, nests were monitored through completion. However, certain nests that were not monitored to completion were considered successful if they had nestlings at least eight days old at the last visit.

In 2002, the practice of addling or removing BHCO eggs from parasitized nests was initiated when necessary and possible. This activity was continued in 2019. SWFL eggs were never disturbed and time spent at the nest was minimized. Frequently, based on nesting chronology, it was determined that the BHCO egg would not have a chance to hatch. In these cases the BHCO egg(s) was left untouched and the nests were monitored normally to minimize disturbance.

Hydrology Monitoring

Beginning in 2004 and continuing through 2019, hydrological conditions below the nest were recorded on each nest visit. These data were collected in order to make informed management decisions in regard to SWFL populations and nesting habitat, and to maximize the benefits from and use of available water. One of three possible hydrologic conditions was recorded – dry soil, saturated soil, or flooded site – and daily data were compiled for each nest at season's end to determine the hydrologic regime throughout the nesting cycle. Four hydrological scenarios emerged, including: 1) Dry all cycle, 2) Saturated/flooded then dry, 3) Saturated/flooded all cycle, and 4) Flooded all cycle. Distance to water was also recorded at each visit and average distance throughout the nest cycle was computed following the breeding season.

Results

Presence/Absence Surveys

During presence/absence surveys conducted from May 15 through July 21, 2019, there were 839 WIFLs detected. Based on detections prior to June 10 and/or the birds' lack of territorial behavior, 249 were believed to have been migrants. The remaining 590 birds comprised 264 pairs and 62 unpaired male territories. SWFL detections within the San Acacia, Escondida, Bosque del Apache, Tiffany, and San Marcial Reaches are presented in Figures 3 through 9, respectively. A total of 326 SWFL territories was documented within the Middle Rio Grande study area during the 2019 season. WIFL detection results are summarized in Table 2.

During the 2019 season, either four or five surveys were completed in 85 sites (92 percent of the sites surveyed). Within 17 of these sites, a total of 38 new SWFL territories were located during the fourth or fifth survey periods (Table 3). Of these territories, 14 were located in close proximity to other SWFL territories during intensive nest searching and monitoring efforts conducted later in the survey season (i.e. during the 4th and 5th survey periods) by experienced biologists. It is likely that, during formal surveys, these birds were mistaken for other territorial SWFLs nearby. Another 13 were in areas where flooding prevented thorough surveys during certain portions of the survey season. The remaining 11 newly documented territories represent only 3 percent of all SWFL territories documented during 2019. Presence/absence survey forms are presented in Appendix A and survey reaches are detailed in the following sections.

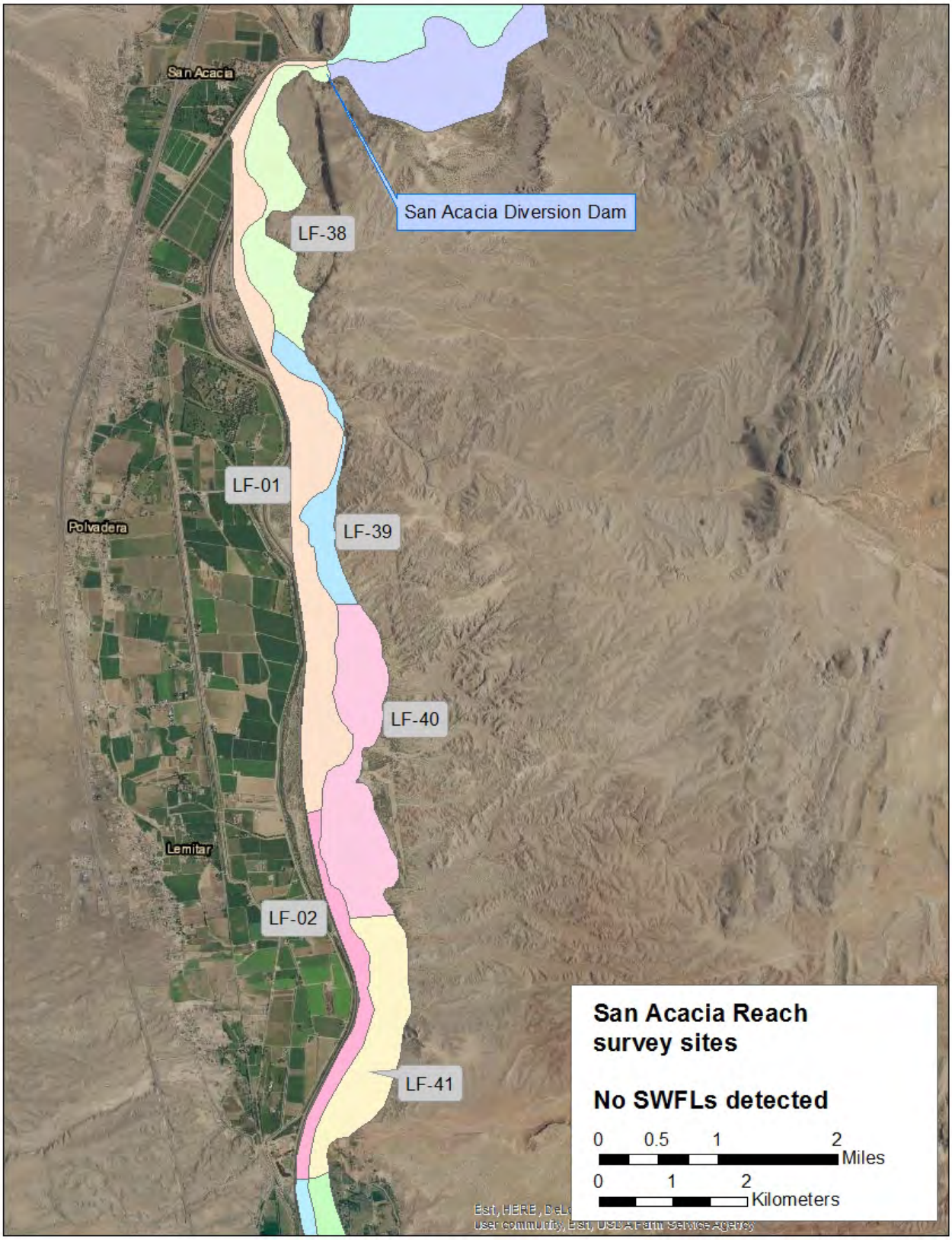


Figure 3. Overview of SWFL detections within the San Acacia survey sites.

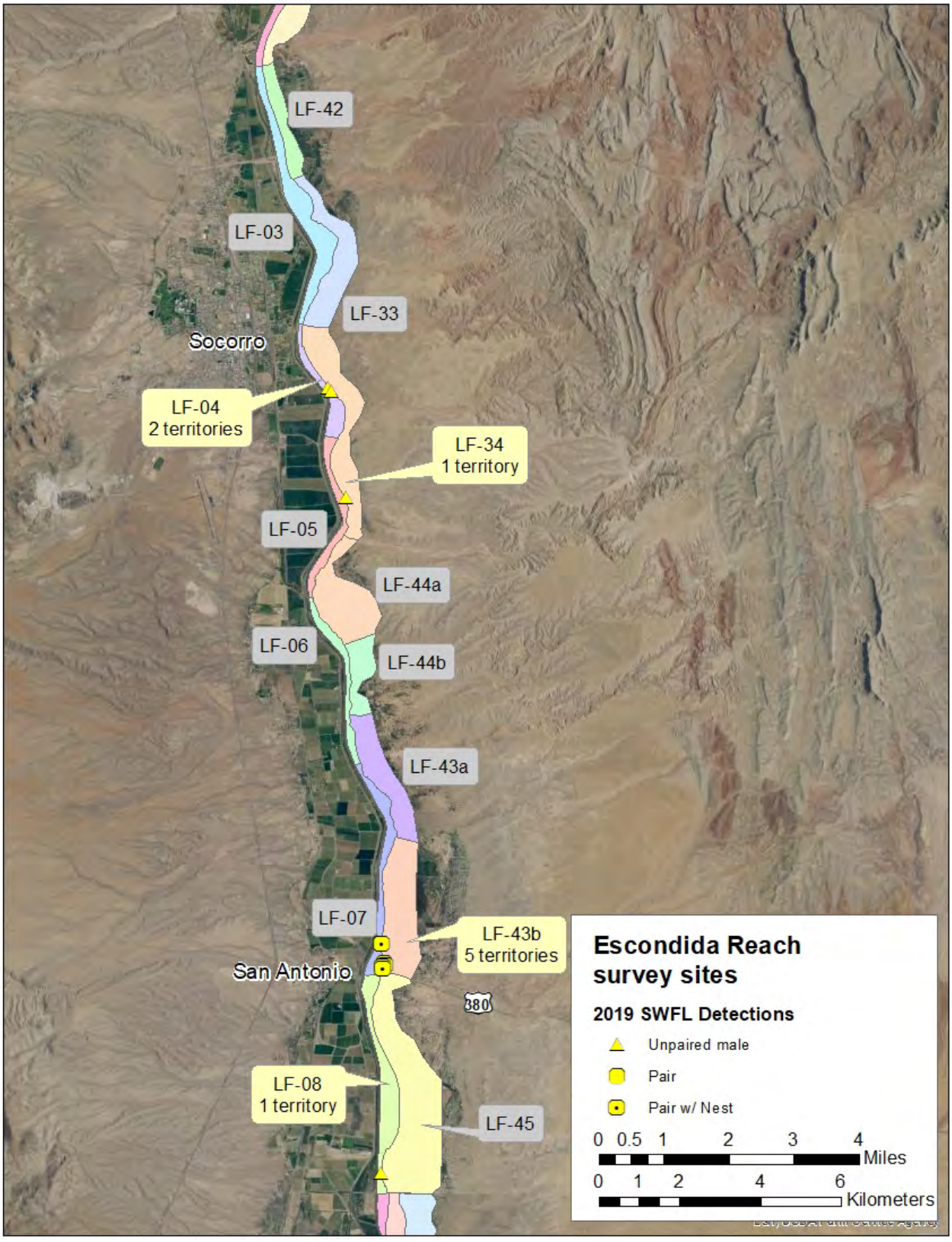


Figure 4. Overview of SWFL detections within the Escondida survey sites.

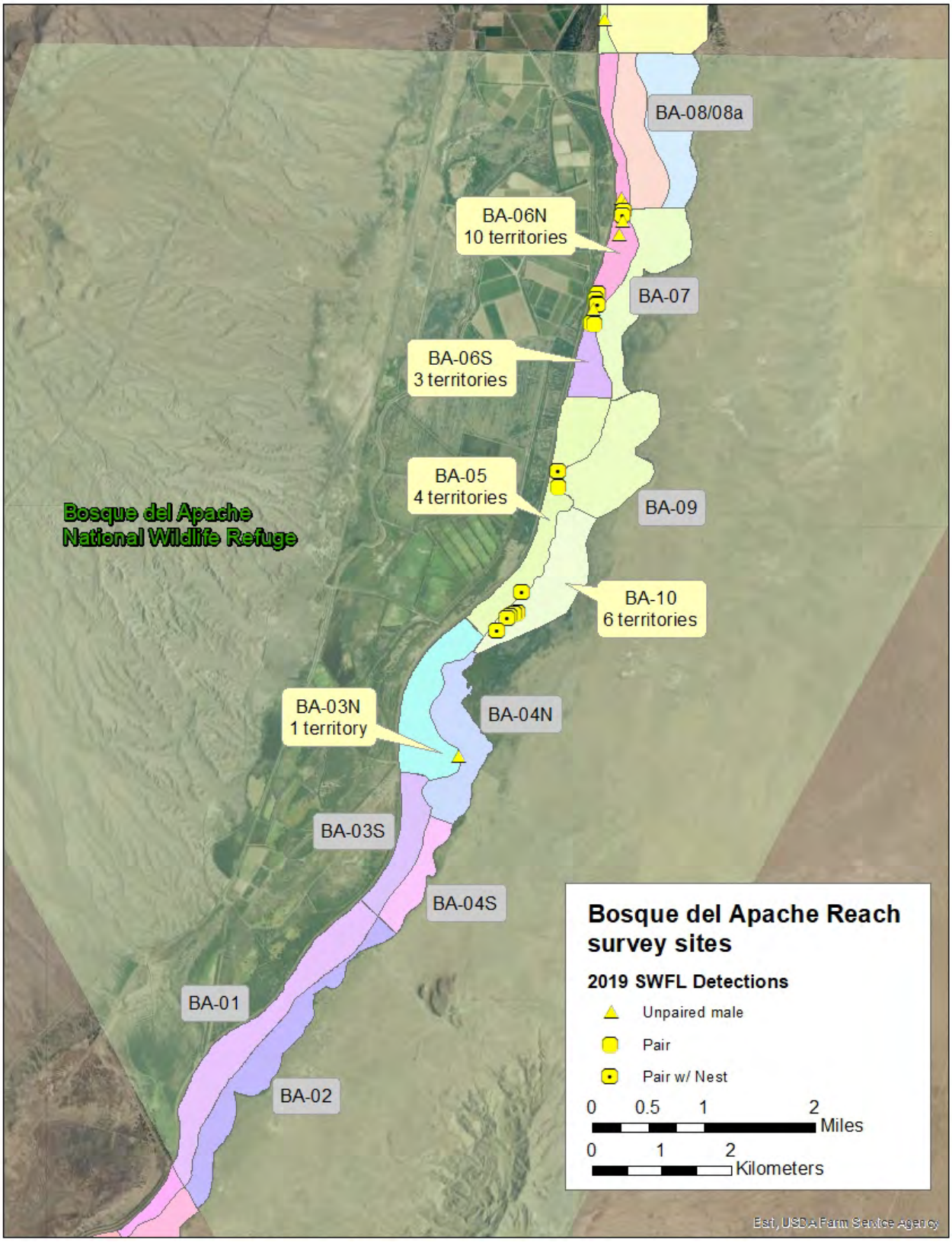


Figure 5. Overview of SWFL detections within the Bosque del Apache survey sites.

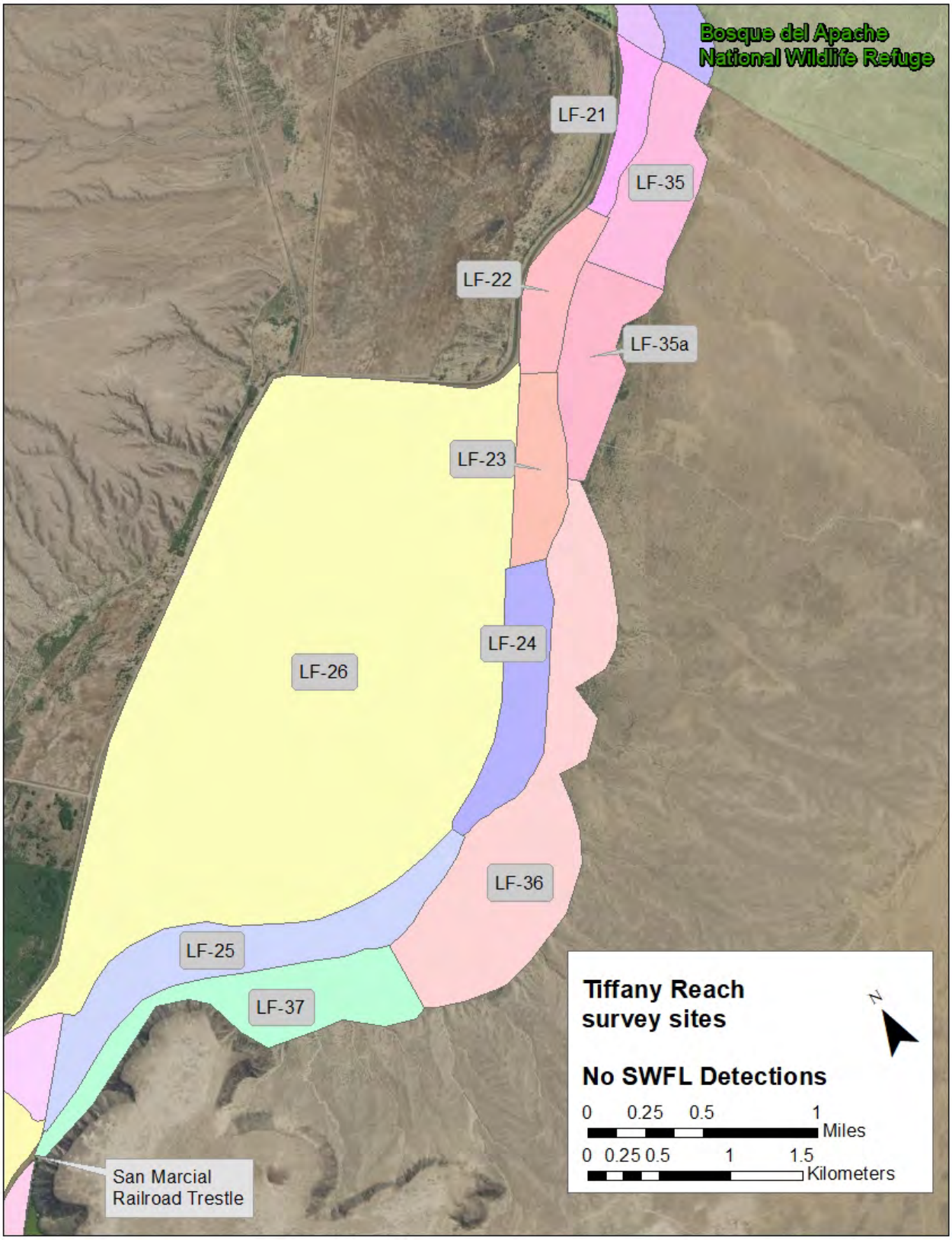


Figure 6. Overview of SWFL detections within the Tiffany survey sites.

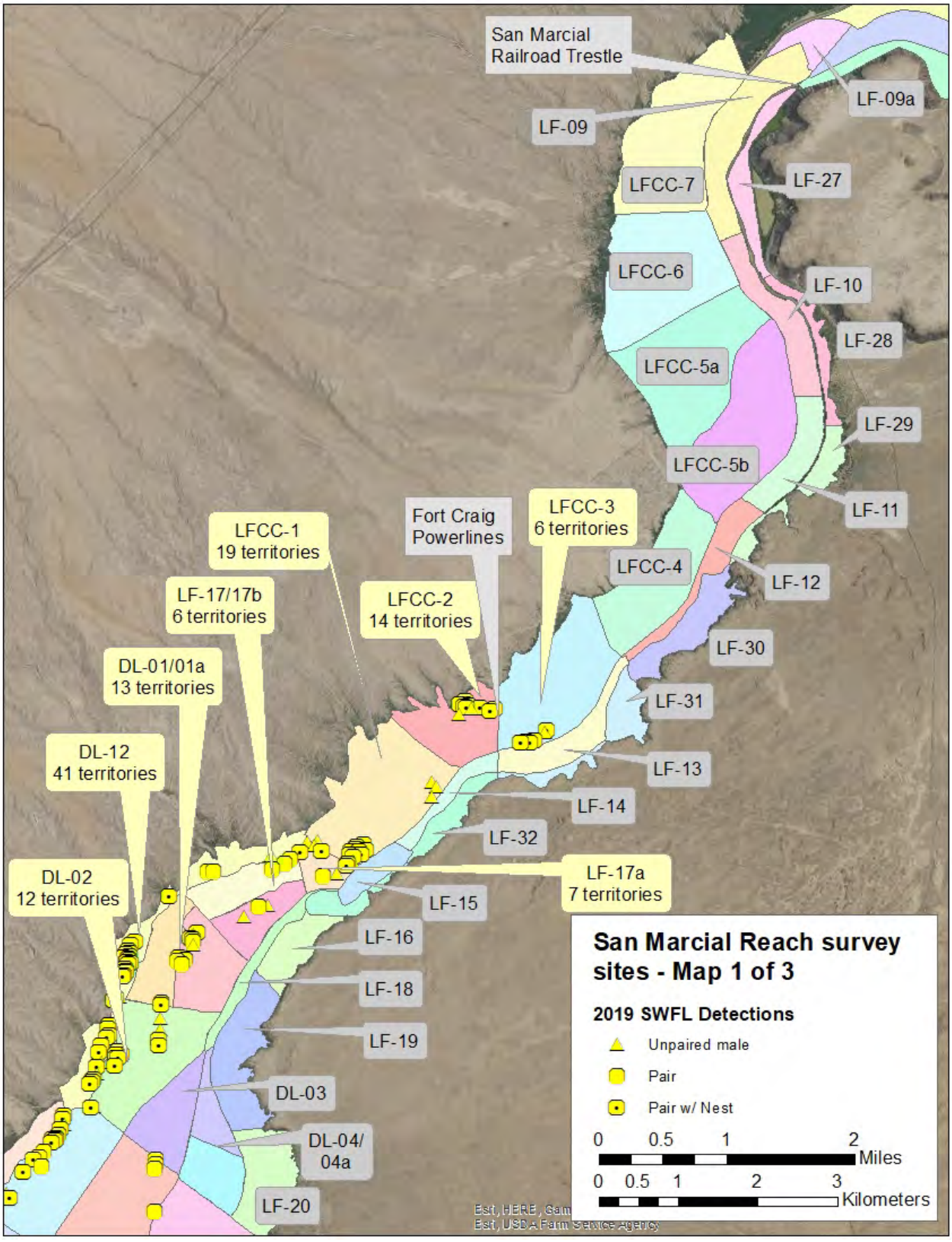


Figure 7. Overview of SWFL detections within the northern San Marcial survey sites.

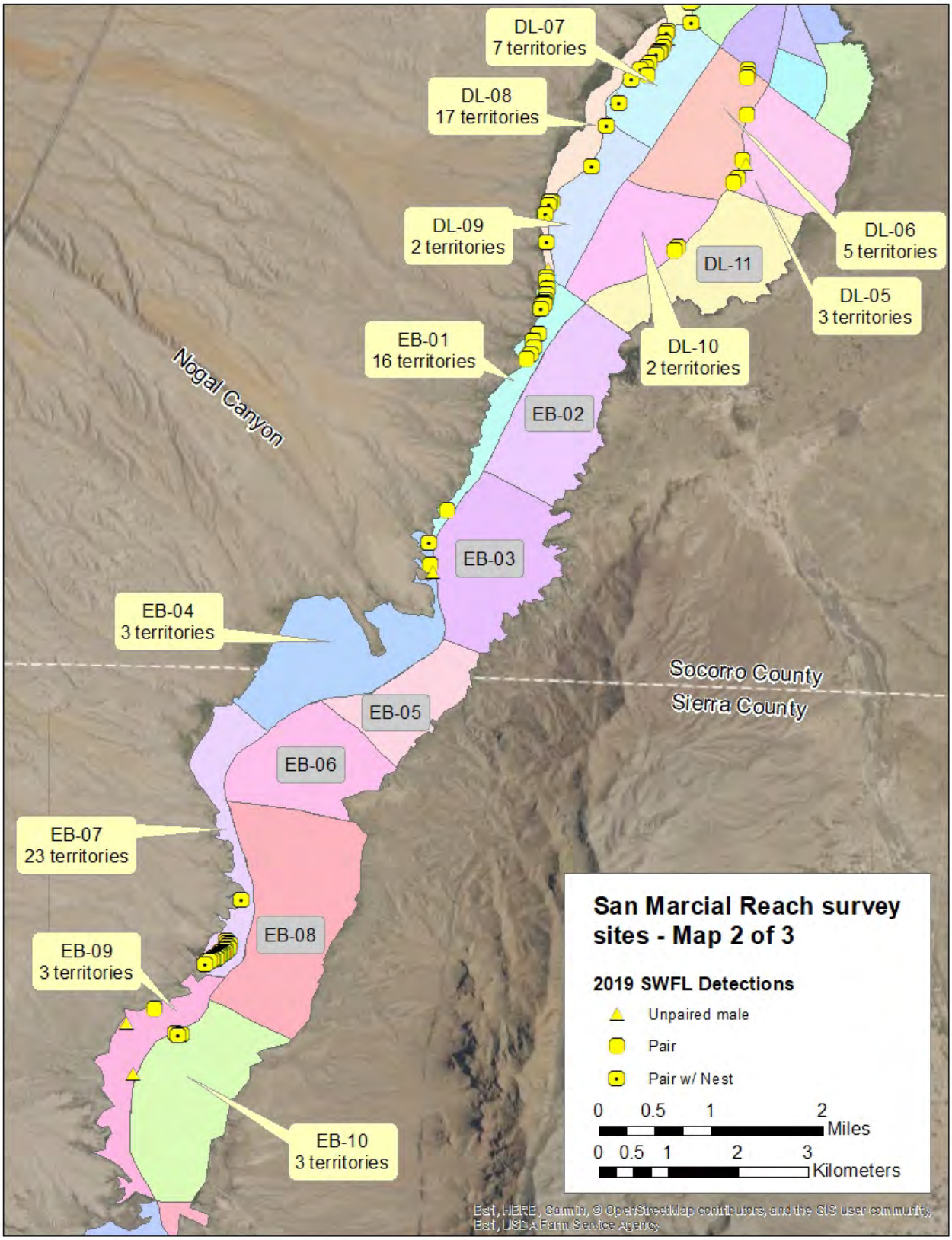


Figure 8. Overview of SWFL detections within the central San Marcial survey sites.

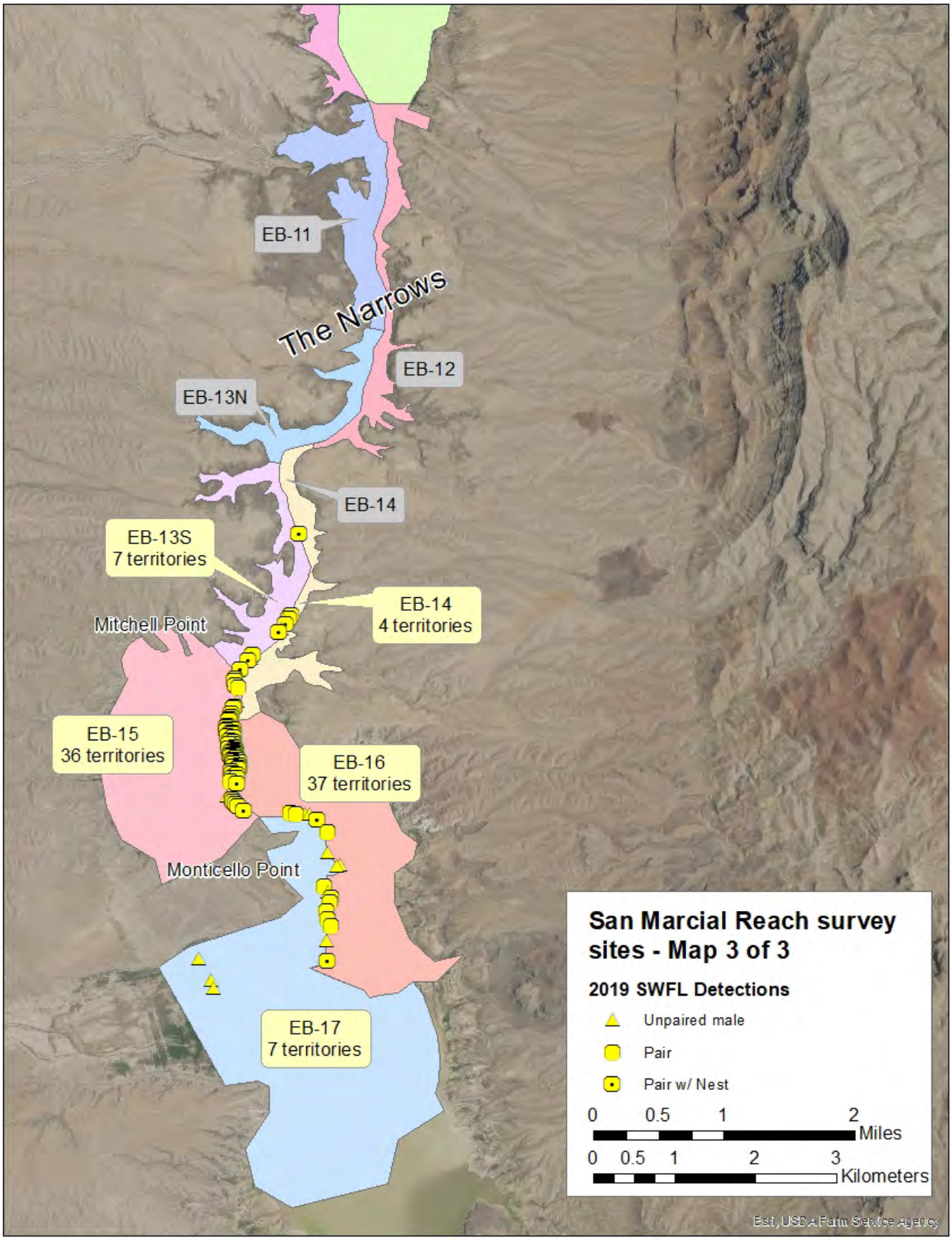


Figure 9. Overview of SWFL detections within the southern San Marcial survey sites.

Table 2. 2019 Willow Flycatcher survey detections within the Middle Rio Grande

Site Name	WIFLs Observed[1]	Est. Number of Pairs	Est. Number of *E.t. extimus*[2]	Est. Number of Territories	Nest(s) Found[3]	Nest Success	Comments	County
LF-01	5	0	0	0	0	N/A	5 migrants	Socorro
LF-38	5	0	0	0	0	N/A	5 migrants	Socorro
LF-39	4	0	0	0	0	N/A	4 migrants	Socorro
LF-40	5	0	0	0	0	N/A	5 migrants	Socorro
LF-41	6	0	0	0	0	N/A	6 migrants	Socorro
San Acacia Reach[4] Summary	25	0	0	0	N/A	N/A	25 migrants	
LF-03	3	0	0	0	0	N/A	3 migrants	Socorro
LF-04	3	0	2	2	0	N/A	1 migrant; 2 unpaired males	Socorro
LF-05	7	0	0	0	0	N/A	2 migrants	Socorro
LF-06	8	0	0	0	0	N/A	8 migrants	Socorro
LF-07	1	0	0	0	0	N/A	1 migrant	Socorro
LF-08	4	0	1	1	0	N/A	3 migrants; 1 unpaired male	Socorro
LF-33	5	0	0	0	0	N/A	5 migrants	Socorro
LF-34	5	0	1	1	0	N/A	4 migrants; 1 unpaired male	Socorro
LF-42	2	0	0	0	0	N/A	2 migrants	Socorro
LF-43b	16	5	10	5	4	3 successful; 1 failed	6 migrants; 1 pair; 4 pairs w/ nests	Socorro
LF-44a	1	0	0	0	0	N/A	1 migrant	Socorro
Escondida Reach[5] Summary	55	5	14	9	4	3 successful; 1 failed	41 migrants; 4 unpaired males; 1 pair; 4 pairs w/ nests	
BA-02	1	0	0	0	N/A	N/A	1 migrant	Socorro
BA-03N	4	0	1	1	N/A	N/A	3 migrants; 1 unpaired male	Socorro
BA-04N	4	0	0	0	N/A	N/A	4 migrants	Socorro
BA-05	14	3	7	4	2	2 unknown	7 migrants; 1 unpaired male; 1 pair; 2 pairs w/ nests	Socorro

Site Name	WIFLs Observed[1]	Est. Number of Pairs	Est. Number of *E.t. extimus*[2]	Est. Number of Territories	Nest(s) Found[3]	Nest Success	Comments	County
BA-06N	26	6	16	10	3	3 unknown	10 migrants; 4 unpaired males; 3 pairs; 3 pairs w/ nests	Socorro
BA-06S	7	2	5	3	0	N/A	2 migrants; 1 unpaired male; 2 pairs	Socorro
BA-07	6	0	0	0	N/A	N/A	6 migrants	Socorro
BA-08A	2	0	0	0	N/A	N/A	2 migrants	Socorro
BA-09	1	0	0	0	N/A	N/A	1 migrant	Socorro
BA-10	15	5	11	6	2	2 unknown	4 migrants; 1 unpaired male; 3 pairs; 2 pairs w/ nests	Socorro
Bosque del Apache Reach[6] Summary	80	16	40	24	7	7 unknown	40 migrants; 8 unpaired males; 9 pairs; 7 pairs w/ nests	
LF-16	2	0	0	0	N/A	N/A	2 migrants	Socorro
LF-17	9	3	6	3	0	N/A	3 migrants; 3 pairs	Socorro
LF-17a	21	4	11	7	3	1 failed; 2 unknown	10 migrants; 3 unpaired males; 1 pair; 3 pairs w/ nests	Socorro
LF-17b	7	1	4	3	0	N/A	3 migrants; 2 unpaired males; 1 pair	Socorro
LF-18	7	0	0	0	N/A	N/A	7 migrants	Socorro
LF-19	1	0	0	0	N/A	N/A	1 migrant	Socorro
LF-27	1	0	0	0	N/A	N/A	1 migrant	Socorro
LFCC-01	39	12	31	19	18	5 successful; 12 failed; 1 unknown	8 migrants; 7 unpaired males; 2 pairs; 10 pairs w/ nests	Socorro
LFCC-02	27	10	24	14	13	4 successful; 6 failed; 3 unknown	3 migrants; 4 unpaired males; 10 pairs w/ nests	Socorro
LFCC-03	13	5	11	6	5	2 successful; 3 failed	2 migrants; 1 unpaired male; 5 pairs w/ nests	Socorro
LFCC-04	2	0	0	0	N/A	N/A	2 migrants	Socorro
LFCC-05b	6	0	0	0	N/A	N/A	6 migrants	Socorro

Site Name	WIFLs Observed[1]	Est. Number of Pairs	Est. Number of *E.t. extimus*[2]	Est. Number of Territories	Nest(s) Found[3]	Nest Success	Comments	County
DL-01	5	2	4	2	1	1 successful	1 migrant; 1 pair; 1 pair w/ nest	Socorro
DL-01a	20	8	19	11	7	1 successful; 5 failed; 1 unknown	1 migrant; 3 unpaired males; 4 pairs; 4 pairs w/ nests	Socorro
DL-02	26	9	21	12	12	4 successful; 6 failed; 2 unknown	5 migrants; 3 unpaired males; 9 pairs w/ nests	Socorro
DL-03	4	0	0	0	N/A	N/A	4 migrants	Socorro
DL-05	5	2	5	3	0	N/A	1 unpaired male; 2 pairs	Socorro
DL-06	13	5	10	5	0	N/A	3 migrants; 5 pairs	Socorro
DL-07	16	6	13	7	4	2 failed; 2 unknown	3 migrants; 1 unpaired male; 2 pairs; 4 pairs w/ nests	Socorro
DL-08	34	14	31	17	17	4 successful; 12 failed; 1 unknown	3 migrants; 3 unpaired males; 2 pairs; 12 pairs w/ nests	Socorro
DL-09	5	2	4	2	3	1 successful; 2 failed	1 migrant; 2 pairs w/ nests	Socorro
DL-10	4	2	4	2	0	N/A	2 pairs	Socorro
DL-11	12	0	0	0	N/A	N/A	12 migrants	
DL-12	86	37	78	41	53	21 successful; 26 failed; 6 unknown	8 migrants; 4 unpaired males; 4 pairs; 33 pairs w/ nests	
EB-01	38	16	32	16	24	8 successful; 16 failed	6 migrants; 2 pairs; 14 pairs w/ nests	
EB-02	18	0	0	0	N/A	N/A	18 migrants	Socorro
EB-04	12	2	5	3	0	N/A	7 migrants; 1 unpaired male; 1 pair; 1 pair w/ nest	Socorro/Sierra
EB-06	1	0	0	0	N/A	N/A	1 migrant	Sierra
EB-07	47	23	46	23	31	14 successful; 15 failed; 2 unknown	1 migrant; 23 pairs w/ nests	Sierra
EB-08	4	0	0	0	N/A	N/A	4 migrants	Sierra
EB-09	6	1	4	3	0	N/A	2 migrants; 2 unpaired males; 1 pair	Sierra

Site Name	WIFLs Observed[1]	Est. Number of Pairs	Est. Number of *E.t. extimus*[2]	Est. Number of Territories	Nest(s) Found[3]	Nest Success	Comments	County
EB-10	8	3	6	3	2	2 failed	2 migrants; 1 pair; 2 pairs w/ nests	Sierra
EB-13N	3	0	0	0	N/A	N/A	3 migrants	Sierra
EB-13S	14	4	11	7	4	3 successful; 1 unknown	3 migrants; 3 unpaired males; 4 pairs w/ nests	Sierra
EB-14	9	4	8	4	5	2 successful; 2 failed; 1 unknown	1 migrant; 4 pairs w/ nests	Sierra
EB-15	70	34	70	36	44	15 successful; 23 failed; 6 unknown	2 unpaired males; 4 pairs; 30 pairs w/ nests	Sierra
EB-16	70	32	69	37	34	18 successful; 11 failed; 5 unknown	1 migrant; 5 unpaired males; 7 pairs; 25 pairs w/ nests	Sierra
EB-17	14	2	9	7	0	N/A	5 migrants; 5 unpaired males; 2 pairs	Sierra
San Marcial Reach[7] Summary	679	243	536	293	280	103 successful; 144 failed; 33 unknown	143 migrants; 50 unpaired males; 47 pairs; 196 pairs w/ nests	
Middle Rio Grande Summary	**839**	**264**	**590**	**326**	**291**	**106 successful; 145 failed; 40 unknown**	**249 migrants; 62 unpaired males; 57 pairs; 207 pairs w/ nests**	

[1] When a single WIFL responded to the tape playback, and there was no evidence of pairing, it was considered to be an unpaired male.
[2] A resident SWFL is a WIFL documented on or after June 10 that exhibits territorial behavior or for which nesting is confirmed.
[3] A second brood occurs after a SWFL pair has had a successful nesting attempt. A re-nest commonly occurs after an unsuccessful first nesting attempt.
[4] San Acacia Reach = From San Acacia Diversion Dam, downstream to Escondida Bridge
[5] Escondida Reach = From Escondida Bridge, downstream to north boundary of Bosque del Apache NWR
[6] Bosque del Apache Reach = From north boundary of NWR, downstream to southern boundary of NWR.
[7] San Marcial Reach = From railroad trestle, downstream through The Narrows to Elephant Butte Reservoir Pool (Monticello Bay)

Migrant – any WIFL that does not exhibit territorial behavior and is typically detected only during the period prior to June 10th.
Unpaired Male – a resident SWFL that exhibited behavioral characteristics typical of a territorial flycatcher, however breeding was neither suspected nor confirmed
Pair – a SWFL territory where breeding was confirmed or behavioral evidence strongly suggested that pairing had occurred
Pair w/ nest – a SWFL territory where breeding was confirmed by the discovery of an active nest.

Table 3. SWFLs and territories documented for the first time during 4th or 5th surveys during 2019

Survey Site	New SWFLs	New Territories
LF-04	2 (2 unpaired males)	2
BA-05	4 (2 pairs)	2
BA-10	2 (pair)	1
LF-17	5 (1 unpaired male, 2 pairs)	3
LF-17a	1 (unpaired male)	1
LFCC-01	5 (1 unpaired male, 2 pairs)	3
DL-01a	2 (pair)	1
DL-07	2 (pair)	1
DL-12	2 (pair)	1
EB-04	2 (pair)	1
EB-07	8 (4 pairs)	4
EB-10	6 (3 pairs)	3
EB-13S	1 (unpaired male)	1
EB-14	4 (2 pairs)	2
EB-15	12 (6 pairs)	6
EB-16	10 (5 pairs)	5
EB-17	1 (unpaired male)	1

San Acacia Reach

This reach extends downstream from San Acacia Diversion Dam to the Escondida Bridge and encompasses approximately 16 km of riparian corridor. Six sites within this reach (Figure 3) were each surveyed three times. The active floodplain within the San Acacia reach is relatively narrow and constrained by uplands to the east and levees along the LFCC to the west. Habitat within this reach is varied and consists of a mixture of gallery cottonwood (*Populus deltoides*), saltcedar (*Tamarix* sp.) of various ages and structures, and coyote willow (*Salix exigua*) and Russian olive (*Eleagnus angustifolia*) along the river. The recent higher river flows have rejuvenated some of the once drought-stressed willows. However, the highly degraded river channel in this reach largely prevents overbank flooding and limits significant understory growth in many areas. Based on habitat mapping conducted in 2016, the San Acacia reach holds the smallest amount of suitable habitat (516 acres) of the five study reaches (Figure 10). During 2019 surveys, 25 migrant WIFLs were documented within this reach.

Escondida Reach

The active floodplain between the Escondida Bridge and the northern Bosque del Apache NWR boundary comprises this survey reach. It is bounded by the LFCC to the west and upland habitat to the east. The 14 sites in this reach (Figure 4) were each surveyed 5 times. This reach is similar hydrologically - although the river is less incised in areas - and vegetatively to the San Acacia Reach. Habitat is a mixture of cottonwood gallery, saltcedar and other woody shrubs of various heights and densities, and smaller patches of native willows along the river. Nearly 1,100 acres of suitable habitat were mapped in this reach in 2016 (Figure 10; Siegle and Ahlers 2017). Typically, little overbank flooding occurs, although high river flows in 2017 and 2019 flooded many lower lying areas for much of the survey seasons. During the past several years, mortality has been observed in certain patches of willows due to drought conditions. Flooding and/or a higher water table during the past three years reversed some of these trends. Small numbers of resident SWFLs have been documented in this reach since 2002. During 2019 surveys, 55 WIFLs were located including 41 migrants, 4 unpaired male territories and 5 breeding pairs (Table 2).

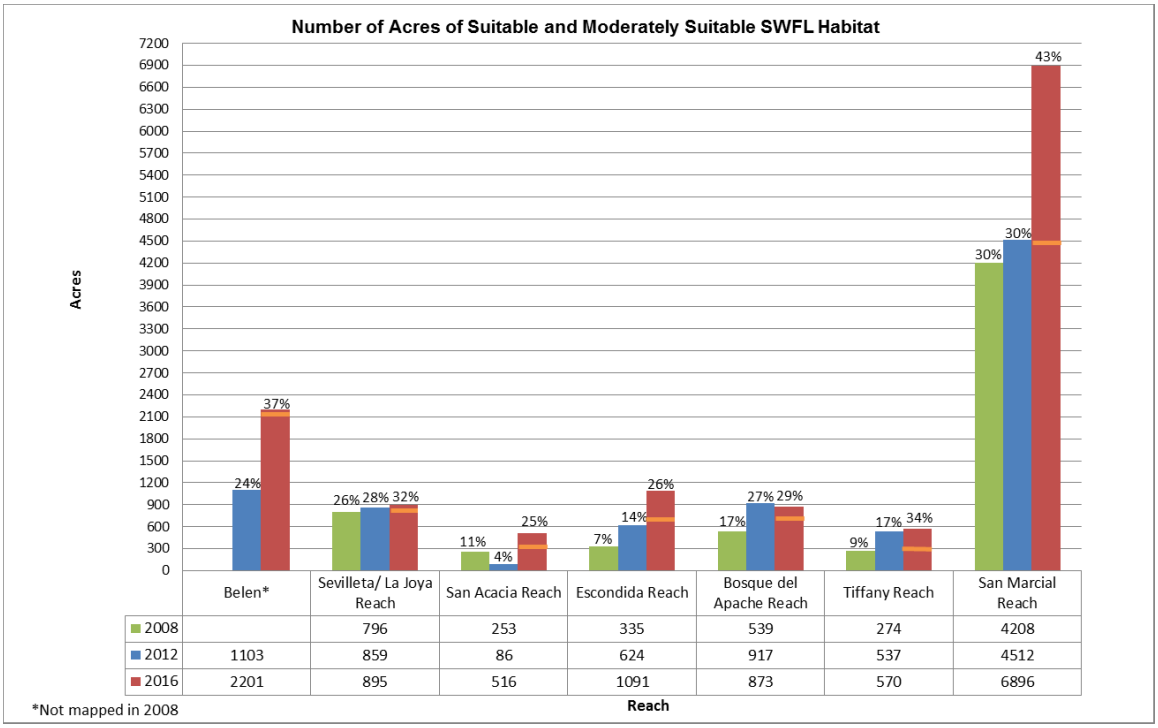


Figure 10. The number of acres of suitable and moderately suitable SWFL habitat mapped in 2008, 2012, and 2016 by river reach along the Middle Rio Grande, New Mexico. The percentage above each column is the percent of total potential habitat acreage within each reach that provided suitable and moderately suitable habitat. All acreage above the orange line in 2016 columns is the number of acres of SC/SC3d and SC4d, vegetation types reclassified to moderately suitable in 2016, within each reach.

Bosque del Apache Reach

This reach encompasses riparian habitat within the active floodplain of the Bosque del Apache NWR. Fourteen sites (Figure 5) were each surveyed five times during 2019. Habitat within this reach varies widely from decadent, dense saltcedar to large, mature cottonwood galleries to dense patches of coyote willow and Russian olive. In 2016, a fire burned through a large portion of the southern extent of this reach. The Rio Grande within the northern portion of this reach is highly aggraded and a sediment plug causes major portions of the active floodplain to be inundated during high flows. Indeed, during the historic river flows experienced during the summer of 2019, most of the floodplain within the Bosque del Apache was under as much as 10 feet of water. The current sediment plug formed in 2008 and flooding of existing habitat increased suitability for breeding SWFLs between 2008 and 2010. Subsequently, multiple years of extreme drought eliminated overbank flooding and drew down the water table. Much of the native component of the occupied habitat in this reach was either severely stressed or died between 2010 and 2013. Recently, however, with higher than average river flows, the native vegetation has begun to recover in certain areas. A total of 873 acres of suitable SWFL habitat was mapped within this reach in 2016 (Figure 10; Siegle and Ahlers 2017). During 2019, 80 WIFLs, including 40 migrants, 8 unpaired male SWFLs, and 16 pairs were detected in this reach (Table 2).

Tiffany Reach

The Tiffany Reach extends from the southern boundary of the Bosque del Apache NWR to the northern boundary of Elephant Butte Project Lands (i.e. San Marcial railroad trestle) and encompasses

riparian habitat both within and outside the active floodplain of the Rio Grande (Figure 6). Most of the habitat in this reach was burned by the Tiffany Fire in 2017. Because of the fire and lack of habitat, only remnant patches of suitable habitat were surveyed and most sites were excluded from surveys entirely. Prior to the fire, vegetation in this reach consisted primarily of various age classes of saltcedar with occasional patches of Russian olive and native willows and cottonwoods, particularly near the river. A large, dry marsh also exists at the foot of Black Mesa, upstream from the railroad trestle. Portions of this reach receive overbank flooding during high river flows and a sediment plug in the southern end of this reach in both 2005 and 2008 forced river water through habitat in the southern end. No WIFLs were recorded during surveys in this reach in 2019.

San Marcial Reach

This reach is the longest survey reach in the study area (52 km – 32 miles) and contains the most survey sites and SWFL territories. The length of this reach has more than tripled since 1995 when surveys began. The gradual recession of Elephant Butte Reservoir between 1998 and 2003 exposed an additional 34 km (21 miles) of survey area. The reach extends from the north boundary of Elephant Butte Project Lands (i.e., San Marcial railroad trestle) downstream through the delta of Elephant Butte Reservoir. It encompasses 61 sites (Figures 7 through 9), both inside and outside the active floodplain. While these sites are typically surveyed five times each for project compliance, the Tiffany Fire burned several sites in the upstream end of this reach (Sites LF-10 to 13) and these sites were not surveyed. Habitat in this reach consists of some of the best native SWFL habitat within the subspecies' range. A total of 6,896 acres of suitable habitat was mapped in this reach in 2016 (Figure 10; Siegle and Ahlers 2017) – by far the highest total of any study reach. Vast expanses of native Goodding's willow (*Salix gooddingii*) and coyote willow habitat formed in the conservation pool of Elephant Butte Reservoir as the reservoir receded during the late 1990's and early 2000's. This habitat, located primarily on the west side of the floodplain, is irrigated by the LFCC outfall which filters through the interspersed patches of willow, saltcedar, and cattail (*Typha* sp.) marsh. River channel degradation through the San Marcial Reach in 2005 lowered the water table in this reach which negatively impacted suitable SWFL habitat. More recently, prolonged drought had impacted high quality habitat within the Elephant Butte Reservoir pool and allowed saltcedar to invade many patches of formerly native habitat. However, the wet years of 2017 and 2019 (Figure 11) reversed some of the drought impacts and promoted the expansion of many patches of willows within the reservoir pool. Smaller patches of high quality habitat have also developed outside the reservoir pool during the past several years. During 2019 surveys, 679 WIFLs, including 143 migrants, 50 unpaired males, and 243 pairs were recorded in the San Marcial reach (Table 2). This reach continues to contain one of the largest breeding populations within the SWFL's range.

Nest Searches/Monitoring

In 2019, including nests in surveyed sites plus 16 nests monitored for a *Diorhabda* study outside the 2019 survey extent, 307 nests were monitored within the Middle Rio Grande. Of these, 112 nests were successful, while 152 failed, and the outcome of 43 nests was unknown. An estimated 295 SWFL young fledged during the 2019 breeding season. Documented nesting attempts confirmed the existence of 217 pairs; 58 additional pairs were observed and, although nesting was suspected, nests were not located in any of these territories. Successful nests include those which fledged young or supported chicks at least eight days old on the last nest visit and every effort was made to monitor nests until nestlings were at least ten days old.

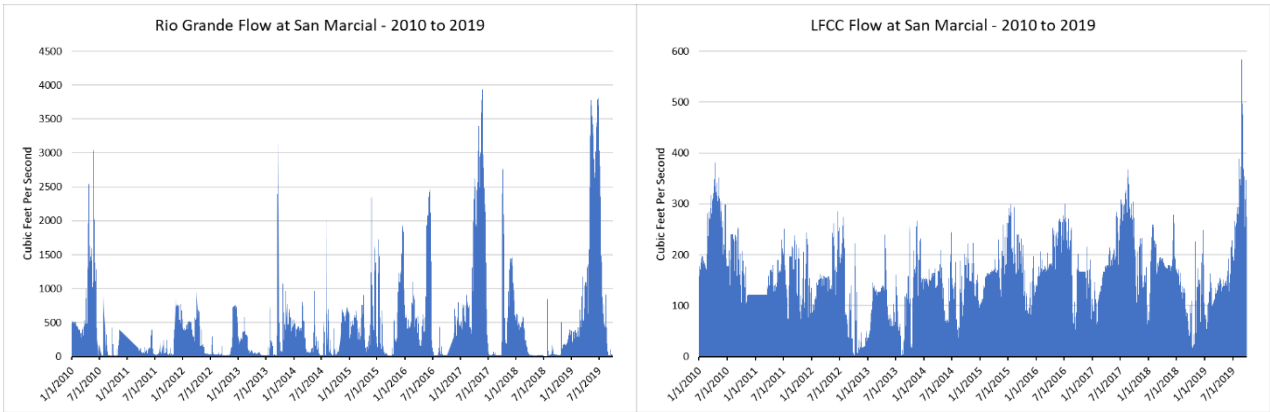


Figure 11. Flows within the Rio Grande and Low Flow Conveyance Channel at San Marcial between 2010 and 2019. Note the lower flows between 2011 and 2015 and the higher flows experienced in 2017 and 2019.

The following is a reach-by-reach summary of SWFL nest monitoring within 2019 survey sites. It is important to note that the number of nests found per site or reach should not be used as a direct measure of breeding activity. Although every reasonable effort was made to locate the nests of breeding pairs, the availability of qualified personnel and logistics limited the extent of nest searching in some areas. The number of territories found within each reach or site should be used in lieu of nests. See Appendix B for detailed nest record data.

Escondida Reach

Only a handful of unpaired male territories were documented in this reach prior to 2011. Habitat quality has slowly increased during the past eight years as river bars and islands formed and dense stands of coyote willow established. Additionally, the small SWFL populations within both the Belen and Bosque del Apache Reaches have acted as source populations for sites in the Escondida Reach. Nesting was first documented in this reach during 2012 when eight pairs and six nests were located. Pair and nest abundance have fluctuated during the past eight years; in 2019 five pairs produced four nests in this reach, all within site LF-43b.

Bosque del Apache Reach

Since the first SWFL nest was documented in this reach in 2003, territories and associated nest numbers increased until 2012, when numbers began to decline (Table 4). The increase was due in large part to a drastic improvement in habitat quality and quantity stimulated by overbank flooding from the sediment plug which formed in 2008. Nest abundance increased from a single nest in 2003 to a high of 38 documented in 2012. Due to habitat degradation caused by the recent drought, nest success and, consequently, nesting pair abundance began a precipitous decline in 2012 which continued through 2015. Recently, habitat and the number of nesting pairs have begun to rebound. Unfortunately, widespread flooding in the reach limited access and the ability to regularly search for and monitor nests in 2019. Thus, of the 16 pairs documented in 2019, nests were found for only 7 and all nest fates were unknown.

Table 4. Summary of SWFL nest monitoring (2003 to 2019) – Bosque del Apache NWR

Year	# Territories	# Pairs	# Nests found*	# Nests parasitized (%)**	# Nests depredated (%)**	# Nests abandoned (%)**	Unknown success	# Successful nests (%)	Estimated total # chicks fledged	Estimated productivity (# chicks per successful nest)
2003	3	1	1	0	0	0	0	1 (100%)	1	1.0
2004	1	1	2	1 (50%)	1 (50%)	0	0	1 (50%)	3	3.0
2005	0	0	0	0	0	0	0	0	0	0
2006	4	1	1	0	1(100%)	0	0	0	0	0
2007	7	6	1	0	0	0	1	0	0	0
2008	5	3	2	0	0	0	2	0	0	0
2009	20	16	19	1 (6%)	5 (28%)	1 (6%)	1	11 (61%)	28	2.3
2010	34	22	25	1 (4%)	8 (35%)	1 (4%)	2	14 (61%)	38	2.7
2011	49	30	34	4 (12%)	15 (44%)	3 (9%)	0	12 (35%)	32	2.7
2012	51	29	38	10 (28%)	19 (53%)	1 (3%)	2	9 (25%)	22	2.4
2013	27	19	20	7 (35%)	11 (55%)	0	0	4 (25%)	11	2.8
2014	23	13	17	2 (13%)	8 (53%)	1 (7%)	2	4 (27%)	9	2.3
2015	11	6	5	1 (50%)	0	0	3	2 (100%)	6	3.0
2016	17	13	1	n/a	n/a	n/a	1	n/a	n/a	n/a
2017	16	11	16	4 (27%)	7 (47%)	1 (7%)	1	5 (33%)	12	2.4
2018	24	21	22	3 (15%)	10 (50%)	2 (10%)	2	6 (30%)	11	1.8
2019	24	16	7	n/a	n/a	n/a	7	n/a	n/a	n/a
Total	319	208	211	34 (18%)	85 (45%)	10 (5%)	24	69 (37%)	173	2.5

Unknowns not included in nest variable calculation.
* Some pairs re-nested after failed attempt or attempted a second, third, or fourth brood.
** Some nests were parasitized, depredated, and/or abandoned.

Tiffany Reach

With the exception of 2004, when 11 nests were documented, the number of SWFL nests located within this reach has been limited and sporadic. Nest numbers fluctuated between zero and four from 2005 to 2010 and nesting has not been documented since 2010. A total of 19 nests have been monitored in this reach since 2004 and overall nesting success was relatively high (65 percent). As nearly all habitat in the reach burned in the 2017 Tiffany Fire, no territories or nesting was documented in this reach in 2019.

San Marcial Reach

A total of 243 pairs and 280 nests (including renests and second broods) were documented within this reach in 2019 (Table 5). The majority – 216 pairs and 244 nests - are located within the conservation pool of Elephant Butte Reservoir. This population, after experiencing huge increases since its discovery

Table 5. Summary of SWFL nest monitoring in the San Marcial Reach (1996 to 2019)

Year	# Territories	# Pairs (% of total territories)	# Nests found*	# Nests parasitized (%)**	# Nests depredated (%)**	# Nests abandoned (%)**	Unknown success	# Successful nests (%)	Estimated total # chicks fledged	Estimated productivity (# chicks per successful nest)
1996	13	1 (8%)	1	0	0	1 (100%)	---	0	0	---
1997	10	3 (30%)	2	0	0	0	0	2 (100%)	4	2.0
1998	11	4 (36%)	2	0	0	0	0	2 (100%)	7	3.5
1999	12	5 (42%)	5	1 (20%)	0	1 (20%)	0	4 (80%)	10	2.5
2000	23	20 (87%)	19	2 (12%)	1 (6%)	2 (12%)	2	14 (82%)	29	2.1
2001	25	25 (100%)	36	0	7 (19%)	2 (6%)	0	27 (75%)	79	2.9
2002	60	50 (83%)	66	11 (17%)	19 (29%)	6 (9%)	0	36 (55%)	86	2.4
2003	82	67 (82%)	96	17 (18%)	31 (33%)	13 (14%)	3	48 (52%)	126	2.6
2004	113	92 (81%)	153	25 (17%)	48 (32%)	15 (10%)	4	71 (48%)	187	2.6
2005	107	77 (72%)	127	16 (13%)	37 (31%)	7 (6%)	7	68 (57%)	197	2.9
2006	142	117 (82%)	148	15 (10%)	47 (33%)	11 (8%)	4	83 (58%)	213	2.6
2007	197	153 (78%)	220	29 (14%)	40 (19%)	31 (15%)	10	117 (56%)	320	2.7
2008	235	168 (71%)	186	5 (3%)	56 (34%)	16 (10%)	23	87 (53%)	209	2.4
2009	319	224 (70%)	294	37 (14%)	90 (33%)	26 (10%)	21	129 (47%)	356	2.8
2010	298	235 (79%)	241	23 (10%)	110 (50%)	14 (6%)	20	82 (37%)	202	2.5
2011	318	237 (75%)	240	48 (23%)	80 (38%)	9 (4%)	30	92 (44%)	208	2.3
2012	252	181 (72%)	223	30 (14%)	106 (51%)	12 (6%)	16	65 (31%)	153	2.4
2013	266	182 (68%)	173	20 (13%)	78 (49%)	1 (1%)	13	72 (45%)	164	2.3
2014	307	205 (67%)	255	28 (12%)	142 (62%)	8 (4%)	27	58 (25%)	151	2.6
2015	300	224 (75%)	287	35 (13%)	130 (50%)	10 (4%)	25	100 (38%)	272	2.7
2016	303	209 (69%)	256	21 (10%)	102 (47%)	20 (9%)	38	87 (42%)	238	2.7
2017	257	223 (87%)	298	28 (11%)	161 (63%)	13 (5%)	41	63 (25%)	158	2.5
2018	277	240 (87%)	315	23 (8%)	113 (39%)	23 (8%)	24	139 (48%)	330	2.4
2019	293	243 (83%)	280	6 (2%)	131 (53%)	6 (2%)	33	103 (42%)	272	2.6
Total	4220	3185 (75%)	3923	420 (12%)	1530 (43%)	247 (7%)	341	1549 (43%)	3971	2.6

Unknowns not included in nest variable calculation.

* Some pairs re-nested after failed attempt or attempted a second, third, or fourth brood.

** Some nests were parasitized, depredated, and/or abandoned.

in 1996, has levelled off. Pair numbers experienced a decline following the peaks documented in 2010 and 2011 but have rebounded recently with 2019 numbers being the highest in the 24 years that nesting has been tracked in the San Marcial reach. Nest numbers have also fluctuated since 2010 and in 2018 the highest nest count to date (315) was recorded in this reach. Nesting activity was confirmed

for 196 pairs and, while the remaining 47 pairs likely nested, nests were not found. Fledging of SWFL young occurred in 103 of the 247 nests with known outcomes, for an overall nest success rate of 42 percent. Nest depredation was higher than average in 2019 (53 percent). However, BHCO parasitism and abandonment rates were both very low (2 percent). A total of 272 SWFLs were assumed to have fledged from this reach in 2019.

Hydrology Monitoring

To investigate microscale impacts of hydrology on SWFL reproduction, hydrology data were compared to SWFL nest variables (i.e., success, productivity, depredation, and BHCO parasitism). During 2019, 96 percent of nests with known outcomes (n = 264) were within 100 m of surface water and 89 percent were within 50 m of surface water. Although nests closer to water appeared to be less successful, we found no significant difference (Page A3). However, successful nests that were less than 50 m from water were more productive (2.7 fledglings per nest) than those greater than 50 m from water (2.2 fledglings per nest - Page A4). Four classes were used to analyze nesting variables based on hydrology immediately under each nest: dry all season, saturated/flooded then dry, saturated all season, and flooded all season (a subset of saturated all season). Being that 2019 was a relatively wet year, 36 percent of Middle Rio Grande nests were above dry ground the entire nest cycle, 3 percent were saturated or flooded then dried, 61 percent were above saturated soil the entire nest cycle, and 40 percent were above flooded conditions (n=264). Nests that were dry all cycle were more successful than those above saturated soil or flooded conditions. However, there was no difference in depredation rates based on hydrologic conditions under the nest.

Discussion

Presence/Absence Surveys

Overview of Middle Rio Grande Surveys

As shown in Figure 12 and Table 6, the number of SWFL territories within Reclamation survey sites has dramatically increased since 1999. The vast majority of these territories (74 percent) have been found within the exposed pool of Elephant Butte Reservoir. Suitable SWFL habitat developed within the exposed reservoir pool in conjunction with the receding reservoir from the late-1990s to 2005 (Figure 13). This habitat continued to develop into the largest expanse of suitable native SWFL habitat in the range of the subspecies. As of the 2016 habitat mapping/modeling effort (Siegle and Ahlers 2017), nearly 7,000 acres of suitable and moderately suitable habitat were located within the San Marcial Reach, most of which is in the conservation pool of Elephant Butte Reservoir. However, in recent years, much of the suitable habitat in the reservoir pool as well as that upstream of the reservoir has declined in quality. Adverse changes due to an incised river channel, prolonged flooding, and drought have all contributed to reduced habitat quality.

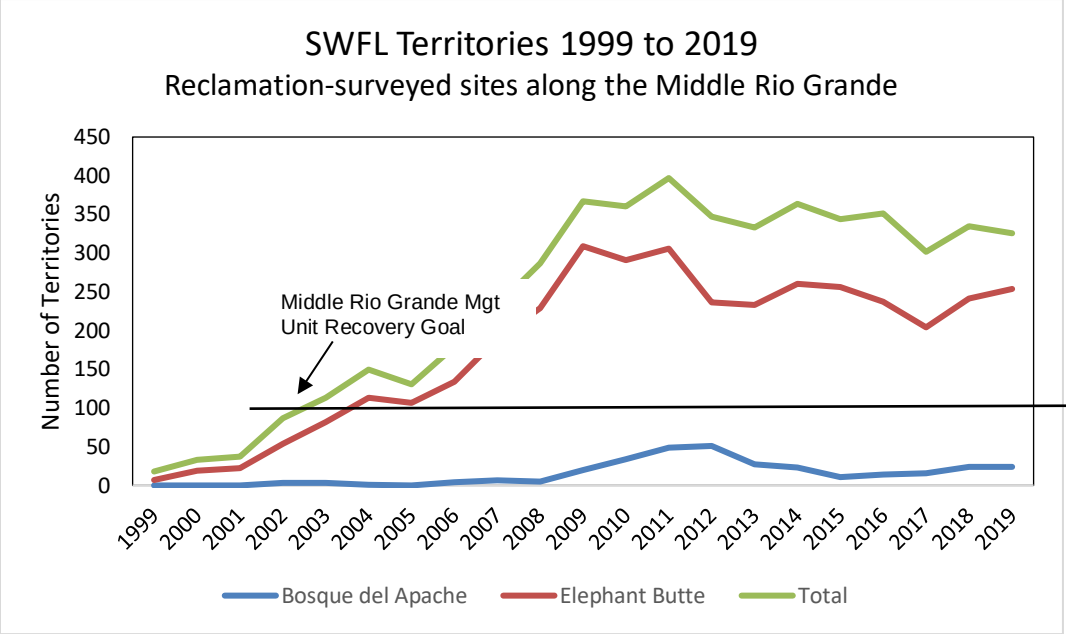


Figure 12. Overview of SWFL territories within the Middle Rio Grande – 1999 to 2019.

Many historically occupied patches of suitable native habitat have transitioned into a mixed community of native willows and exotic saltcedar during the past 12 years. Others slowly converted to cattail marsh due to prolonged flooding. Both of these situations can reduce the structure and density of suitable

SWFL habitat, making it less attractive to breeding SWFLs. Other smaller patches of suitable habitat have also developed within various reaches of the study area. Typically, these other patches were on low

Table 6. Reach summary of SWFL territories/pairs within the active floodplain of the Rio Grande surveyed by Reclamation between 1995 and 2019

Reach	1995	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005	2006	2007
Belen	n/s	n/s	n/s	n/s	n/s	n/s	n/s	1 T 0 P	n/s	0	4 T 1 P	1 T 0 P	10 T 1 P
Sevilleta/ La Joya	n/s	n/s	n/s	n/s	4 T 4 P	8 T 5 P	11 T 10 P	13 T 10 P	17 T 9 P	19 T 18 P	17 T 10 P	21 T 15 P	14 T 8 P
San Acacia	n/s	0	0	0	0	0	0	0	0	0	0	0	0
Escondida	n/s	n/s	0	0	0	0	0	4 T 0 P	0	0	0	1 T 0 P	0
Bosque del Apache	n/s	n/s	n/s	1 T 0 P	0	0	0	3 T 0 P	3 T 1 P	1 T 1 P	0	4 T 1 P	7 T 6 P
Tiffany[1]	11 T 7 P	4 T 0 P	n/s	n/s	n/s	n/s	n/s	3 T 2 P	4 T 3 P	16 T 13 P	3 T 2 P	9 T 2 P	4 T 3 P
San Marcial[2]	3 T 0 P	13 T 3 P	10 T 4 P	11 T 4 P	12 T 5 P	23 T 20 P	25 T 25 P	63 T 52 P	86 T 70 P	113 T 92 P	107 T 77 P	142 T 117 P	197 T 153 P
Total	14 T 7 P	17 T 3 P	10 T 4 P	12 T 4 P	16 T 9 P	31 T 25 P	36 T 35 P	87 T 64 P	110 T 83 P	149 T 124 P	131 T 90 P	178 T 135 P	232 T 171 P

Reach	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019
Belen	4 T 1 P	3 T 3 P	6 T 4 P	9 T 4 P	14 T 9P	23 T 17 P	18 T 16 P	17 T 16 P	20 T 13 P	17 T 16 P	20 T 17 P	n/s
Sevilleta/ La Joya	31 T 18 P	18 T 14 P	13 T 9 P	9 T 7 P	6 T 5 P	4 T 4 P	4 T 0 P	8 T 0 P	5 T 4 P	4 T 3 P	12 T 7 P	n/s
San Acacia	2 T 0 P	1 T 0 P	0	0	0	0	0	0	0	0	0	0
Escondida	1 T 0 P	0	4 T 0 P	8 T 2 P	23 T 8 P	8 T 5 P	4 T 0 P	7 T 1 P	5 T 4 P	8 T 6 P	4 T 4 P	9 T 5 P
Bosque del Apache	5 T 3 P	20T 16 P	34 T 22 P	49 T 30 P	51 T 29 P	27 T 19 P	23 T 13 P	11 T 6 P	17 T 13 P	16 T 11 P	24 T 21 P	24 T 16 P
Tiffany[1]	8 T 3 P	5 T 4 P	5 T 2 P	4 T 0 P	1 T 0 P	4 T 0 P	8 T 0 P	1 T 0 P	5 T 2 P	0	0	0
San Marcial[2]	235 T 168 P	319 T 224 P	298 T 235 P	318 T 237 P	252 T 181 P	266 T 182 P	307 T 205 P	300 T 224 P	303 T 209 P	257 T 223 P	277 T 240 P	293 T 243 P
Total	286 T 193 P	366 T 261 P	360 T 272 P	397 T 280 P	347 T 232 P	332 T 227 P	364 T 234 P	344 T 247 P	355 T 245 P	302 T 259 P	337 T 289 P	326 T 264 P

n/s = not surveyed, T = territory, P = pair.

[1] Survey results from 1995 and 1996 in the Tiffany Reach are a combination of Reclamation and NMNHP surveys. The Tiffany Reach, with the exception of sites LF-21 and LF-22 (surveyed in 2002 and 2003), was not surveyed during the years 1997-2003.

[2] The San Marcial Reach includes all sites below the railroad bridge including the active flood plain and sites LFCC-1 through LFCC-7, outside the active flood plain.

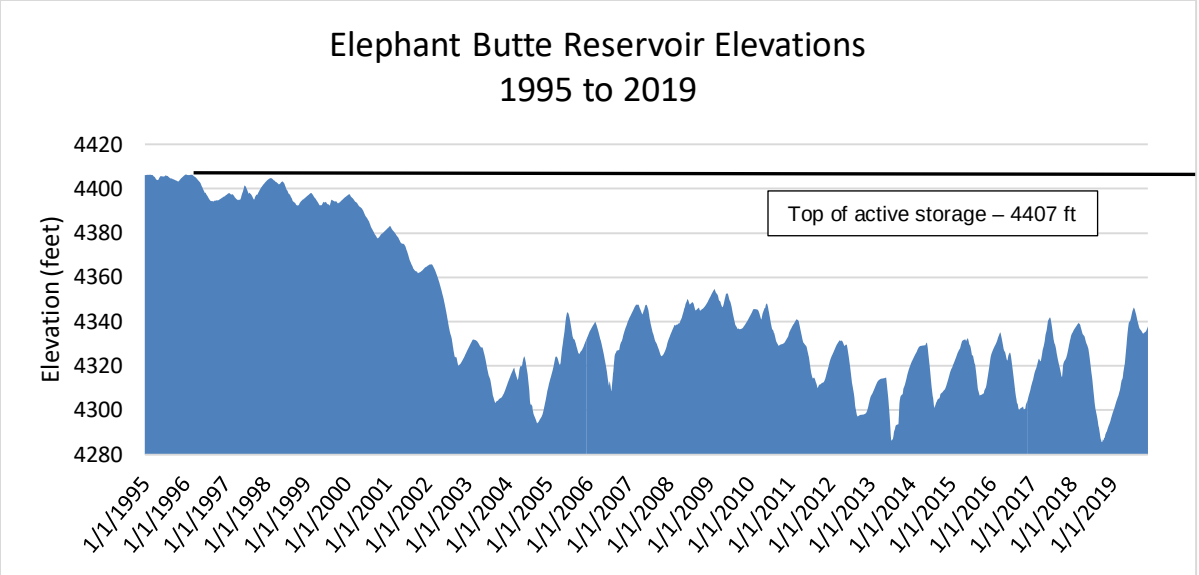


Figure 13. Elephant Butte Reservoir elevations – 1995 to 2019.

lying terraces immediately adjacent to the Rio Grande that were subject to overbank flooding during high flow periods. One such area was aided by the sediment plug which formed at River Mile 82 in the Bosque del Apache Reach, forcing river water onto the adjacent floodplain and attracting a relatively large population of nesting SWFLs between 2009 and 2012. This habitat declined in quality between 2012 and 2015 due to drought but has begun to recover.

During the last nine years, a breeding population of SWFLs has developed in suitable habitat in the Belen Reach. This population appears to have stabilized at approximately 20 territories, however, the reach was not surveyed in 2019. Additionally, a new sub-population of SWFLs has recently emerged within the LFCC sites in the San Marcial reach. These territories occupy habitat ranging from nearly monotypic saltcedar to willow-dominated and are outside the active Rio Grande floodplain. In 2019, 39 territories were recorded in these sites. Lastly, during the past six years, a large population of SWFLs has established downstream of The Narrows of Elephant Butte Reservoir – 80 territories were located in this area in 2019. This habitat is most directly influenced by a rising and falling reservoir and many of these territories have been in deeply flooded habitat periodically during the past three years. This pattern of habitat creation and loss, and the flycatcher's ability to follow the movement of suitable habitat, is how the species has been able to persist in the ephemeral systems of the desert Southwest.

The SWFL recovery plan (USFWS 2002) established a recovery goal of 100 territories for the Middle Rio Grande Management Unit which is one of six Management Units within the larger Rio Grande Recovery Unit. This goal was achieved in 2003 and has been exceeded every year since. In 2019, 326 SWFL territories were documented within Reclamation surveyed sites along the Middle Rio Grande. The remaining portion of this section discusses the number, trends, and distribution of SWFL territories within each of the surveyed reaches since surveys were initiated.

San Acacia Reach

Habitat in this reach is dominated by dry, decadent exotic vegetation in the form of saltcedar and Russian olive with an occasional cottonwood overstory. Quality SWFL habitat within this reach is very limited – only 516 acres were mapped in 2016 (Siegle and Ahlers 2017) - and composed of small patches

of native vegetation along the river channel. Very little overbank flooding occurs due to the degraded nature of the river channel. Sporadic high river flows during the past several years combined with the formation of river bars and lower terraces have resulted in reestablishment of riparian vegetation, both native and exotic, along these bars and terraces. In 2008, two SWFL territories within this reach were discovered, which were the first documented since surveys began in 1996 (Table 6). In 2009, a single unpaired male was found on June 13th and again on June 23rd at the same location. Pairing was not confirmed, and the territory was designated as that of an unpaired male. No territorial SWFLs have been documented in this reach since. Due to the limited amount of suitable habitat within this reach, it is unlikely that a substantial number of SWFL territories will become established here in the near future.

Escondida Reach

Habitat within this reach is similar to that in the San Acacia Reach. However, the river channel is less incised in many areas and quality habitat has increased in abundance during the past eight years (Figure 10; Siegle and Ahlers 2017). The majority of habitat is sparse exotic vegetation in the form of saltcedar and Russian olive with an occasional overstory of cottonwood. Suitable SWFL habitat exists adjacent to the river and on recently formed river bars. This reach of the river, aside from lower terraces and river bars, seldom receives any overbank flooding. Small numbers of resident SWFLs have been documented in this reach since 2002 (Table 6). Between 2011 and 2013, a small breeding population of SWFLs emerged in the lower portion of this reach, adjacent to the Bosque del Apache NWR. This population was likely supported by the relatively large source population established in the Bosque del Apache NWR during those years. However, during 2014 and 2015, this small population decreased in size as only a single breeding pair and several scattered territories were recorded in this reach. This occurred coincidentally with the reduction in territories in the Bosque del Apache Reach. Between 2016 and 2019, a handful of territories and breeding pairs were again documented annually within the downstream sites in the Escondida Reach.

Bosque del Apache Reach

SWFL territories within the active floodplain of the Bosque del Apache NWR were few in number and broadly distributed throughout the reach during the 2002 to 2008 period (Table 6). The number of SWFL territories for this seven-year period ranged annually from zero to seven. However, from 2009 through 2012, the number of SWFL territories dramatically increased (Table 6). As predicted in the 2008 report (Moore and Ahlers 2009: "Flooding in 2007 and 2008 will likely promote development of higher quality SWFL habitat and it will be interesting to see if larger populations develop in this reach"), the attractiveness of habitat did improve due to overbank flooding and the SWFLs responded accordingly. The 51 territories documented in 2012 were second only to the San Marcial Reach in terms of abundance. This relatively large local population likely benefitted adjacent reaches by serving as a source population for colonization of developing suitable habitat.

As noted in previous sections, overbank flooding and the formation of the sediment plug in 2008 were largely responsible for increasing habitat suitability within this reach. This, in combination with the high levels of nest success observed in both 2009 and 2010, promoted the explosive growth of this SWFL population (Table 6). Conversely, drought conditions experienced between 2012 and 2016 severely impacted habitat quality, and consequently nest success, within this reach. Many of the occupied habitat patches have shown signs of extreme water stress and most of the younger age cottonwoods and willows either did not entirely leaf out or died altogether. This reduction in habitat suitability prompted returning birds to relocate during the past several years as evidenced by the large reduction in SWFL territories. During 2017 and 2019, however, high flows and the sediment plug again forced water onto

the floodplain within most of this reach. This seems to have rejuvenated native habitat. Additionally, Reclamation has initiated a river realignment project to reduce maintenance by bypassing the sediment plug and relocating the river channel to the east. Construction of the realignment will be completed during the winter of 2019/2020. All of the above factors will undoubtedly affect the SWFL population in this reach into the future.

Tiffany Reach

When formal SWFL surveys began in the Middle Rio Grande in 1995, this reach contained the largest documented population of breeding SWFLs (11 territories including 7 pairs - referred to as the "Condo Site" – NMNHP 1995). Surveys were suspended in 1996 and the reach was not surveyed in its entirety again until 2004 when 16 territories, including 13 pairs, were documented. Since then, the population has fluctuated between one and nine territories and no breeding has been documented since 2010 (Table 6). The reason for this decrease is unclear since the suitability of habitat had not declined until the Tiffany Fire burned the entire Tiffany Reach in 2017 (570 acres of suitable habitat were recorded in this reach in 2016). The future of the reach depends on the regeneration of habitat that occurs. However, given the severity of the burn, it is highly unlikely that a substantial SWFL population will establish in the near future.

San Marcial Reach

SWFL surveys in this reach began in 1995 (Table 6). For the following 14 years, the SWFL population increased dramatically (Figure 14). Since 2000, a majority of these SWFL territories have occurred in the exposed conservation pool of Elephant Butte Reservoir. As reservoir levels decreased during the late-1990s and early-2000s (Figure 13), vast expanses of primarily native habitat developed on the western side of the floodplain. This habitat consisted of dense Goodding's and coyote willow of various age classes and was provided with water by the LFCC outfall. SWFLs first occupied suitable habitat in the uppermost reaches of the reservoir (sites LF-17 and LF-17a) and expanded downstream as habitat became suitable. During this same period, channel degradation and lower flows within the Rio Grande caused habitat upstream of the reservoir pool in the San Marcial Reach to decline in quality. Due to these factors, the vast majority of SWFL territories in this reach, and the study area as a whole, are found within the exposed reservoir pool.

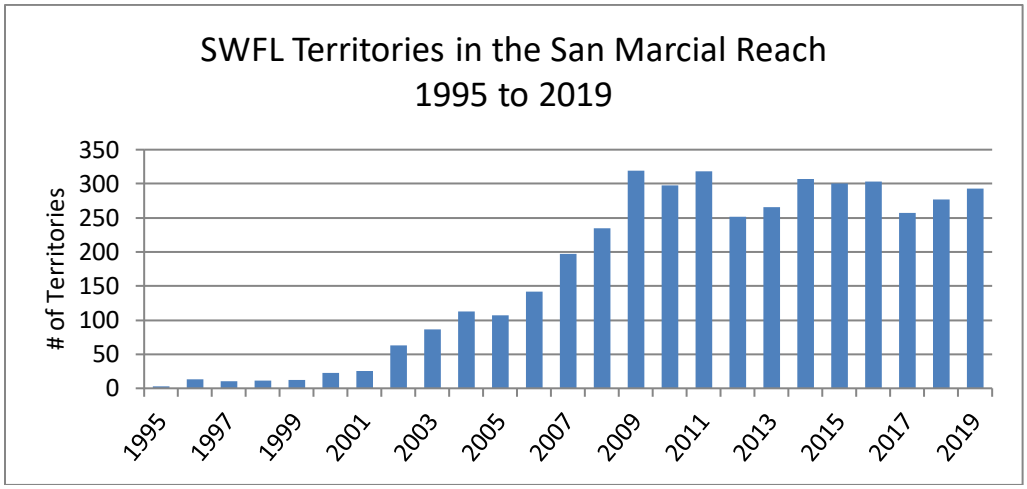


Figure 14. SWFL territories within the San Marcial Reach – 1995 to 2019.

Currently, the oldest age classes of suitable habitat in the upper reservoir pool have deteriorated in quality during the past several years. A combination of prolonged flooding, natural succession, and drought (Figures 11 and 15) has led to a die-off of willows and encroachment by less suitable vegetation including saltcedar and cattails. Conversely, water from the LFCC outfall has shifted east as sedimentation has aggraded the surrounding area, increasing habitat quality in these more easterly areas. However, an overall decline in habitat quality has caused the SWFL population in the upper reservoir pool to either move into adjacent, potentially less suitable habitat or occupy other reaches of the Rio Grande. This decline in habitat quality and shift to more marginal habitat has halted the dramatic growth observed in this population between 2001 and 2009.

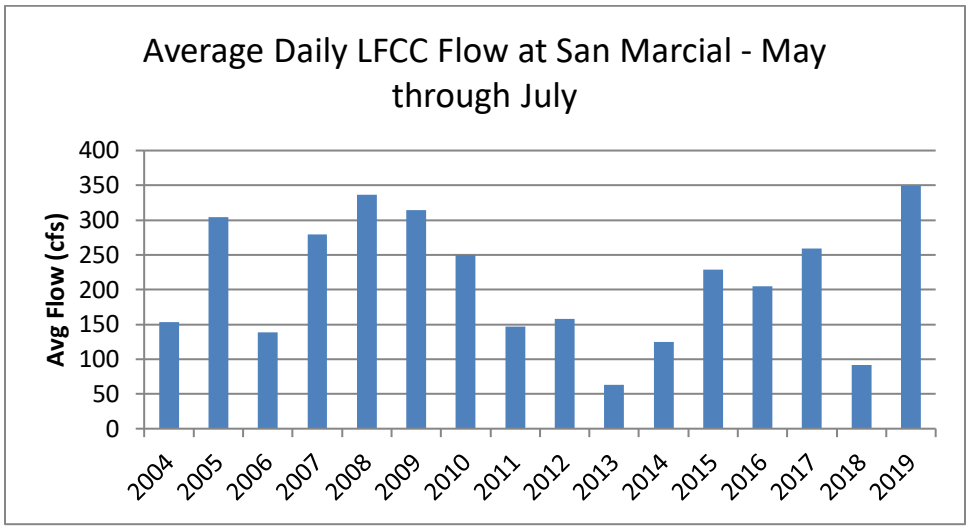


Figure 15. Average daily LFCC flow at San Marcial during the SWFL breeding season.

Conversely, a large proportion of the developing habitat within the three southern-most survey sites – EB-15, 16 and 17 – which is supported by a shallow water table and fluctuating reservoir level, is comprised of native willow and is healthy and vigorous. The population in these three sites first established in 2010 and 2011, when one and five territories were located, respectively. During 2019, 80 territories were located, and currently this habitat is some of the highest quality habitat found in the study area. This localized population is likely to expand as additional habitat becomes available and will represent a valuable source population for the San Marcial Reach and beyond. Conversely, this population, being the furthest downstream, is also the most susceptible to habitat loss from a rising reservoir, just as several territories were displaced in 2019 as reservoir levels flooded habitat in late-June and early July.

Habitat mapping/modeling conducted in 2016 documented a 2,384 acre increase in suitable habitat within the San Marcial Reach compared to 2012 (Figure 10). However, two new classes of monotypic saltcedar habitat were added to the moderately suitable habitat class based on their usage by breeding SWFLs between 2014 and 2016 (Siegle and Ahlers 2017). Without these classes, suitable acreages in the San Marcial reach were roughly equal in 2012 and 2016. However, as noted above, drought, the increased presence of exotic saltcedar, the age of many of these native stands, and the 2017 Tiffany Fire have decreased the quantity and suitability of habitat, although not enough to be reclassified as unsuitable. A slight decrease in habitat suitability is enough to halt the rapid growth exhibited by this population between 2000 and 2009. Conversely, two years of above average river flows (2017 and 2019) have rejuvenated and expanded many patches of willows and territory numbers are now on an upswing

(Figure 14). Surveys and another round of habitat mapping to be completed in 2020, will determine if these improvements are enough to promote further increases in territory numbers and suitable habitat.

Lastly, much consideration has been given to the potential detrimental effects of a rising reservoir pool on this population of SWFLs. In fact, several territories in EB-16 and EB-17 were likely displaced by rising reservoir levels in 2019. During the past 10 years, SWFLs have moved farther into the exposed pool of Elephant Butte Reservoir (see figures in Attachment – Pages A-22 to A-28) and the sub-population in sites EB-15 through 17 would be most highly impacted and likely displaced if reservoir levels were to rise significantly. However, it is also likely that not only within the reservoir pool, but within the Middle Rio Grande as a whole, a stagnant reservoir could be far more detrimental to the SWFL population. During the past 10 years, prolonged drought conditions and reduced flows in both the river and LFCC have prevented irrigation of habitat via flooding. This has reduced habitat vigor and density, and promoted encroachment of exotics like saltcedar. Within the reservoir itself, the dynamics of a rising and falling pool would cause habitat to be created and destroyed. It is this type of dynamic system that SWFLs depend on for breeding habitat. From year to year there may be net gains and losses of habitat, but as a whole this habitat could persist and provide highly suitable SWFL habitat for a large source population. Reclamation is currently modeling impacts of a rising reservoir on SWFL habitat and territories within the Elephant Butte Reservoir pool. Results of this study will be available in early 2020 (Siegle, Dillon, and Moore 2020).

Nest Searches/Monitoring

Overview of Middle Rio Grande Nest Monitoring

During the 2019 SWFL breeding season a total of 307 nests (264 with known outcomes) were monitored within the Middle Rio Grande Study Area (Table 7). A total of 4,079 nests with known outcomes have been monitored since 1999 (Table 8). As shown in Figure 16, nest success declined drastically to 25 percent in 2017 – the lowest rate in the history of this study – but has recovered the past two years. Nest success declined due to the increase in depredation rates which is presumably a factor of decreasing habitat quality. Nest success rates above 50 percent usually led to growth of the Middle Rio Grande SWFL population. Rates below 50 percent have caused population growth to level off and, in certain years, territory numbers have decreased.

Table 7. Summary of 2019 SWFL nesting parameters within the Middle Rio Grande

General Nest Data 2019		
Parasitism Rate 3% (7 out of 264 nests)		
Depredation Rate 51% (135 out of 264 nests)		
Abandonment Rate 3% (9 out of 264 nests)		
Nest Success 43% (112 out of 264 nests)		
Territory Vegetation Type		
Number of nests in exotic-dominated territories	61	23% of total
Number of nests in *Salix*-dominated territories	92	35% of total
Number of nests in mixed dominance territories	111	42% of total
Nest Substrate Species		
Number of nests in *Salix* substrate	86	33% of total
Number of nests in saltcedar substrate	176	67% of total
Number of nests in Russian olive substrate	1	<1% of total
Nest Substrate/Territory Vegetation Combination		
Number of nests in saltcedar substrate within *Salix*-dominated territories	10	(11% of 92 nests)

Number of nests in *Salix* substrate within exotic or mixed dominance territories	4	(2% of 172 nests)
Nest Success Per Nest Substrate Species		
Percentage of successful nests in *Salix* substrate	37%	(32 out of 86 nests)
Percentage of successful nests in saltcedar substrate	46%	(80 out of 176 nests)
Nest Success Per Territory Vegetation Type		
Percentage of successful nests in *Salix*-dominated territories	37%	(34 out of 92 nests)
Percentage of successful nests in exotic-dominated territories	36%	(22 out of 61 nests)
Percentage of successful nests in mixed dominance territories	51%	(56 out of 111 nests)
Cowbird Parasitism Per Nest Substrate Species		
Percentage of nests parasitized in *Salix* substrate	1%	(1 out of 86 nests parasitized)
Percentage of nests parasitized in saltcedar substrate	3%	(6 out of 176 nests parasitized)
Cowbird Parasitism Per Territory Vegetation Type		
Percentage of nests parasitized in *Salix*-dominated territories	1%	(1 out of 92 nests)
Percentage of nests parasitized in exotic-dominated territories	2%	(1 out of 61 nests)
Percentage of nests parasitized in mixed dominance territories	5%	(5 out of 111 nests)
Productivity[(1)] Per Territory Vegetation Type		
Productivity of nests found in *Salix*-dominated territories	2.56/nest	(87 young from 34 nests)
Productivity of nests found in exotic-dominated territories	2.45/nest	(54 young from 22 nests)
Productivity of nests found in mixed dominance territories	2.75/nest	(154 young from 56 nests)
Productivity[(1)] Per Nest Substrate Species		
Productivity of nests found in *Salix* substrate	2.53/nest	(81 young from 32 nests)
Productivity of nests found in saltcedar substrate	2.68/nest	(214 young from 80 nests)
Productivity[(1)] Compared to Nest Substrate Species and Territory Vegetation Type		
Productivity of nests in *Salix* substrate within *Salix* dominated territories	2.50/nest	(75 young from 30 nests)
Productivity of nests in saltcedar substrate within *Salix* dominated territories	3.00/nest	(12 young from 4 nests)
Productivity of nests in saltcedar substrate within exotic dominated territories	2.45/nest	(54 young from 22 nests)
Total SWFL nests of known outcomes monitored during 2019	264	

Note: Summary data only from nests with known outcomes
([1])Productivity is defined as the number of SWFL young fledged per successful nest.

Table 8. Summary of SWFL nesting parameters within the Middle Rio Grande – 1999 to 2019

General Nest Data 1999 to 2019		
Parasitism Rate 12% (506 out of 4079 nests)		
Depredation Rate 42% (1721 out of 4079 nests)		
Abandonment Rate 7% (277 out of 4079 nests)		
Nest Success 43% (1767 out of 4079 nests)		
Territory Vegetation Type		
Number of nests in *Salix*-dominated territories	2213	54% of total
Number of nests in exotic-dominated territories	619	15% of total
Number of nests in mixed dominance territories	1247	31% of total
Nest Substrate Species		
Number of nests in *Salix* substrate	1847	45% of total
Number of nests in saltcedar substrate	2165	53% of total
Number of nests in Russian olive substrate	52	1% of total
Number of nests in other (*Baccharis*/cottonwood) substrate	15	<1% of total
Nest Substrate/Territory Vegetation Combination		
Number of nests in saltcedar substrate within *Salix*-dominated territories	522	24% of 2213 nests
Number of nests in *Salix* substrate within exotic or mixed dominance territories	171	9% of 1866 nests
Nest Success Per Nest Substrate Species		
Percentage of successful nests in *Salix* substrate	44%	819 out of 1847 nests
Percentage of successful nests in saltcedar substrate	42%	917 out of 2165 nests
Percentage of successful nests in Russian olive substrate.	50%	26 out of 52 nests
Percentage of successful nests in other (*Baccharis*/cottonwood) substrate	33%	5 out of 15 nests

Nest Success Per Territory Vegetation Type		
Percentage of successful nests in *Salix*-dominated territories	45%	1002 out of 2213 nests
Percentage of successful nests in exotic-dominated territories	42%	259 out of 619 nests
Percentage of successful nests in mixed dominance territories	41%	506 out of 1247 nests
Cowbird Parasitism Per Nest Substrate Species		
Percentage of nests parasitized in *Salix* substrate	12%	222 out of 1847 nests parasitized
Percentage of nests parasitized in saltcedar substrate	13%	272 out of 2165 nests parasitized
Percentage of nests parasitized in Russian olive substrate	17%	9 out of 52 nests parasitized
Percentage of nests parasitized in other (*Baccharis*/cottonwood) substrate	20%	3 out of 15 nests parasitized
Cowbird Parasitism Per Territory Vegetation Type		
Percentage of nests parasitized in *Salix*-dominated territories	12%	268 out of 2213 nests
Percentage of nests parasitized in exotic-dominated territories	12%	71 out of 619 nests
Percentage of nests parasitized in mixed dominance territories	13%	167 out of 1247 nests
Productivity[(1)] Per Territory Vegetation Type		
Productivity of nests found in *Salix*-dominated territories	2.57/nest	2578 young from 1002 nests
Productivity of nests found in exotic-dominated territories	2.42/nest	628 young from 259 nests
Productivity of nests found in mixed dominance territories	2.58/nest	1308 young from 506 nests
Productivity[(1)] Per Nest Substrate Species		
Productivity of nests found in *Salix* substrate	2.60/nest	2130 young from 819 nests
Productivity of nests found in saltcedar substrate	2.53/nest	2316 young from 917 nests
Productivity of nests found in Russian olive substrate	2.23/nest	58 young from 26 nests
Productivity[(1)] Compared to Nest Substrate Species and Territory Vegetation Type		
Productivity of nests in *Salix* substrate within *Salix* dominated territories	2.59/nest	1965 young from 759 nests
Productivity of nests in saltcedar substrate within *Salix* dominated territories	2.54/nest	604 young from 238 nests
Productivity of nests in saltcedar substrate within exotic dominated territories	2.42/nest	611 young from 253 nests
Total SWFL nests of known outcomes monitored from 1999-2019	4079	

Note: Summary data only from nests with known outcomes 1999-2019

([1])Productivity is defined as the number of SWFL young fledged per successful nest.

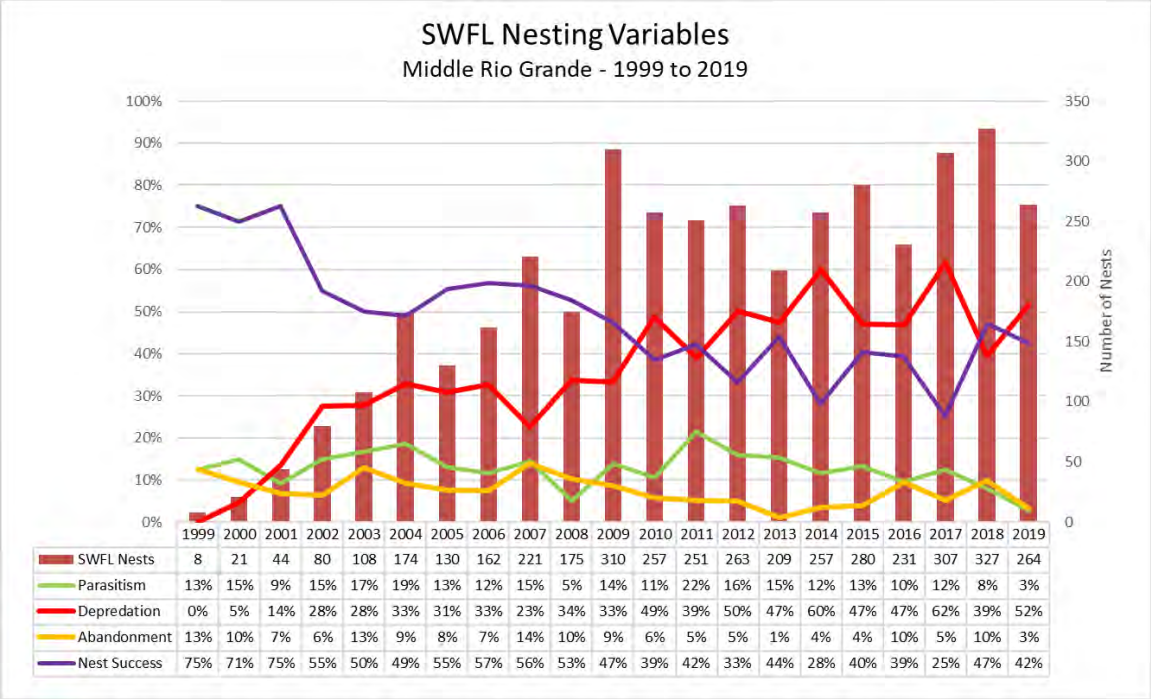


Figure 16. Summary of SWFL nesting within Bureau of Reclamation surveyed sites between 1999 and 2019.

Habitat Availability and Selection

Since 2005, nesting SWFLs in the study area have begun utilizing habitat with a greater saltcedar component (Figure 17). SWFLs gradually converted from using almost entirely *Salix*-dominated habitats to a more even mixture of the three different habitat types: *Salix*-dominated, exotic-dominated (usually saltcedar), and mixed. Dominance is defined as habitat composed of at least 75 percent *Salix* or exotic species. During 2014, a switch in habitat use took place and SWFLs nested more often in mixed habitat than in *Salix* or exotic-dominated habitats. This trend has continued into 2019 (Table 7). This is the eighth consecutive year that fewer than 50 percent of territories were in *Salix*-dominated habitat and illustrates the shift in habitat use within the Middle Rio Grande.

Drought conditions and senescence of natives has allowed exotic saltcedar to become more of a habitat component and prompted SWFLs to occupy lesser quality habitats – primarily within the Elephant Butte Reservoir delta. This ability to occupy saltcedar-dominated habitat may benefit the SWFL population in times of drought as saltcedar is more drought tolerant and may provide a refuge until conditions are suitable for native habitat. Conversely, the recent spread of the tamarisk beetle, which has been documented throughout the Middle Rio Grande during the past four years, could negatively impact occupied saltcedar habitat via defoliation and changes to microclimate during the SWFL breeding season. Dillon and Moore (2020) documented defoliation and microclimate impacts during the past two breeding seasons. These impacts are only likely to intensify as the extent and abundance of *Diorhabda* increases within the Middle Rio Grande.

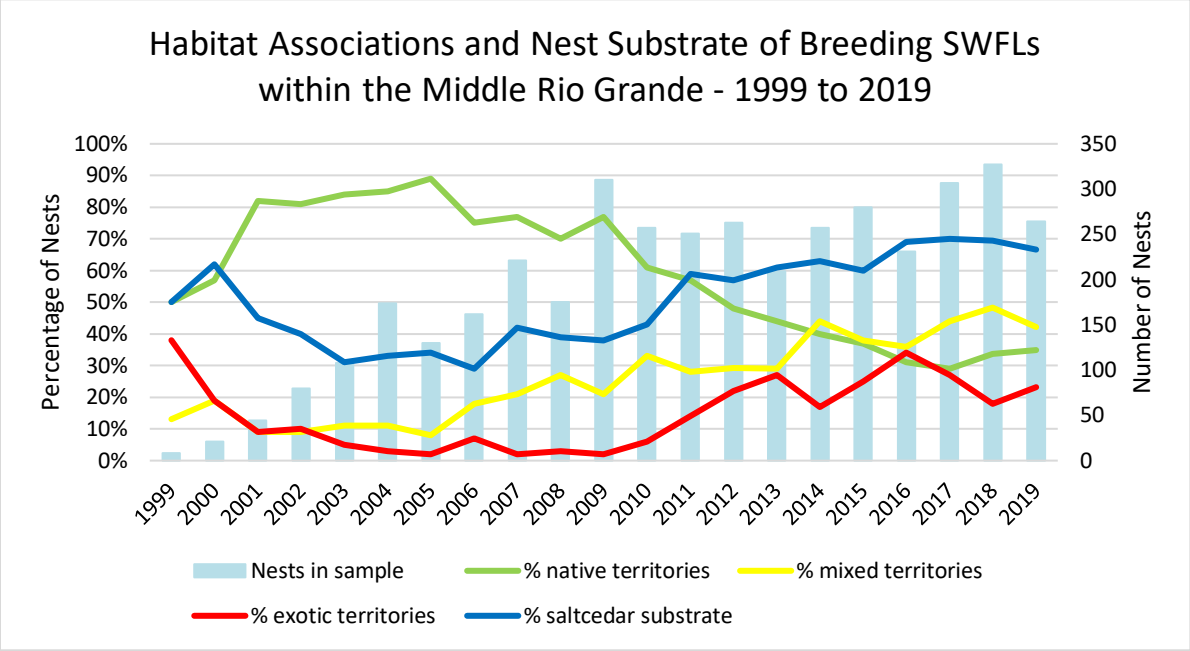


Figure 17. Percentage of SWFL territories located in three habitat types (native, exotic, and mixed) and saltcedar substrate within the Middle Rio Grande between 1999 and 2019.

In order to explore the relationship between SWFL nesting variables and habitat, data collected at nests between 1999 and 2019 were commingled and statistically analyzed. Over the past 21 years, a total of 4,079 SWFL nests (with known outcomes) have been monitored along the Middle Rio Grande (Table 8). Tables 9 and 10, and this section of the report, provide details of habitat comparisons for SWFLs

nesting along the Middle Rio Grande. Graphical illustrations of key nesting parameters are also provided in the Attachment. General nest data from the 4,079 monitored nests indicate an overall brood parasitism rate of 12 percent, a nest depredation rate of 42 percent, a nest abandonment rate of 7 percent, and an overall nest success rate of 43 percent over the past 21 years (Table 8). Although annual results were often similar to average study period rates, the large sample size associated with the commingled data set provides greater insight into the relationships of habitat, hydrology and nesting variables. Sound management decisions should be based on the best available data and should not typically be based on a single year's dataset.

Table 9. Habitat and SWFL nest variable comparisons from the Middle Rio Grande – 1999 to 2019

Chi-square Test (± = 0.05)		
Comparison	Df and Ç² value	*P*-value
Success and dominant territory vegetation	Df=2, 7.83	0.02
Success and substrate species	Df=2, 2.55	0.28
Depredation and dominant territory vegetation	Df=2, 8.90	0.01
Depredation and substrate species	Df=2, 0.88	0.64
Parasitism and dominant territory vegetation	Df=2, 1.79	0.41
Parasitism and substrate species	Df=2, 1.45	0.48
Kruskal-Wallis Test (± = 0.05)		
Comparison	Df and H	*P*-value
Productivity and dominant territory vegetation	Df=2, 10.77	<0.01
Productivity and substrate species (*Salix,* saltcedar, Russian olive)	Df=2, 8.28	0.02

Data from known nest outcomes only. **Yellow** = statistically significant difference.

Table 10. Hydrology and SWFL nest variable comparisons from the Middle Rio Grande – 2004 to 2019

Chi-square Test (± = 0.05)		
Comparison	Df and Ç² value	*P*-value
Nest success and hydrology under the nest	Df=3, 7.42	0.06
Depredation rates and hydrology under the nest	Df=3, 8.98	0.03
Parasitism rates and hydrology under the nest	Df=3, 11.74	0.01
Nest success and distance to water (> or < 100m)	Df=1, 2.71	0.10
Nest success and distance to water (> or < 50m)	Df=1, 0.17	0.68
Mann-Whitney W-test (± = 0.05)		
Comparison	Df and w	*P*-value
Productivity and distance to water (> or < 100m)	Df=1, -7,471.0	0.15
Productivity and distance to water (> or < 50m)	Df=1, -16,914.5	0.02
Kruskall-Wallis Test (± = 0.05)		
Comparison	Df and H	*P*-value
Productivity of successful nests based on hydrology under the nest	Df=3, 22.85	<0.01

Data from known nest outcomes only. **Yellow** = statistically significant difference.

Between 1999 and 2019, data on the nest substrate and dominant vegetation within the territory were collected at all 4,079 nests. It is likely that vegetative density and structure, and hydrology play a greater role in territory selection than species composition. However, as shown in Table 8, 54 percent of SWFL nesting territories were dominated by *Salix* and only 15 percent were dominated by exotic species (primarily saltcedar). The remaining nests were found in mixed stands (31 percent).

From these data it is clearly evident that SWFLs select native dominated stands, when available, far more often than exotic dominated stands when establishing territories on the Middle Rio Grande.

However, a disproportionate use of saltcedar as the nest substrate is also apparent. SWFLs selected saltcedar as the nest substrate 67 percent of the time in 2019 (n=264) and 53 percent of the time since 1999 (n=4,079). These data suggest a preference for establishing territories within native dominated stands, while selecting saltcedar as the substrate when constructing a nest. It is likely that the preference for saltcedar as the nest substrate is due to the natural twig structure that saltcedar provides. Table 9 summarizes the following statistical comparisons used to assess relationships between vegetation species composition and nesting variables.

A Chi-square test was conducted to compare success rates and dominant territory vegetation (i.e., native, exotic, and mixed) for SWFL nest data between 1999 and 2019 (n=4,079; Page A11). Nests in native stands (46 percent success) were statistically more successful (χ^2=7.83, Df=2, *P*=0.02) than mixed stands (40 percent). It is unclear why nests in mixed stands experience such a reduced nest success rate.

Statistical analysis (Chi-square test) comparing nest success to nest substrate was also conducted for the past 21 years of SWFL nesting data (Page A12). No difference in success rates was observed between *Salix*, saltcedar and Russian olive substrates (χ^2=2.55, Df=2, *P*=0.28).

Nest depredation is usually the primary cause of nest failure. Depredation rates between habitat types and substrate species were compared using a Chi-square test. Nests in native-dominated habitat were depredated at a lower rate than those found in mixed dominance habitat (Page A15 - χ^2=8.90, Df=2, *P*=0.01). Presumably, native habitats provide the highest nest concealment which reduces depredation. Nests in the three common substrates – *Salix*, saltcedar and Russian olive - were all depredated around 40 percent of the time (Page A14 - χ^2=0.88, Df=2, *P*=0.64).

Cowbird brood parasitism was once considered to be a primary limiting factor to SWFL populations (USFWS 2002) and can severely impact populations locally. Reclamation personnel trapped cowbirds in the San Marcial Reach between 1996 and 2001. Thus, discussion and analysis of cowbird parasitism is warranted. A Chi-square test was conducted to compare BHCO parasitism rates between 1999 and 2019 within the three territory vegetation types - native, exotic, and mixed (Page A17). No statistically significant difference in parasitism rates was documented among the three habitat types (χ^2=1.79, Df=2, *P*=0.41). The cowbird parasitism rate within all three habitat types was 12 or 13 percent. A similar result was found when looking at parasitism and nest substrate (Page A16). There was no statistical difference in parasitism rates by nesting substrate (χ^2=1.45, Df=2, *P*=0.48).

Productivity (i.e. nestlings fledged per nest) is also an important variable to the maintenance or growth of SWFL populations. Nest productivity of successful nests among the dominant vegetation communities and nest substrates were compared using a Kruskal-Wallis H test (Pages A18 and A19). A successful nest is defined as one which fledges at least one SWFL chick. Productivity of successful nests within exotic territories (2.42 young/nest) was statistically less (H=10.77, Df=2, P<0.01) than that of nests located in both mixed territories (2.58 young/nest) and native territories (2.57 young/nest). This is likely due to native habitat typically being of higher quality and thus providing increased shade, forage, thermal stability, and concealment from predators. Similarly, successful nests placed in *Salix* substrate (2.60 young/nest) were statistically more productive (H=8.28, Df=2, P=0.02) than those placed in saltcedar (2.53 young/nest) and Russian olive (2.23 young/nest).

Hydrology and Nesting Variables

Beginning in 2004, hydrological data at each nest was collected on each nest visit. One of three possible hydrologic conditions, including dry, saturated soil, or flooded, was recorded and daily data were compiled for each nest at season's end to determine the hydrologic regime throughout the nesting cycle. As a result, four separate scenarios were evaluated, including: 1) dry all cycle, 2) saturated/flooded then dry, 3) saturated/flooded all cycle, and 4) flooded all cycle (a subset of saturated/flooded all cycle). These four scenarios were then compared to nesting variables to determine potential relationships. Distance to water was also recorded and averaged at the end of the season. Table 10 and the following sections present these comparisons. Graphical illustrations of the study results are presented in the Attachment.

Between 2004 and 2019, nest success rates for all four hydrologic scenarios were similar statistically (between 38 and 46 percent - Chi-square test, χ^2=7.42, Df=3, P=0.06 - Page A5). Conversely, nest depredation and brood parasitism rates were higher in the drier hydrologic regimes (e.g. dry all cycle and saturated/flooded then dry). Nest depredation rate for nests that were dry all cycle and saturated/flooded then dry were 45 and 49 percent, respectively; depredation rates within saturated/flooded all cycle and flooded all cycle nests were 42 and 40 percent, respectively (Page A5). Based on a Chi-square test (χ^2=8.98, Df=3, P=0.03), nests that were dry all season were depredated at a higher rate than those that were saturated/flooded all season and flooded all season (Table 10). BHCO parasitism was 13 percent in nests that were dry all cycle, 14 percent for nests saturated or flooded then dry, and 10 percent for both saturated/flooded all cycle and flooded all cycle categories (Page A6). Again, a Chi-square test showed a significantly higher parasitism rate for nests that were dry all season compared to those that were either saturated/flooded all season or flooded all season (χ^2=11.74, Df=3, P=0.01). It is likely that the increased habitat quality, vegetative cover, and reduced predator access associated with wetter conditions are responsible for these differences.

Lastly, productivity within each of the four hydrologic regimes was investigated and, similar to the previous comparisons, dry all cycle was the least productive during the 2004 to 2019 sample period (n=1,964; Page A8). This regime produced an average of 2.49 young per successful nest while the other three ranged from 2.56 to 2.72. A Kruskall-Wallis test showed that both saturated/flooded all cycle and flooded all cycle were more productive than dry all cycle (H=22.85, Df=3, P<0.01). Considering the previous three comparisons, this is no surprise. Wetter sites provide higher thermal stability, relative humidity, prey abundance and foliage density – all factors that contribute to higher overall habitat quality for this species.

Regarding distance to water, 79 percent of nests monitored between 2004 and 2019 were within 50 meters of water and 91 percent were within 100 meters. No significant difference in success rates was discovered for nests greater or less than both 50 m (Chi-square test, χ^2=0.17, Df=1, *P*=0.68 – Page A7) and 100 m (Chi-square test, χ^2=2.71, Df=1, *P*=0.10) from water. Regarding productivity (Page A8), nests that were less than 50 m from water were more productive (2.59 young per nest) than those further than 50 m from water (2.46 young per nest) based on a Mann-Whitney W test (W=-16,914.5, Df=1, P=0.02). No difference in productivity was found for nests less than or greater than 100 m from water.

Brown-headed Cowbird Brood Parasitism

In 1995, four of six (66 percent) SWFL nests within the Tiffany Reach "Condo Site" were parasitized by cowbirds (NMNHP 1995). Cowbird control efforts were implemented within the San Marcial Reach

from 1996 through 2001; only 3 of 65 nests (5 percent) during this period were parasitized. From 2002 to present, cowbird trapping has not been conducted. During this post-trapping period, parasitism rates among San Marcial SWFL nests ranged from 3 to 23 percent, with an overall parasitism rate of 12 percent (n=3,519) (Table 5). The higher parasitism rate documented after cowbird trapping was discontinued may indicate that, on a local scale, cowbird trapping is effective at reducing parasitism rates. However, nest success rates, which are the ultimate indicator of BHCO trapping effectiveness, were not affected. The relatively small sample size of SWFL nests monitored during the cowbird trapping period compared to the post-trapping nest numbers may also be responsible for the different results.

A riparian-obligate nest monitoring study was initiated in 1999 and continued through 2004 to study the effectiveness of BHCO trapping at reducing parasitism rates and increasing nesting success. Data analysis indicates that, while during certain years trapping may significantly lower BHCO parasitism rates, there was no statistically significant difference in nesting success rates between trapped and untrapped locations (Moore 2006). With many variables involved, including hydrology, vegetation characteristics, predator abundance, and the overall dynamism of the Rio Grande floodplain, it is difficult to determine what is responsible for the variation in BHCO parasitism and nest success rates between years. The SWFL recovery plan (USFWS 2002) states that "cowbird control should be considered if parasitism exceeds 20 to 30 percent after collection of two or more years of baseline data," so the decision to end the trapping program continues to be justified based on this recommendation.

The practice of addling or removing BHCO eggs from parasitized SWFL nests was initiated in 2002 and continued through 2019. All of the seven nests that were parasitized in 2019 failed. BHCO eggs were addled in two nests. From 2002 to 2019, 496 SWFL nests have been parasitized and the outcomes known. BHCO eggs were addled or removed from 141 nests, 30 of which successfully fledged SWFL young (21 percent success). Parasitized nests during the same period in the Middle Rio Grande that were unaltered were not as successful. Of 355 parasitized nests monitored, 323 failed and 32 successfully fledged SWFL young—a 9 percent success rate. This difference was statistically significant based on a Chi-square test (χ^2=13.87, Df=1, P<0.01).

Elephant Butte Reservoir Pool SWFL Population

Although the previous section discussed the nest parameters of the entire Middle Rio Grande SWFL population, a brief discussion of the population within Elephant Butte Reservoir is warranted when discussing changes in habitat, vegetation dominance and use of saltcedar in SWFL territories. The reservoir delta continues to contain the majority of nesting SWFLs in the study area (Table 11). The exposed pool of Elephant Butte Reservoir contained 79 percent of all nests found during the 2019 breeding season. This is a smaller percentage than during the earlier years of this study due to the sizeable subpopulations upstream of the reservoir in the San Marcial, Bosque del Apache and Belen Reaches but still represents a majority of the breeding territories.

A summary of SWFL nest variables from 1999 through 2019 within Elephant Butte Reservoir is shown in Figure 18 and Table 12 and data analyses are presented in the Attachment. Figure 19 shows the relationship between the percentage of both dry and flooded nests and nest variables. Several notable trends emerge from these charts. Nesting success has declined greatly since the peaks observed during the mid-2000's but was higher in 2018 than during the previous ten years (Figure 18).

Table 11. Rio Grande Reach summary of SWFL nests in lands surveyed by Reclamation between 1995 and 2019

	1995	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005	2006
Velarde	n/a[1]	n/a[1]	6	3	1	2	0	0	0	0	0	0
Belen	n/s	n/s	n/s	n/s	n/s	n/s	n/s	0	n/s	0	2	0
Sevilleta/ La Joya	n/s	n/s	n/s	n/s	3	6	9	13	12	21	10	18
Escondida	n/s	n/s	0	0	0	0	0	0	0	0	0	0
Bosque del Apache	n/s	n/s	n/s	0	0	0	0	0	1	2	0	1
Tiffany[(2)]	6	0	n/s	n/s	n/s	n/s	n/s	1	2	11	4	1
San Marcial	0	1	2	2	5	19	36	66	96	153	127	148
Elephant Butte Reservoir[(3)]	0	0	2	1	2	13	35	65	96	153	127	145
Total	6	1	8	5	9	27	45	80	111	187	143	168

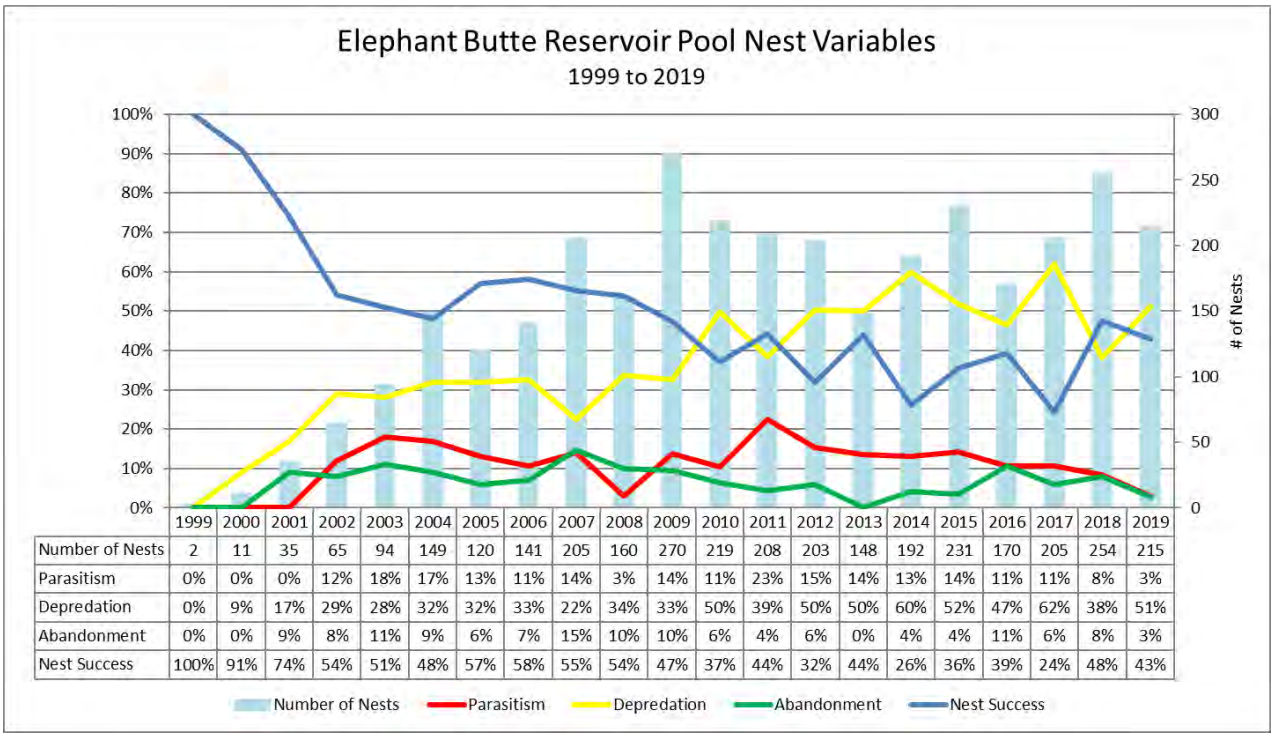
	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019
Velarde	0	0	0	n/s	n/s	n/s	n/s	n/s	n/s	n/s	n/s	n/s	n/s
Belen	2	1	3	3	3	10	22	14	17	21	27	17	n/s
Sevilleta/ La Joya	6	13	14	10	6	5	6	0	0	1	1	3	n/s
Escondida	0	0	0	0	0	6	3	0	1	0	9	4	4
Bosque del Apache	1	2	19	25	34	38	20	17	5	1	16	22	7
Tiffany[(2)]	3	0	3	1	0	0	0	0	0	0	0	0	0
San Marcial	220	186	294	241	240	223	173	255	287	256	298	315	280
Elephant Butte Reservoir[(3)]	215	183	291	236	237	218	159	214	251	197	233	272	244
Total	232	202	333	280	283	282	224	286	310	279	351	361	291

n/s = not surveyed

(1) Nest monitoring not conducted by Reclamation (NMNHP conducted nest monitoring)

(2) Nest monitoring results from 1995 and 1996 in the Tiffany Reach are from the NMNHP (1995). The Tiffany Reach, with the exception of sites LF-21 and LF-22 (surveyed in 2002 and 2003), was not surveyed during the years 1997-2003.

(3) Elephant Butte Reservoir is a subset of San Marcial and not counted towards the totals.



	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019
Number of Nests	2	11	35	65	94	149	120	141	205	160	270	219	208	203	148	192	231	170	205	254	215
Parasitism	0%	0%	0%	12%	18%	17%	13%	11%	14%	3%	14%	11%	23%	15%	14%	13%	14%	11%	11%	8%	3%
Depredation	0%	9%	17%	29%	28%	32%	32%	33%	22%	34%	33%	50%	39%	50%	50%	60%	52%	47%	62%	38%	51%
Abandonment	0%	0%	9%	8%	11%	9%	6%	7%	15%	10%	10%	6%	4%	6%	0%	4%	4%	11%	6%	8%	3%
Nest Success	100%	91%	74%	54%	51%	48%	57%	58%	55%	54%	47%	37%	44%	32%	44%	26%	36%	39%	24%	48%	43%

Figure 18. Summary of SWFL nesting within Elephant Butte Reservoir pool from 1999 to 2019.

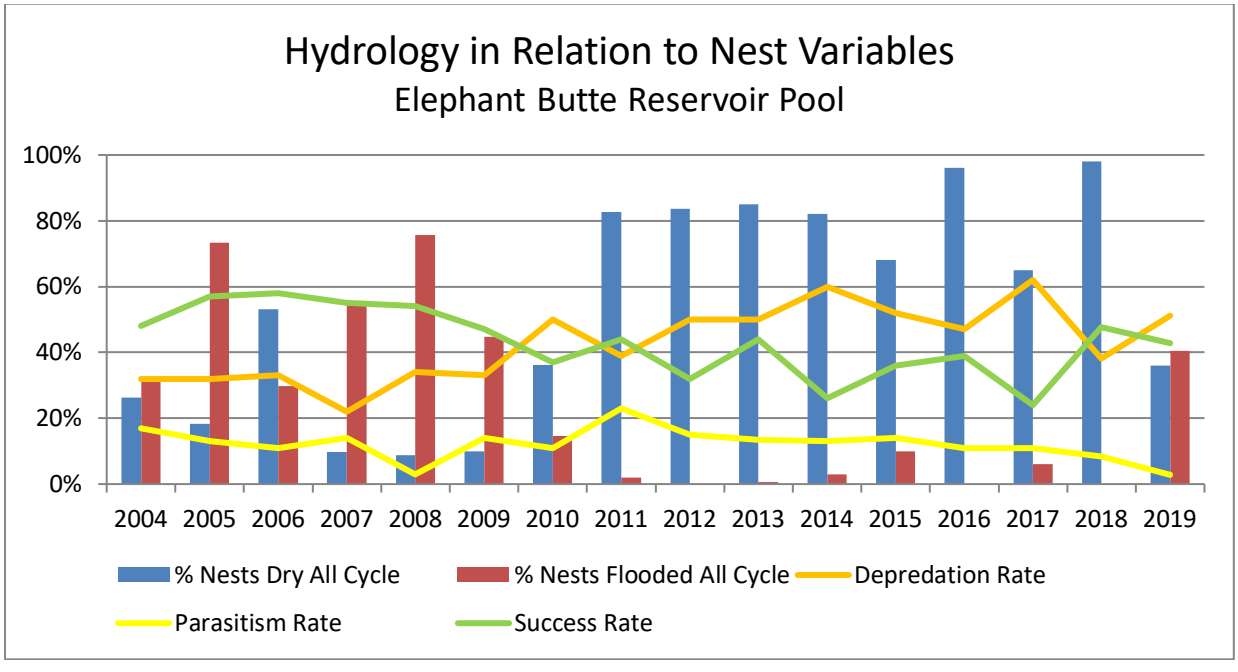


Figure 19. Relationship of hydrology under the nest and nesting variables within Elephant Butte Reservoir nesting SWFLs between 2004 and 2019.

Table 12. Summary of SWFL nesting parameters within Elephant Butte Reservoir – 1999 to 2019

General Nest Data – Elephant Butte Reservoir – 1999 to 2019		
Parasitism Rate 12% (398 nests)		
Depredation Rate 42% (1395 nests)		
Abandonment Rate 7% (231 nests)		
Nest Success 44% (1434 nests)		
Territory Vegetation Type		
Number of nests in *Salix*-dominated territories	1914	58% of total
Number of nests in exotic-dominated territories	415	13% of total
Number of nests in mixed dominance territories	968	29% of total
Nest Substrate Species		
Number of nests in *Salix* substrate	1524	46% of total
Number of nests in saltcedar substrate	1765	54% of total
Number of nests in Russian olive substrate	1	<1% of total
Number of nests in other (*Baccharis*/cottonwood) substrate	7	<1% of total
Nest Substrate/Territory Vegetation Combination		
Number of nests in saltcedar substrate within *Salix*-dominated territories	486	25% of 1914 nests
Number of nests in *Salix* substrate within exotic or mixed dominance territories	102	7% of 1383 nests
Nest Success Per Nest Substrate Species		
Percentage of successful nests in *Salix* substrate	45%	692 out of 1524 nests
Percentage of successful nests in saltcedar substrate	42%	741 out of 1765 nests
Percentage of successful nests in Russian olive substrate.	0%	0 out of 1 nest
Percentage of successful nests in other (*Baccharis*/cottonwood) substrate	14%	1 out of 7 nests
Nest Success Per Territory Vegetation Type		
Percentage of successful nests in *Salix*-dominated territories	47%	893 out of 1914 nests
Percentage of successful nests in exotic-dominated territories	40%	165 out of 415 nests
Percentage of successful nests in mixed dominance territories	39%	376 out of 968 nests
Cowbird Parasitism Per Nest Substrate Species		
Percentage of nests parasitized in *Salix* substrate	12%	183 out of 1524 nests parasitized
Percentage of nests parasitized in saltcedar substrate	12%	214 out of 1765 nests parasitized
Percentage of nests parasitized in Russian olive substrate	0%	0 out of 1 nest parasitized
Percentage of nests parasitized in other (*Baccharis*/cottonwood) substrate	14%	1 out of 7 nests parasitized
Cowbird Parasitism Per Territory Vegetation Type		
Percentage of nests parasitized in *Salix*-dominated territories	13%	239 out of 1914 nests
Percentage of nests parasitized in exotic-dominated territories	10%	41 out of 415 nests
Percentage of nests parasitized in mixed dominance territories	12%	118 out of 968 nests
Productivity[(1)] Per Territory Vegetation Type		
Productivity of nests found in *Salix*-dominated territories	2.58/nest	2305 young from 893 nests
Productivity of nests found in exotic-dominated territories	2.40/nest	396 young from 165 nests
Productivity of nests found in mixed dominance territories	2.62/nest	986 young from 376 nests
Productivity[(1)] Per Nest Substrate Species		
Productivity of nests found in *Salix* substrate	2.60/nest	1799 young from 692 nests
Productivity of nests found in saltcedar substrate	2.55/nest	1886 young from 741 nests
Productivity of nests found in Russian olive substrate	N/A	N/A
Productivity[(1)] Compared to Nest Substrate Species and Territory Vegetation Type		
Productivity of nests in *Salix* substrate within *Salix* dominated territories	2.60/nest	1721 young from 661 nests
Productivity of nests in saltcedar substrate within *Salix* dominated territories	2.54/nest	582 young from 229 nests
Productivity of nests in saltcedar substrate within exotic dominated territories	2.41/nest	396 young from 164 nests
Total SWFL nests with known outcomes monitored from 1999-2019	3297	

Depredation rates continue to be the primary cause of nest failure and have fluctuated dramatically during the past five years. The high depredation rates observed recently are likely due to decreased habitat quality in the reservoir pool caused by alternating periods of extended flooding and extreme drought. The high density of SWFL nests in the heavily occupied habitat of the reservoir pool may also contribute to the increased depredation rate and relatively low BHCO parasitism rates.

During the past 21 years, BHCO parasitism of SWFL nests within Elephant Butte Reservoir has averaged 12 percent. Parasitism rates have fluctuated annually but only once has parasitism exceeded 20 percent. Parasitism rate is likely tied to habitat quality, and apparently habitat within the reservoir pool is still sufficient to prevent BHCO parasitism from limiting the growth of the SWFL population. Future monitoring will determine if parasitism rates increase in the face of potential habitat quality decreases from continued drought and tamarisk beetle expansion.

Historically, native vegetation (e.g, Goodding's willow) has been the primary component of most SWFL territories within Elephant Butte Reservoir. However, over the period of study there has been a gradual increase in the number of territories found in both exotic stands and mixed stands of native and exotic vegetation. In 2002, 100 percent of all SWFL territories (n=54) were found within native-dominated stands; in 2019, 32 percent (n=215) were considered native-dominated (Figure 20). This shift coincides with the slow die-off or senescence of suitable native habitat in the upper reservoir pool, the 2005 river channel degradation event, and the prolonged drought. Both the channel degradation and drought effects resulted in a lowering of the water table, depriving some occupied, native-dominated stands of water and favoring the more drought-tolerant saltcedar. Additionally, while SWFLs have always selected saltcedar as nesting substrate at a disproportionate rate (Table 8), for the past two years it provided substrate for more than 70 percent of nests – the highest rates observed during the entire study period. In 2002, 29 percent of SWFL nests (n=65) were found in saltcedar, compared to 70 percent (n=215) in 2019. In 2011, the percentage of nests found in saltcedar surpassed the number found in native species (Figure 20). However, the relatively wet conditions of 2017 and 2019 appear to have rejuvenated native habitat within the reservoir pool. Indeed, the percentage of nests found in willow substrate and native territories have both slightly increased since 2017 (Figure 20). If these hydrologic trends were to continue, the encroachment of saltcedar into native SWFL habitat within Elephant Butte Reservoir may be halted. However, considering the amount of saltcedar already on the landscape, the effects of tamarisk beetles on saltcedar-dominated habitat present an unknown threat to the persistence of this habitat that will play out in the coming years.

The breeding SWFL population within Elephant Butte Reservoir is the largest, and potentially most important, breeding population within the range of the Southwestern Willow Flycatcher. This population acts as a source for colonization of nearby developing habitat, both natural and man-made. Although this population experienced near-exponential growth between 2002 and 2009, it now appears to have leveled off (Figure 12). Limiting factors, such as declining habitat quality and increasing nest depredation, are adversely affecting the growth of this population. Conversely, developing habitat within downstream sites (e.g. EB-01, 07, 15, 16 and 17) in the reservoir pool is being colonized by expanding SWFL populations. These sites could compensate for habitat declines upstream and continue to be a valuable source population for the surrounding area. However, habitat restoration activities within the Middle Rio Grande should continue in an effort to compensate for the predicted decline in habitat quality and availability during the coming years.

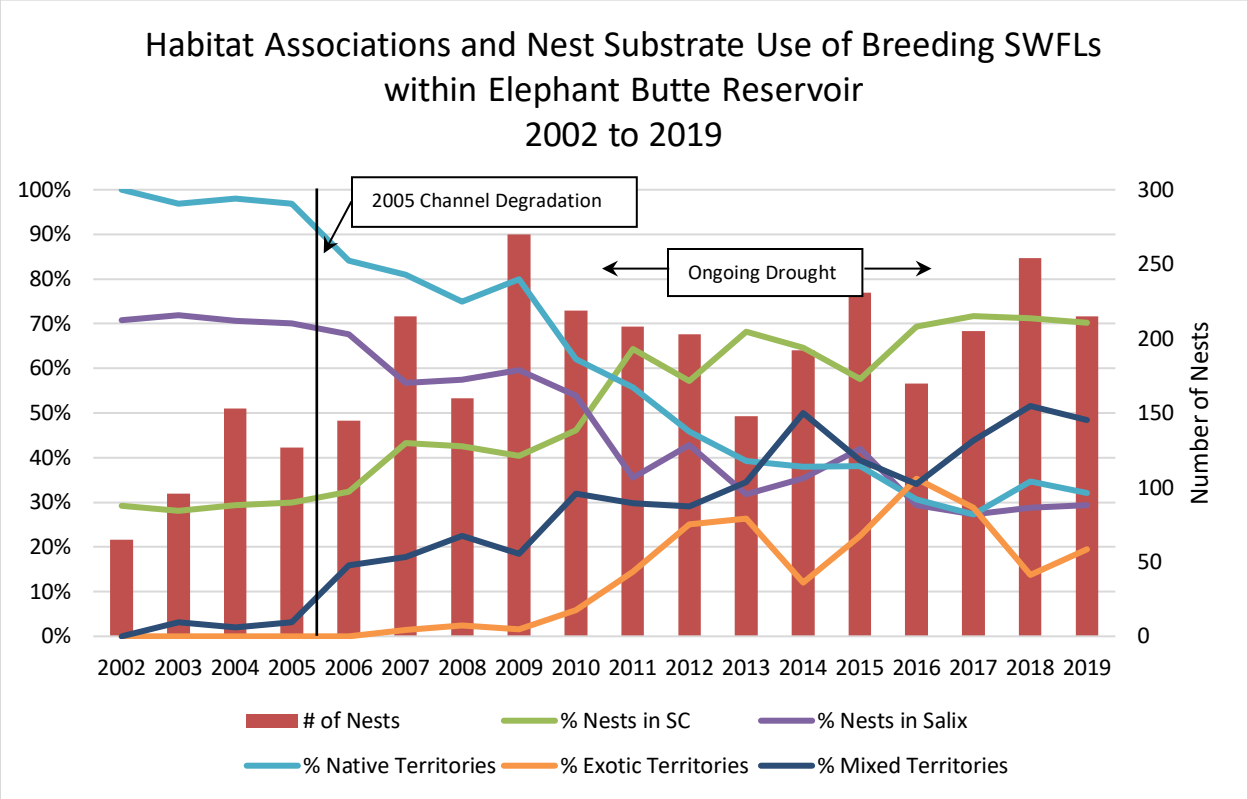


Figure 20. Habitat associations and nest substrate use of breeding SWFLs within Elephant Butte Reservoir – 2002 to 2019.

Tamarisk Beetle

As outlined in previous sections, SWFLs within the Middle Rio Grande nested within native (n=2,213), saltcedar (n=619), and mixed native/exotic habitats (n=1,247) between 1999 and 2019. They also nest in saltcedar substrate at a disproportionate rate (53 percent of nests between 1999 and 2019). Given these facts, it is necessary to discuss the potential impacts of tamarisk beetles on occupied SWFL habitat within the Middle Rio Grande. More than 50 percent of SWFL territories within the study area were located in either exotic-dominated or mixed dominance habitat during the past eight years (Figure 21). As noted previously, the use of both saltcedar substrate and saltcedar-dominated habitat has dramatically increased during the past several years. Since 2015, more than 60 percent of SWFL territories annually contained a saltcedar component. However, most of the large, monotypic stands of saltcedar in the Middle Rio Grande are not suitable flycatcher breeding habitat and are not occupied by resident flycatchers. Saltcedar-dominated territories occur scattered throughout the study area, interspersed within mixed and native-dominated habitat. These exotic-dominated territories would be adversely impacted by beetle defoliation, as well as mixed territories that contain a significant saltcedar component. Indeed, *Diorhabda* monitoring conducted during 2018 (Dillon and Moore, in press) documented negative impacts to occupied SWFL habitat. It seems that these impacts are likely to intensify in future years as tamarisk beetles increase in abundance and spread across the landscape. The location, timing and intensity of defoliation will determine the impacts to SWFLs and their habitat.

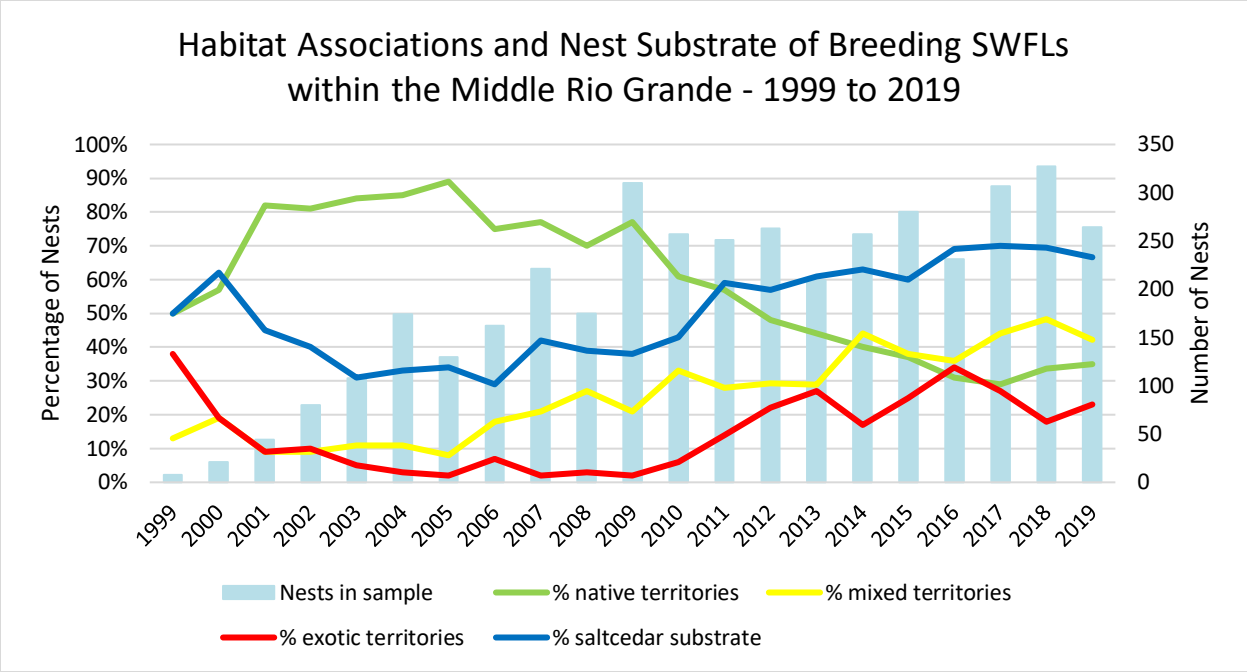


Figure 21. Habitat associations and nest substrate of breeding SWFLs within the Middle Rio Grande between 1999 and 2019.

In contrast, a significant percentage of SWFLs continue to nest in native-dominated habitat within Elephant Butte Reservoir. In 2019, 69 SWFL nests (32 percent, n=215) were located in habitat consisting of at least 75 percent *Salix*. This habitat will not be adversely impacted by the tamarisk beetle but has been greatly impacted by drought conditions during the past ten years. If climatic and hydrologic conditions beneficial to native habitat persist, native willows may expand into areas impacted by tamarisk beetles. Conversely, the combination of persistent drought and tamarisk beetle expansion could devastate the various SWFL-occupied habitat types within the reservoir pool. Continued monitoring of habitat, beetle impacts and SWFL occupancy will provide information on the future status of this valuable SWFL population.

Hydrology Monitoring

Southwestern Willow Flycatcher habitat can be succinctly described as dense and wet. Hydrology is often the most important factor in the creation and maintenance of high quality SWFL habitat. The hydrology studies conducted by Reclamation during the past 16 years have documented interesting trends within occupied habitat in the Elephant Butte Reservoir pool. For several years, much of this habitat was continually flooded and began to decline in quality presumably due to this prolonged flooding. The photostation study initiated in 2005 documented this phenomenon (Ahlers 2018). Conversely, between 2010 and 2016 drought conditions reduced flow in the LFCC that sustains the high quality habitat on the western side of the reservoir pool to the point that this habitat dried significantly. This allowed saltcedar to encroach into formerly native-dominated habitat. And although the wet years experienced recently provided a respite from the ongoing drought, if beneficial hydrologic conditions do not occur on a regular basis, this native habitat will eventually be lost.

Rising reservoir levels and inundation of potential/occupied habitat are other concerns regarding hydrology within the reservoir pool. Habitat created by reduced reservoir elevations could be stressed and/or killed if flooded for an extended period (greater than 5 years [Reclamation 2009]). Occupied SWFL habitat within The Narrows and downstream (e.g., sites EB-13 through 17) has already been periodically flooded by a rising reservoir during the past several years. This has only benefitted this habitat so far, as the reservoir level has annually declined and not adversely impacted habitat.

Figure 22 shows the current elevational distribution of SWFL territories within Elephant Butte Reservoir. In 2019, 36 percent of SWFL territories were within seven feet of the spillway elevation within the historic floodplain. This number has decreased during the past several years as suitable SWFL habitat has developed downstream in the reservoir pool (Pages A22 to A28). It is unlikely that habitat within this elevational range would be negatively impacted by reservoir water even at full pool. Annual fluctuation of reservoir elevations, even during average water years, would likely be enough to remove water from this habitat and prevent vegetative mortality. Conversely, much of the formerly occupied habitat in this elevational range has become decadent and lost suitability due to its age and the aforementioned flood and drought cycles. Reservoir levels peaked at just over 4,346 feet (ft) in July 2019. At this level, occupied sites below The Narrows (Figure 23) become flooded, and a handful of SWFL territories were likely displaced during the summer of 2019 by the rising reservoir. This lower elevation habitat could be adversely impacted by a persistent rise in reservoir levels (i.e. 20 feet). However, as observed the past three years, flows of the magnitude sufficient to raise the reservoir significantly would likely improve and/or create flycatcher habitat elsewhere, possibly equating to no net loss of habitat.

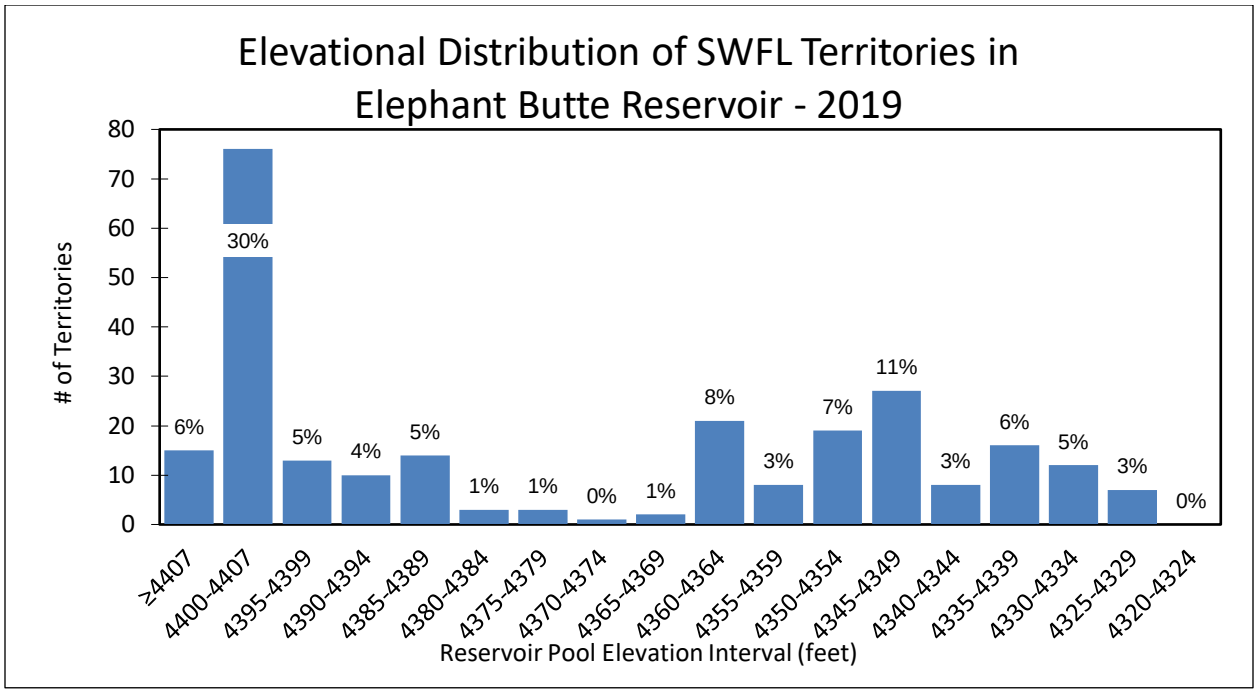


Figure 22. Elevational distribution of SWFL territories within Elephant Butte Reservoir in 2019. Thirty-six percent of territories were within seven feet of reservoir spillway elevation.

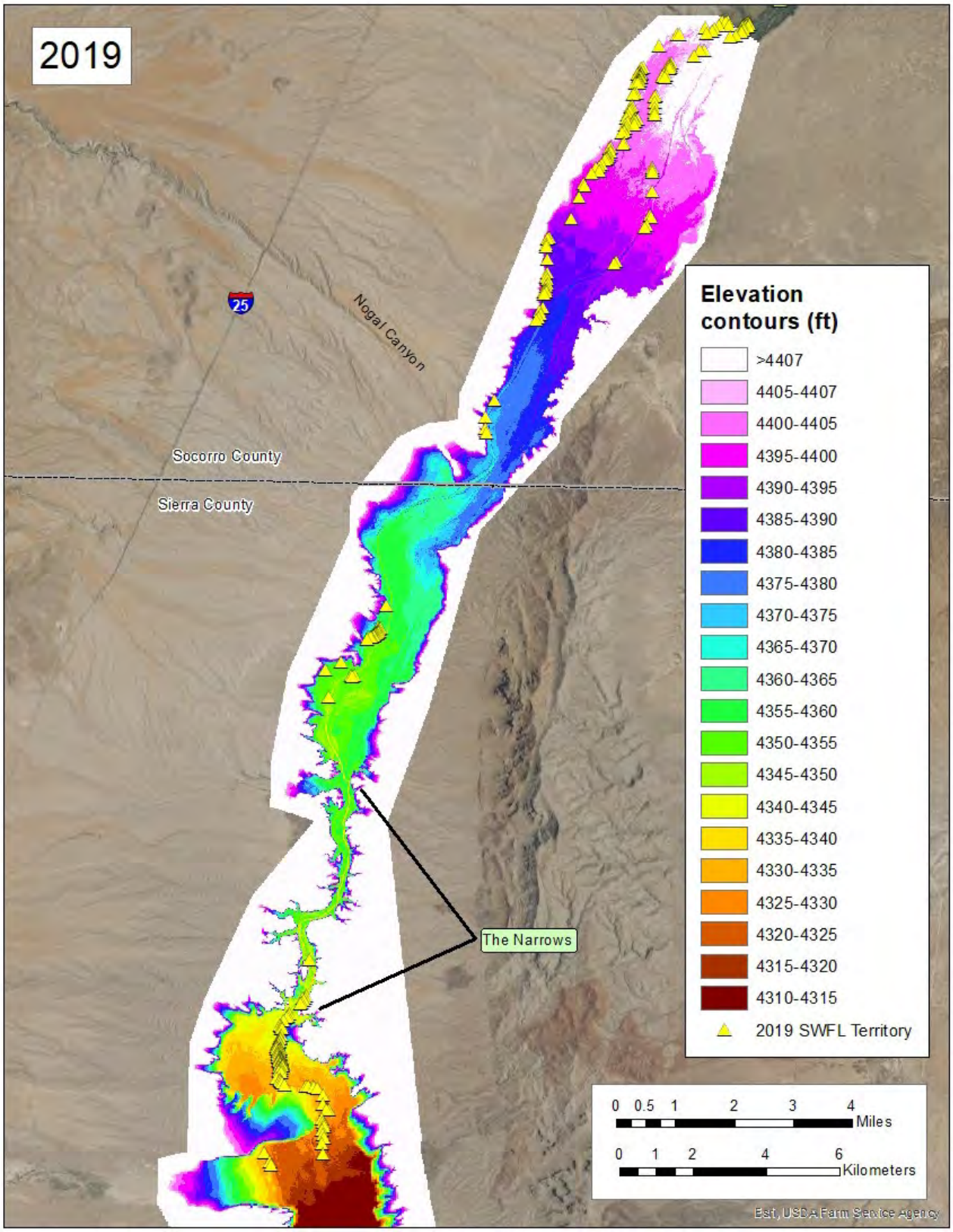


Figure 23. Elevation contours within the delta of Elephant Butte Reservoir. Reservoir levels ranged from 4,333 to 4,346 feet in elevation during the 2019 SWFL survey season. See Attachment for additional years.

Recommendations

Recommendations for future SWFL-related studies within the Middle Rio Grande fall into three categories:

1. Annual surveys of SWFL population concentrations
2. Periodic surveys of potential/unoccupied suitable habitat or restoration sites
3. Non survey-related studies

Annual Surveys

- Presence/absence surveys should continue in occupied reaches of the Middle Rio Grande to monitor the status of the SWFL population. These surveys will provide data regarding population trends and colonization of new sites adjacent to occupied sites. Special attention should be given to the sizeable populations in the San Marcial, Bosque del Apache, and Belen Reaches due to their importance to the Middle Rio Grande population as a whole.
- Presence/absence surveys should also continue in project-related areas where ESA compliance mandates and within designated critical habitat.
- Nest monitoring should continue in areas where pairing activity is documented. While it is becoming increasingly difficult to monitor every nest, a sample of at least 100 nests (if available) should be monitored each year in order to provide a sufficient sample size for nest variable analyses. Focus should be given to areas with potential project/habitat impacts (e.g. San Marcial, Bosque del Apache). These data will provide insight into factors limiting recruitment and population growth such as parasitism and depredation rates.
- Addling/removal of BHCO eggs from parasitized SWFL nests should continue, provided it can be done with minimal disturbance to the nest and the adult SWFLs.
- Monitoring of tamarisk beetle expansion and impacts should continue in order to determine effects of this biocontrol agent on SWFL habitat.

Periodic Surveys

- Periodic surveys (every 3 to 5 years) by the appropriate land management entity should be performed in suitable/potential habitat within the Middle Rio Grande in order to document any SWFL colonization of newly suitable habitat.
- In any sites where resident SWFLs are documented, nest searching and monitoring should be conducted by the appropriate management agency.

Non Survey-related Studies

- Monitoring of the river channel realignment within the Bosque del Apache NWR should continue in order to detect any impacts to groundwater, riparian habitat and the breeding SWFL population within the project area.
- The sediment plug monitoring study within the Elephant Butte Reservoir delta (survey site EB-09) should be continued if it is anticipated that work to alleviate sediment plug impacts will be initiated in the next three years.
- Habitat monitoring data from the nest vegetation quantification study should be utilized at restoration sites to document the effectiveness of various restoration practices.
- The Hink and Ohmart habitat mapping and SWFL habitat model should be updated to reflect current suitable habitat location and abundance within the various reaches of the Middle Rio Grande.
- Investigations into the options for water management in the delta of Elephant Butte Reservoir should be conducted in order to determine possible solutions to the flood/drought cycle that has been detrimental to SWFL habitat.

Conclusions

Presence/absence data will be beneficial when ESA compliance is required for river maintenance and/or restoration projects. The data will also aid in better understanding of the species' distribution, abundance, and potential threats. All available data are beneficial in the implementation of the Southwestern Willow Flycatcher Recovery Plan. As defined by the Recovery Plan for the Southwestern Willow Flycatcher (USFWS 2002), the Middle Rio Grande Management Unit, a part of the Rio Grande Recovery Unit, extends from just upstream of Cochiti Reservoir to Elephant Butte Dam. The recovery goal for the Middle Rio Grande Management Unit is 100 SWFL territories. This goal has been exceeded for 17 consecutive years. However, recent trends of habitat decline and conversion to saltcedar in combination with the spread of the tamarisk beetle throughout the Middle Rio Grande do not bode well for the persistence of this large population. And, although the recovery goal for the Middle Rio Grande Management Unit has been exceeded, other Management Units and Recovery Units are far from reaching their respective goals, and down listing or delisting appears unlikely in the near future.

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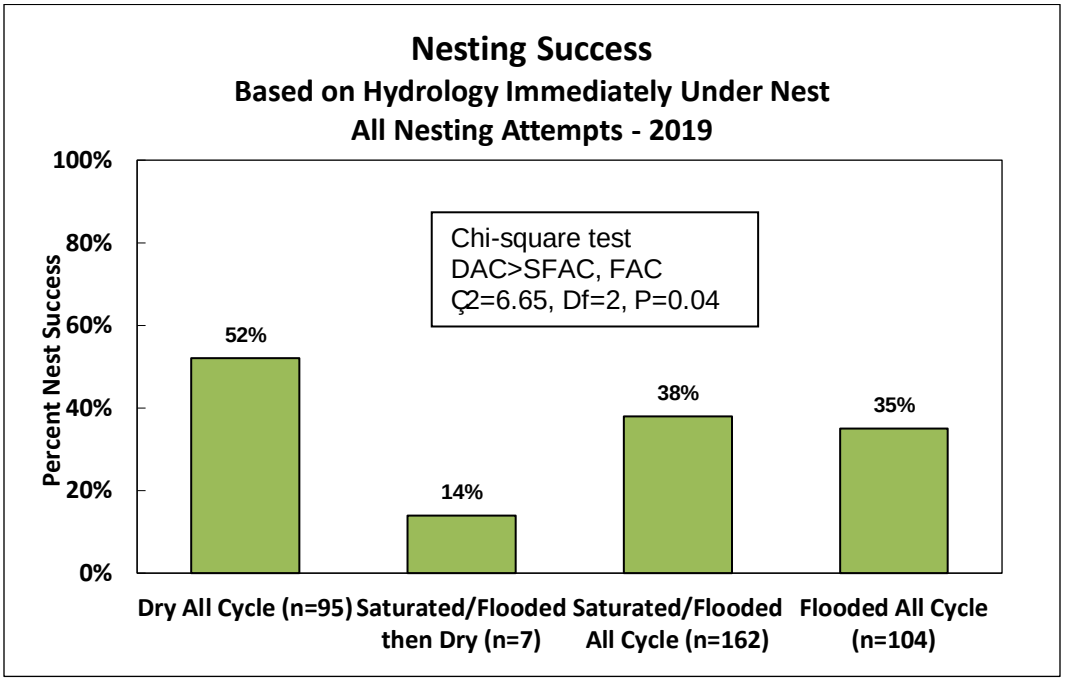
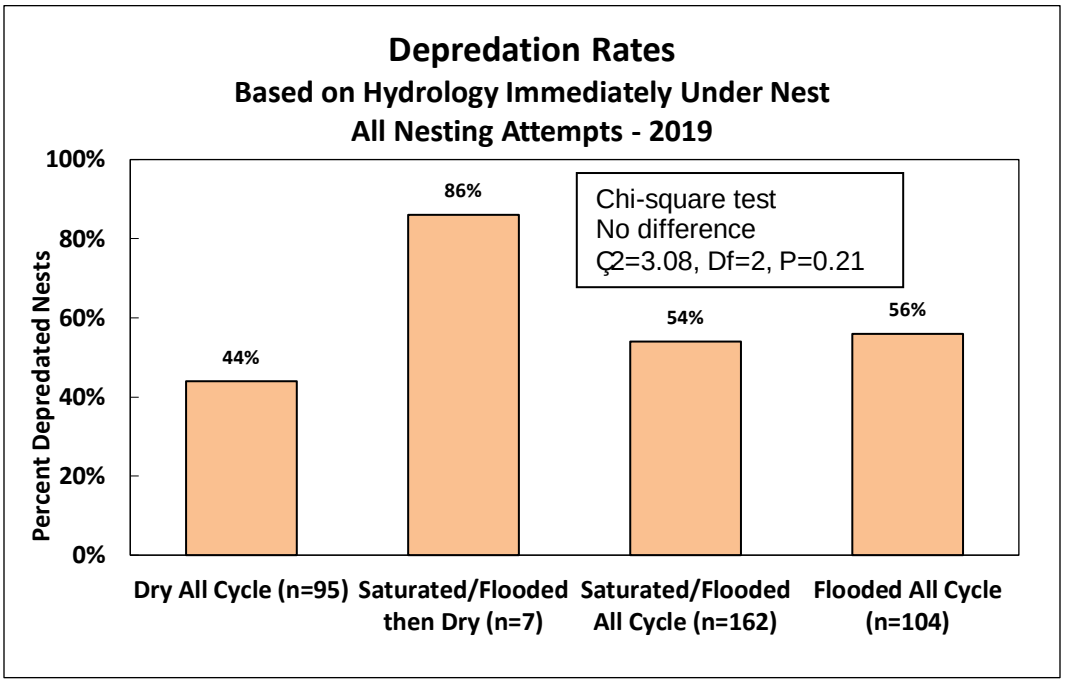
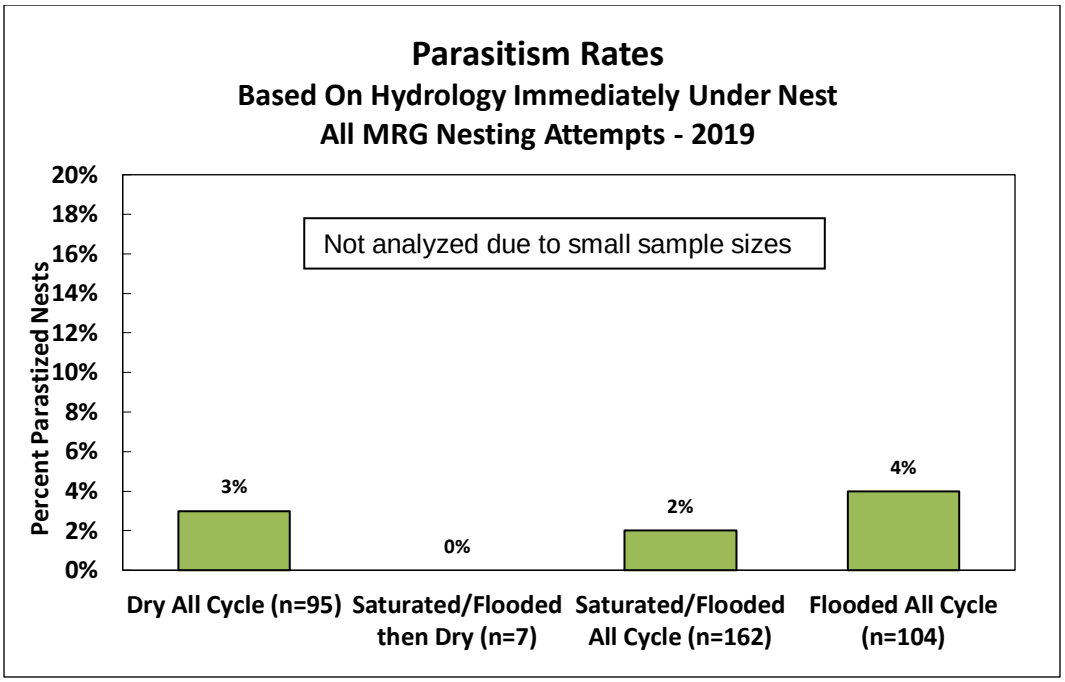
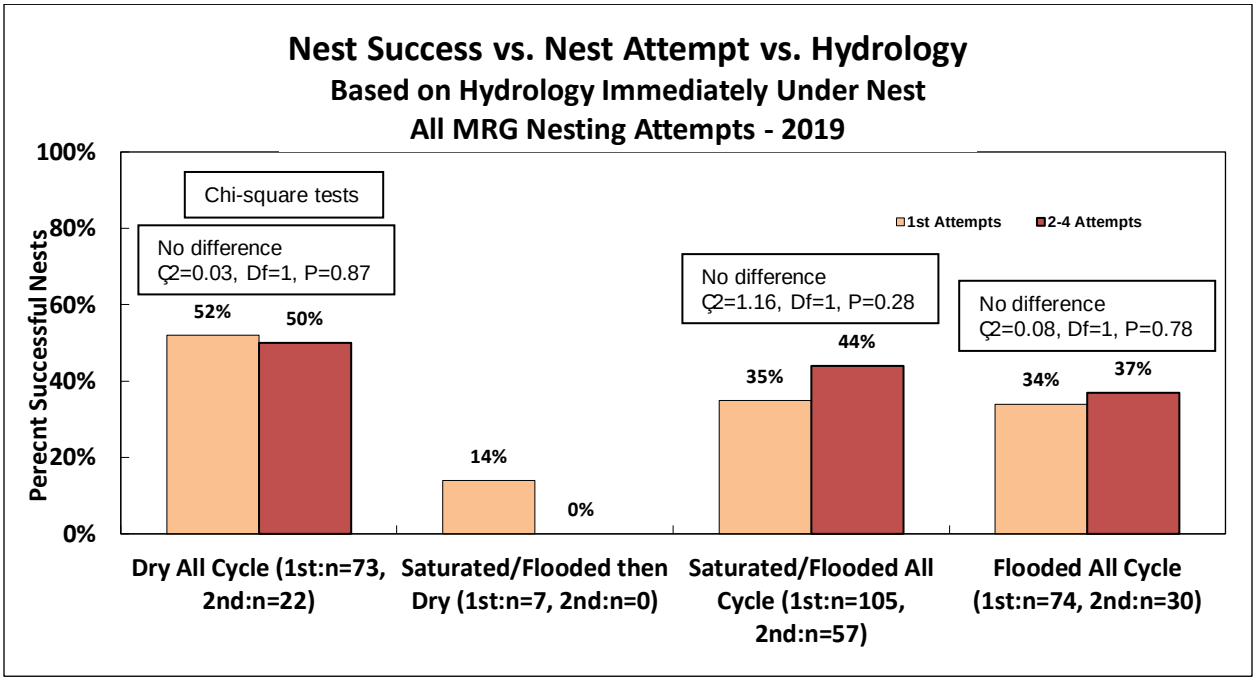
Attachment – Territories, nests, habitat and hydrological analyses

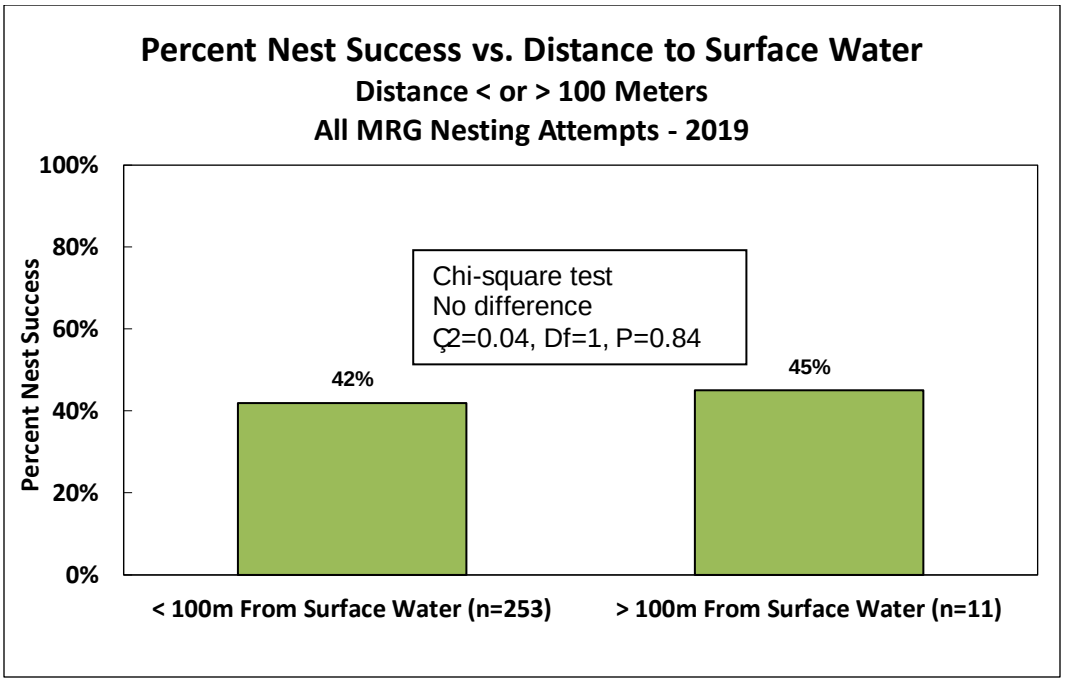
Nesting Variable and Hydrology Comparisons – All Middle Rio Grande Nests 2019

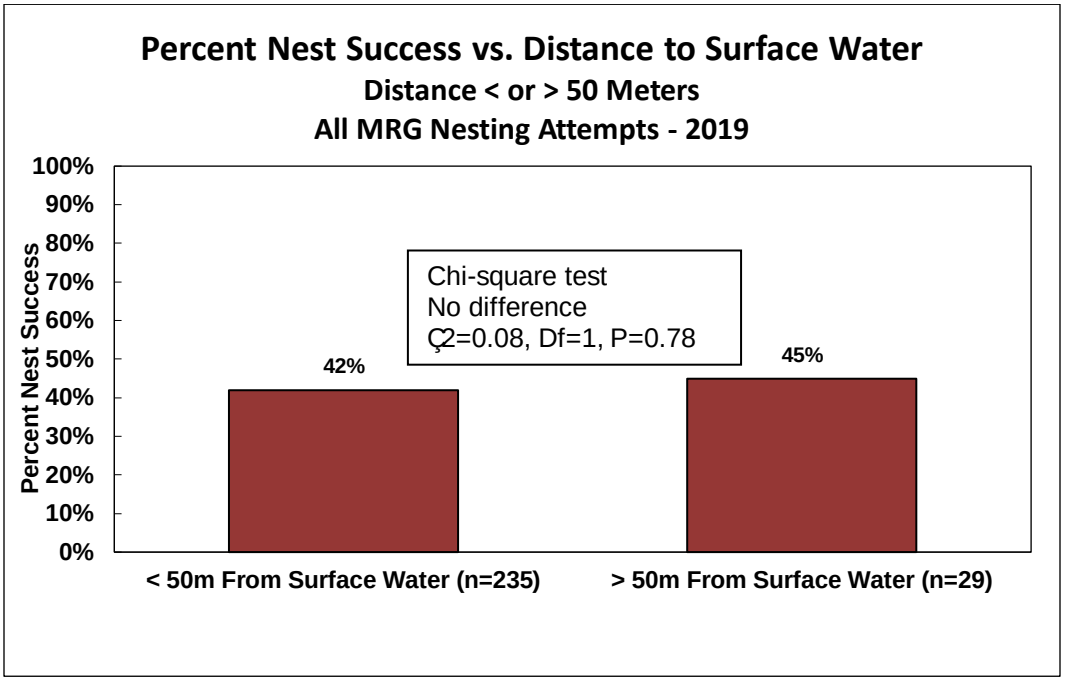


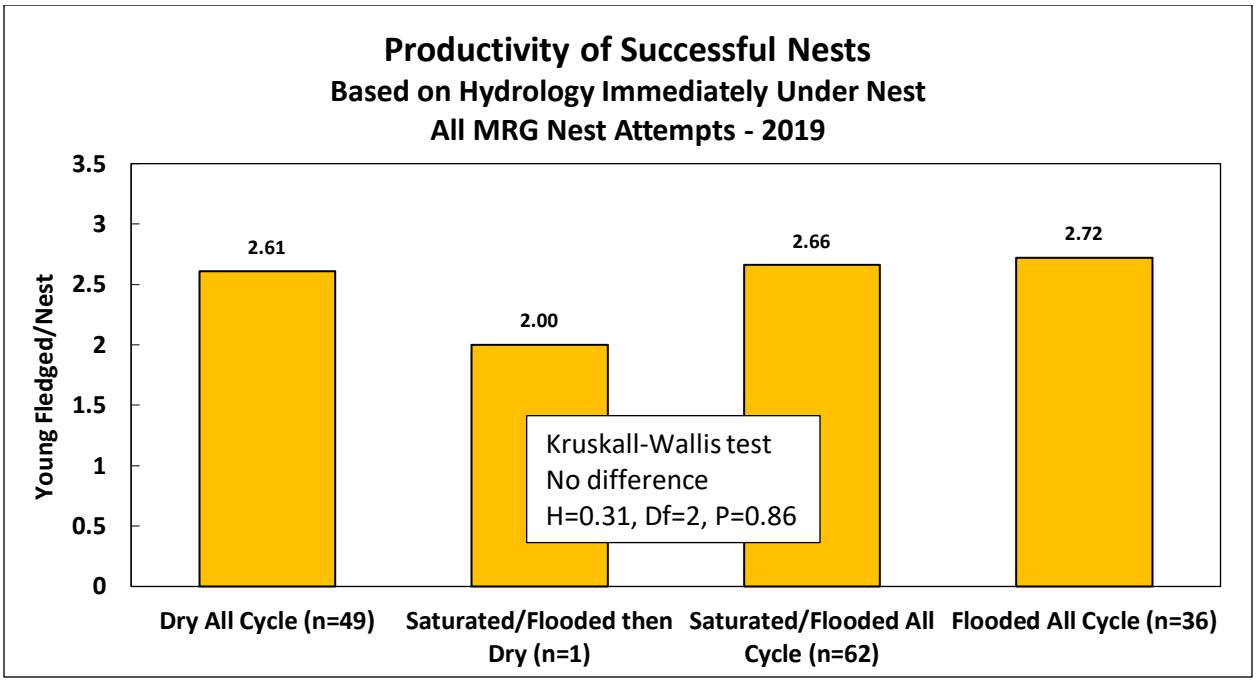


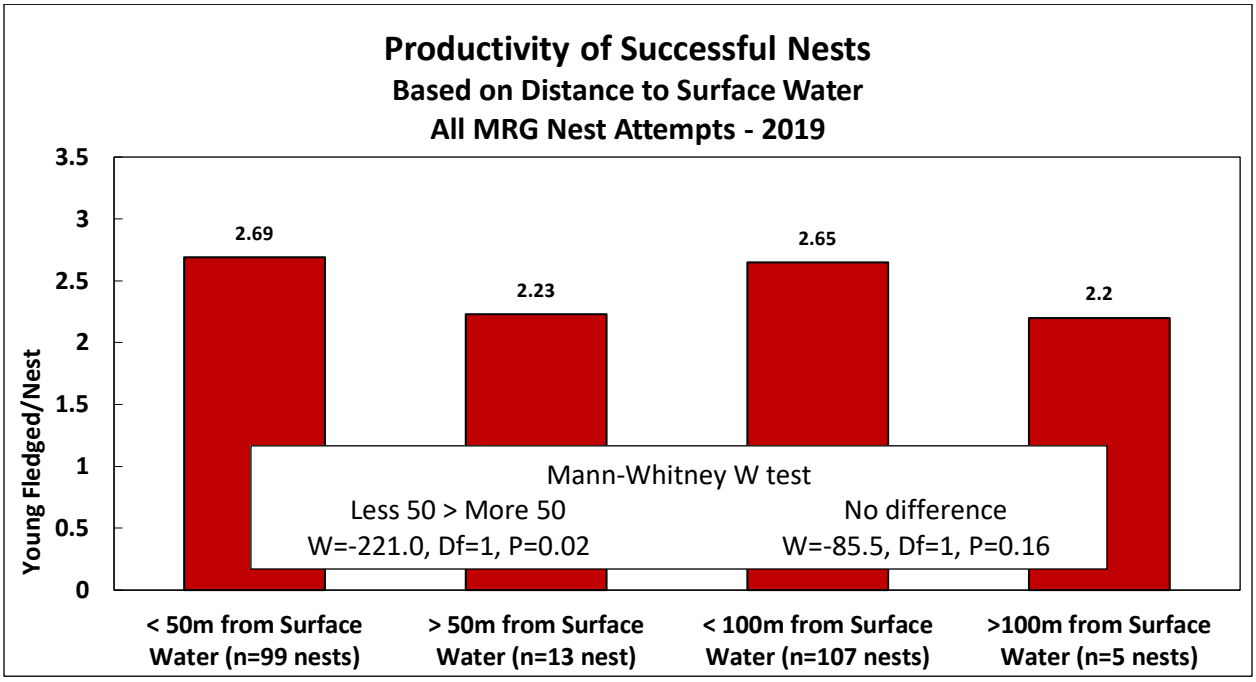

Parasitism Rates
Based On Hydrology Immediately Under Nest
All MRG Nesting Attempts - 2019
Percent Parastized Nests
20%
18%
16%
14%
12%
10%
8%
6%
4%
2%
0%
Not analyzed due to small sample sizes
3%
0%
2%
4%
Dry All Cycle (n=95)
Saturated/Flooded then Dry (n=7)
Saturated/Flooded All Cycle (n=162)
Flooded All Cycle (n=104)


Nest Success vs. Nest Attempt vs. Hydrology
Based on Hydrology Immediately Under Nest
All MRG Nesting Attempts - 2019
Perecnt Successful Nests
100%
80%
60%
40%
20%
0%
Chi-square tests
No difference
Ç2=0.03, Df=1, P=0.87
1st Attempts
2-4 Attempts
No difference
Ç2=1.16, Df=1, P=0.28
No difference
Ç2=0.08, Df=1, P=0.78
52%
50%
14%
0%
35%
44%
34%
37%
Dry All Cycle (1st:n=73, 2nd:n=22)
Saturated/Flooded then Dry (1st:n=7, 2nd:n=0)
Saturated/Flooded All Cycle (1st:n=105, 2nd:n=57)
Flooded All Cycle (1st:n=74, 2nd:n=30)

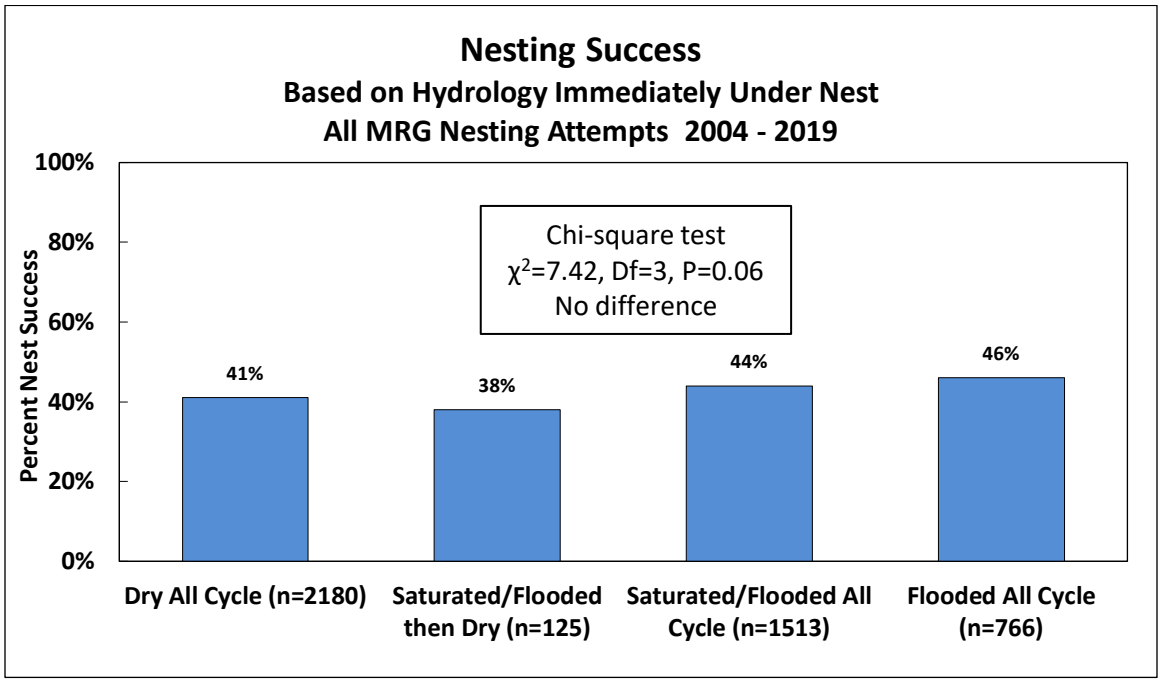

Percent Nest Success vs. Distance to Surface Water
Distance < or > 100 Meters
All MRG Nesting Attempts - 2019
100%
80%
60%
40%
20%
0%
Percent Nest Success
Chi-square test
No difference
Ç2=0.04, Df=1, P=0.84
42%
45%
< 100m From Surface Water (n=253)
> 100m From Surface Water (n=11)

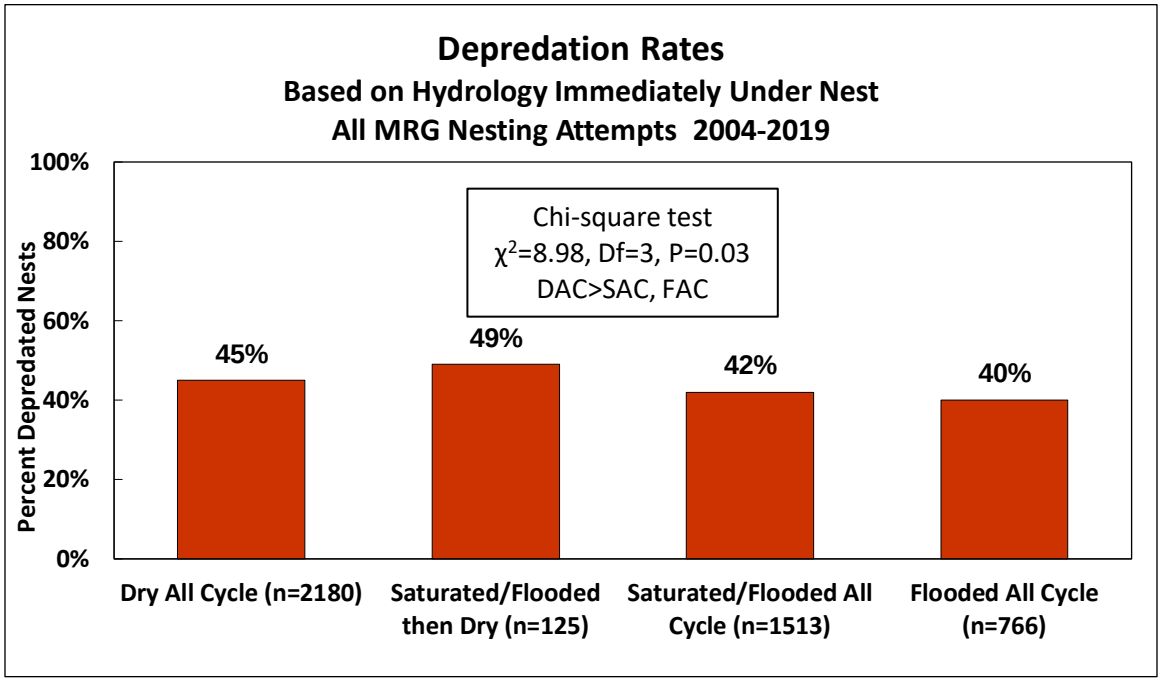

Percent Nest Success vs. Distance to Surface Water
Distance < or > 50 Meters
All MRG Nesting Attempts - 2019
100%
90%
80%
70%
60%
50%
40%
30%
20%
10%
0%
Percent Nest Success
Chi-square test
No difference
Ç2=0.08, Df=1, P=0.78
42%
45%
< 50m From Surface Water (n=235)
> 50m From Surface Water (n=29)

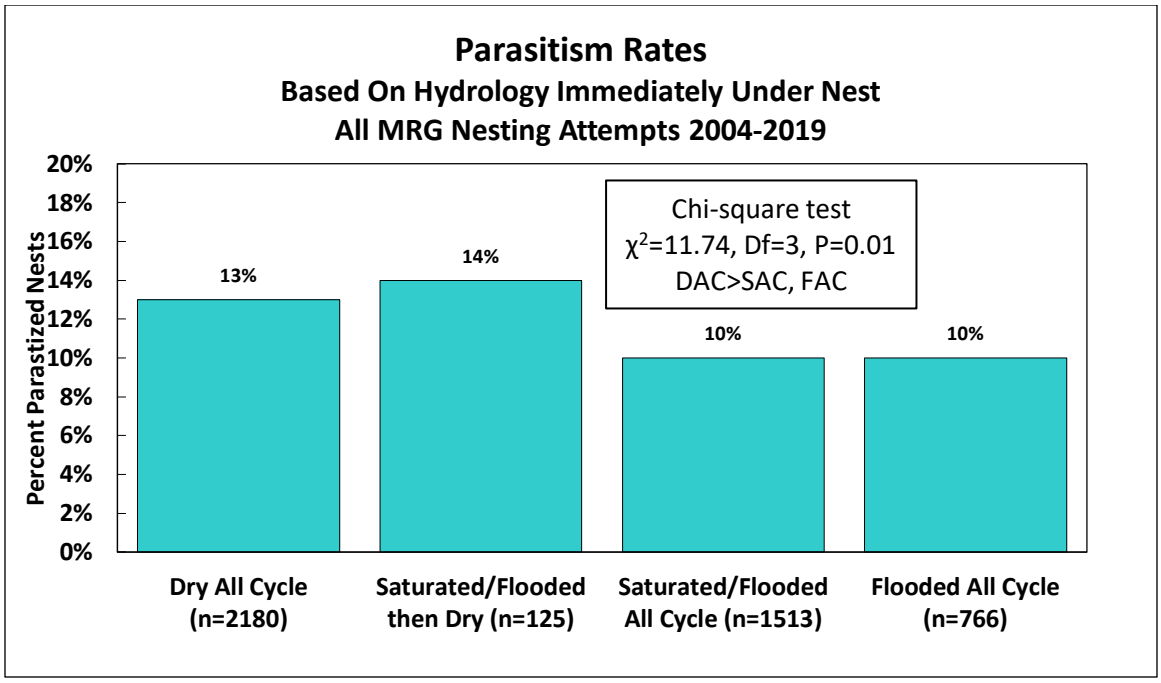

Productivity of Successful Nests
Based on Hydrology Immediately Under Nest
All MRG Nest Attempts - 2019
Young Fledged/Nest
3.5
3
2.5
2
1.5
1
0.5
0
2.61
2.00
2.66
2.72
Kruskall-Wallis test
No difference
H=0.31, Df=2, P=0.86
Dry All Cycle (n=49)
Saturated/Flooded then Dry (n=1)
Saturated/Flooded All Cycle (n=62)
Flooded All Cycle (n=36)

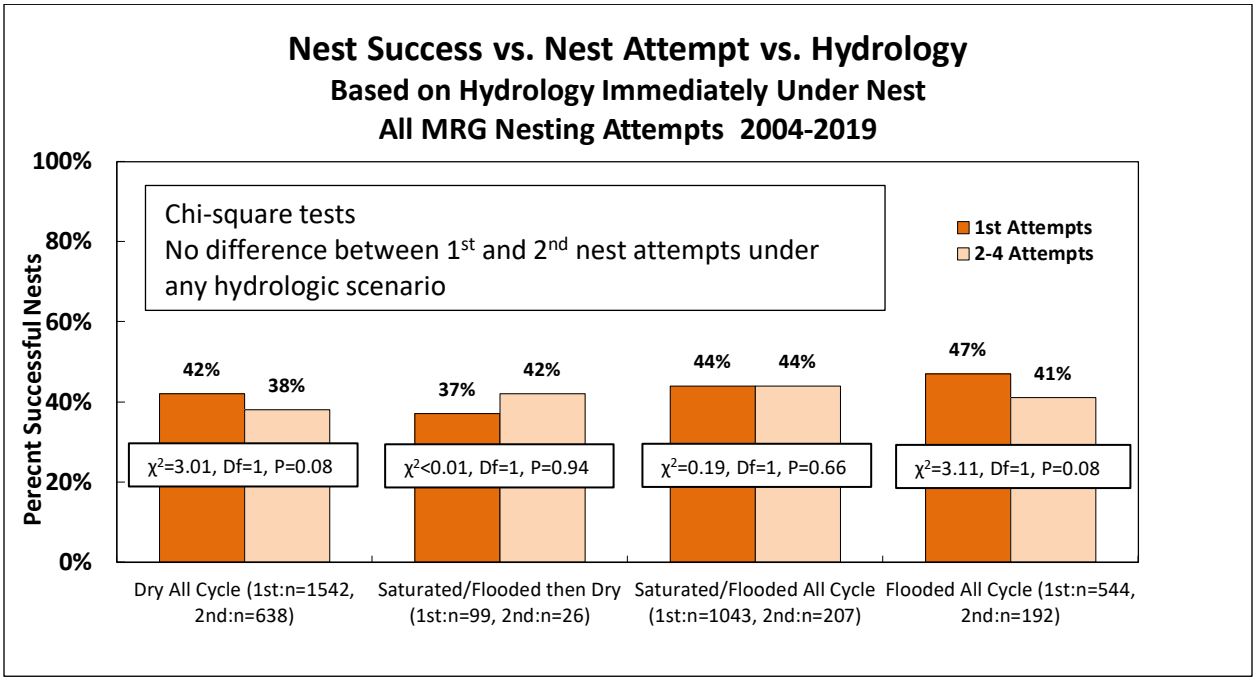

Productivity of Successful Nests
Based on Distance to Surface Water
All MRG Nest Attempts - 2019
Young Fledged/Nest
3.5
3
2.5
2
1.5
1
0.5
0
2.69
2.23
2.65
2.2
Mann-Whitney W test
Less 50 > More 50
W=-221.0, Df=1, P=0.02
No difference
W=-85.5, Df=1, P=0.16
< 50m from Surface Water (n=99 nests)
> 50m from Surface Water (n=13 nest)
< 100m from Surface Water (n=107 nests)
>100m from Surface Water (n=5 nests)

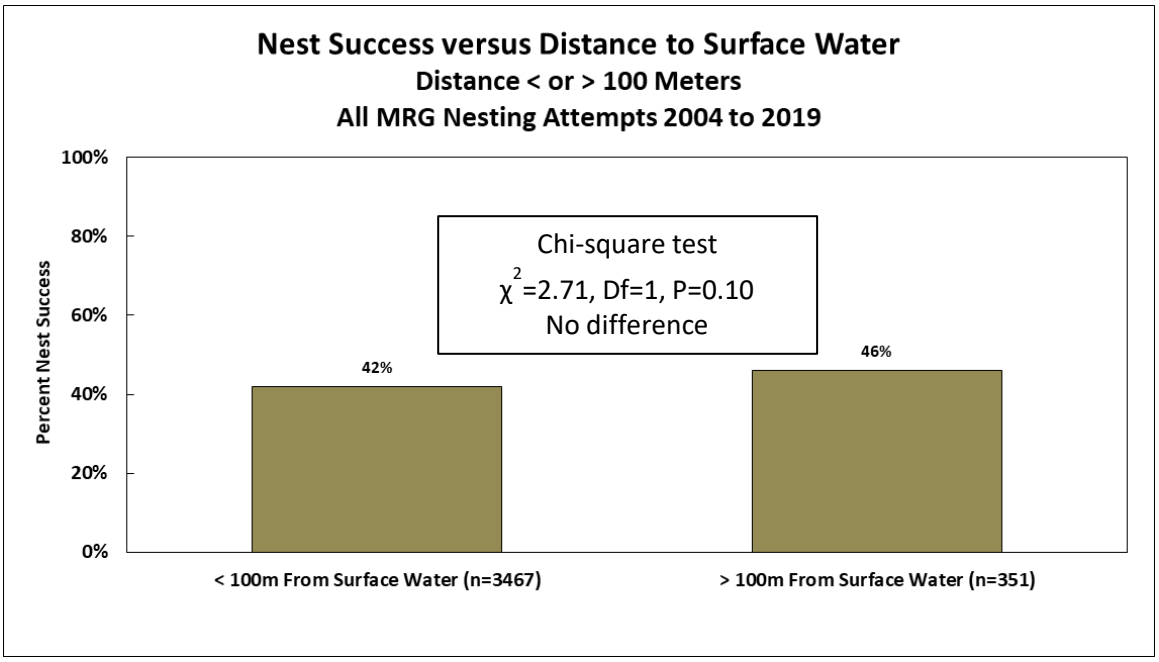
Nesting Variable and Hydrology Comparisons – All Middle Rio Grande Nests 2004 to 2019

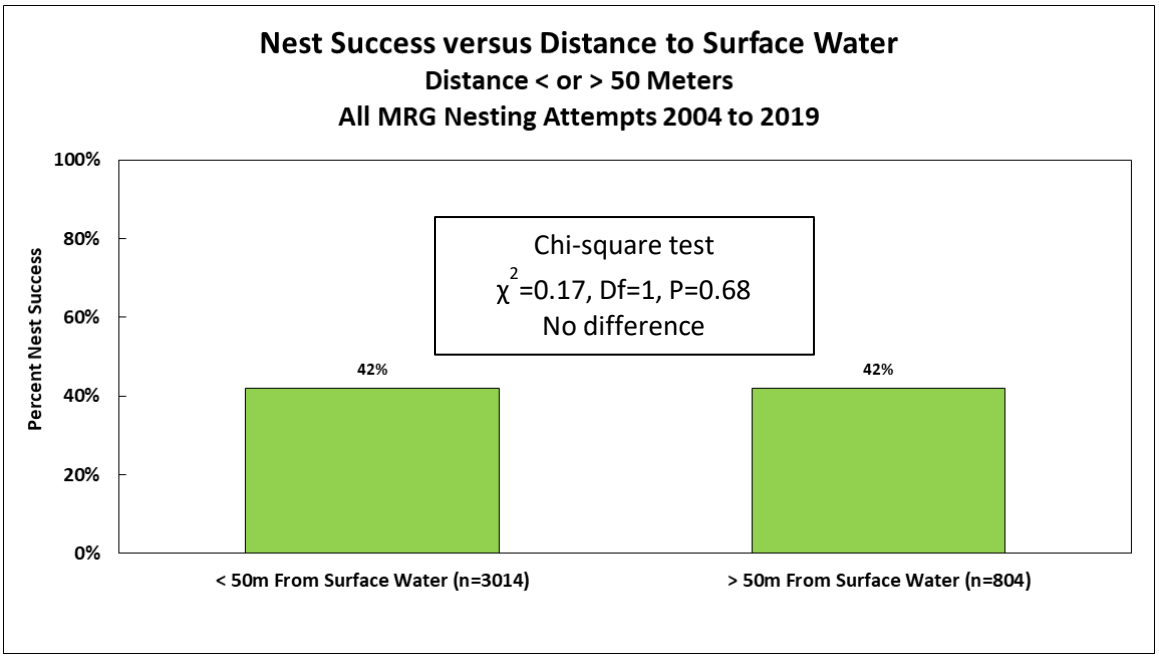


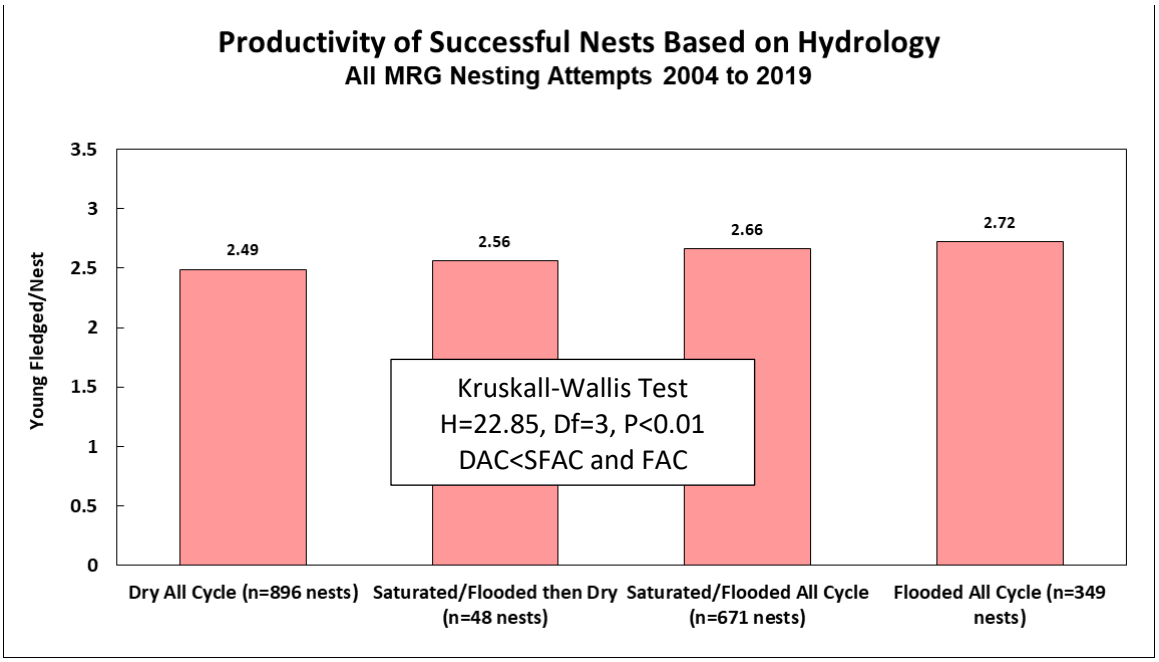


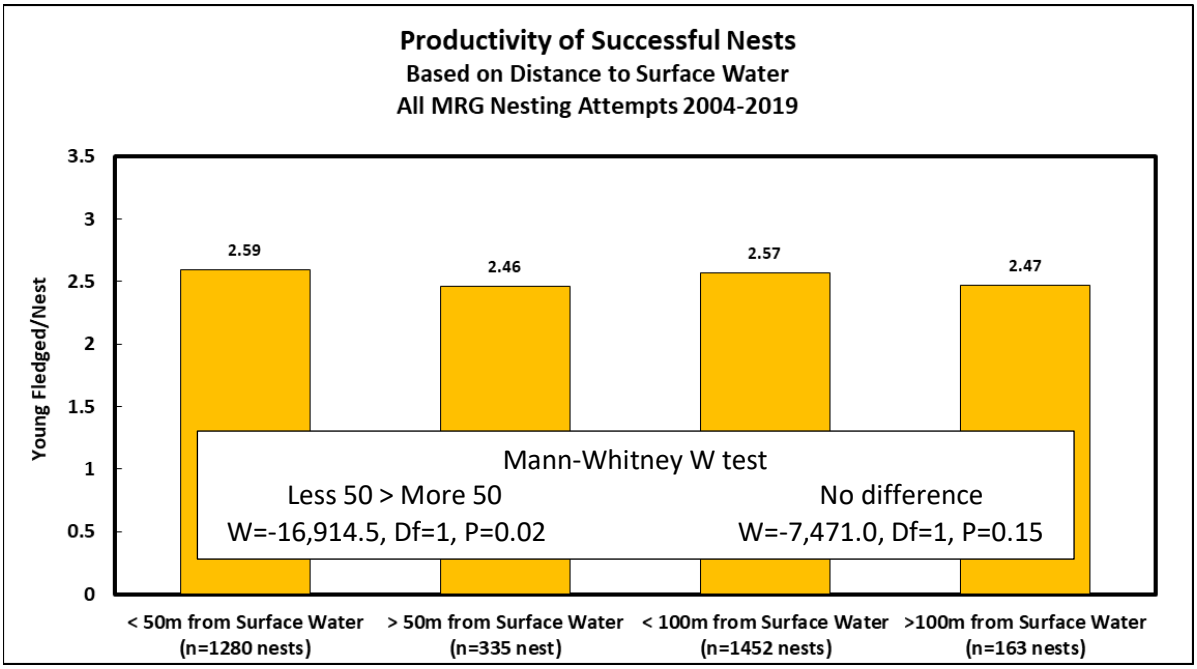

Parasitism Rates
Based On Hydrology Immediately Under Nest
All MRG Nesting Attempts 2004-2019
Percent Parastized Nests
20%
18%
16%
14%
12%
10%
8%
6%
4%
2%
0%
13%
14%
10%
10%
Chi-square test
χ2=11.74, Df=3, P=0.01
DAC>SAC, FAC
Dry All Cycle (n=2180)
Saturated/Flooded then Dry (n=125)
Saturated/Flooded All Cycle (n=1513)
Flooded All Cycle (n=766)

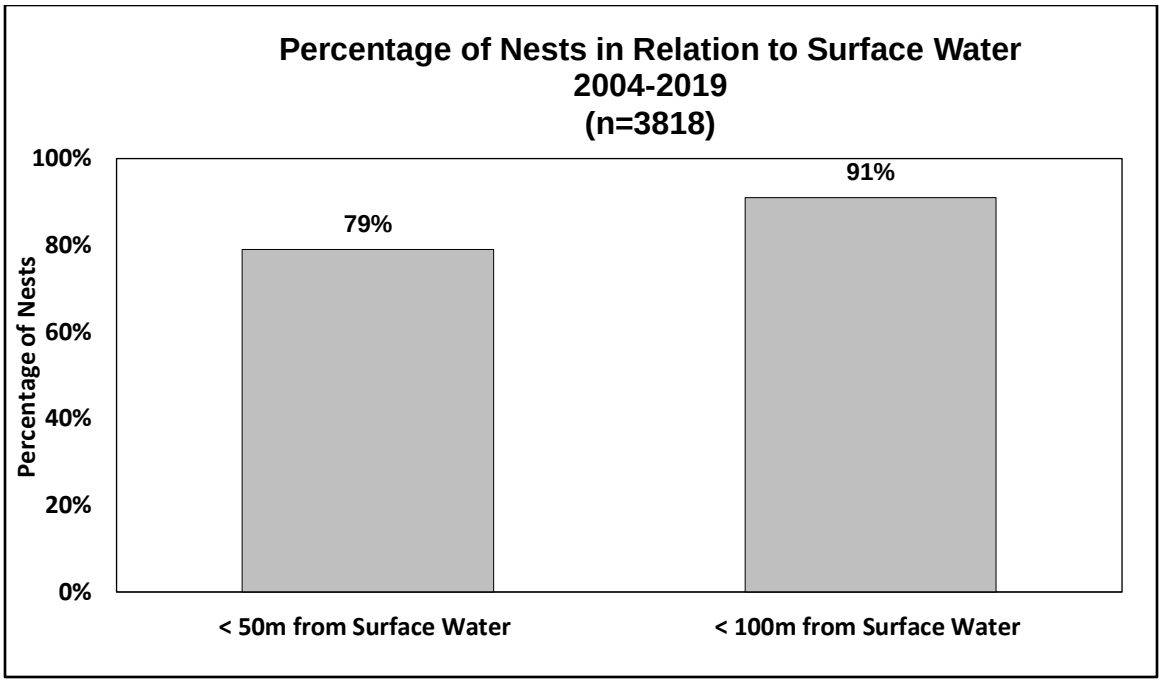

Nest Success vs. Nest Attempt vs. Hydrology
Based on Hydrology Immediately Under Nest
All MRG Nesting Attempts 2004-2019
Perecnt Successful Nests
100%
80%
60%
40%
20%
0%
Chi-square tests
No difference between 1st and 2nd nest attempts under any hydrologic scenario
1st Attempts
2-4 Attempts
42%
38%
37%
42%
44%
44%
47%
41%
χ2=3.01, Df=1, P=0.08
χ2<0.01, Df=1, P=0.94
χ2=0.19, Df=1, P=0.66
χ2=3.11, Df=1, P=0.08
Dry All Cycle (1st:n=1542, 2nd:n=638)
Saturated/Flooded then Dry (1st:n=99, 2nd:n=26)
Saturated/Flooded All Cycle (1st:n=1043, 2nd:n=207)
Flooded All Cycle (1st:n=544, 2nd:n=192)


Nest Success versus Distance to Surface Water
Distance < or > 100 Meters
All MRG Nesting Attempts 2004 to 2019
100%
80%
60%
40%
20%
0%
Percent Nest Success
Chi-square test
χ2=2.71, Df=1, P=0.10
No difference
42%
46%
< 100m From Surface Water (n=3467)
> 100m From Surface Water (n=351)

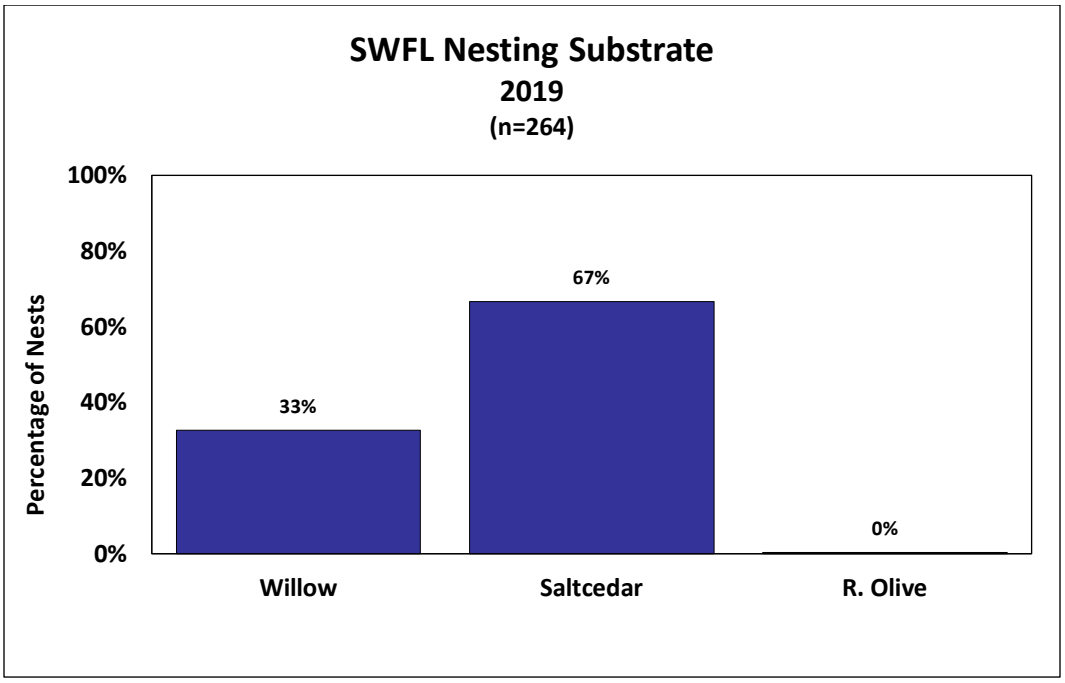

Nest Success versus Distance to Surface Water
Distance < or > 50 Meters
All MRG Nesting Attempts 2004 to 2019
100%
80%
60%
40%
20%
0%
Percent Nest Success
Chi-square test
χ2=0.17, Df=1, P=0.68
No difference
42%
42%
< 50m From Surface Water (n=3014)
> 50m From Surface Water (n=804)

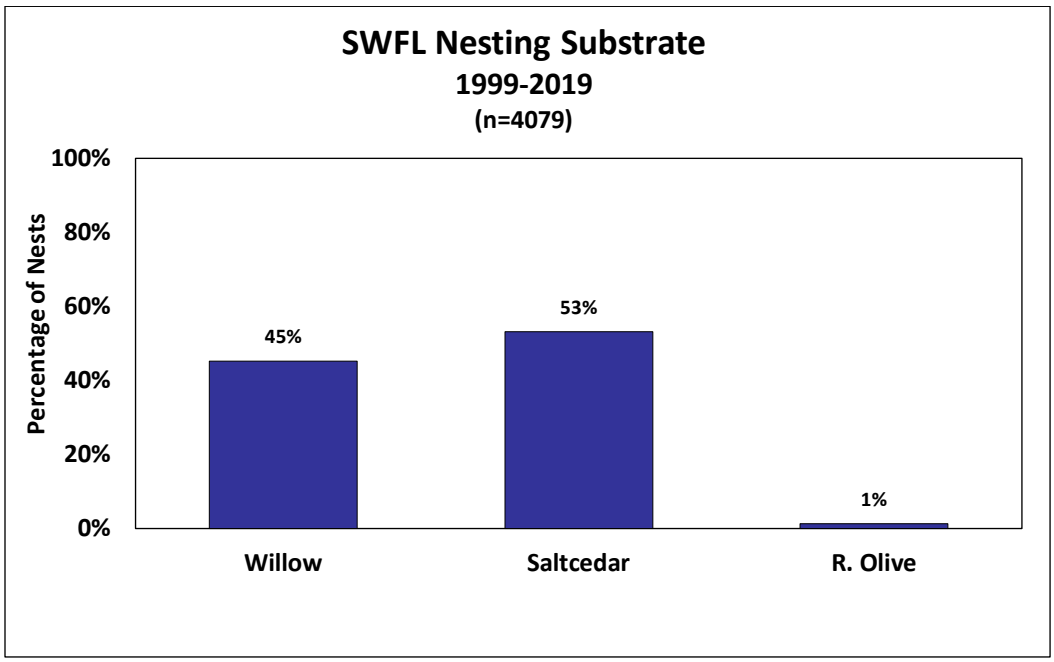

Productivity of Successful Nests Based on Hydrology
All MRG Nesting Attempts 2004 to 2019
Young Fledged/Nest
3.5
3
2.5
2
1.5
1
0.5
0
2.49
2.56
2.66
2.72
Kruskall-Wallis Test
H=22.85, Df=3, P<0.01
DAC<SFAC and FAC
Dry All Cycle (n=896 nests)
Saturated/Flooded then Dry (n=48 nests)
Saturated/Flooded All Cycle (n=671 nests)
Flooded All Cycle (n=349 nests)

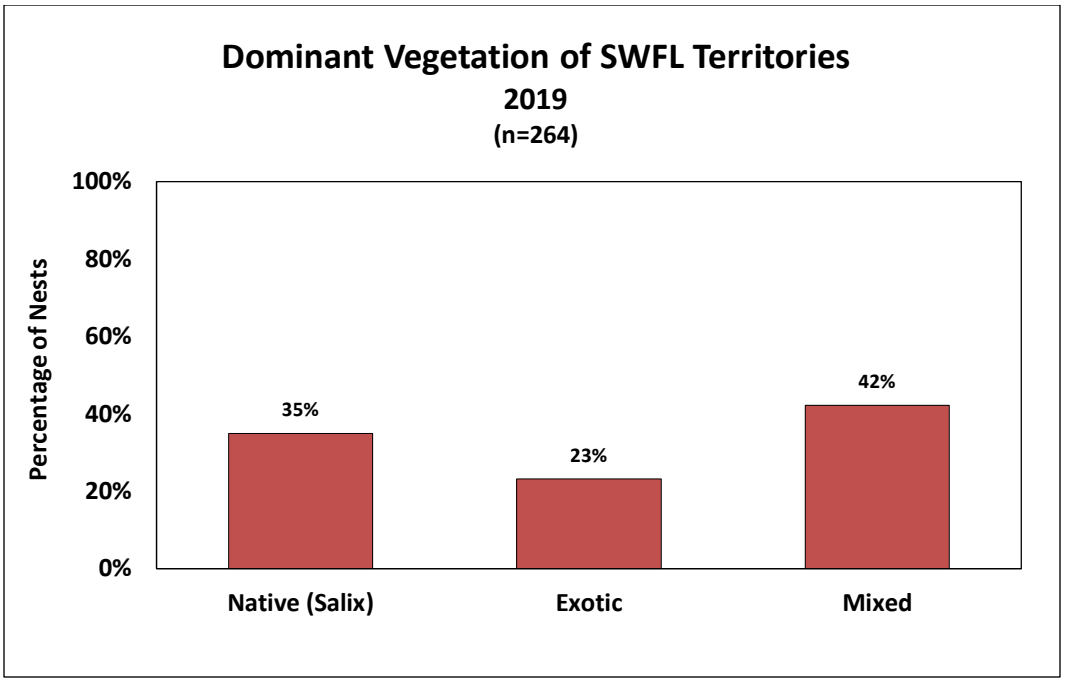

Productivity of Successful Nests
Based on Distance to Surface Water
All MRG Nesting Attempts 2004-2019
Young Fledged/Nest
3.5
3
2.5
2
1.5
1
0.5
0
2.59
2.46
2.57
2.47
Mann-Whitney W test
Less 50 > More 50
W=-16,914.5, Df=1, P=0.02
No difference
W=-7,471.0, Df=1, P=0.15
< 50m from Surface Water (n=1280 nests)
> 50m from Surface Water (n=335 nest)
< 100m from Surface Water (n=1452 nests)
>100m from Surface Water (n=163 nests)

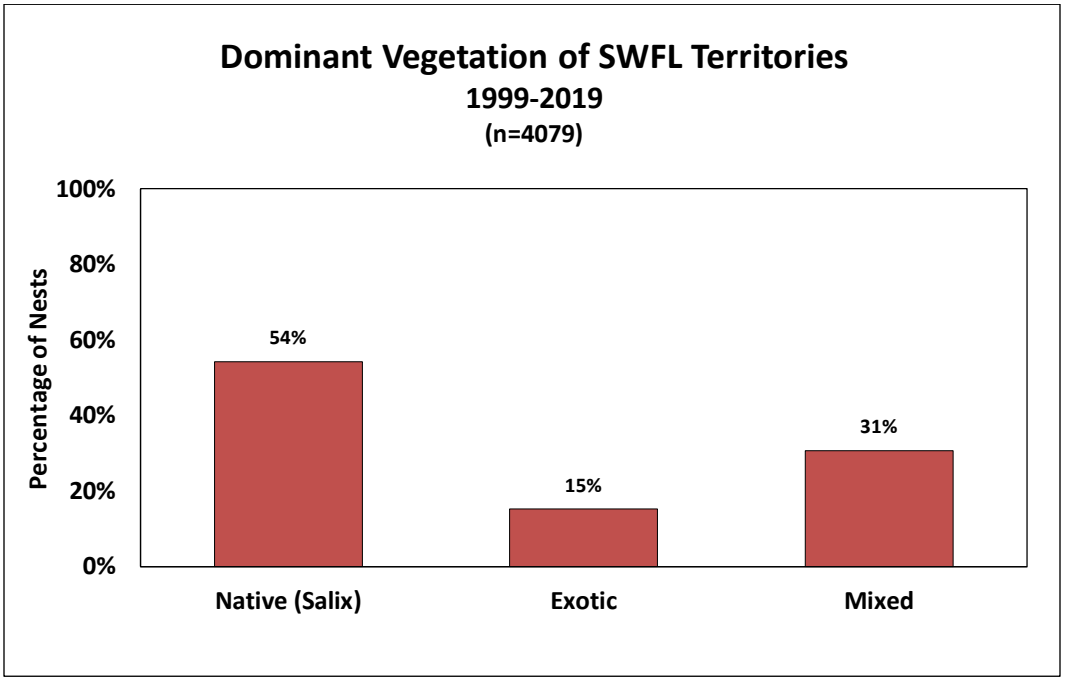

Percentage of Nests in Relation to Surface Water
2004-2019
(n=3818)
100%
80%
60%
40%
20%
0%
Percentage of Nests
79%
91%
< 50m from Surface Water
< 100m from Surface Water

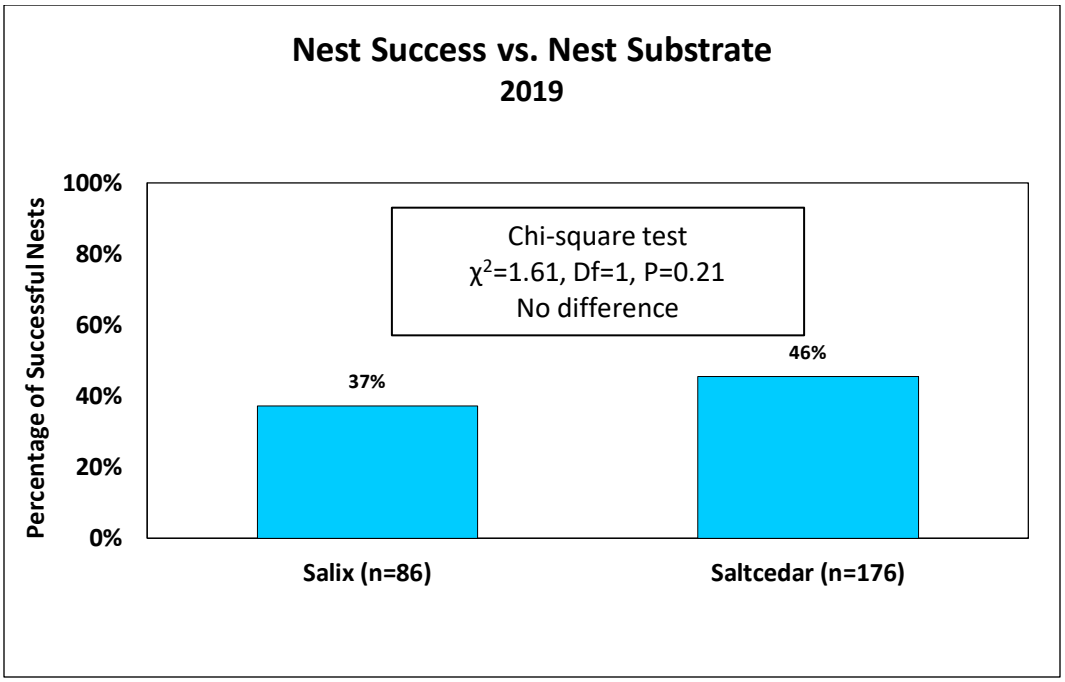
Nesting Variable and Habitat Comparisons – All Middle Rio Grande Nests

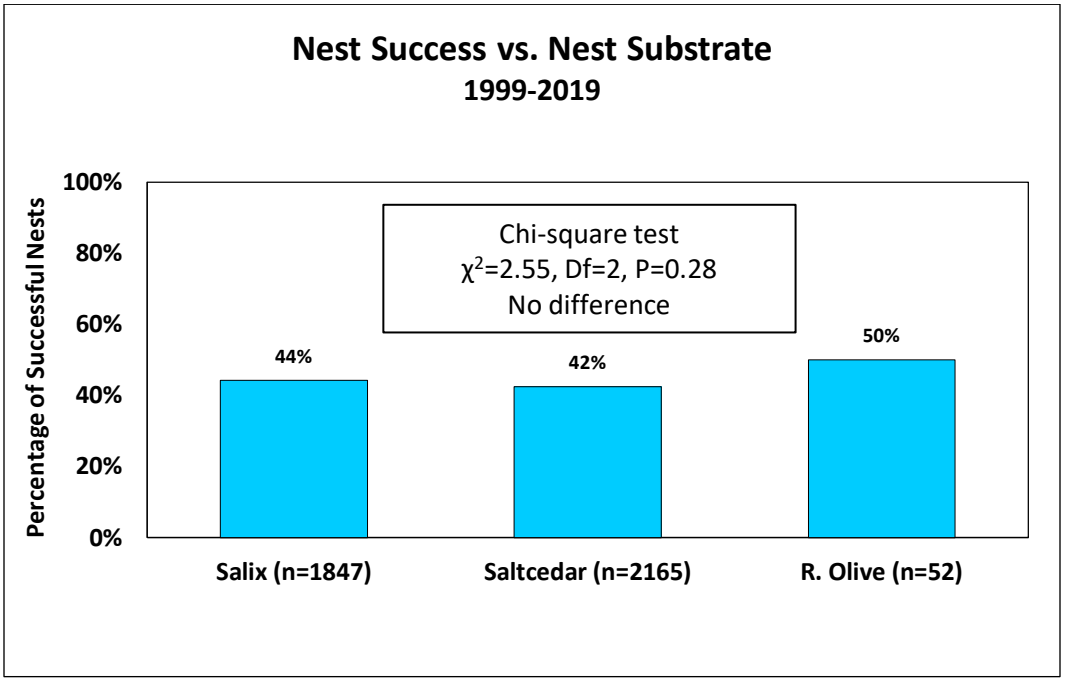


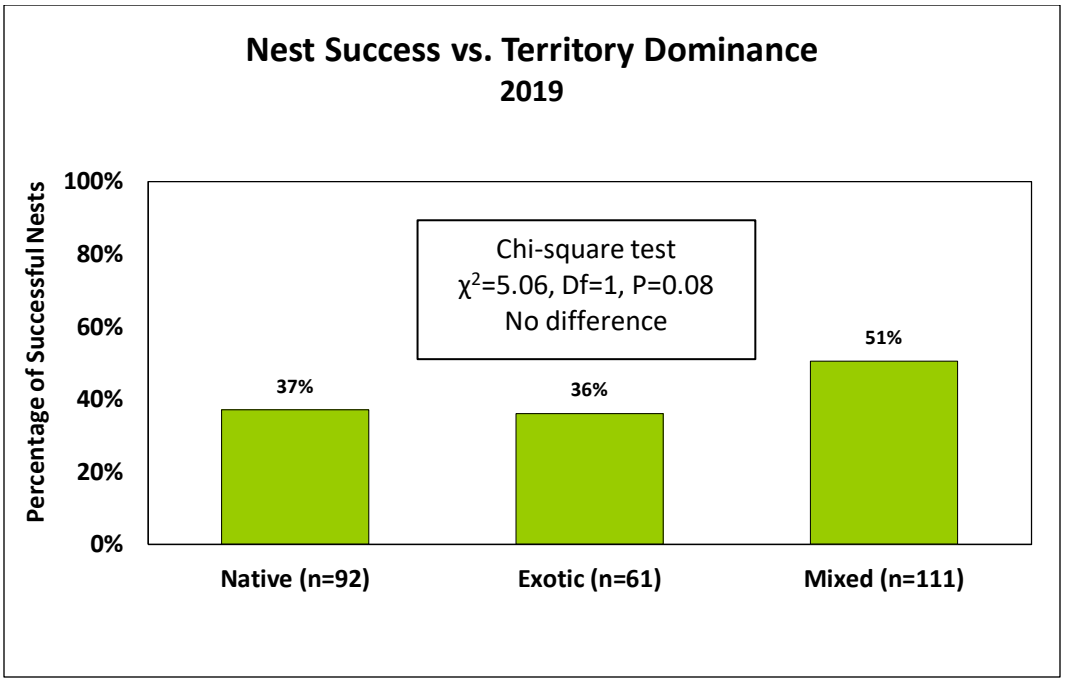


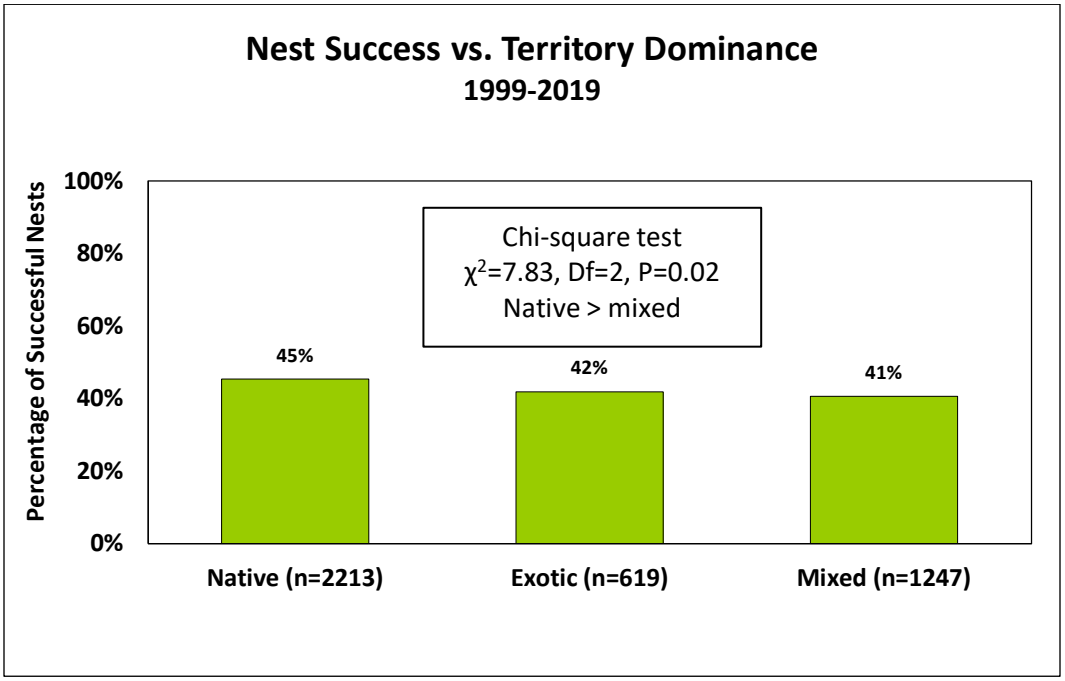

Dominant Vegetation of SWFL Territories
2019
(n=264)
Percentage of Nests
100%
80%
60%
40%
20%
0%
35%
23%
42%
Native (Salix)
Exotic
Mixed

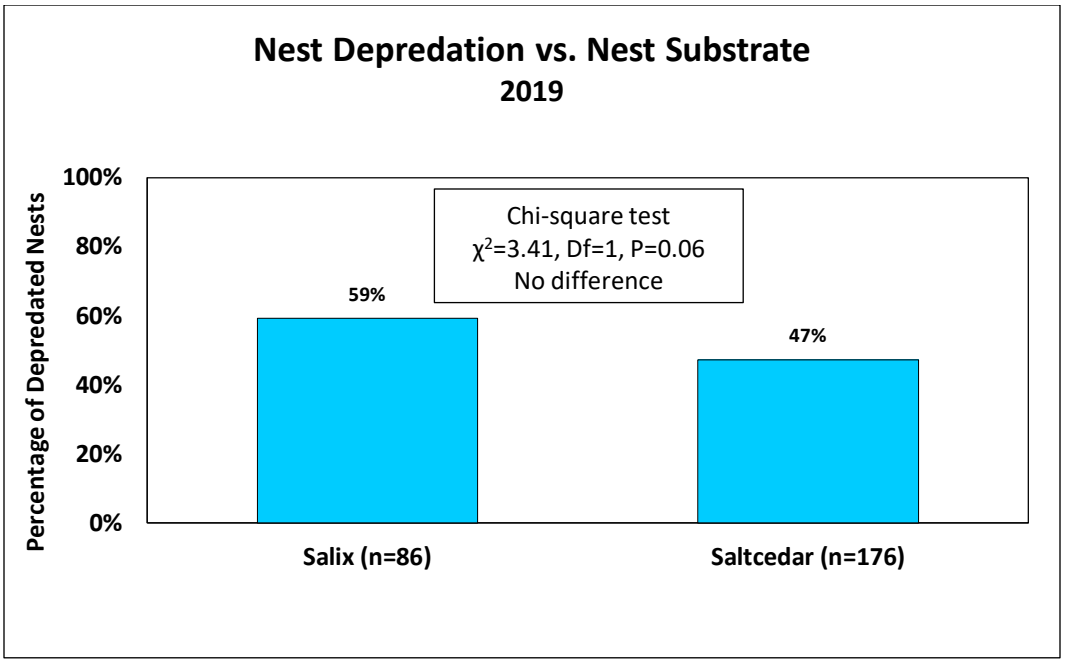

Dominant Vegetation of SWFL Territories
1999-2019
(n=4079)
Percentage of Nests
100%
80%
60%
40%
20%
0%
54%
15%
31%
Native (Salix)
Exotic
Mixed

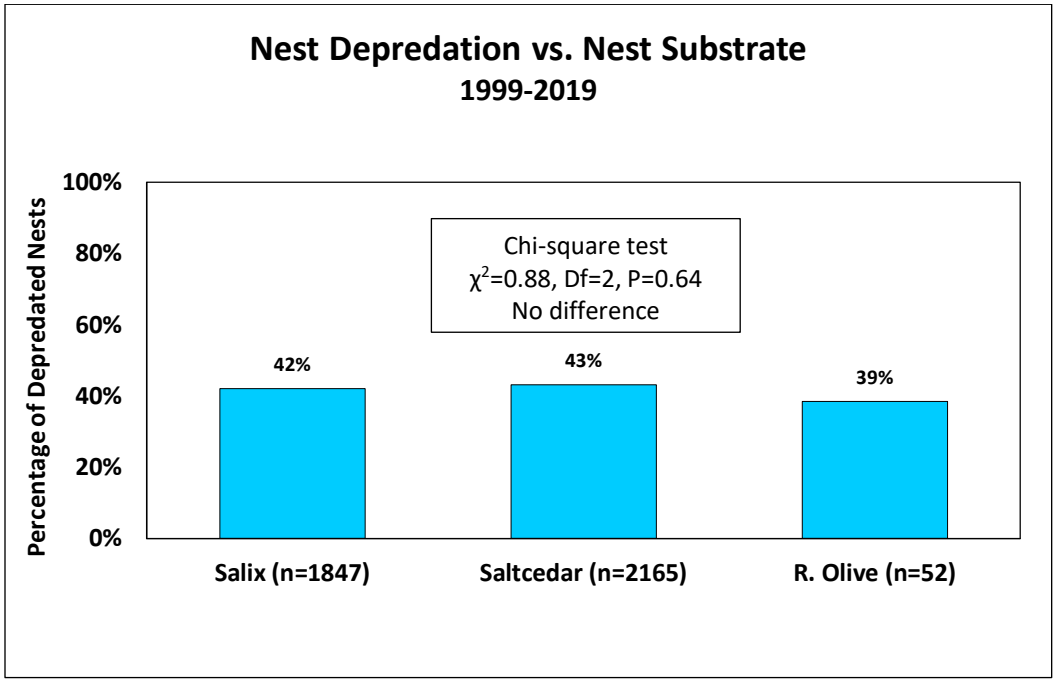

Nest Success vs. Nest Substrate
2019
Percentage of Successful Nests
100%
80%
60%
40%
20%
0%
Chi-square test
χ2=1.61, Df=1, P=0.21
No difference
37%
46%
Salix (n=86)
Saltcedar (n=176)

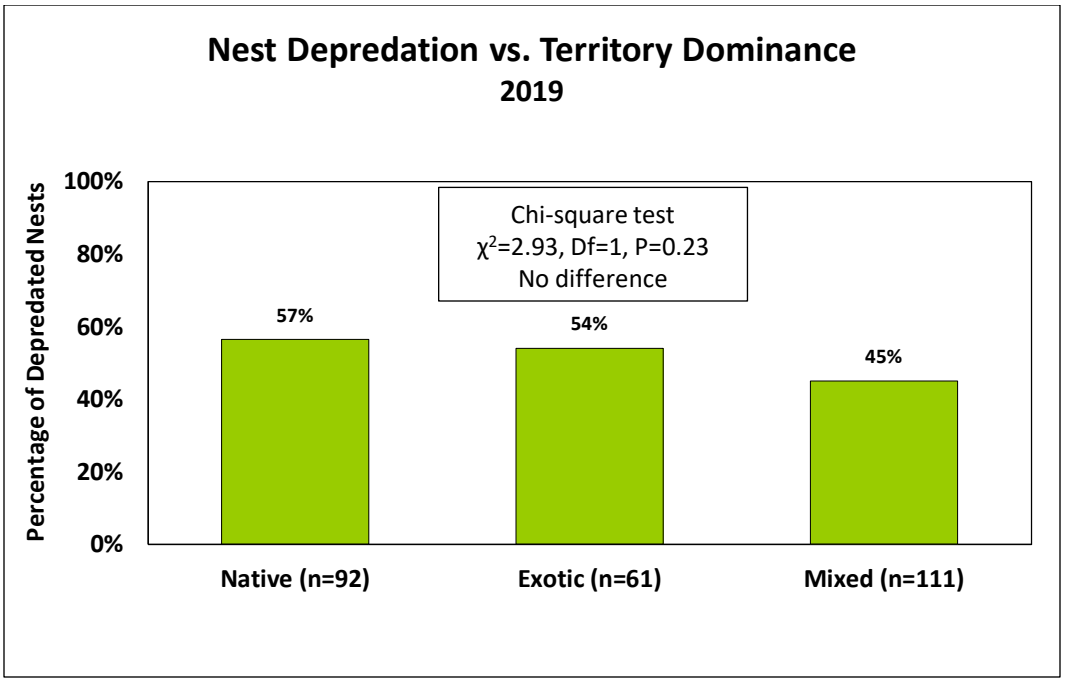

Nest Success vs. Nest Substrate
1999-2019
Percentage of Successful Nests
100%
80%
60%
40%
20%
0%
Chi-square test
χ2=2.55, Df=2, P=0.28
No difference
44%
42%
50%
Salix (n=1847)
Saltcedar (n=2165)
R. Olive (n=52)

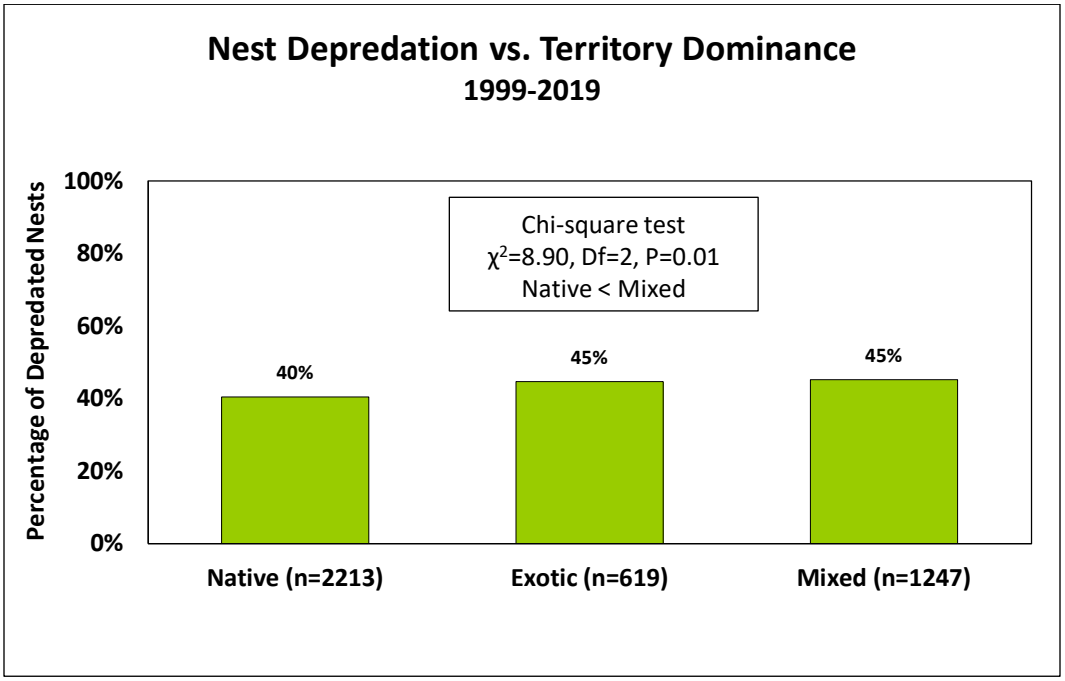

Nest Success vs. Territory Dominance
2019
Percentage of Successful Nests
100%
80%
60%
40%
20%
0%
Chi-square test
χ2=5.06, Df=1, P=0.08
No difference
37%
36%
51%
Native (n=92)
Exotic (n=61)
Mixed (n=111)

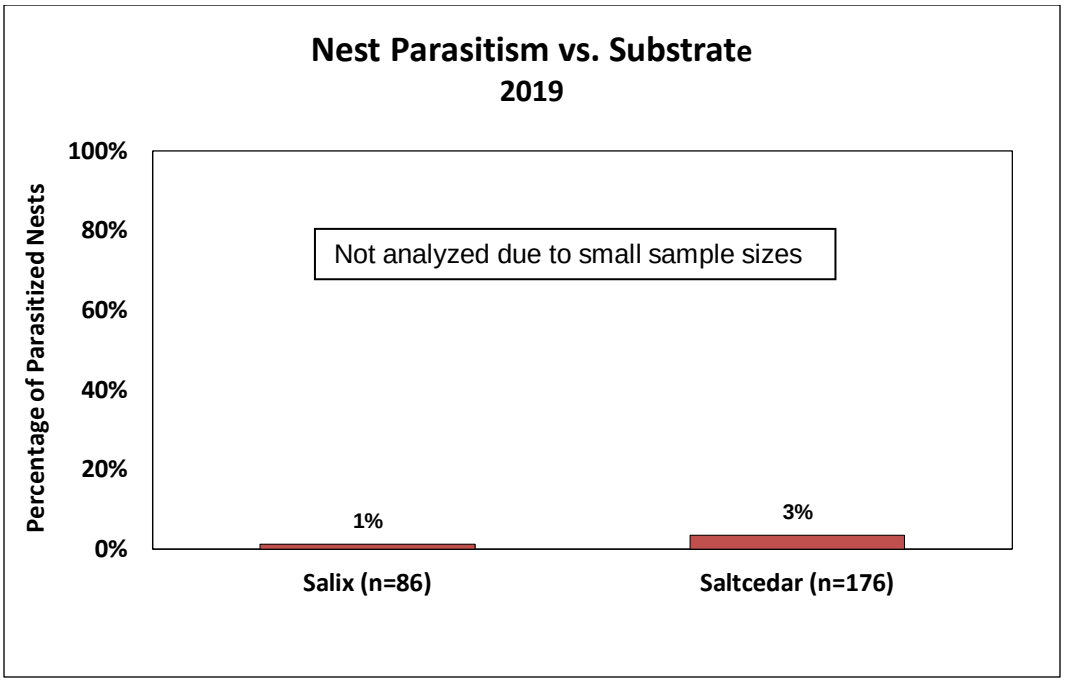

Nest Success vs. Territory Dominance
1999-2019
Percentage of Successful Nests
100%
80%
60%
40%
20%
0%
Chi-square test
χ2=7.83, Df=2, P=0.02
Native > mixed
45%
42%
41%
Native (n=2213)
Exotic (n=619)
Mixed (n=1247)

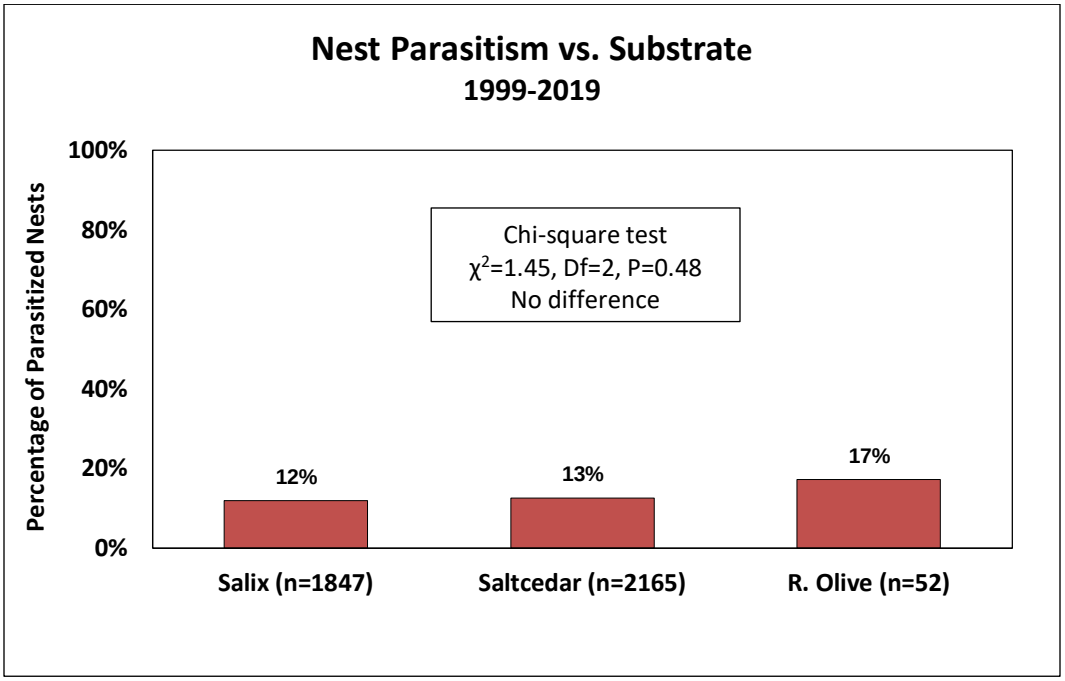

Nest Depredation vs. Nest Substrate
2019
Percentage of Depredated Nests
100%
80%
60%
40%
20%
0%
Chi-square test
χ²=3.41, Df=1, P=0.06
No difference
59%
47%
Salix (n=86)
Saltcedar (n=176)

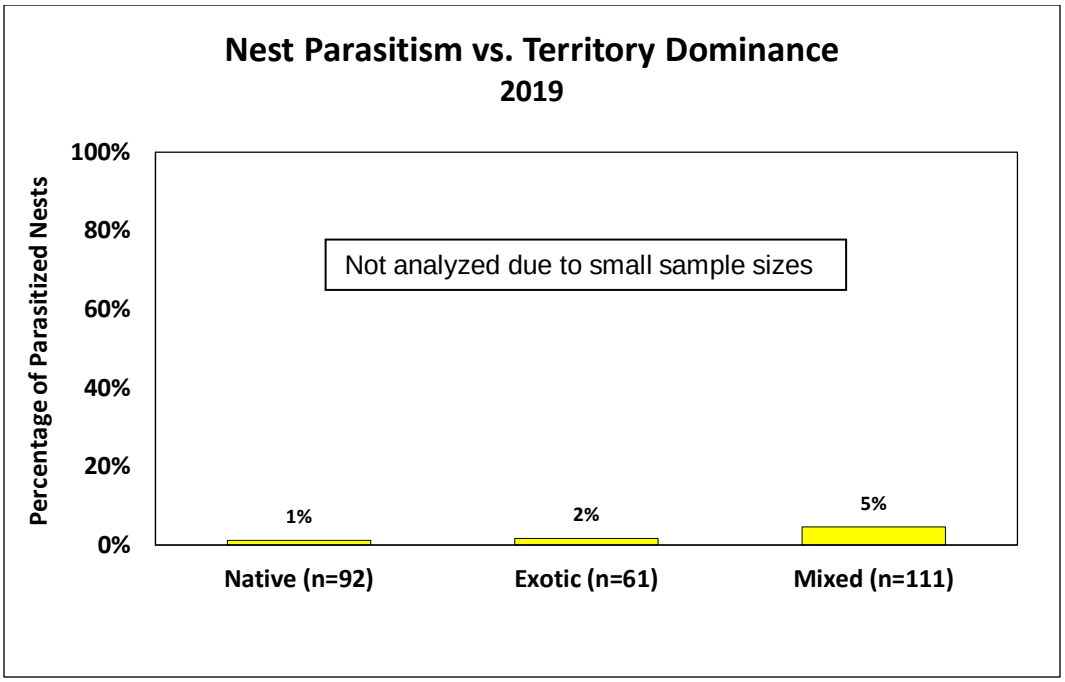

Nest Depredation vs. Nest Substrate
1999-2019
Percentage of Depredated Nests
100%
80%
60%
40%
20%
0%
Chi-square test
χ²=0.88, Df=2, P=0.64
No difference
42%
43%
39%
Salix (n=1847)
Saltcedar (n=2165)
R. Olive (n=52)

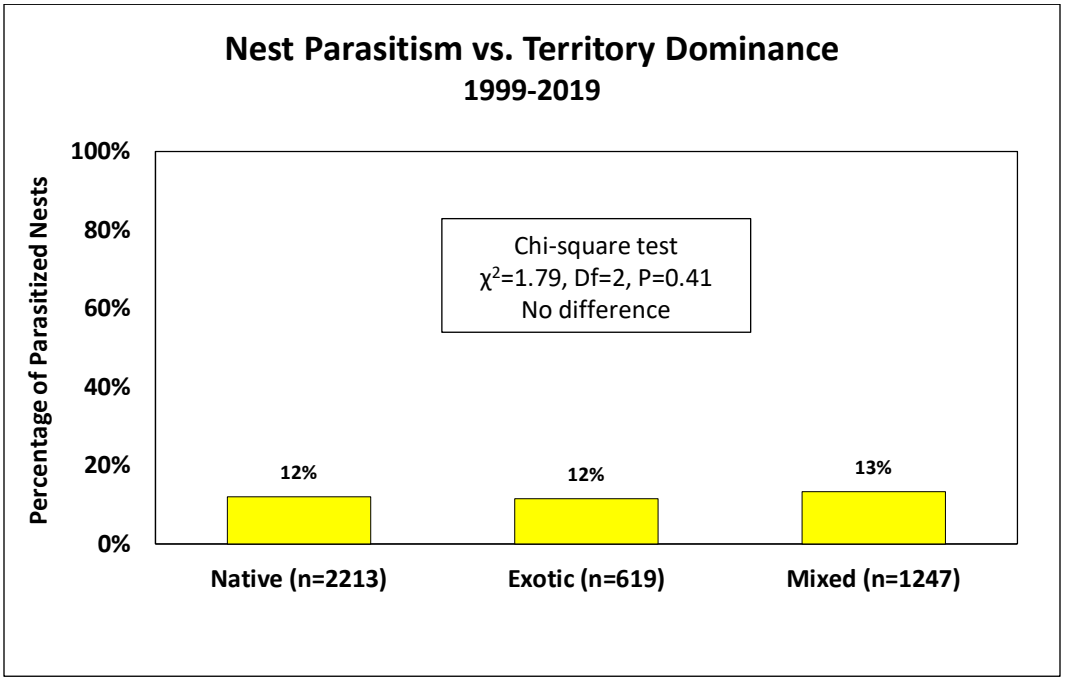

Nest Depredation vs. Territory Dominance
2019
Percentage of Depredated Nests
100%
80%
60%
40%
20%
0%
Chi-square test
χ²=2.93, Df=1, P=0.23
No difference
57%
54%
45%
Native (n=92)
Exotic (n=61)
Mixed (n=111)

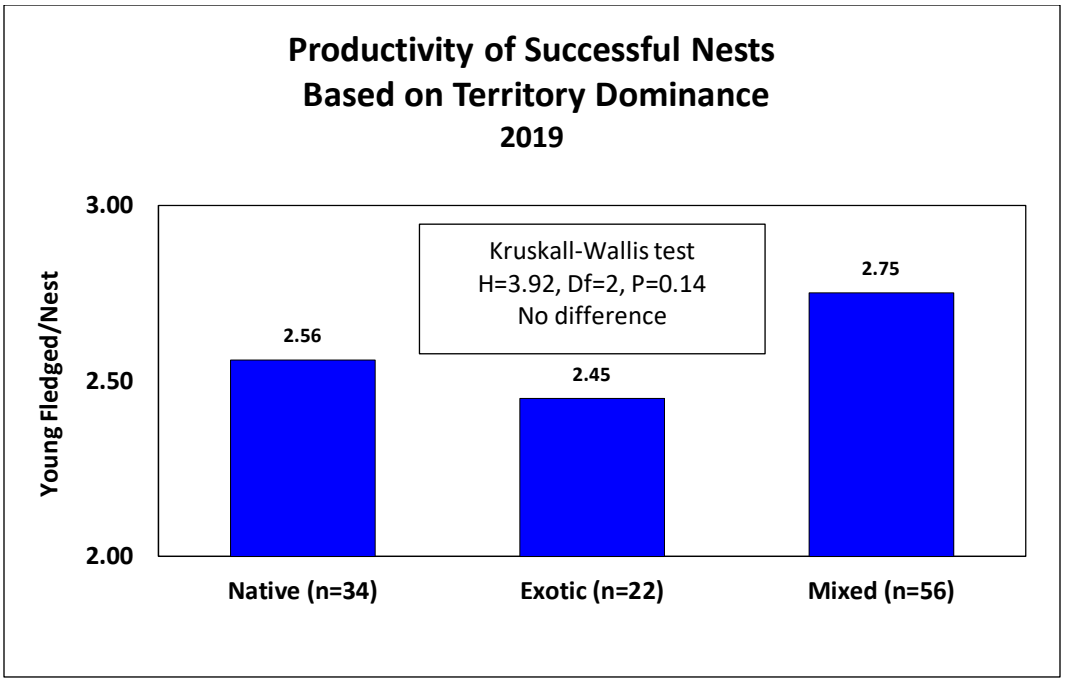

Nest Depredation vs. Territory Dominance
1999-2019
Percentage of Depredated Nests
100%
80%
60%
40%
20%
0%
Chi-square test
χ²=8.90, Df=2, P=0.01
Native < Mixed
40%
45%
45%
Native (n=2213)
Exotic (n=619)
Mixed (n=1247)

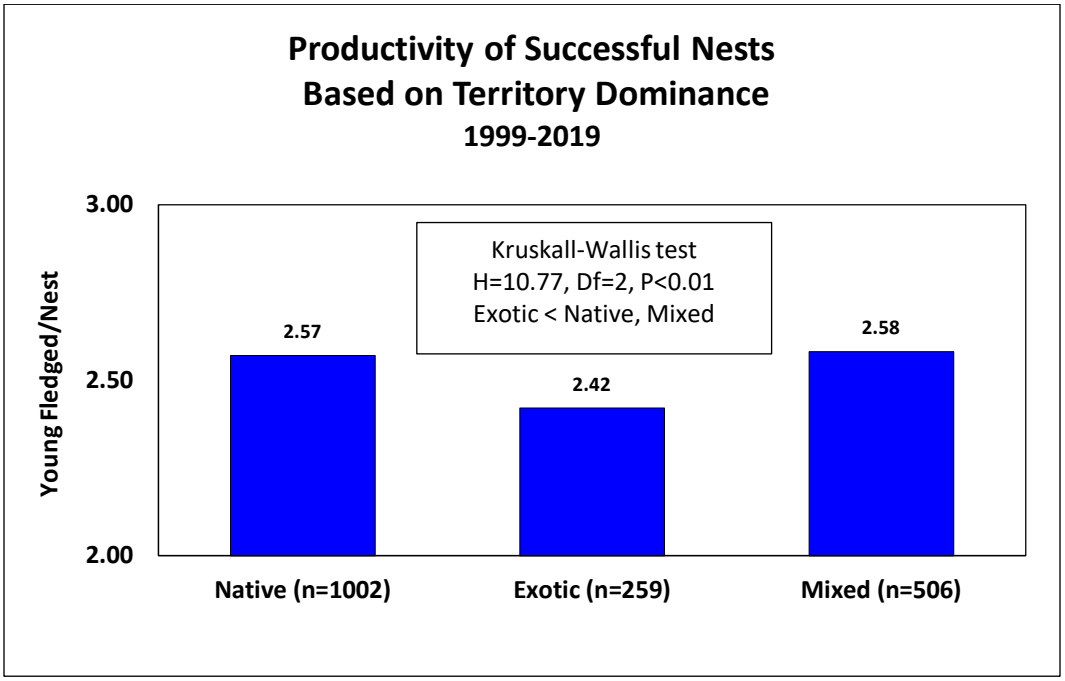

Nest Parasitism vs. Substrate
2019
Percentage of Parasitized Nests
100%
80%
60%
40%
20%
0%
Not analyzed due to small sample sizes
1%
3%
Salix (n=86)
Saltcedar (n=176)

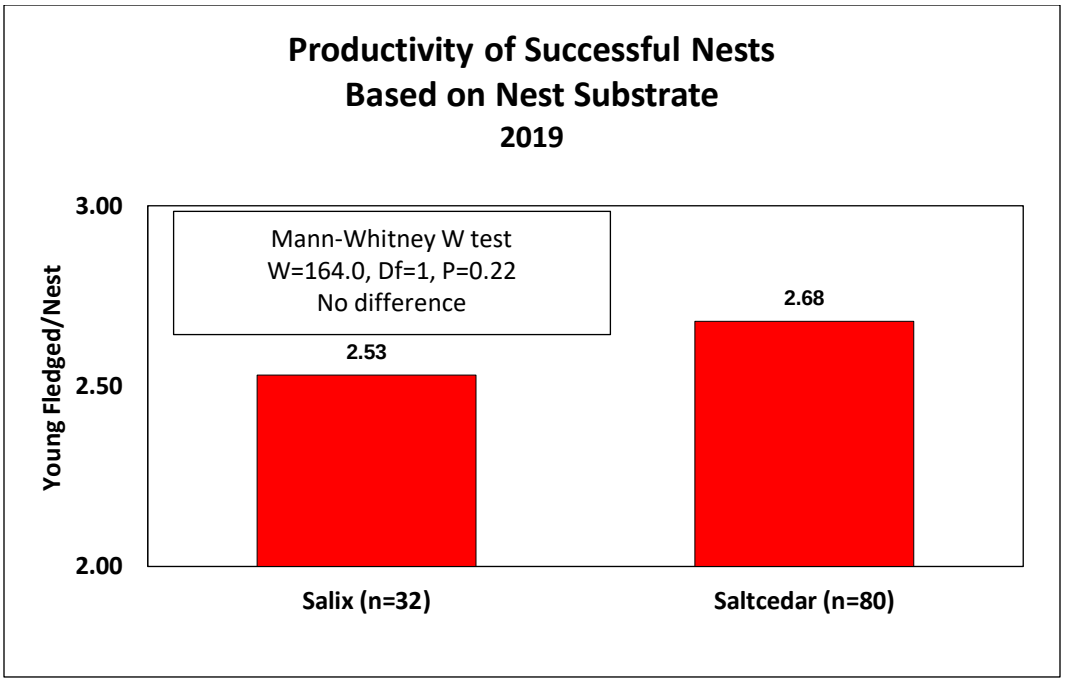

Nest Parasitism vs. Substrate
1999-2019
Percentage of Parasitized Nests
100%
80%
60%
40%
20%
0%
Chi-square test
χ2=1.45, Df=2, P=0.48
No difference
12%
13%
17%
Salix (n=1847)
Saltcedar (n=2165)
R. Olive (n=52)

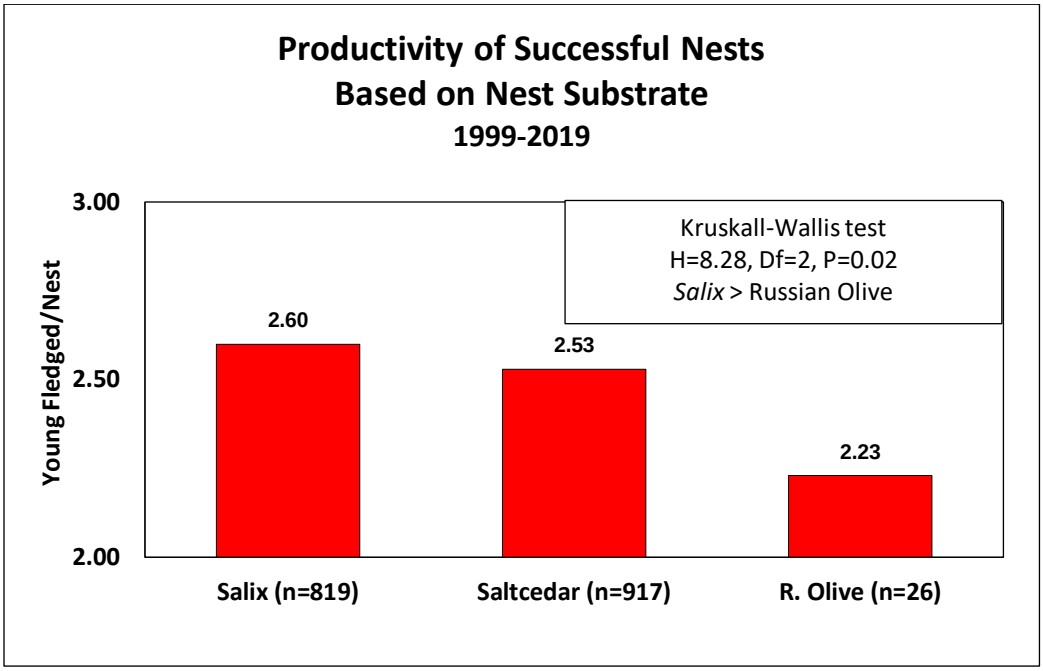

Nest Parasitism vs. Territory Dominance
2019
Percentage of Parasitized Nests
100%
80%
60%
40%
20%
0%
Not analyzed due to small sample sizes
1%
2%
5%
Native (n=92)
Exotic (n=61)
Mixed (n=111)


Nest Parasitism vs. Territory Dominance
1999-2019
Percentage of Parasitized Nests
100%
80%
60%
40%
20%
0%
Chi-square test
χ2=1.79, Df=2, P=0.41
No difference
12%
12%
13%
Native (n=2213)
Exotic (n=619)
Mixed (n=1247)

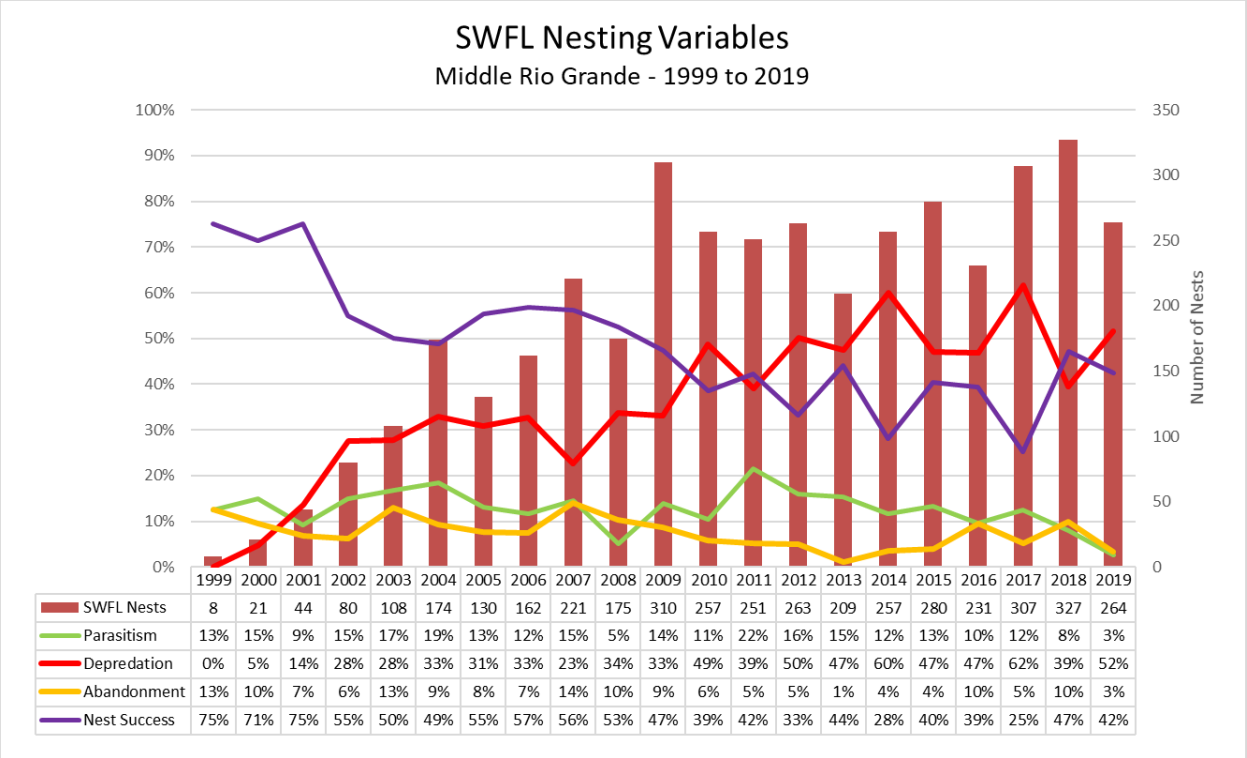

Productivity of Successful Nests
Based on Territory Dominance
2019
Young Fledged/Nest
3.00
2.50
2.00
Kruskall-Wallis test
H=3.92, Df=2, P=0.14
No difference
2.56
2.45
2.75
Native (n=34)
Exotic (n=22)
Mixed (n=56)


Productivity of Successful Nests
Based on Territory Dominance
1999-2019
Young Fledged/Nest
3.00
2.50
2.00
Kruskall-Wallis test
H=10.77, Df=2, P<0.01
Exotic < Native, Mixed
2.57
2.42
2.58
Native (n=1002)
Exotic (n=259)
Mixed (n=506)

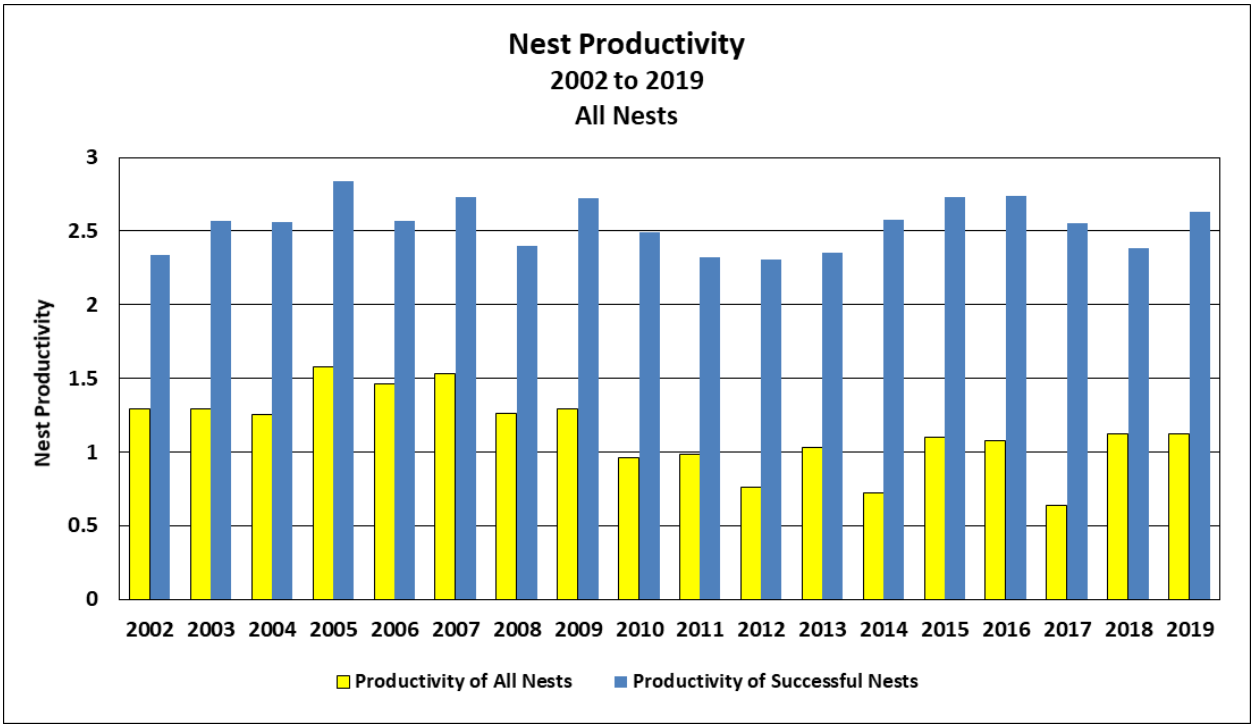

Productivity of Successful Nests
Based on Nest Substrate
2019
Young Fledged/Nest
3.00
2.50
2.00
Mann-Whitney W test
W=164.0, Df=1, P=0.22
No difference
2.53
2.68
Salix (n=32)
Saltcedar (n=80)


Productivity of Successful Nests
Based on Nest Substrate
1999-2019
Young Fledged/Nest
3.00
2.50
2.00
Kruskall-Wallis test
H=8.28, Df=2, P=0.02
Salix > Russian Olive
2.60
2.53
2.23
Salix (n=819)
Saltcedar (n=917)
R. Olive (n=26)

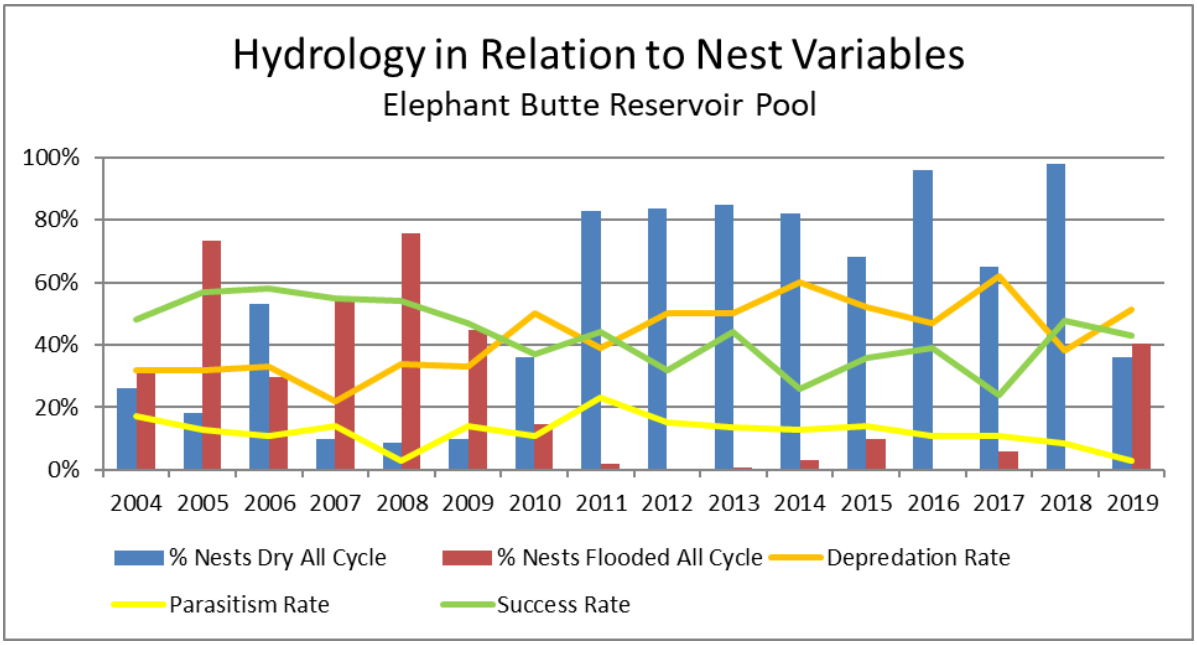
General Nesting Variable Charts – Middle Rio Grande

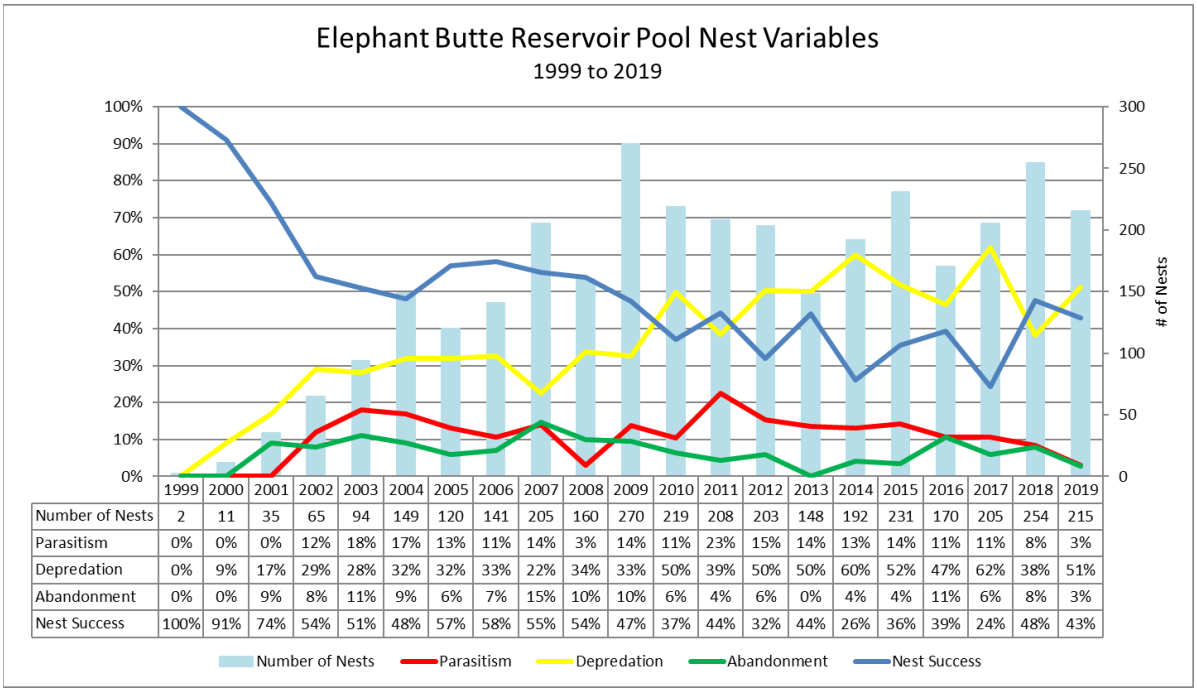


	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019
SWFL Nests	8	21	44	80	108	174	130	162	221	175	310	257	251	263	209	257	280	231	307	327	264
Parasitism	13%	15%	9%	15%	17%	19%	13%	12%	15%	5%	14%	11%	22%	16%	15%	12%	13%	10%	12%	8%	3%
Depredation	0%	5%	14%	28%	28%	33%	31%	33%	23%	34%	33%	49%	39%	50%	47%	60%	47%	47%	62%	39%	52%
Abandonment	13%	10%	7%	6%	13%	9%	8%	7%	14%	10%	9%	6%	5%	5%	1%	4%	4%	10%	5%	10%	3%
Nest Success	75%	71%	75%	55%	50%	49%	55%	57%	56%	53%	47%	39%	42%	33%	44%	28%	40%	39%	25%	47%	42%

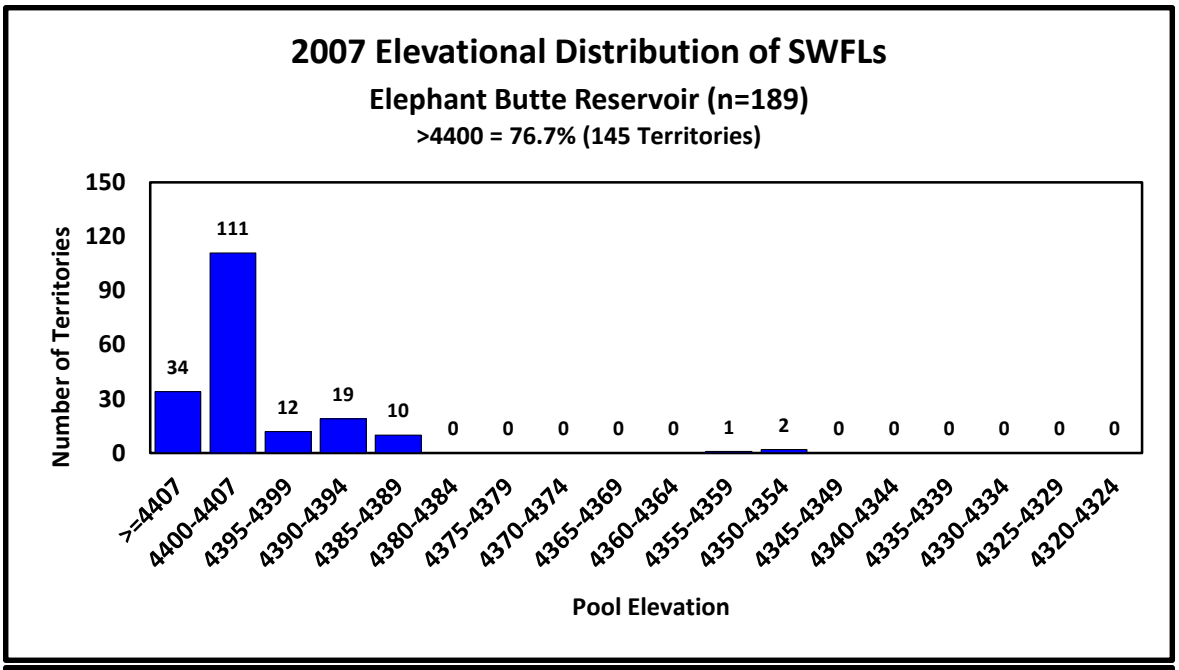


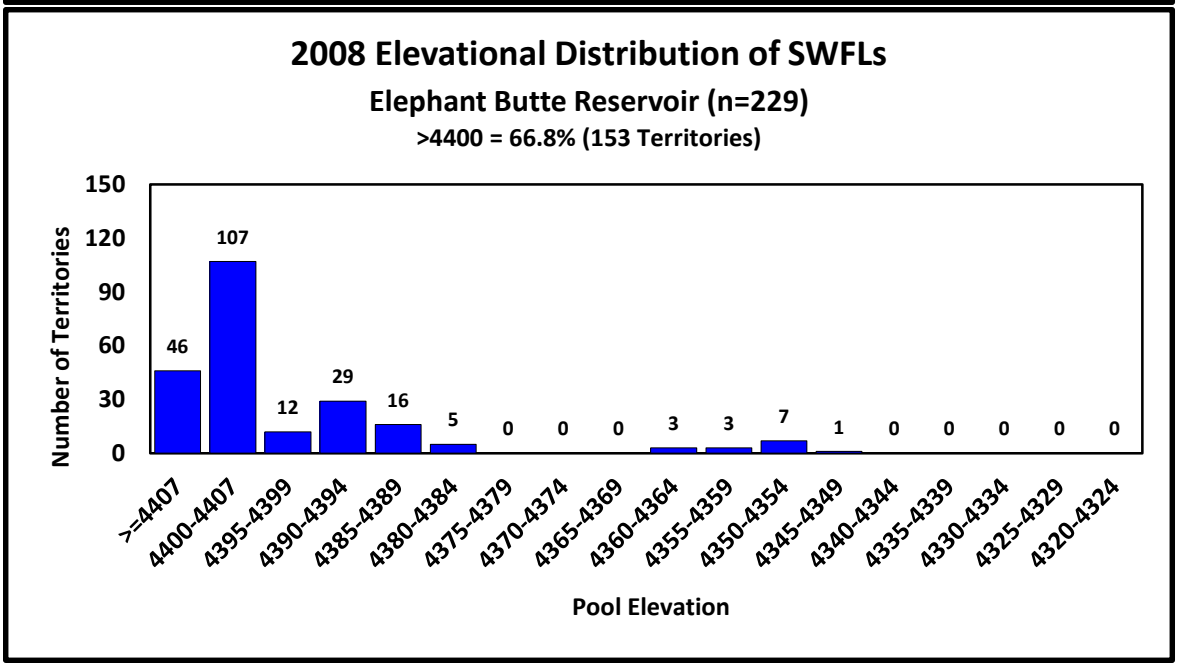
Nesting Variable and Hydrology Comparisons – Elephant Butte Reservoir Nests 2004 to 2019

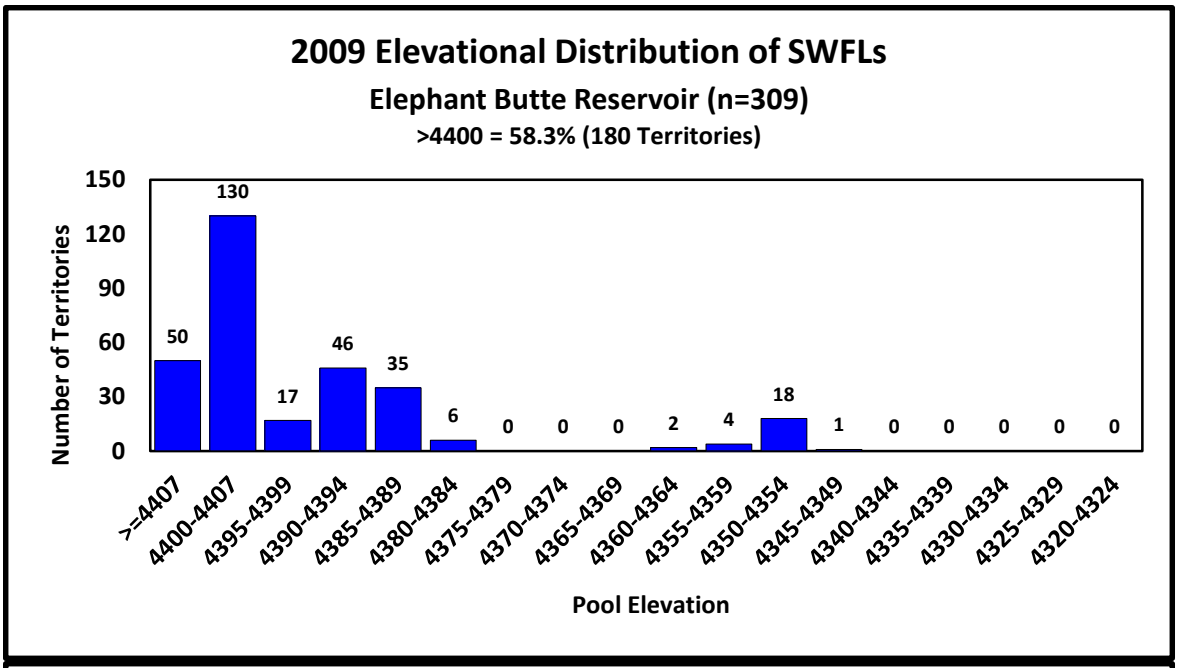


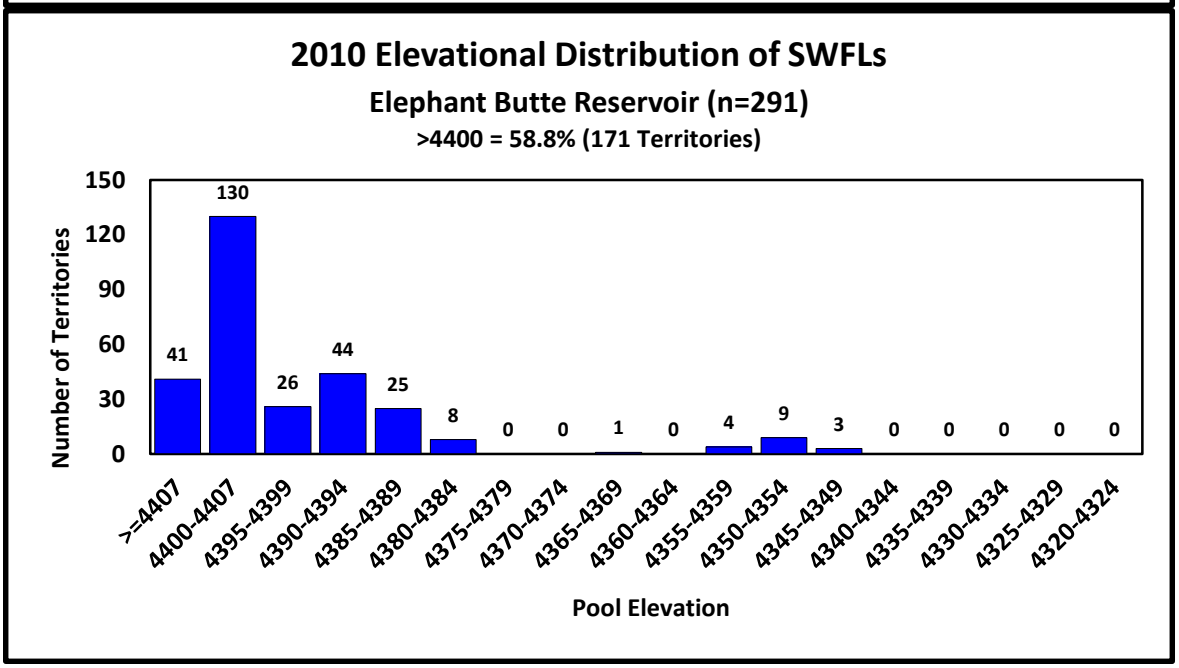


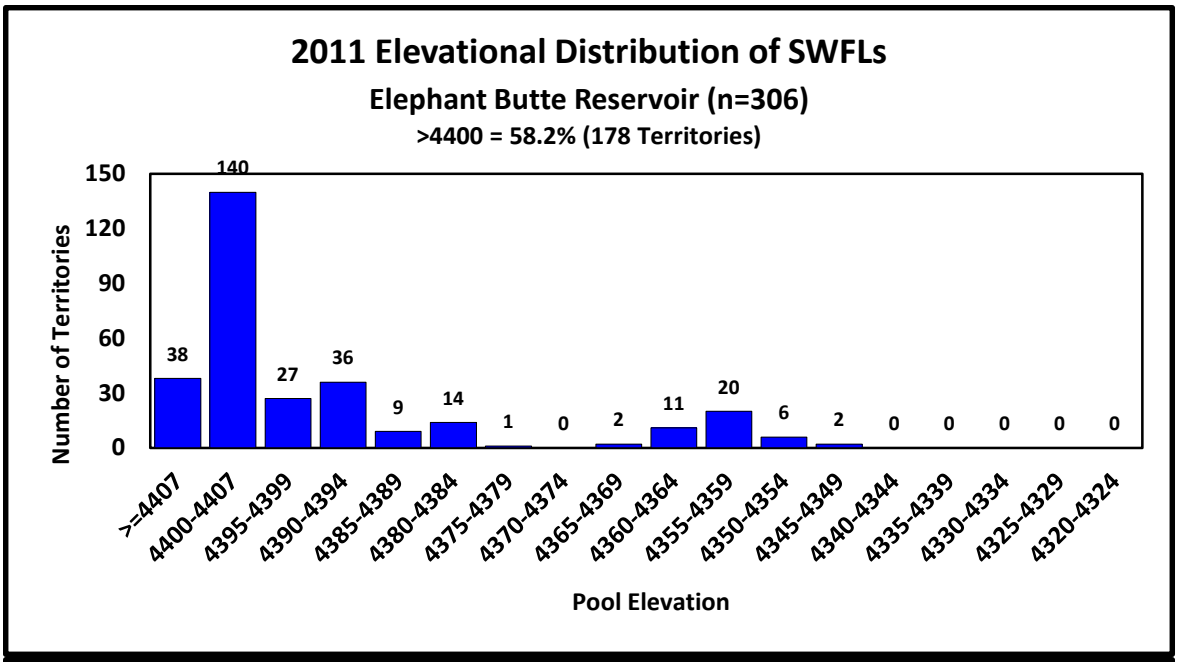
	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019
Number of Nests	2	11	35	65	94	149	120	141	205	160	270	219	208	203	148	192	231	170	205	254	215
Parasitism	0%	0%	0%	12%	18%	17%	13%	11%	14%	3%	14%	11%	23%	15%	14%	13%	14%	11%	11%	8%	3%
Depredation	0%	9%	17%	29%	28%	32%	32%	33%	22%	34%	33%	50%	39%	50%	50%	60%	52%	47%	62%	38%	51%
Abandonment	0%	0%	9%	8%	11%	9%	6%	7%	15%	10%	10%	6%	4%	6%	0%	4%	4%	11%	6%	8%	3%
Nest Success	100%	91%	74%	54%	51%	48%	57%	58%	55%	54%	47%	37%	44%	32%	44%	26%	36%	39%	24%	48%	43%

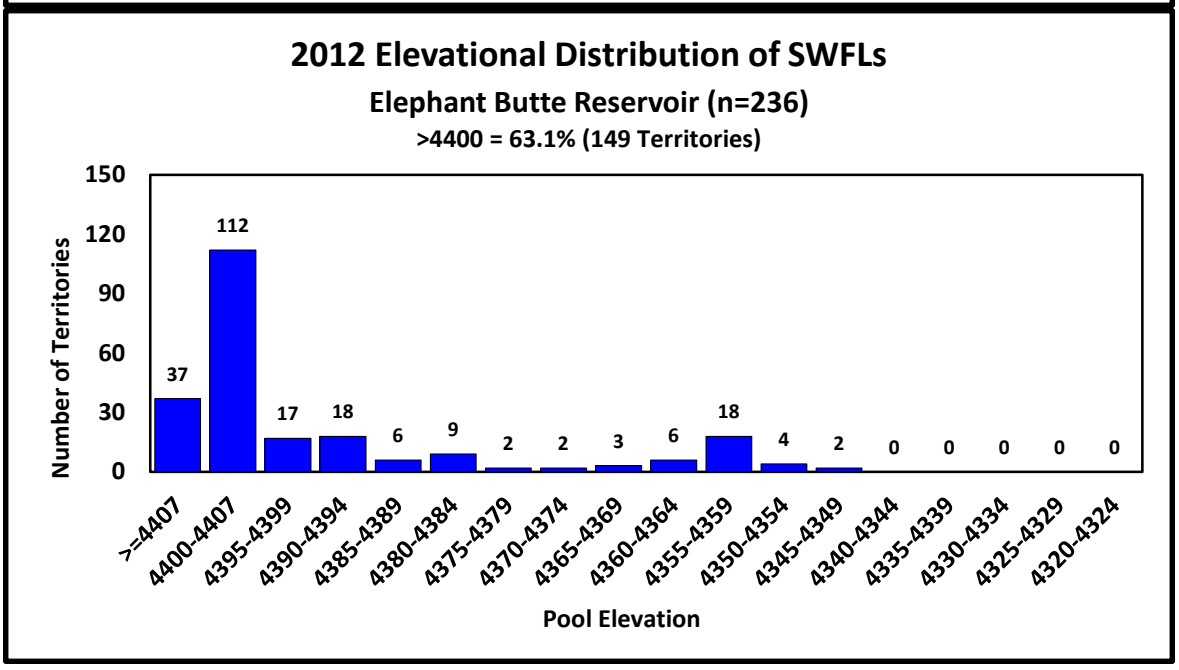

2007 Elevational Distribution of SWFLs
Elephant Butte Reservoir (n=189)
>4400 = 76.7% (145 Territories)
Number of Territories
150
120
90
60
30
0
34
111
12
19
10
0
0
0
0
0
1
2
0
0
0
0
0
0
>=4407
4400-4407
4395-4399
4390-4394
4385-4389
4380-4384
4375-4379
4370-4374
4365-4369
4360-4364
4355-4359
4350-4354
4345-4349
4340-4344
4335-4339
4330-4334
4325-4329
4320-4324
Pool Elevation

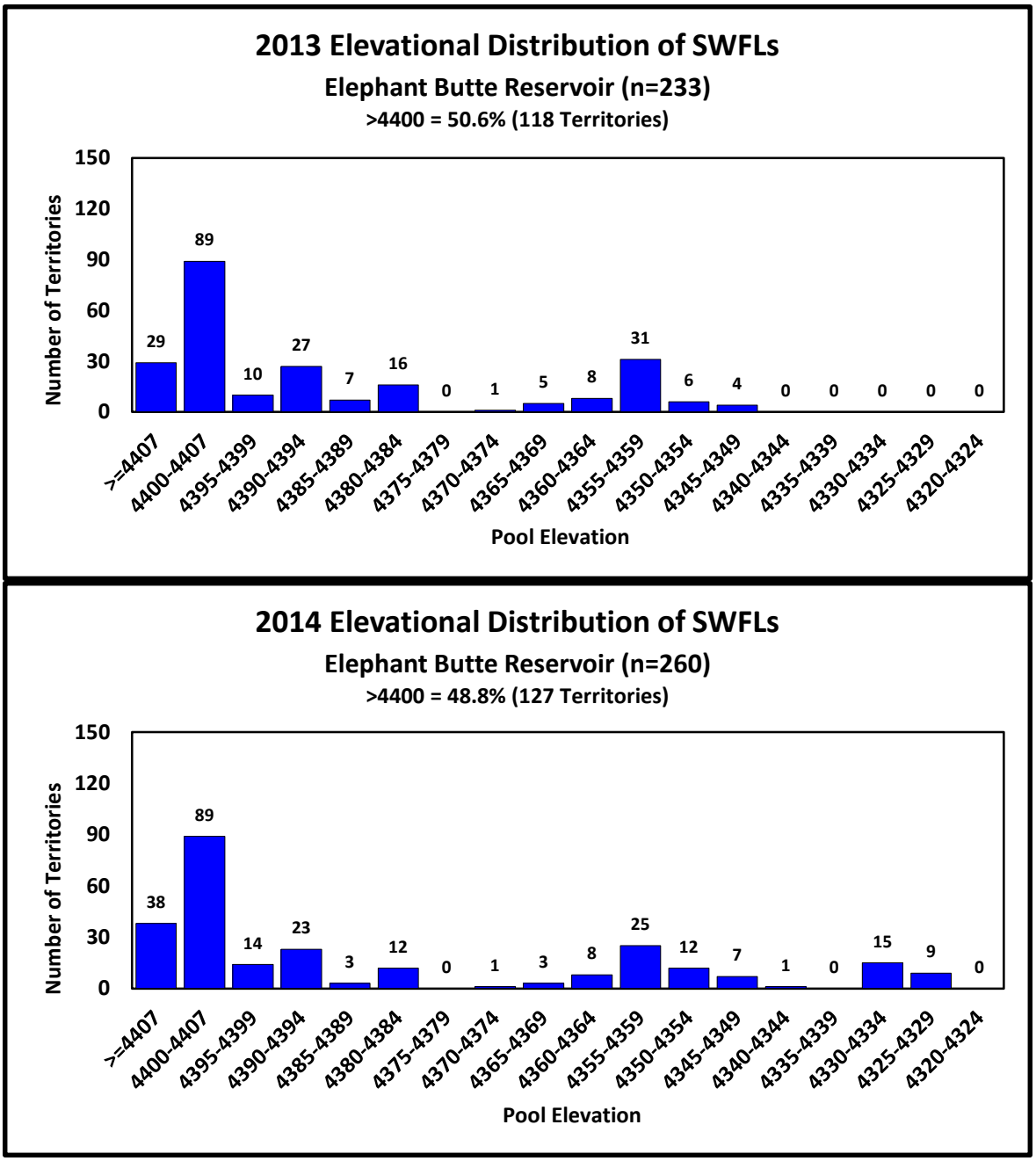

2008 Elevational Distribution of SWFLs
Elephant Butte Reservoir (n=229)
>4400 = 66.8% (153 Territories)
Number of Territories
150
120
90
60
30
0
46
107
12
29
16
5
0
0
0
3
3
7
1
0
0
0
0
0
>=4407
4400-4407
4395-4399
4390-4394
4385-4389
4380-4384
4375-4379
4370-4374
4365-4369
4360-4364
4355-4359
4350-4354
4345-4349
4340-4344
4335-4339
4330-4334
4325-4329
4320-4324
Pool Elevation


2009 Elevational Distribution of SWFLs
Elephant Butte Reservoir (n=309)
>4400 = 58.3% (180 Territories)
Number of Territories
150
120
90
60
30
0
50
130
17
46
35
6
0
0
0
2
4
18
1
0
0
0
0
0
>=4407
4400-4407
4395-4399
4390-4394
4385-4389
4380-4384
4375-4379
4370-4374
4365-4369
4360-4364
4355-4359
4350-4354
4345-4349
4340-4344
4335-4339
4330-4334
4325-4329
4320-4324
Pool Elevation

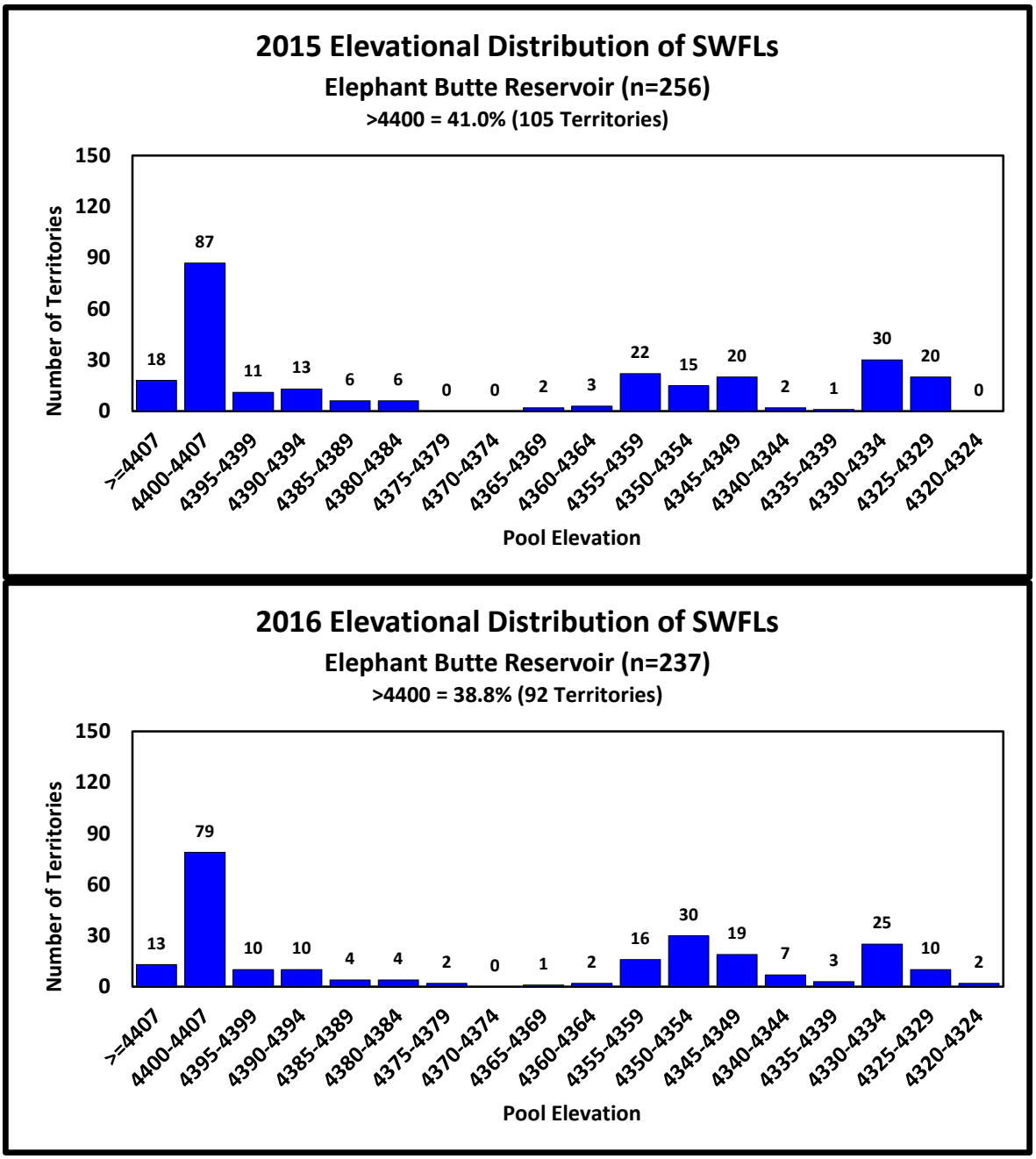

2010 Elevational Distribution of SWFLs
Elephant Butte Reservoir (n=291)
>4400 = 58.8% (171 Territories)
Number of Territories
150
120
90
60
30
0
41
130
26
44
25
8
0
0
1
0
4
9
3
0
0
0
0
0
>=4407
4400-4407
4395-4399
4390-4394
4385-4389
4380-4384
4375-4379
4370-4374
4365-4369
4360-4364
4355-4359
4350-4354
4345-4349
4340-4344
4335-4339
4330-4334
4325-4329
4320-4324
Pool Elevation


2011 Elevational Distribution of SWFLs
Elephant Butte Reservoir (n=306)
>4400 = 58.2% (178 Territories)
Number of Territories
150
120
90
60
30
0
38
140
27
36
9
14
1
0
2
11
20
6
2
0
0
0
0
0
>=4407
4400-4407
4395-4399
4390-4394
4385-4389
4380-4384
4375-4379
4370-4374
4365-4369
4360-4364
4355-4359
4350-4354
4345-4349
4340-4344
4335-4339
4330-4334
4325-4329
4320-4324
Pool Elevation

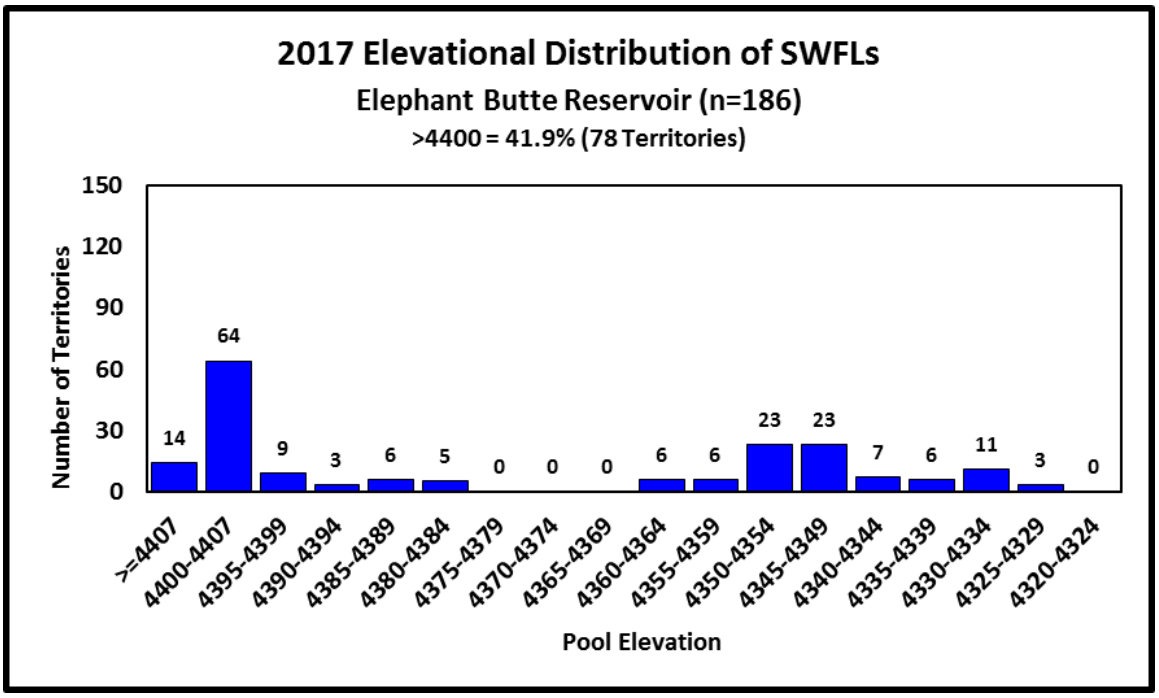

2012 Elevational Distribution of SWFLs
Elephant Butte Reservoir (n=236)
>4400 = 63.1% (149 Territories)
Number of Territories
150
120
90
60
30
0
37
112
17
18
6
9
2
2
3
6
18
4
2
0
0
0
0
0
>=4407
4400-4407
4395-4399
4390-4394
4385-4389
4380-4384
4375-4379
4370-4374
4365-4369
4360-4364
4355-4359
4350-4354
4345-4349
4340-4344
4335-4339
4330-4334
4325-4329
4320-4324
Pool Elevation

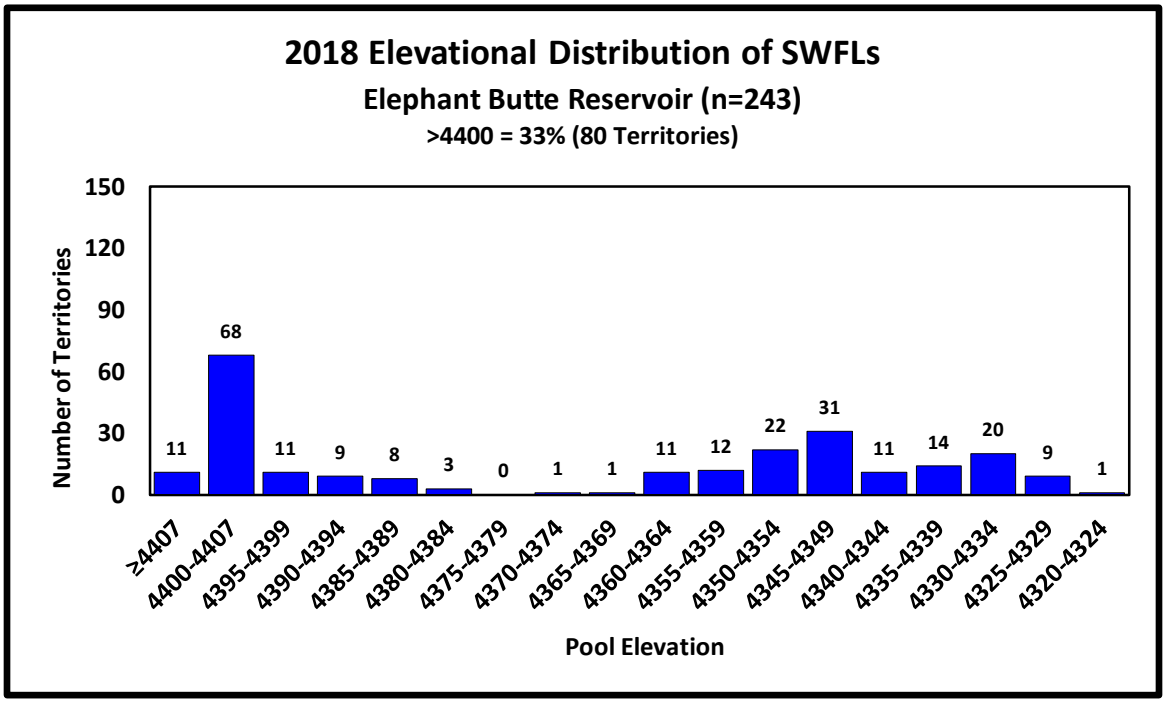

2013 Elevational Distribution of SWFLs
Elephant Butte Reservoir (n=233)
>4400 = 50.6% (118 Territories)
Number of Territories
150
120
90
60
30
0
29
89
10
27
7
16
0
1
5
8
31
6
4
0
0
0
0
0
>=4407
4400-4407
4395-4399
4390-4394
4385-4389
4380-4384
4375-4379
4370-4374
4365-4369
4360-4364
4355-4359
4350-4354
4345-4349
4340-4344
4335-4339
4330-4334
4325-4329
4320-4324
Pool Elevation

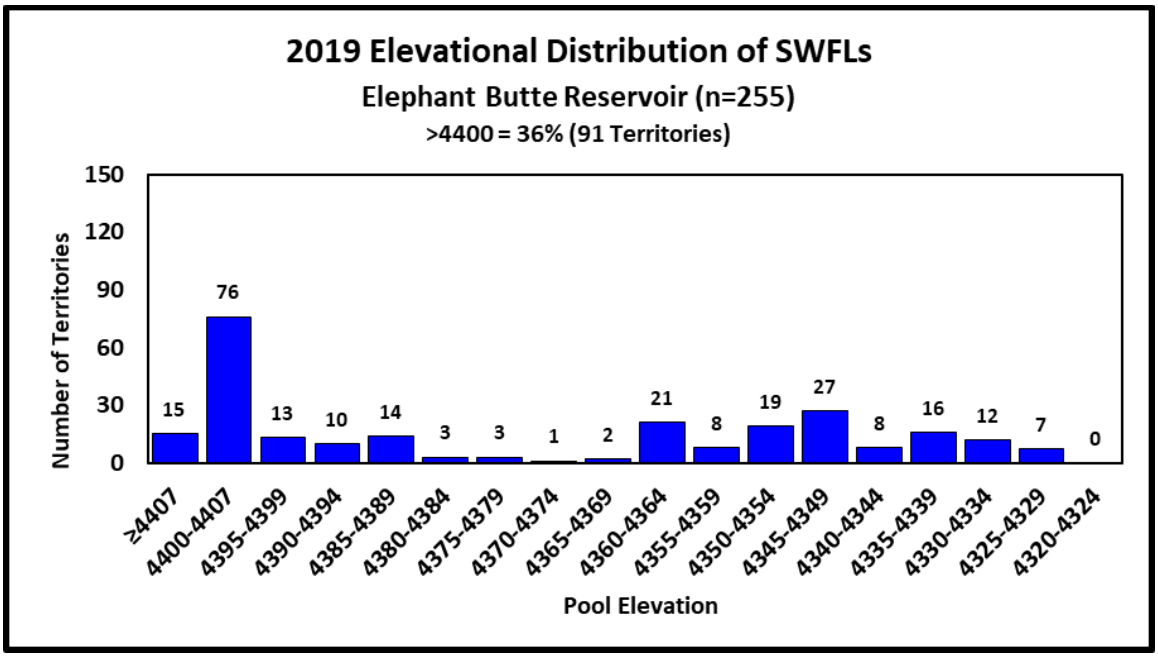
2014 Elevational Distribution of SWFLs
Elephant Butte Reservoir (n=260)
>4400 = 48.8% (127 Territories)
Number of Territories
150
120
90
60
30
0
38
89
14
23
3
12
0
1
3
8
25
12
7
1
0
15
9
0
>=4407
4400-4407
4395-4399
4390-4394
4385-4389
4380-4384
4375-4379
4370-4374
4365-4369
4360-4364
4355-4359
4350-4354
4345-4349
4340-4344
4335-4339
4330-4334
4325-4329
4320-4324
Pool Elevation

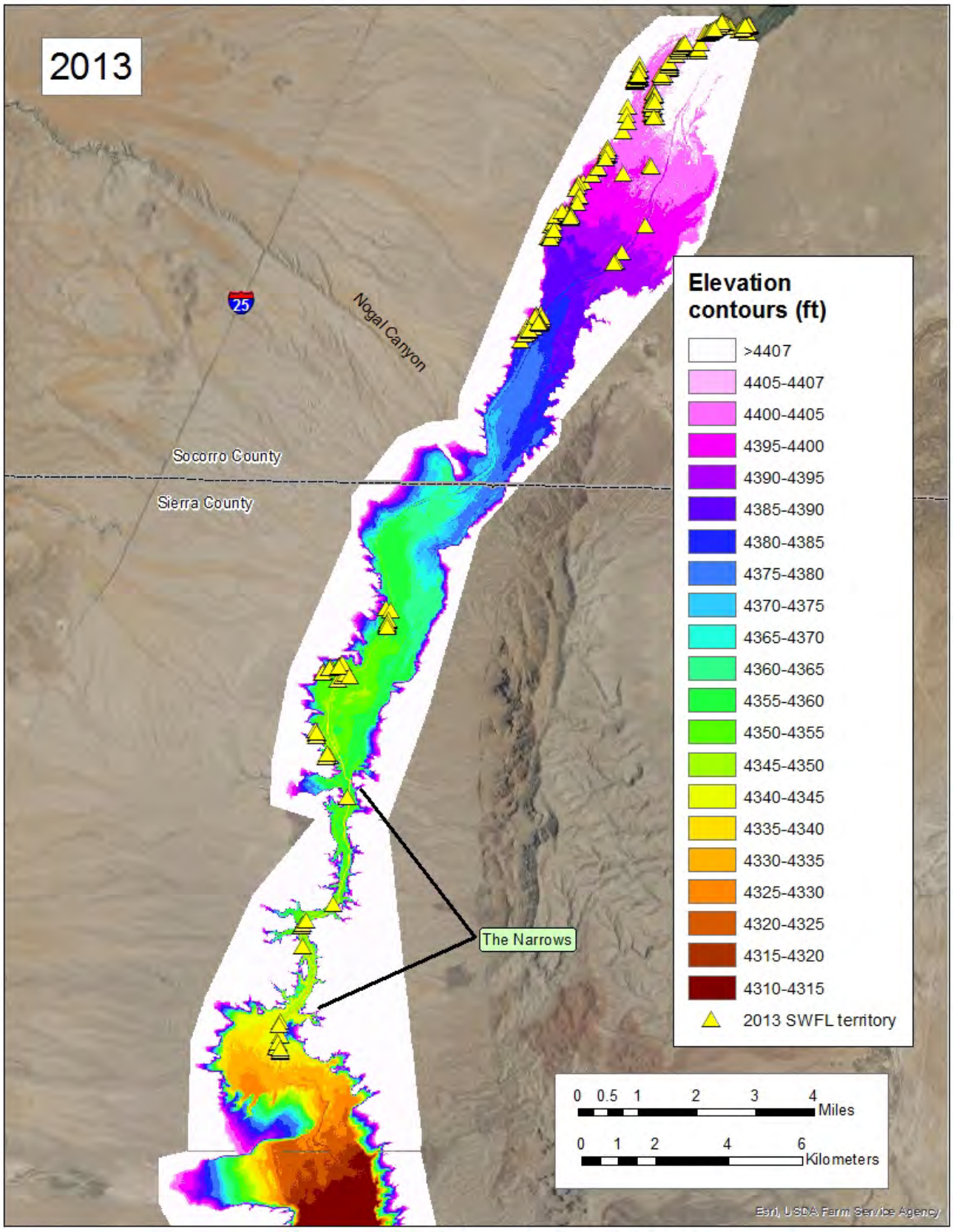

2015 Elevational Distribution of SWFLs
Elephant Butte Reservoir (n=256)
>4400 = 41.0% (105 Territories)
Number of Territories
150
120
90
60
30
0
18
87
11
13
6
6
0
0
2
3
22
15
20
2
1
30
20
0
>=4407
4400-4407
4395-4399
4390-4394
4385-4389
4380-4384
4375-4379
4370-4374
4365-4369
4360-4364
4355-4359
4350-4354
4345-4349
4340-4344
4335-4339
4330-4334
4325-4329
4320-4324
Pool Elevation

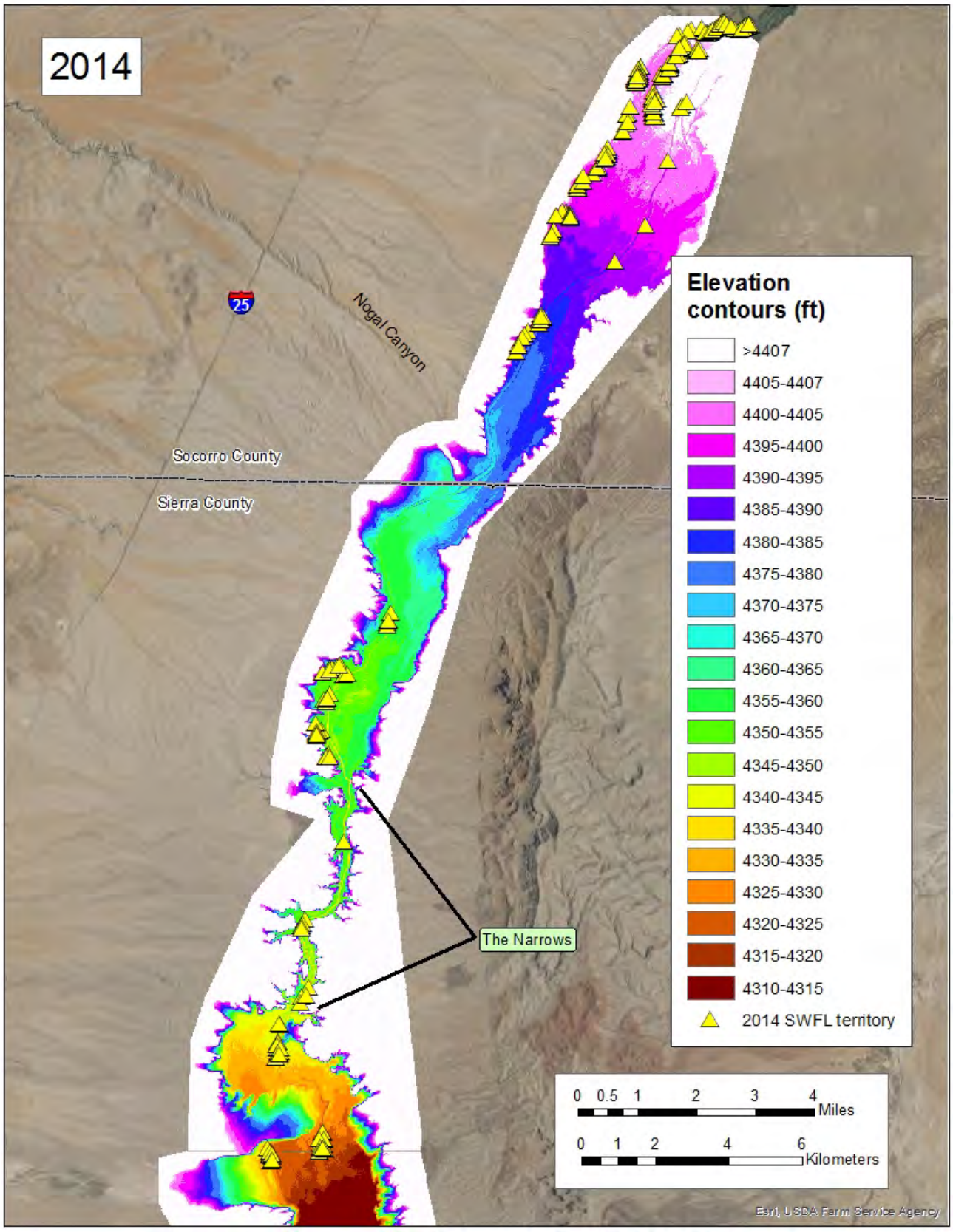
2016 Elevational Distribution of SWFLs
Elephant Butte Reservoir (n=237)
>4400 = 38.8% (92 Territories)
Number of Territories
150
120
90
60
30
0
13
79
10
10
4
4
2
0
1
2
16
30
19
7
3
25
10
2
>=4407
4400-4407
4395-4399
4390-4394
4385-4389
4380-4384
4375-4379
4370-4374
4365-4369
4360-4364
4355-4359
4350-4354
4345-4349
4340-4344
4335-4339
4330-4334
4325-4329
4320-4324
Pool Elevation

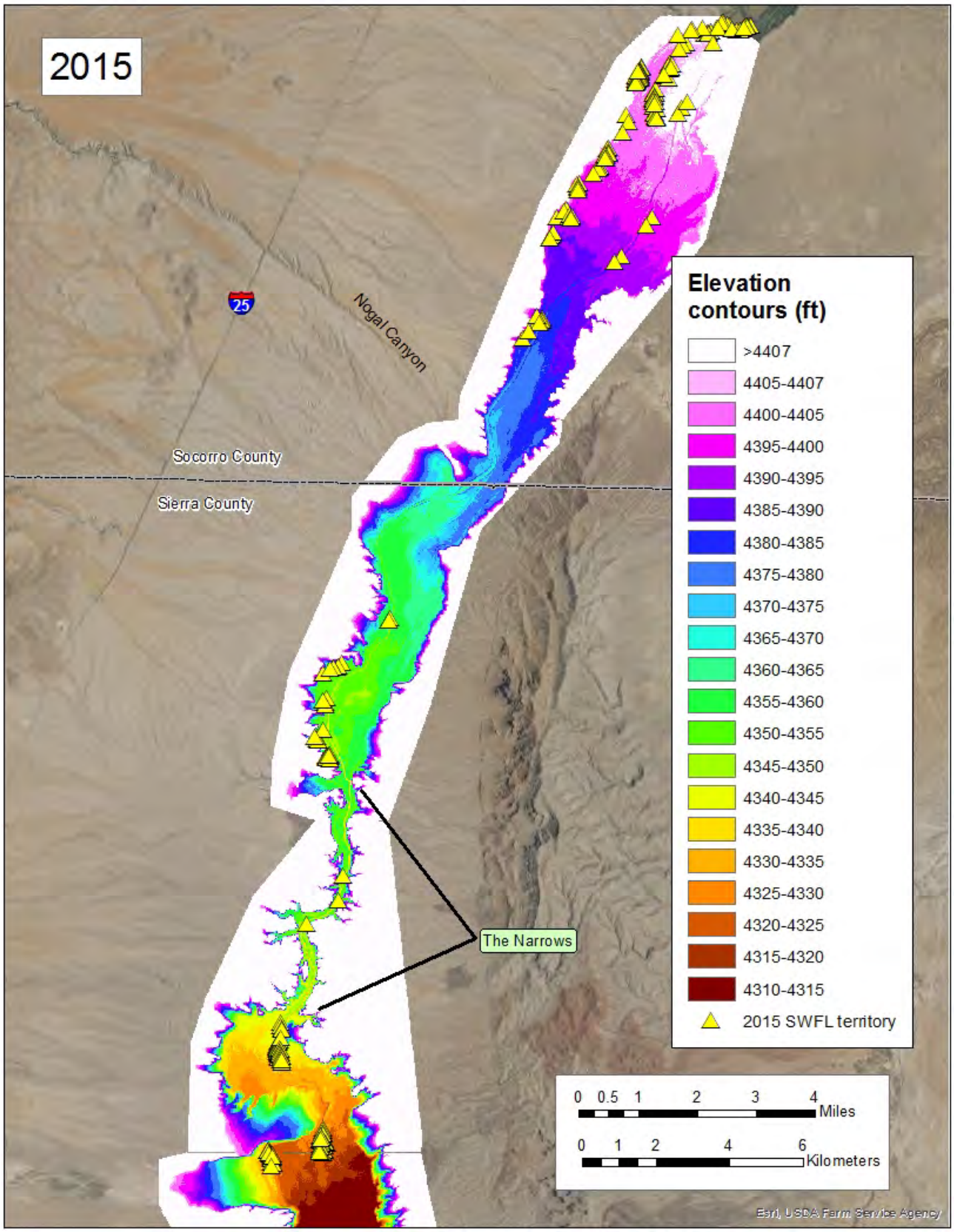

2017 Elevational Distribution of SWFLs
Elephant Butte Reservoir (n=186)
>4400 = 41.9% (78 Territories)
Number of Territories
150
120
90
60
30
0
14
64
9
3
6
5
0
0
0
6
6
23
23
7
6
11
3
0
>=4407
4400-4407
4395-4399
4390-4394
4385-4389
4380-4384
4375-4379
4370-4374
4365-4369
4360-4364
4355-4359
4350-4354
4345-4349
4340-4344
4335-4339
4330-4334
4325-4329
4320-4324
Pool Elevation

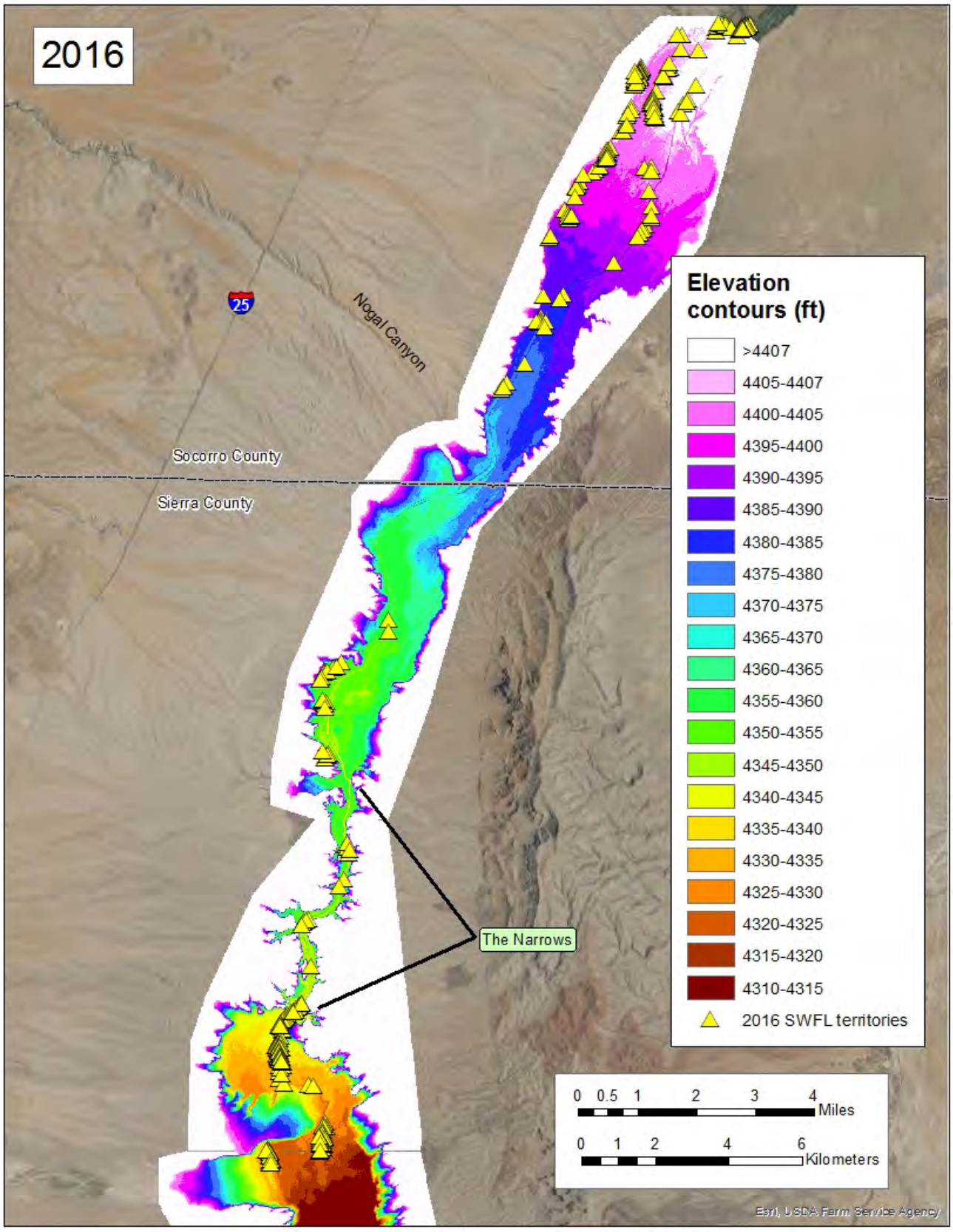

2018 Elevational Distribution of SWFLs
Elephant Butte Reservoir (n=243)
>4400 = 33% (80 Territories)
Number of Territories
150
120
90
60
30
0
11
68
11
9
8
3
0
1
1
11
12
22
31
11
14
20
9
1
≥4407
4400-4407
4395-4399
4390-4394
4385-4389
4380-4384
4375-4379
4370-4374
4365-4369
4360-4364
4355-4359
4350-4354
4345-4349
4340-4344
4335-4339
4330-4334
4325-4329
4320-4324
Pool Elevation


2019 Elevational Distribution of SWFLs
Elephant Butte Reservoir (n=255)
>4400 = 36% (91 Territories)
Number of Territories
150
120
90
60
30
0
15
76
13
10
14
3
3
1
2
21
8
19
27
8
16
12
7
0
≥4407
4400-4407
4395-4399
4390-4394
4385-4389
4380-4384
4375-4379
4370-4374
4365-4369
4360-4364
4355-4359
4350-4354
4345-4349
4340-4344
4335-4339
4330-4334
4325-4329
4320-4324
Pool Elevation


2013
25
Nogal Canyon
Socorro County
Sierra County
The Narrows
Elevation contours (ft)
>4407
4405-4407
4400-4405
4395-4400
4390-4395
4385-4390
4380-4385
4375-4380
4370-4375
4365-4370
4360-4365
4355-4360
4350-4355
4345-4350
4340-4345
4335-4340
4330-4335
4325-4330
4320-4325
4315-4320
4310-4315
2013 SWFL territory
0 0.5 1 2 3 4
Miles
0 1 2 4 6
Kilometers
Esri, USDA Farm Service Agency


2014
25
Nogal Canyon
Socorro County
Sierra County
The Narrows
Elevation contours (ft)
>4407
4405-4407
4400-4405
4395-4400
4390-4395
4385-4390
4380-4385
4375-4380
4370-4375
4365-4370
4360-4365
4355-4360
4350-4355
4345-4350
4340-4345
4335-4340
4330-4335
4325-4330
4320-4325
4315-4320
4310-4315
2014 SWFL territory
0 0.5 1 2 3 4
Miles
0 1 2 4 6
Kilometers
Esri, USDA Farm Service Agency


2015
25
Nogal Canyon
Socorro County
Sierra County
The Narrows
Elevation contours (ft)
>4407
4405-4407
4400-4405
4395-4400
4390-4395
4385-4390
4380-4385
4375-4380
4370-4375
4365-4370
4360-4365
4355-4360
4350-4355
4345-4350
4340-4345
4335-4340
4330-4335
4325-4330
4320-4325
4315-4320
4310-4315
2015 SWFL territory
0 0.5 1 2 3 4
Miles
0 1 2 4 6
Kilometers
Esri, USDA Farm Service Agency


2016
25
Nogal Canyon
Socorro County
Sierra County
The Narrows
Elevation contours (ft)
>4407
4405-4407
4400-4405
4395-4400
4390-4395
4385-4390
4380-4385
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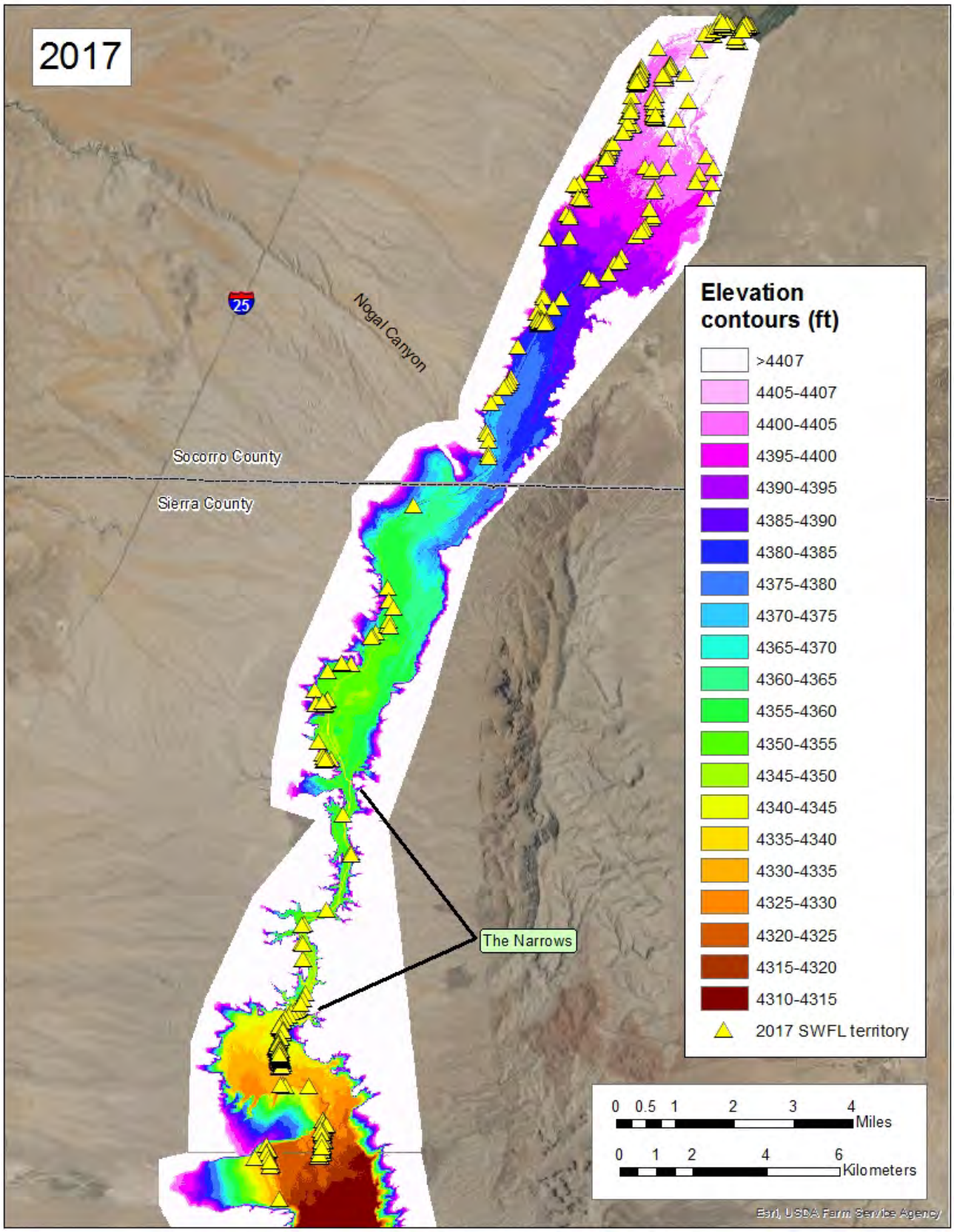
4370-4375
4365-4370
4360-4365
4355-4360
4350-4355
4345-4350
4340-4345
4335-4340
4330-4335
4325-4330
4320-4325
4315-4320
4310-4315
2016 SWFL territories
0 0.5 1 2 3 4
Miles
0 1 2 4 6
Kilometers
Esri, USDA Farm Service Agency


2017
25
Nogal Canyon
Socorro County
Sierra County
The Narrows
Elevation contours (ft)
>4407
4405-4407
4400-4405
4395-4400
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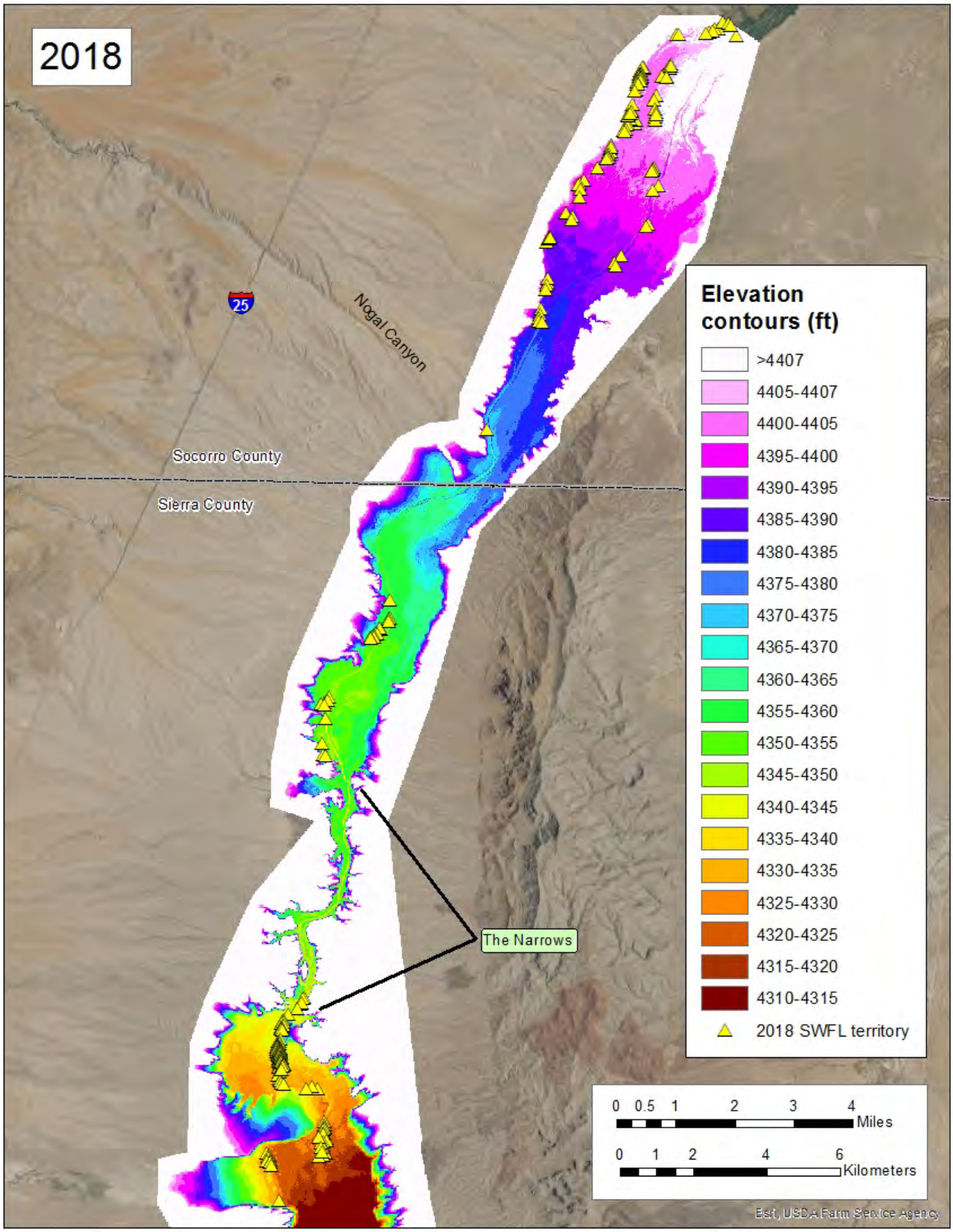
4355-4360
4350-4355
4345-4350
4340-4345
4335-4340
4330-4335
4325-4330
4320-4325
4315-4320
4310-4315
2017 SWFL territory
0 0.5 1 2 3 4 Miles
0 1 2 4 6 Kilometers
Esri, USDA Farm Service Agency


2018
25
Nogal Canyon
Socorro County
Sierra County
The Narrows
Elevation contours (ft)
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4405-4407
4400-4405
4395-4400
4390-4395
4385-4390
4380-4385
4375-4380
4370-4375
4365-4370
4360-4365
4355-4360
4350-4355
4345-4350
4340-4345
4335-4340
4330-4335
4325-4330
4320-4325
4315-4320
4310-4315
2018 SWFL territory
0 0.5 1 2 3 4
Miles
0 1 2 4 6
Kilometers
Esri, USDA Farm Service Agency