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Managing Water in the West

Status and Monitoring of Southwestern Willow Flycatchers within Elephant Butte Reservoir, New Mexico

U.S. Department of the Interior
Bureau of Reclamation
Ecological Planning and Assessment
Denver, Colorado

December 2005

Mission Statements

The mission of the Department of the Interior is to protect and provide access to our Nation's natural and cultural heritage and honor our trust responsibilities to Indian Tribes and our commitments to island communities.

The mission of the Bureau of Reclamation is to manage, develop, and protect water and related resources in an environmentally and economically sound manner in the interest of the American public.

Status and Monitoring of Southwestern Willow Flycatchers within Elephant Butte Reservoir, New Mexico

prepared for

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by

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Background

Elephant Butte Reservoir and the Low Flow Conveyance Channel

Elephant Butte Dam, located 4 miles east of Truth or Consequences, New Mexico, along the Rio Grande, was constructed between 1912 and 1916. It is a concrete dam constructed on a foundation of fissured sandstone and friable shale. The drainage area that contributes to Elephant Butte Reservoir is 28,900 square miles (mi^2) in size. Reservoir storage at elevation 4,407 feet (ft) (full capacity) is 2,109,423 acre-feet (ac-ft). Climatic variation has fluctuated reservoir levels greatly during the past 90 years (Figure 1). Reservoir storage increased gradually to full capacity in the early 1920s following dam completion and, on average, stayed above 50 percent capacity until the early 1940s. Between 1948 and 1983, reservoir levels were very low due to below average riverflows. Wetter than average years again raised reservoir levels to near capacity between 1985 and 2000. Reservoir levels have dropped since then to the current elevation of 4,327 ft (as of September 25, 2005).

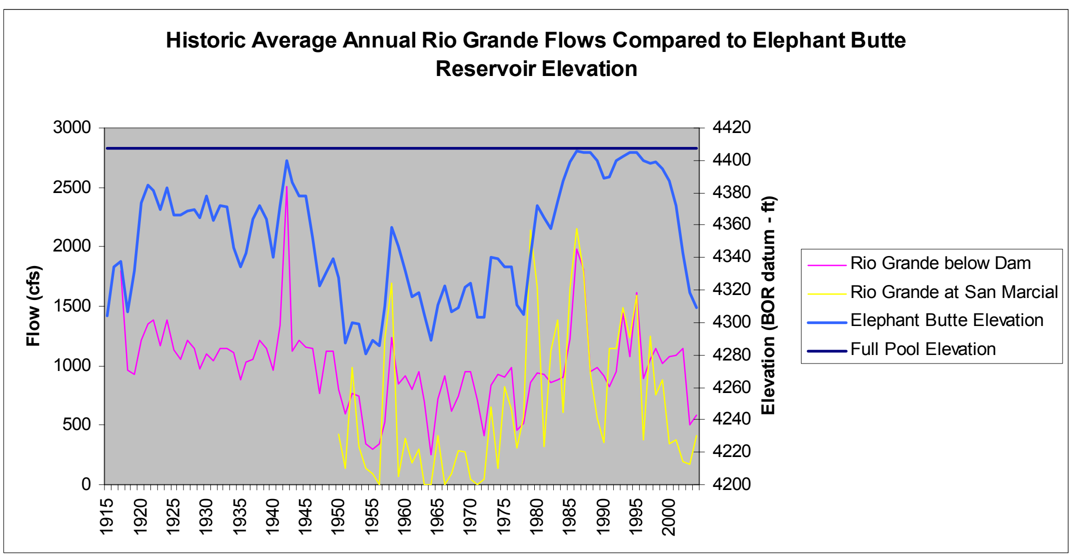

Figure 1. Average annual flow in the Rio Grande compared to Elephant Butte Reservoir elevations from 1915 to 2004. The San Marcial station was not installed until 1950.

Habitability and agricultural productivity of the Middle Rio Grande Valley declined greatly during the first half of the 20th century due to inefficient water delivery, poor drainage, and frequent floods. The Middle Rio Grande Conservancy District was founded in the 1920s in an attempt to address these issues. Also, during this time the States of Colorado, New Mexico, and Texas began negotiating river appropriations among themselves. In 1939, the Rio Grande Compact took effect requiring the State of New Mexico to deliver a predefined portion of the Rio Grande flow from Elephant Butte Dam to Texas and Mexico and effectively limited the amount of river depletions for the Middle Rio Grande Valley. Subsequently, floods of the early 1940s completely filled the reservoir. However, during these floods, channels into and upstream of the reservoir were filled in with sediment. These sediments plugged the river channel and caused river water to spread widely over the flood plain when the reservoir receded again in the late 1940s and early 1950s.

In an effort to improve water delivery, sediment transport, and valley drainage, construction of the Low Flow Conveyance Channel (LFCC) began in 1951. The LFCC, an artificial channel running from San Acacia Diversion Dam to Elephant Butte Reservoir, was completed in 1959. The hydraulically efficient channel allowed diverted water to be moved downstream to Elephant Butte Reservoir without the high evaporative and seepage losses associated with a natural river channel. Higher flow velocities also allowed sediment to continue moving downstream, eliminating sediment deposition. The nominal capacity of the LFCC is 2,000 cubic feet per second (cfs), however, diversions at San Acacia rarely exceeded 1,800 cfs. A peak flow of 3,940 cfs occurred at San Marcial in 1952 before the entire LFCC was completed (a diversion near the southern boundary of the Bosque del Apache National Wildlife Refuge provided water for the LFCC prior to 1959) and since then, peaks above 1,800 cfs have rarely occurred. The average annual flow in the LFCC rarely exceeded 800 cfs (Figure 2). Except for a few short-term experimental diversions in the upper 9 miles of the LFCC, diversions into the LFCC at San Acacia have not occurred since 1985, and consequently, flows in the LFCC have been much lower and more regular, being fed solely by irrigation returns and groundwater.

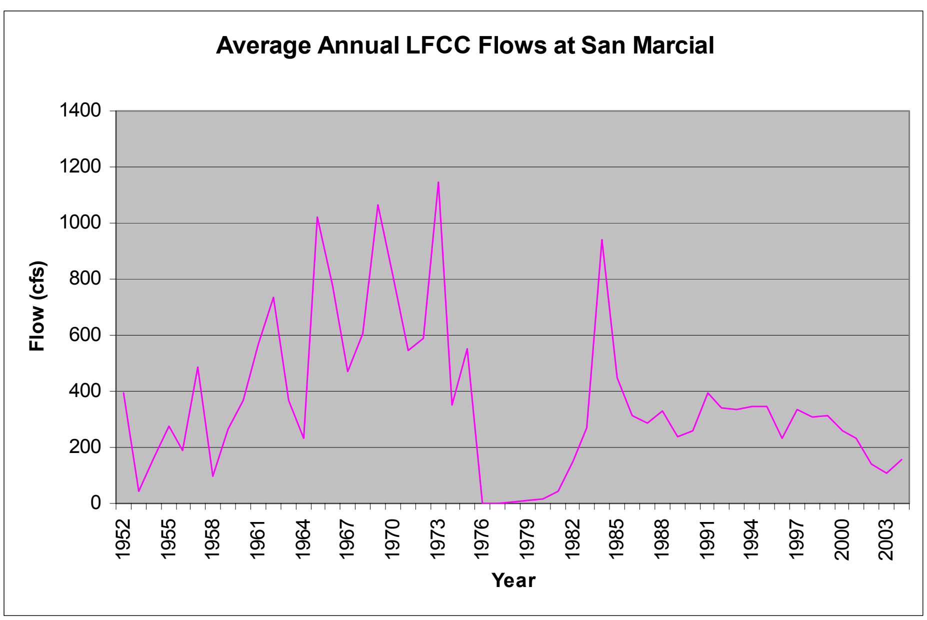

Figure 2. Average annual flow in the Low Flow Conveyance Channel at San Marcial from construction to present.

As reservoir levels rose in the late 1970s and early 1980s, the levee between the Rio Grande and LFCC breached sequentially northward in the northern end of the reservoir. As the reservoir approached full pool in 1987, a final breach of the levee allowed the river, because of its aggraded nature, to occupy the LFCC channel. Since the LFCC no longer conveyed diverted Rio Grande water, the Rio Grande was allowed to maintain the former LFCC as its primary channel, and a new levee was built to cap the LFCC. This cap effectively prevented the irrigation returns and groundwater in the LFCC from moving downstream and caused the LFCC to eventually breach its western levee (Figure 3). This situation remains and water from the LFCC outfall courses southward through the western flood plain until it rejoins the mainstem Rio Grande in the vicinity of Silver Canyon.

Vegetation

Watson (1912) described flood plain vegetation within the Middle Rio Grande Valley as being composed of "two major floristic associations: (1) cottonwood forest, composed of open, nearly pure stands of Rio Grande cottonwood (*Populus deltoides* var. w*islizenii*), with a few willows (*Salix* spp.) and scattered clumps of *Baccharis wrightii* and *Cassia bauhinoides*," and sparse herbaceous groundcover; "(2) a wet meadow-like association dominated by *Juncus balticus* and *Houttuynia* (=*Anemopsis californica*)." He described the cottonwood forest as "uniform and composed of small trees" and considered "mudbanks colonized by cottonwood, willow, and cattails to be an early seral stage in cottonwood forest succession." Watson (1908) also mentions saltcedar (*Tamarix* sp.) planted as a hedge in Albuquerque but gives no mention of it in the wild. Russian olive (*Elaeagnus angustifolia*), which is presently abundant, is not discussed at all. Vegetation between Cochiti and San Marcial was subsequently mapped by the State of New Mexico in 1917 and 1918. Natural vegetation was classified as "timber and brush, marsh, salt grass, meadow or alkali" (Hink and Ohmart 1984). At the time of this mapping, "timber and brush" and "marsh" composed 18,294 and 3585 acres of habitat between Cochiti and San Acacia, respectively (Hink and Ohmart 1984). During the 1920s, saltcedar and Russian olive began to spread in the valley and had become widely naturalized by the early- to mid-1930s.

Van Cleave (1935) described flood plain vegetation of the early 1930s and the effects caused by drainage of the Middle Rio Grande Valley for agriculture. The author defined five distinct habitat types: (1) small lakes maintained by river seepage; (2) swampland (i.e., marsh) composed of cattails and other emergent aquatic plants; (3) wet meadow; (4) grass-woodland bosque (riparian forest); and (5) cottonwood-willow forest along the river. The cottonwood-willow forest was frequently flooded and lacked any significant amount of saltcedar or Russian olive. During the early 1980s, Hink and Ohmart (1984) again classified vegetation along the Middle Rio Grande. They documented similar habitat in the 1918 mapping effort. However, marsh habitat had decreased greatly (68 percent) and riparian forest habitat, once composed entirely of cottonwood-willow, was now also composed of large patches of exotic vegetation (saltcedar and Russian olive) (Hink and Ohmart 1984).

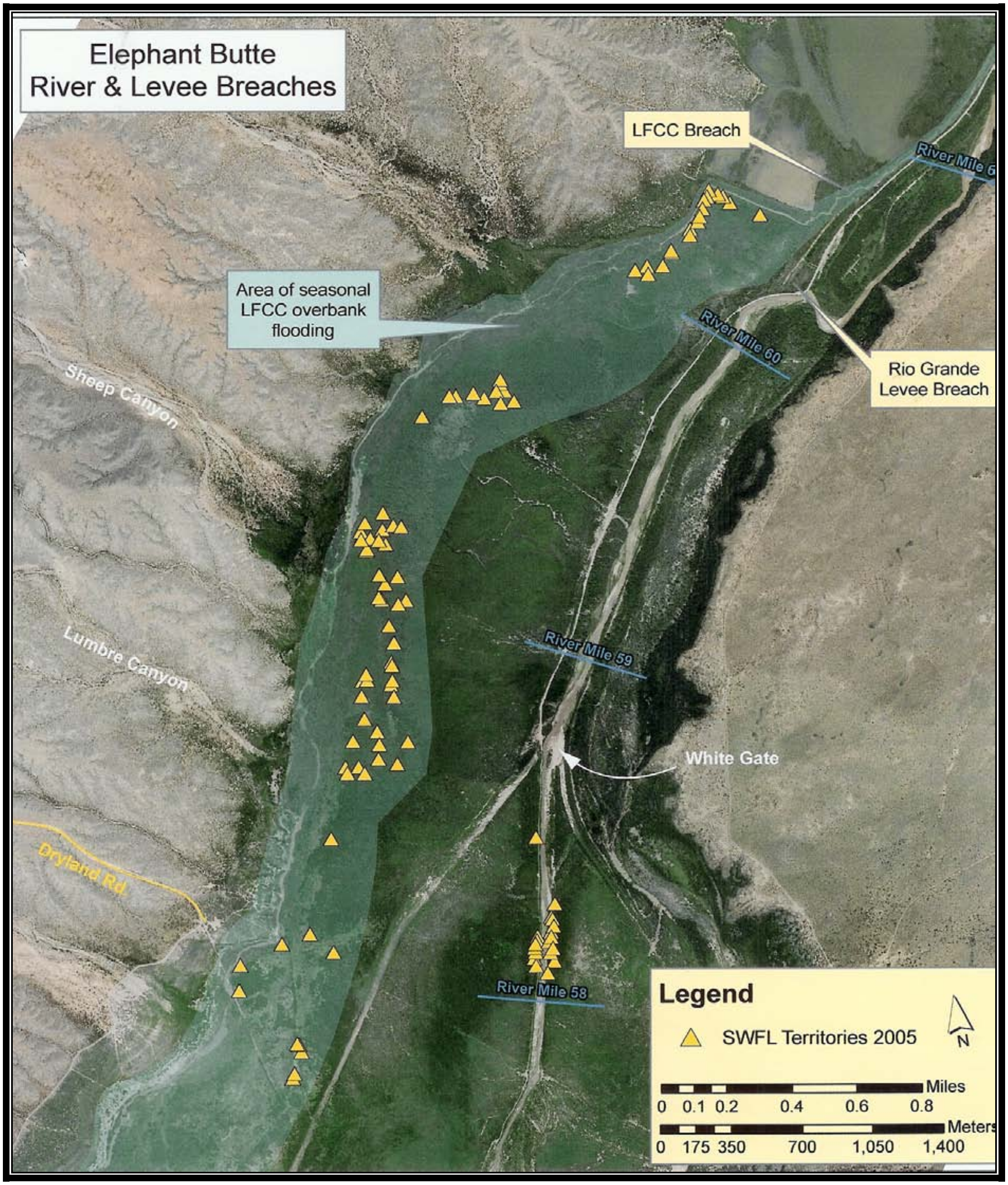

Figure 3. Aerial photograph showing location of historic river and LFCC breaches and area flooded by LFCC outfall.

When reservoir levels were high, all but the most upstream portions of the pool would have been flooded, preventing vegetation growth. However, when the reservoir receded, large swaths of barren soil kept wet by Rio Grande floodwaters and, later, the LFCC, would have produced extensive stands of riparian forest, wet meadow, and marsh habitat.

This is currently evidenced by cottonwood snags and large patches of dead saltcedar on the western side of the flood plain that were killed by rising reservoir levels in the mid- to late 1980s.

Southwestern Willow Flycatcher

The Southwestern Willow Flycatcher (*Empidonax traillii extimus*) (SWFL) is a State- and Federal-listed endangered subspecies of the Willow Flycatcher. It is an insectivorous, Neotropical migrant that nests in dense riparian or wetland vegetation in the Southwestern United States (Figure 4) where they display a strong affinity to standing or running water. These birds generally arrive at their breeding grounds between early May and early June. By late July or August, they depart for wintering areas in Mexico, Central America, and northern South America (Sogge et al. 1997, USFWS 2005).

Recent studies indicate that SWFL populations have declined across their range (USFWS 2002). The primary causes of declining populations are likely habitat loss/modification and brood parasitism by the Brown-headed Cowbird (*Molothrus ater*) (USFWS 2002). The U.S. Fish and Wildlife Service (USFWS) listed the SWFL as endangered in February 1995 (USFWS 1995). The SWFL is also listed as endangered or a species of concern by the States of Arizona, California, Colorado, New Mexico, Texas, and Utah (Sogge et. al. 1997, 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 has also been prepared by the Recovery Team. These papers address current issues and recommend management alternatives in regard to cowbird parasitism, livestock grazing, water management, exotic vegetation, habitat restoration, fire management, and recreational impacts (USFWS 2002). In October 2005, USFWS designated Critical Habitat for the SWFL along the Middle Rio Grande in three separate 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 to the northern boundary of the Sevilleta NWR. The middle Rio Grande segment extends for 27.3 miles 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 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 active pool of Elephant Butte Reservoir.

SWFLs have been an historic occupant of the Middle Rio Grande Valley. Territories were documented as early as 1920 near Las Cruces, 1939 at Radium Springs, and 1964 at Escondida (Hubbard 1987, Unitt 1987). SWFLs have also been historically documented in the active pool of Elephant Butte Reservoir. Studies conducted in the 1970s documented several territories in the area then known as Elephant Butte Marsh (Hundertmark 1978, Hubbard 1987). Hundertmark (1978) documented 10 and 6 territories in 1974 and 1975, respectively. The location of these SWFLs was

Figure 4. Breeding range of the SWFL (adapted from Unitt 1987 and Browning 1993).

subsequently flooded by rising water levels, displacing the existing territories (Unitt 1987). Although suitable habitat occurred upstream, SWFL territories were not documented during surveys between 1979 and 1981 (Hubbard 1987). The Bureau of Reclamation (Reclamation) began surveying for SWFLs in the Middle Rio Grande in the mid-1990s. Detailed survey data since this time, as well as data from related studies conducted by Reclamation, are presented in the following sections.

Current Status

Elephant Butte Reservoir and the Low Flow Conveyance Channel

As of September 27, 2005, Elephant Butte Reservoir elevation was 4,327 ft; 80 ft below the full pool elevation of 4,407 ft. Reservoir storage at this elevation is 350,950 ac-ft, approximately 17 percent of full pool storage. Due to low Rio Grande flows, reservoir levels have dropped from nearly full pool elevation in the mid- to late-90s to the current level (Figure 5). This recession of the reservoir pool, in combination

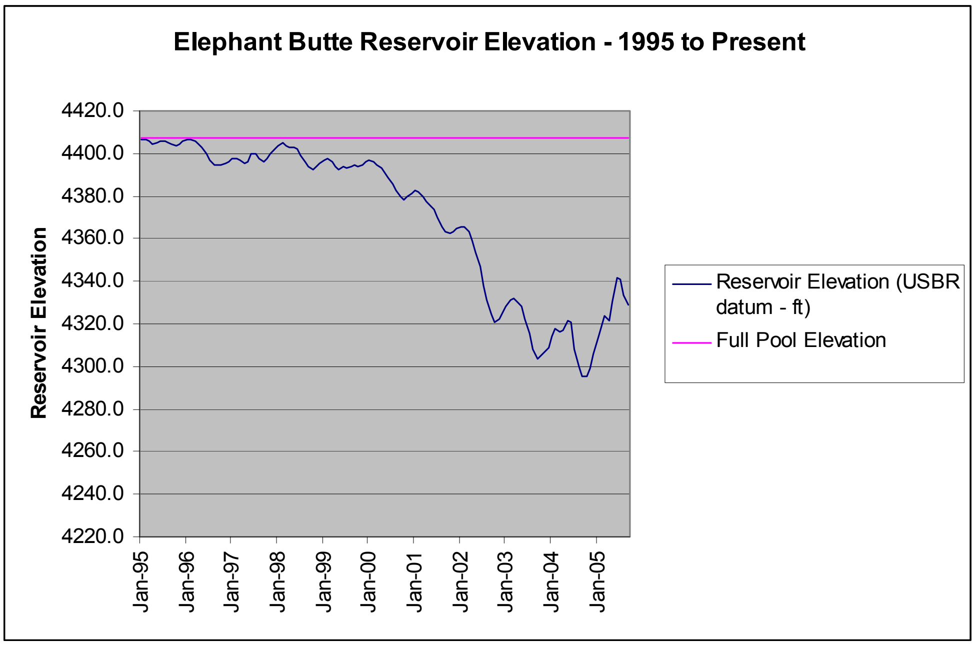

Figure 5. Elephant Butte Reservoir surface elevation – 1995 to present.

with water provided by the LFCC outfall to the north, has allowed establishment of extensive stands of native vegetation within the upper reservoir, particularly between the 4,390 and full pool (4,407 ft) elevations (Figure 6). Table 1 shows the area covered by each habitat class that has established within the headwaters of the reservoir within the past 7 years. Within the upper reaches of the reservoir pool, land exposed by dropping water levels progressed from bare earth to suitable SWFL breeding habitat in 4 to 5 years. This increase in suitable SWFL habitat over the past 9 years has accommodated dramatic growth of the local SWFL population within the reservoir pool (Table 2).

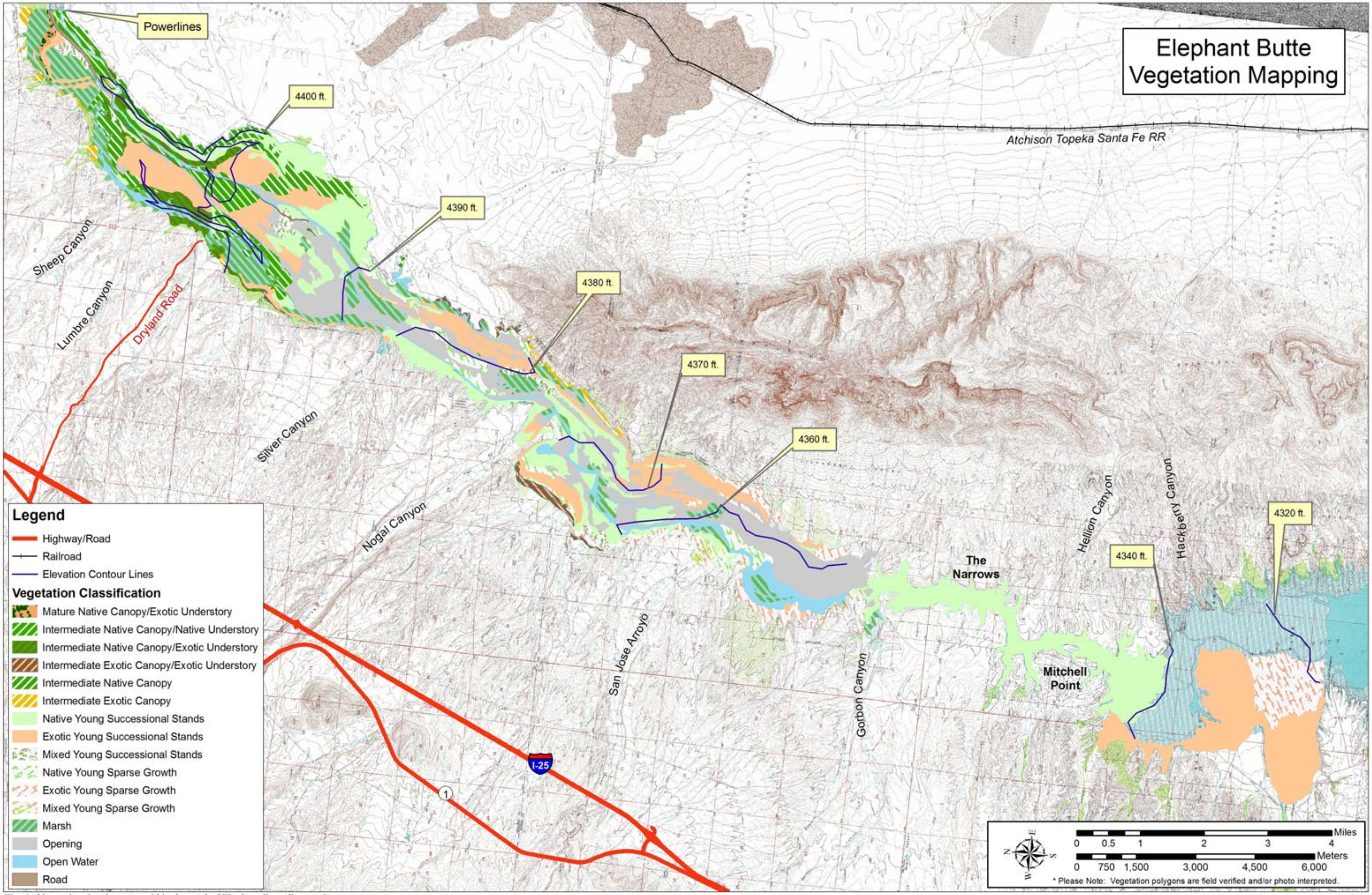

Fig. 6. Vegetation development within the pool of Elephant Butte Reservoir.

Table 1. Area covered by various habitat classes within the upper reaches of Elephant Butte Reservoir (corresponding to Figure 6), based on 2002 aerial data

Vegetation Class	Acres	Percent of Total
Mature Native Canopy	44	<0.1%
Intermediate Native Canopy/ Native Understory	756	0.1%
Intermediate Native Canopy/ Exotic Understory	388	<0.1%
Intermediate Exotic Canopy/ Exotic Understory	119	<0.1%
Intermediate Native Canopy	558	<0.1%
Intermediate Exotic Canopy	175	<0.1%
Native Young Successional Stands	3981	29.4%
Exotic Young Successional Stands	3847	28.4%
Mixed Young Successional Stands	232	<0.1%
Native Young Sparse Growth	423	<0.1%
Exotic Young Sparse Growth	1208	0.1%
Mixed Young Sparse Growth	126	<0.1%
Marsh	1703	12.6%
All classes	13,560	100%

*Openings and open water not included. These data have changed since 2002 and will be updated using 2004 aerial photos and 2005 ground-truthing.

Table 2. Resident SWFL territories within the Middle Rio Grande and Elephant Butte Reservoir pool from 1995 to 2005

Year	Resident SWFL Territories/Nests within Reclamation-surveyed Sites in the Middle Rio Grande	Resident SWFL Territories/Nests within Elephant Butte Reservoir Pool (% of Total)
1995	8 territories/ 6 nests	2 territories (14%)/ 0 nests (0%)
1996	17/ 1	12 (71%)/ 1 (100%)
1997	10/ 2	10 (100%)/ 2 (100%)
1998	11/ 2	9 (82%)/ 1 (50%)
1999	16/ 8	7 (44%)/ 3 (38%)
2000	31/ 25	19 (61%)/ 15 (60%)
2001	36/ 45	22 (61%)/ 35 (78%)
2002	87/ 80	54 (62%)/ 66 (83%)
2003	113/ 111	82 (73%)/ 96 (86%)
2004	149/ 187	113 (76%)/ 153 (82%)
2005	131/ 143	107 (82%)/ 127 (89%)

(1) Survey results from 1995 and 1996 are a combination of Reclamation and New Mexico Natural Heritage Program surveys.
(2) These numbers do not reflect territories known to occur on the Pueblo of Isleta.
(3) Not all reaches within the Middle Rio Grande were surveyed each year. For example, the Tiffany reach, which has contained SWFL territories, was only surveyed in 1995, 1996, 2004, and 2005.

Surface Water Monitoring Stations

Channelization of the Rio Grande below San Marcial has effectively disconnected the western flood plain from the river. Thus, groundwater and irrigation returns within the LFCC have supplied the only water to the west side of the flood plain below the LFCC outfall since 1987. LFCC flows during this time typically fluctuated between 100 and 500 cfs, however there have been periods when flows were much greater and conversely, when the LFCC was totally dry (Figure 7). In order to determine flows that would

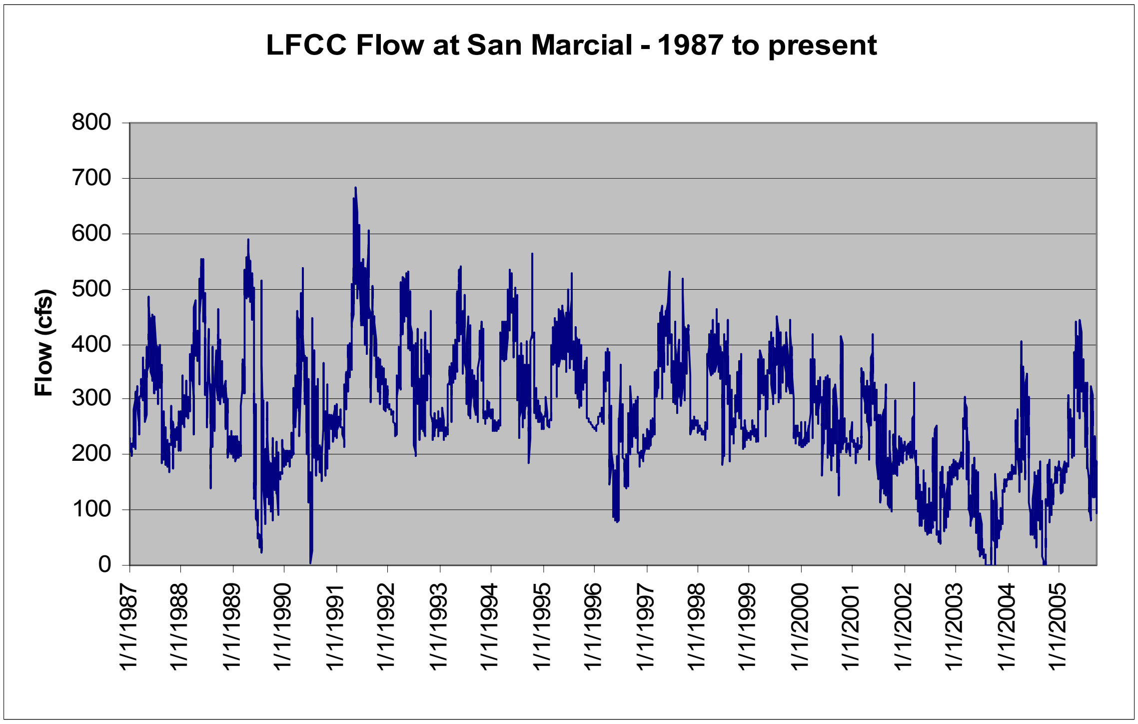

Figure 7. Average daily flow within the Low Flow Conveyance Channel, 1987 to present.

provide inundation of the flood plain west of the Rio Grande, Reclamation began a floodwater monitoring program in 2004. Nineteen "hydrostations" (custom-built staff gauges; see Figure 8) were installed in proximity to the "core" SWFL population in the headwaters of the reservoir (Figure 9). These hydrostations were placed in locations representative of the overall site's hydrology (with the exception of HS14 which was placed in the LFCC outfall adjacent to Dryland Road) and were monitored approximately once a week during the 2004 and 2005 SWFL breeding seasons. These data were used to determine the relationship between flows in the LFCC and depth of water within the "core" SWFL breeding areas.

Data were also compared to SWFL nest variables (i.e., success, productivity, predation, parasitism, distance to water) from the 2004 and 2005 breeding seasons. Overall, based on current data, hydrology did not influence nest variables greatly. Nest success, predation rate, and parasitism rate were all similar based on distance to water and hydrology immediately under the nest. All nests (n=269) were within 100 m (0.06 mi) of water and 99 percent were within 50 m (0.03 mi) of water. Successful nests that were either above saturated soil all season or above floodwater all season (a subset of saturated all season) produced more fledglings than successful nests that were above dry soil all season (ANOVA, P=0.04, Df=3, F-ratio=2.85). Also, nesting success differed based on hydrology immediately under the nest (χ^2=9.23, Df=3, P=0.03). See the Appendix for graphical representations of hydrology/nest variable comparisons.

Figure 8. Hydrostation 13.

As shown in Figure 10, all but one hydrostation (HS 4) were flooded when LFCC flows reached 100 cfs during 2004 and 2005. Thirteen of 19 hydrostations were flooded when flows were at least 75 cfs. Stations that dried out at the highest flows were those stations located in survey site LF-17a. These stations are the first downstream of the LFCC breach where the LFCC begins to branch out over a larger flood plain, resulting in slower water velocities. These sites have likely aggraded during the past several years of sediment deposition, making them slightly higher in elevation (and, thus, the first to dry out) than downstream sites that receive less sediment deposition. Consequently, it is likely that site LF-17a will continue to aggrade at a much faster rate than downstream sites.

Vegetation

As the water level in Elephant Butte Reservoir receded over the past 7 years, a vast expanse of native riparian forest became established in the upper end of the reservoir pool (Figure 6). Reclamation has conducted several vegetation studies within this area of the pool of Elephant Butte Reservoir during the past several years. Development of a SWFL habitat suitability model was initiated in 1998 for the Middle Rio Grande Basin, including the reservoir pool, and continues to be refined based on changes in hydrology and vegetation. Riparian vegetation in the Middle Rio Grande Basin between San Acacia Diversion Dam and Elephant Butte Reservoir has been classified using the Hink and Ohmart (1984) classification system through a cooperative effort with the U.S. Forest

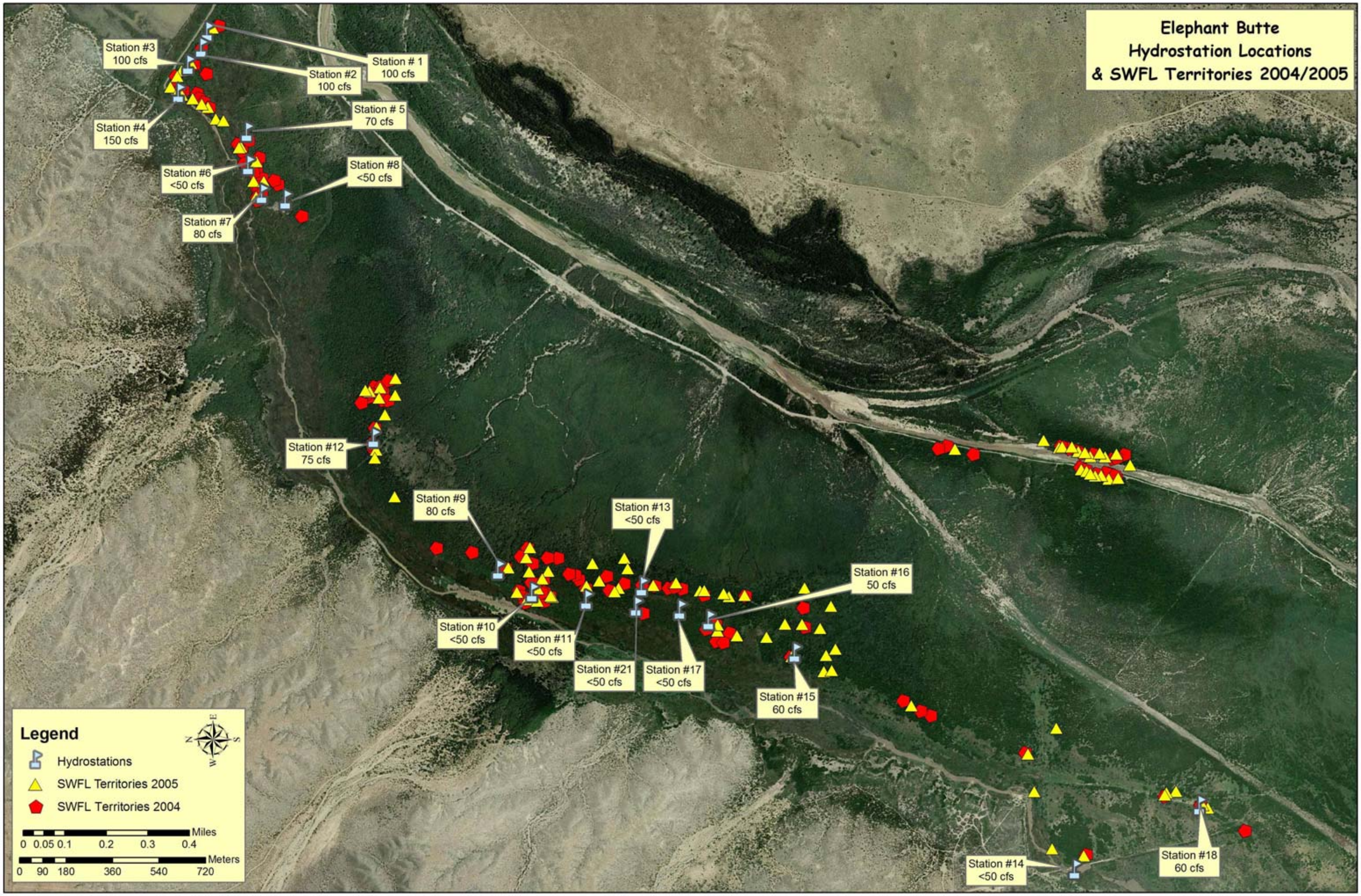

Fig. 9. Location of floodwater monitoring "hydrostations" within the headwaters of Elephant Butte Reservoir.

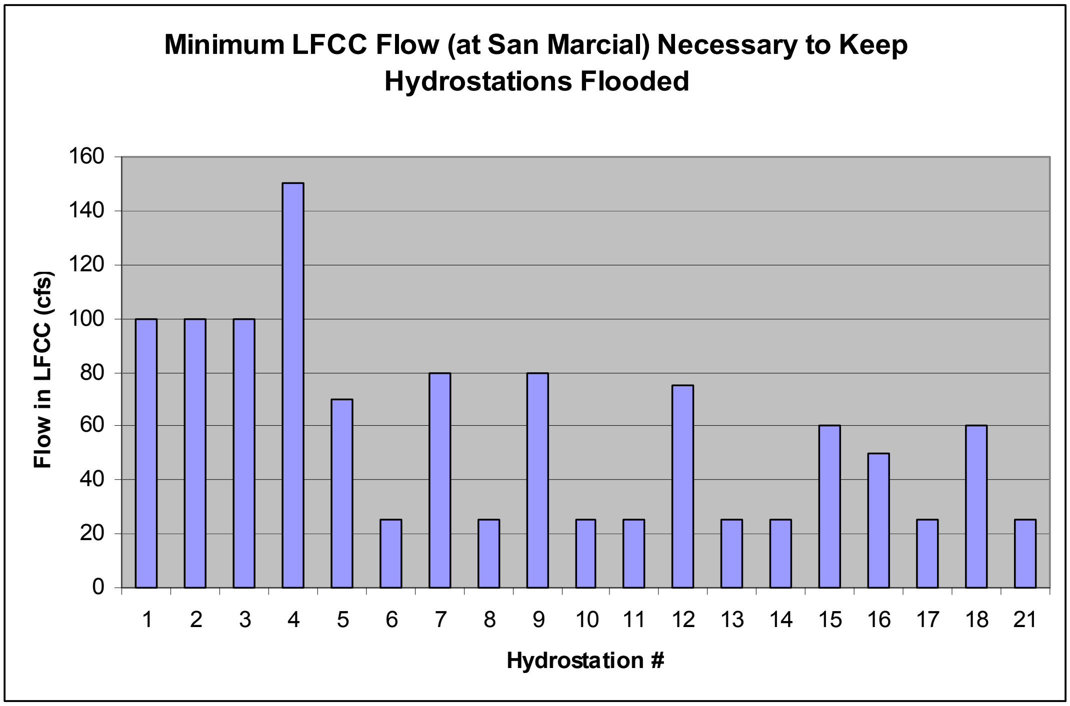

Figure 10. Minimum LFCC flows needed to keep hydrostations flooded during the 2004 and 2005 SWFL breeding seasons. Many hydrostations never dried out during the 2004 and 2005 seasons and the minimum flow during those years was 45 cfs, therefore stations were assigned a minimum flow of 25 cfs.

Service. This system identifies vegetation polygons based on dominant species and structure. Plant community types are classified according to the dominant and/or co-dominant species in the canopy and shrub layers. During summer and fall of 2002, as part of the ESA Collaborative Program, Reclamation updated vegetation maps from Belen to San Marcial using a combination of ground-truthing and aerial photo analysis.

A riparian vegetation study, established in conjunction with a Neotropical migrant bird nest monitoring study, was conducted in 1999 and 2000 as a pilot study developed by Reclamation, the New Mexico Natural Heritage Program, and the University of New Mexico to develop a standard vegetation monitoring protocol for the Middle Rio Grande. Data from this study showed that tree (> 2 inches DBH) density, percentage of native trees, and concealment at the upper height levels (above 9 ft) within the reservoir pool were greater than those outside the pool. For full details of this study, see *Riparian Obligate Nesting Success as Related to Cowbird Abundance and Vegetation Characteristics Along the Middle Rio Grande, New Mexico* (Moore 2005, in prep.).

In cooperation with the New Mexico Natural Heritage Program and the University of New Mexico, Reclamation initiated a study to quantify vegetation characteristics at known SWFL breeding sites in 2003. Data gathered included nest height and substrate, vegetation density, height diversity, canopy cover, and hydrology. During 2003 and 2004, data were gathered at 27 and 49 nests, respectively, and will be used to increase overall knowledge of the nesting and general habitat requirements of the species. It is anticipated that the findings from this study will provide guidelines for riparian restoration projects targeted for SWFL habitat. Data gathered in 2005 will be added to the data analysis performed following the 2004 field season, and a summary report will be prepared. For details of this study, see *Habitat Quantification of Southwestern Willow Flycatcher Nest Sites, Rio Grande from La Joya to Elephant Butte Reservoir Delta, New Mexico – 2004* (Bureau of Reclamation 2005).

During the summer of 2004, the conservation pool of Elephant Butte Reservoir was again aerially photographed. In spring and summer of 2005, vegetation polygons derived from the 2004 aerial photos were ground-truthed to confirm the accuracy of remotely classified vegetation and for purposes of detecting changes to the habitat following the 2002 classification. These data are currently being processed and will be used to update vegetation maps and the SWFL habitat model. For details of the SWFL habitat model, see *2002 Southwestern Willow Flycatcher Study Results, Appendix D, Southwestern Willow Flycatcher Habitat Suitability Model* (Moore and Ahlers 2003).

Lastly, during fall 2004, Light Detection and Ranging (LIDAR) aerial data were obtained from within the entire pool of Elephant Butte Reservoir. LIDAR provides information regarding the elevation of the ground surface plus heights of any natural or manmade features. These data are being used to: (1) construct an elevation model of the reservoir bottom (above water), and (2) measure vegetation canopy heights for all vegetation polygons within the reservoir pool. These data will then be incorporated into Reclamation's SWFL habitat suitability model to increase the model's accuracy.

Potential Detriments to SWFL Habitat

Similar to the beneficial dynamics of the Rio Grande system that allowed for the creation of vast expanses of high quality SWFL habitat within the reservoir pool, there are several factors that may be detrimental to the suitability of SWFL habitat within the reservoir pool. Three factors can be noted as potentially detrimental to the establishment or persistence of SWFL breeding habitat in this area: salt accumulation in the soil, lowering of the groundwater table resulting from a degraded river channel, and an infestation by cottonwood leaf beetles.

During the past 8 years, the reservoir level decreased and native habitat grew in the reservoir headwaters. Over time, this habitat increased in extent and suitability for breeding flycatchers, and the frequency of flooding decreased. Some of these areas became occupied by breeding SWFLs. Salt content of the soil increased and "flushing" flows, either from overbank flooding or fluctuating reservoir levels, decreased in frequency. The native vegetation in these areas slowly died off as soil chemistry became unsuitable and saltcedar became a more prominent component of these native habitats. Eventually, these areas became unsuitable to flycatchers as most of the canopy trees died.

A prime example of this occurrence took place in SWFL survey site LF-14, which is located immediately downstream of the powerline crossing at River Mile 62. Although outside the reservoir pool, this site became suitable flycatcher breeding habitat and was occupied by SWFLs between 1997 and 2002. Reduced Rio Grande flows beginning in

1998 prevented overbank flooding from flushing salts from the soil in this site. Between 1998 and 2002 suspected salt accumulation killed the native vegetation, rendering the site unsuitable for breeding SWFLs. Although no soil testing has been conducted, salt accumulation is a key factor in mortality of willows in areas with reduced flood frequency (J. Taylor, pers. comm. 2002) Figure 11 shows the result of salt accumulation on native willows in the headwaters of Elephant Butte Reservoir. Notice the dead and downed Goodding's willow (*Salix gooddingii*) and the encroaching saltcedar.

Figure 11. Native vegetation in the reservoir pool killed by salt accumulation and lack of "flushing" flows.

The Rio Grande in the San Marcial area has a long-term pattern of rapid aggradation (Makar and Strand 2002, Massong et al. 2006). As a consequence to the rapid aggradation, the floodway is super-elevated from its historical flood plain (Makar and Strand 2002). For the past 10 years, with lower than average spring flows in the Rio Grande, shallow-rooted plants (such as willows) have thrived.

Starting in the early 1990s, Reclamation and the New Mexico Interstate Stream Commission built temporary channels through the Elephant Butte Reservoir delta to maintain the connection between the Rio Grande to the reservoir pool. This 'temporary' channel construction created a series of 'headcuts' as the base level continued to be lowered to the ever decreasing reservoir pool elevation. With the larger-than-average spring flows in 2005, several of the 'headcuts' migrated upstream to the San Marcial railroad bridge crossing, creating an incised channel. The current bed elevation at San Marcial is estimated to be as much as 5 ft lower than in 2004 (T. Massong, pers. comm. 2005). This process will likely contribute to lowering of the water table adjacent to the river and reducing available water to the root zone of many of the native vegetation patches. It is possible that these patches will suffer significant mortality, reducing their suitability to nesting SWFLs. Figures 12.1 and 12.2 show the Rio Grande channel at San Marcial before and after the degradation even in 2005. Although incision was rampant in 2005, and may continue for the next few years as other ‘headcuts’ migrate into the San Marcial area, this reach is still an aggrading reach and will likely begin aggrading again in the next 5 to 10 years (T. Massong, pers. comm. 2005).

Lastly, in the spring of 2005, an outbreak of cottonwood leaf beetles (*Chrysomela scripta*) was noted in the headwaters of Elephant Butte Reservoir. It was the first time in 10 years of surveying in the San Marcial area that these beetles were documented by Reclamation personnel. The beetles’ population can be somewhat cyclical in nature, flourishing when conditions are right (M. Nelson, pers. comm. 2005). Their host plant is typically cottonwood (*Populus* spp.). However, in the spring of 2005, these beetles were prolific on the Goodding’s willow in certain areas of the reservoir headwaters. Defoliation occurred on a broad scale in several areas (Figures 13.1 and 13.2) and SWFL territories in one severely impacted area dropped from four in 2004 to two in 2005.

Southwestern Willow Flycatcher

Reclamation has conducted presence/absence surveys and nest monitoring for SWFLs during the May to July breeding season within the Rio Grande Basin since 1995. In 1995, eight territorial SWFLs were documented within the Middle Rio Grande. At this time, the reservoir was nearly full and only two territories were found within the active pool (Table 2). Nests were documented in five of the territories (one re-nested), however no nests were located in the reservoir pool at that time. In successive years, as the reservoir receded and the amount of suitable habitat increased, the SWFL population in the Middle Rio Grande increased, and a large percentage of this increase occurred in the reservoir pool (Table 2). The SWFL population within Reclamation-surveyed portions of the Middle Rio Grande peaked in 2004 to a total of 149 territories and 187 nests (including several re-nests), surpassing the Middle Rio Grande Management Unit Recovery Goal of 100 territories. Due to the high quality habitat present within the reservoir pool, a large percentage of territories and nests (76 and 82 percent, respectively) occurred in the reservoir pool.

In 2005, territory and nest numbers decreased slightly, both within and outside the reservoir pool. However, a large percentage of territories and nests were still found within the pool. As is shown in Figure 14, all SWFL territories documented in the reservoir pool within the past 12 years were located in the upper 5 ft of the reservoir pool. At the current reservoir elevation (as of September 25, 2005), the southernmost SWFL territory documented in 2005 was 73 ft in elevation and approximately 16 mi upstream of the current water level (Figure 15).

Figures 12.1 and 12.2. River channel below San Marcial before and after high flow degradation event of 2005.

Figures 13.1 and 13.2. Photos of cottonwood leaf beetle defoliation in the headwaters of Elephant Butte Reservoir – spring 2005.

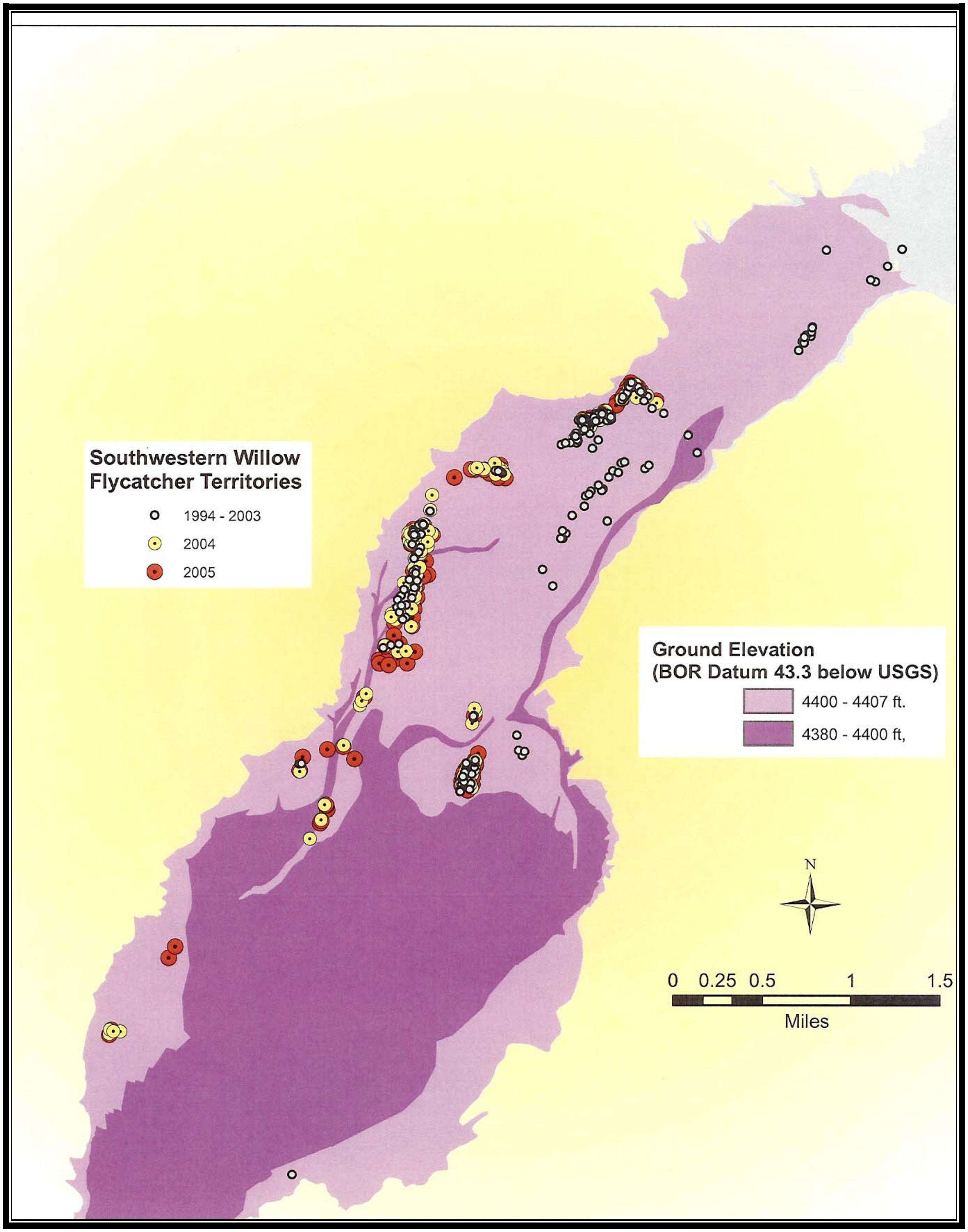

Figure 14. SWFL territory locations within Elephant Butte Reservoir pool – 1994-2005.

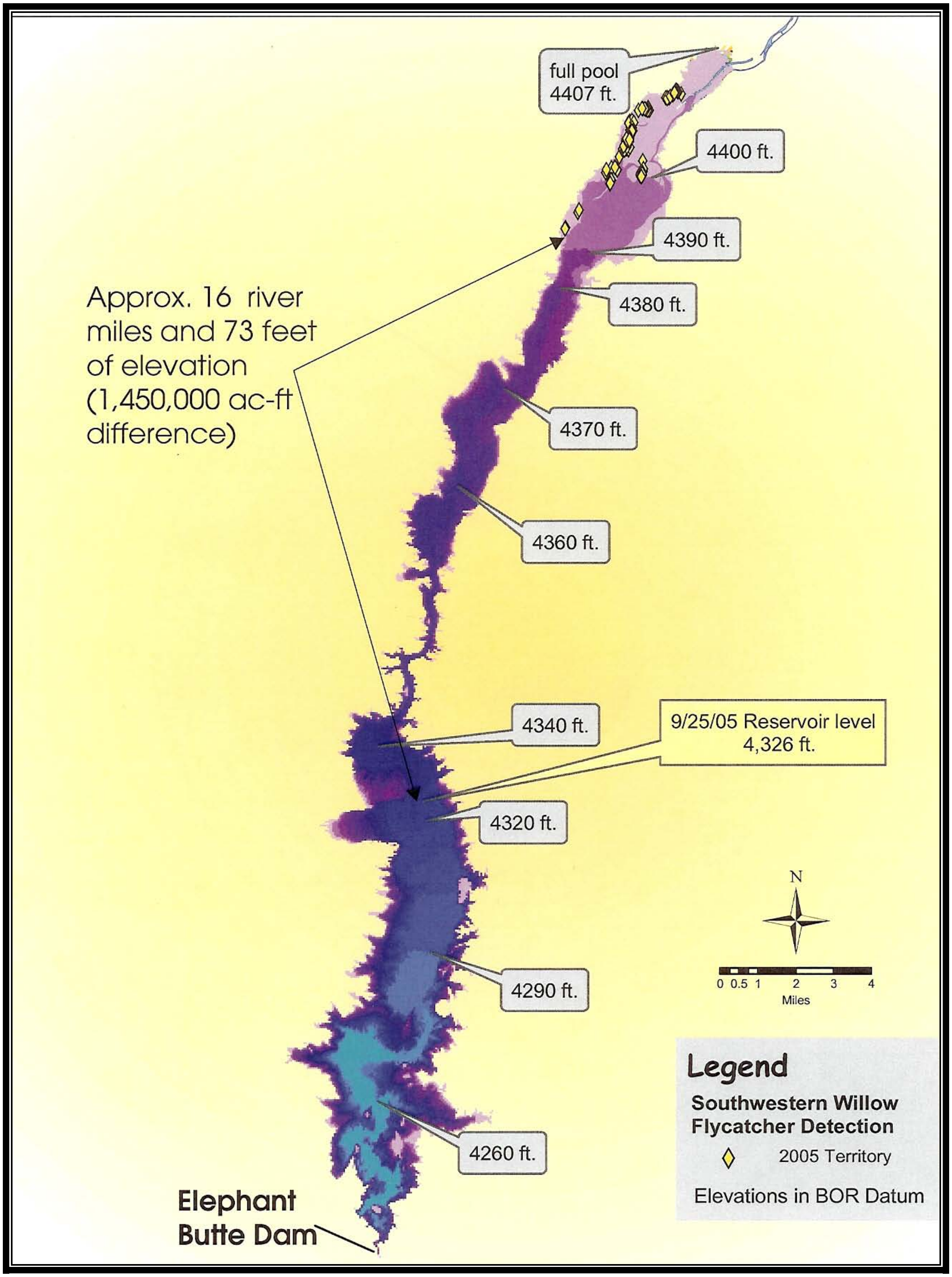

Figure 15. Map of 2005 SWFA territories within Elephant Butte Reservoir, contour elevations, and current reservoir level.
Note: Southernmost SWFL territory is approximately 16 mi and 73 ft in elevation above the reservoir pool as of September 25, 2005.

Future

Given the historic and recent trends regarding the SWFL population, as well as regional climate, the patterns of vegetation development, and hydrology in the reservoir pool, it is possible to predict, with a moderate degree of certainty, what level of growth the population will sustain and what new areas will possibly be colonized by this bird. The SWFL population within the reservoir has increased significantly over the past 7 years due in part to an increase in available breeding habitat resulting from recession of the reservoir during the late 1990s and early 2000s. Groundwater and irrigation returns from the LFCC outfall provided water to this habitat, allowing it to develop rapidly. Currently, there is more breeding habitat available than the existing SWFL population can occupy. Therefore it is likely that, given sufficient hydrologic inflow, this habitat will continue to expand and SWFLs could occupy newly available habitat, allowing for population growth. The SWFL population within the reservoir pool has moved southward during the past several years and could continue as new, more structurally suitable habitat develops, augmenting the increasingly less-suitable habitat to the north.

Limiting factors to habitat suitability are present within the reservoir headwaters as well. Existing habitat is unable to remain suitable for breeding SWFLs on a permanent basis. As the habitat matures, it loses structural diversity that is crucial to breeding SWFLs. This habitat suitability loss has occurred in the headwaters of the reservoir and corresponding reductions in SWFL territory numbers were documented. Salt accumulation and lowering of the water table will impact native vegetation development and growth in certain areas, particularly in areas not supplied with LFCC outfall water. Lastly, cottonwood leaf beetles could impact SWFL breeding habitat if beetle populations continue to flourish. In other studies, populations were known to be prolific for up to 5 years and mortality occurred in host trees after 3 years of defoliation (M. Nelson, pers. comm. 2005).

Willow Flycatchers depend on dynamic riverine and palustrine wetland systems to provide breeding habitat. Current flow modeling predicts that it may take 18 years of 100 percent of normal flow amounts in the Rio Grande to fill Elephant Butte Reservoir (W. Treers, pers. comm.). As the reservoir fills, water levels are likely to fluctuate both seasonally and over the span of several years making the above modeled scenario less likely. While these hydrologic events may flood some habitat, potentially killing it, the dynamic movement of water within the reservoir pool should create new patches of habitat for SWFLs to occupy. Even at full pool, the habitat in the upper end of the reservoir (between elevation 4400 and 4407 ft) could be at most flooded by 7 ft of water. Native willow species are able to withstand long periods of flooding, and such flooding in the upper reaches of the reservoir would probably not persist for more than several months. Thus, habitat and SWFLs should ultimately receive benefit from the filling of Elephant Butte Reservoir.

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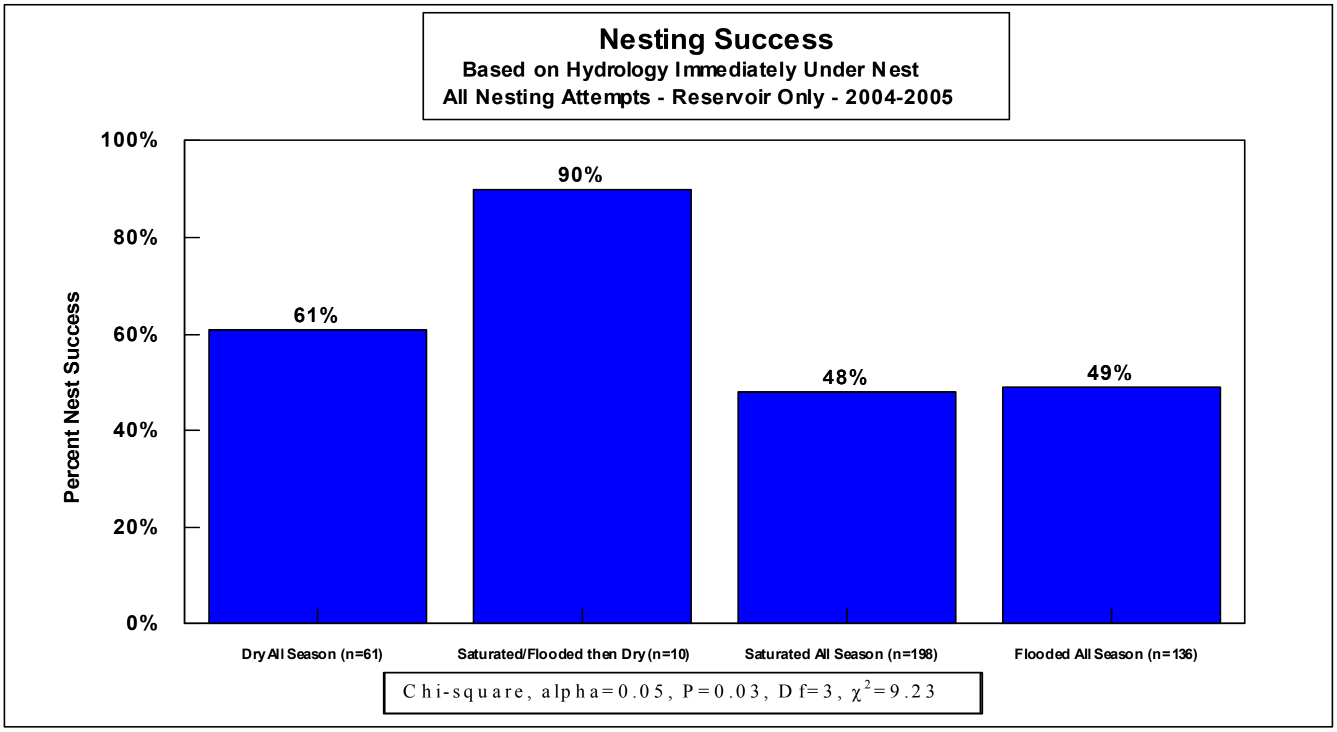
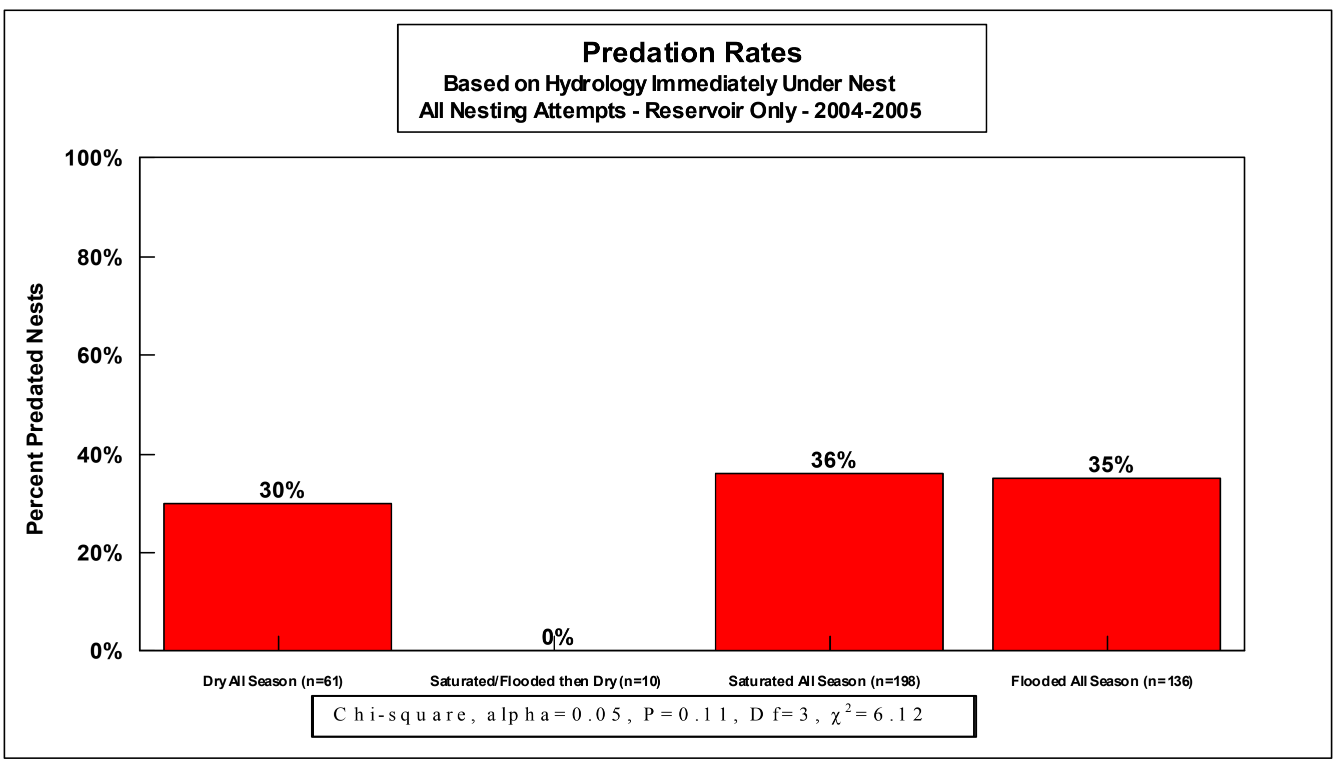
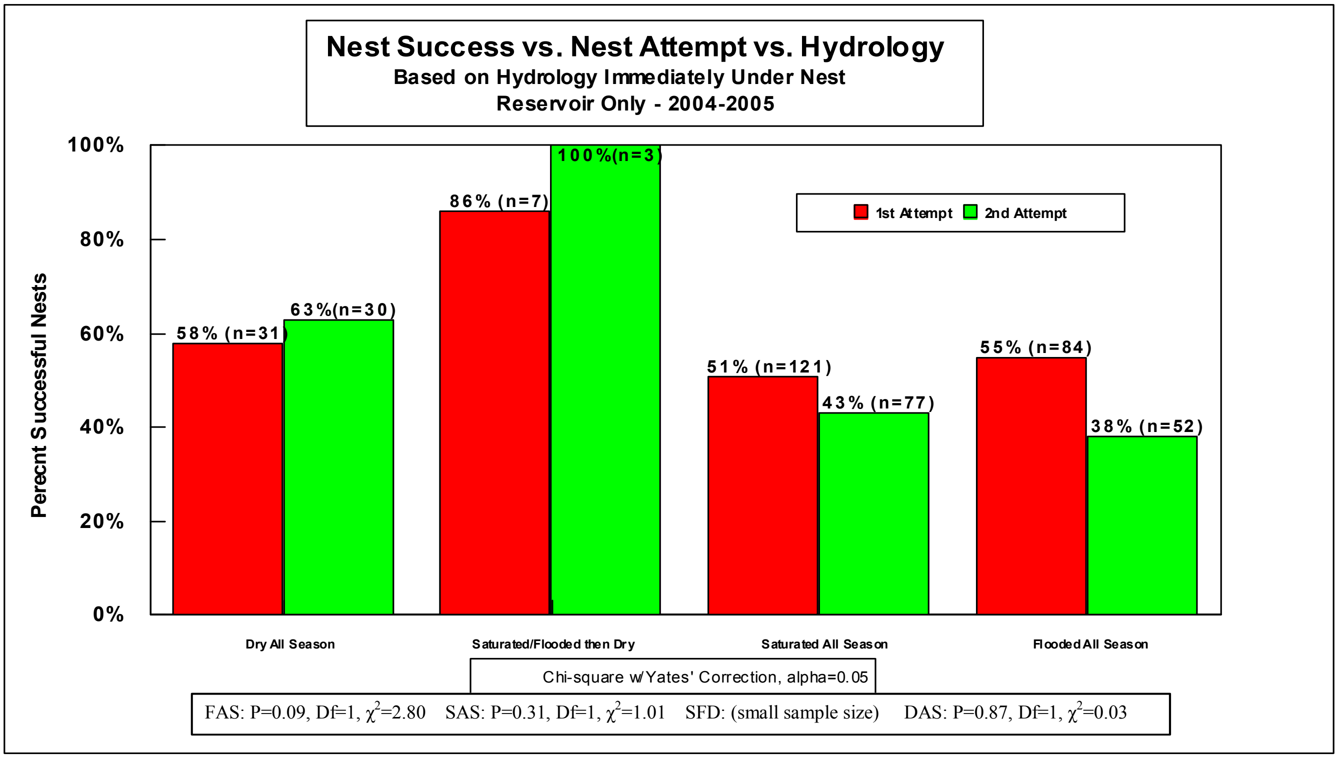
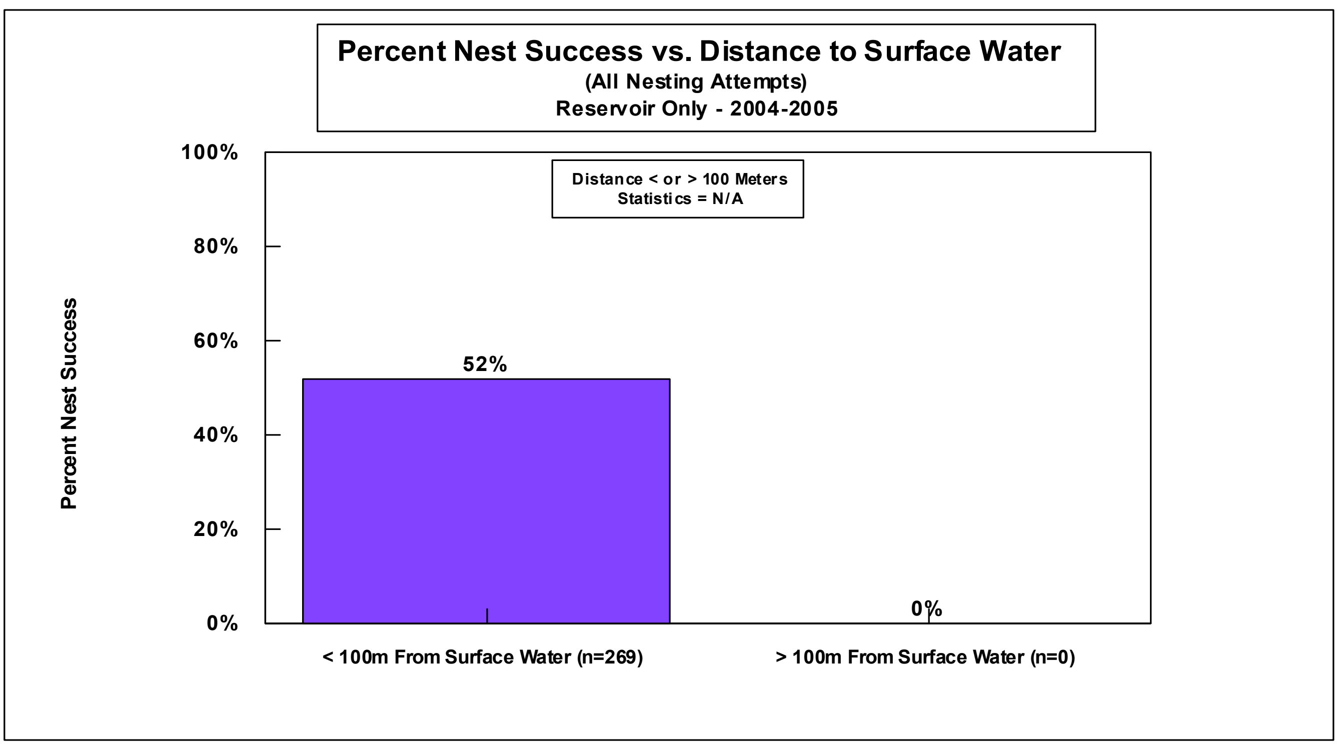
Appendix

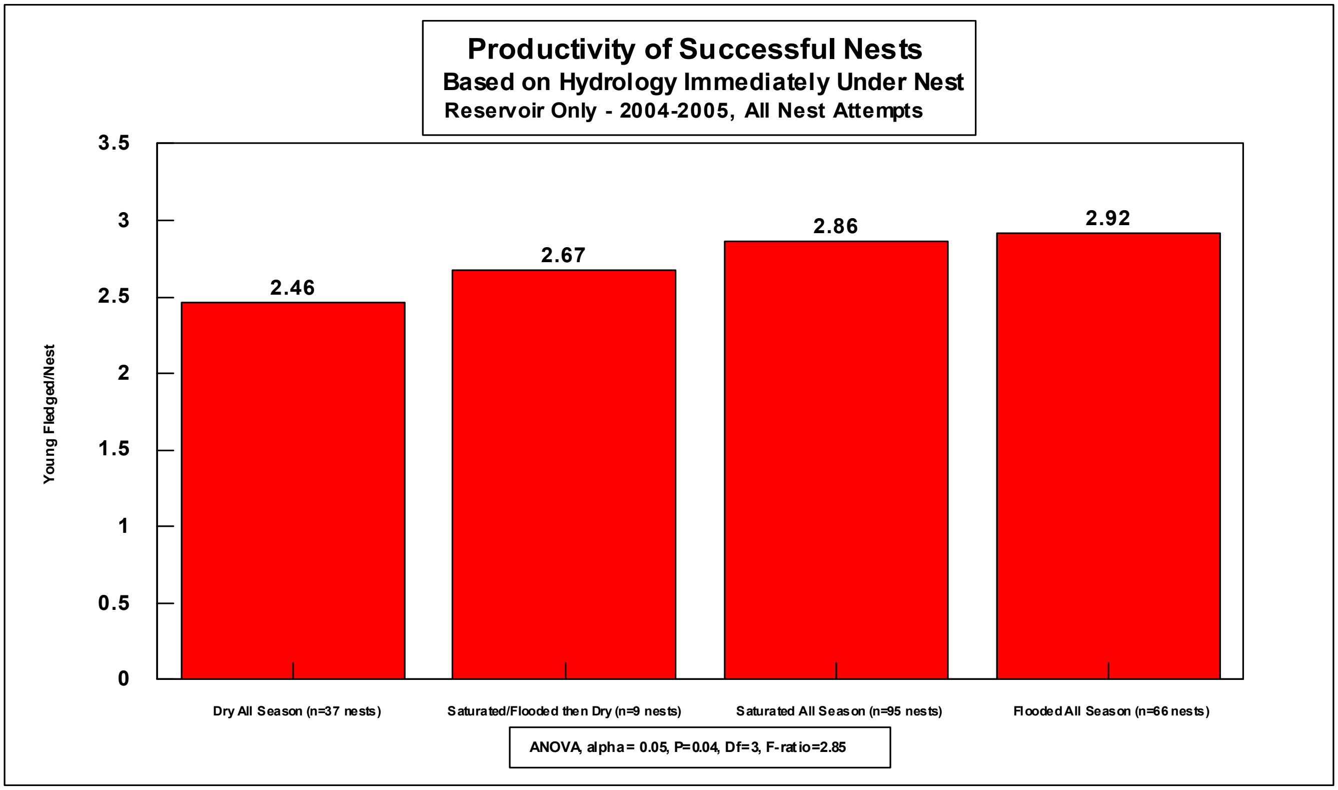
Graphical Representations of Hydrology/SWFL Nesting Variable Comparisons

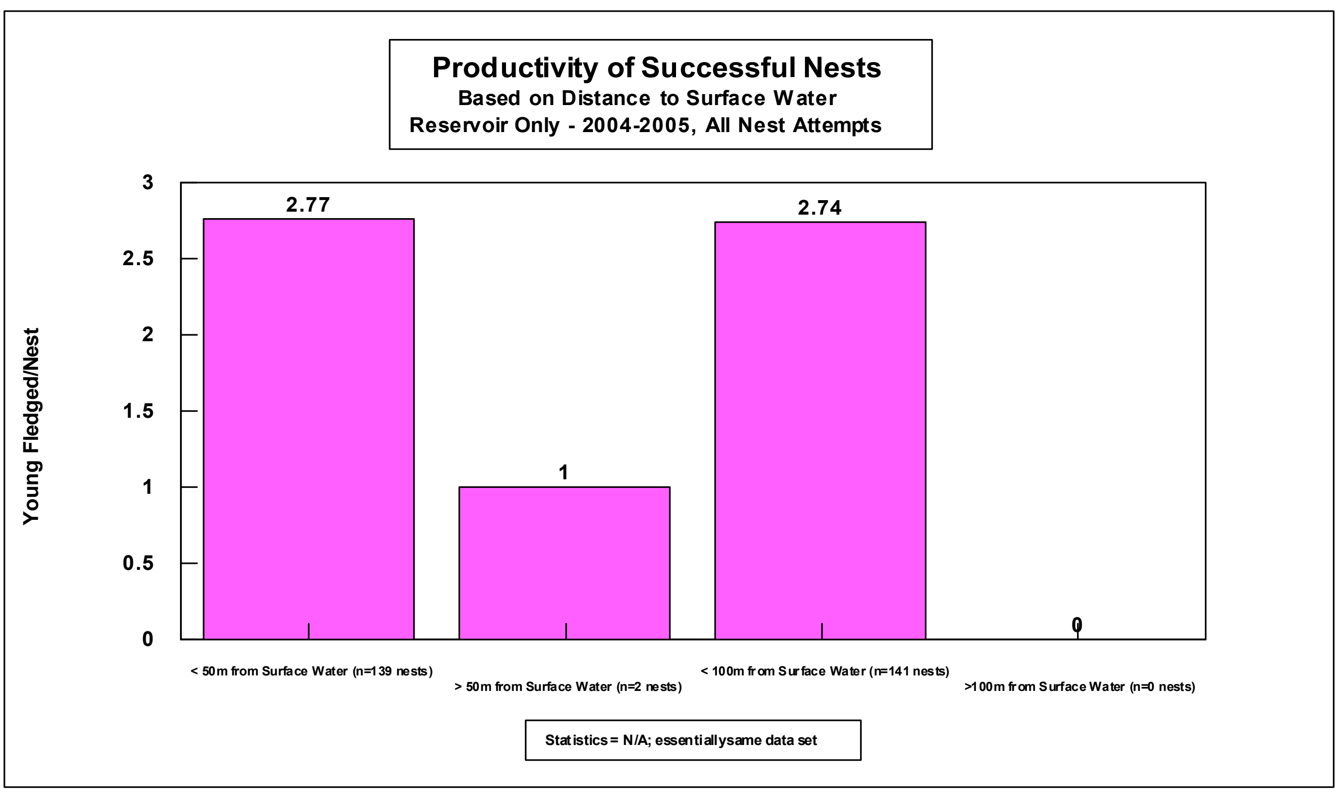

Nesting Success
Based on Hydrology Immediately Under Nest
All Nesting Attempts - Reservoir Only - 2004-2005
Percent Nest Success
100%
80%
60%
40%
20%
0%
61%
90%
48%
49%
Dry All Season (n=61)
Saturated/Flooded then Dry (n=10)
Saturated All Season (n=198)
Flooded All Season (n=136)
Chi-square, alpha=0.05, P=0.03, Df=3, χ2=9.23

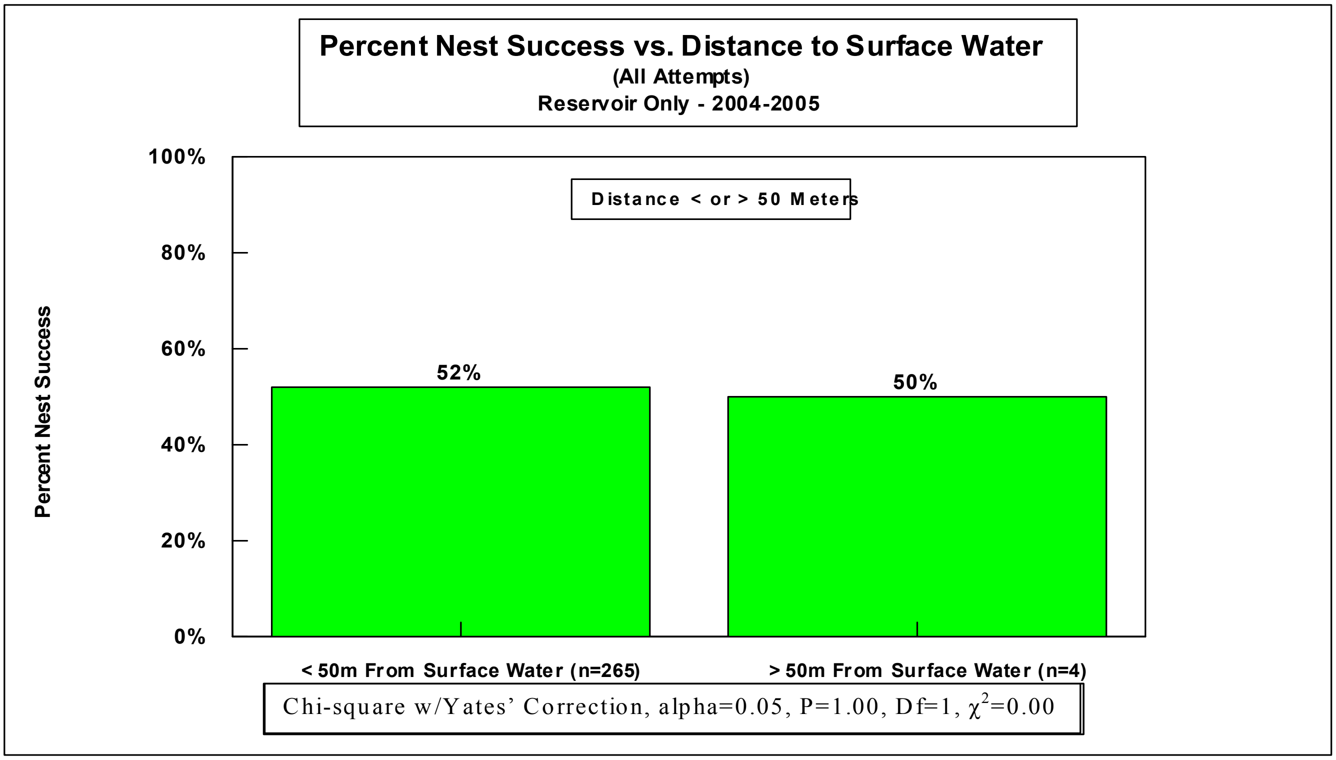

Predation Rates
Based on Hydrology Immediately Under Nest
All Nesting Attempts - Reservoir Only - 2004-2005
Percent Predated Nests
100%
80%
60%
40%
20%
0%
30%
0%
36%
35%
Dry All Season (n=61)
Saturated/Flooded then Dry (n=10)
Saturated All Season (n=198)
Flooded All Season (n=136)
Chi-square, alpha=0.05, P=0.11, Df=3, χ2=6.12

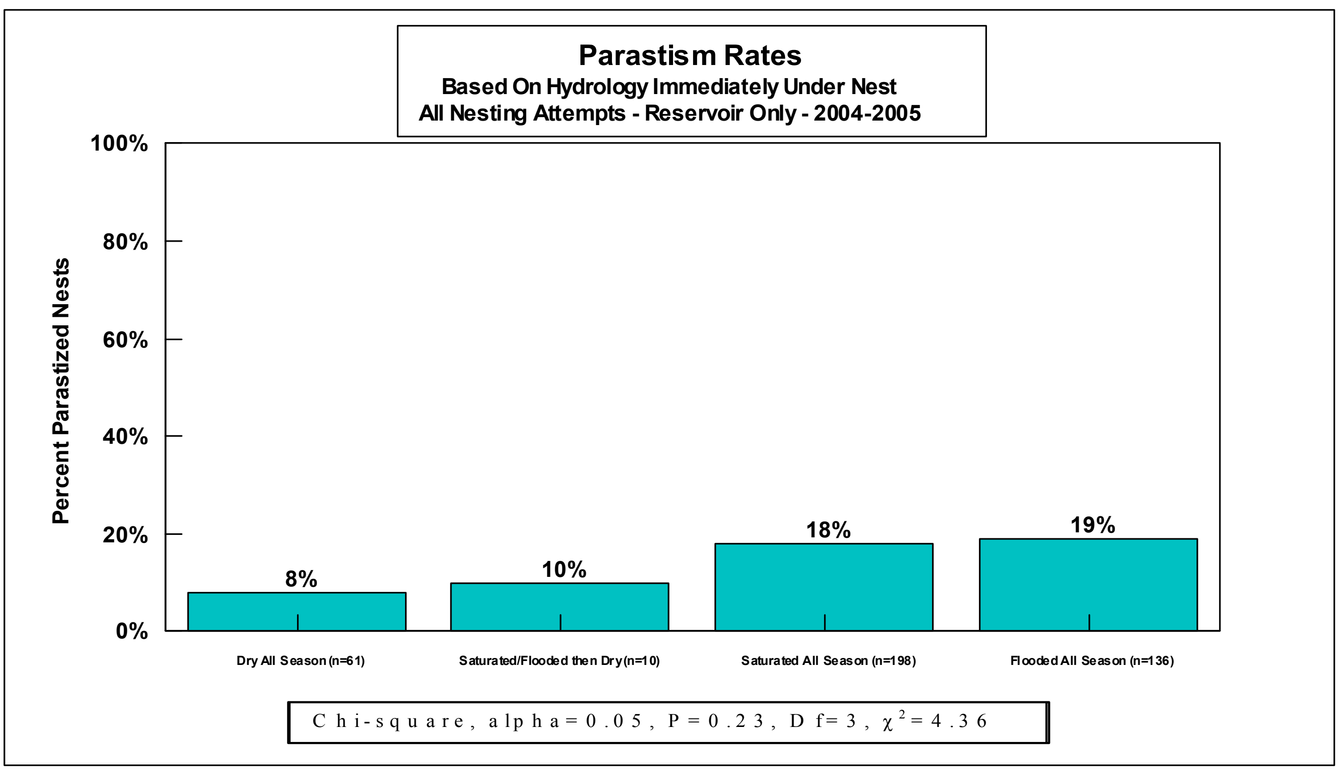

Nest Success vs. Nest Attempt vs. Hydrology
Based on Hydrology Immediately Under Nest
Reservoir Only - 2004-2005
Perecnt Successful Nests
100%
80%
60%
40%
20%
0%
1st Attempt
2nd Attempt
58% (n=31)
63%(n=30)
86% (n=7)
100%(n=3)
51% (n=121)
43% (n=77)
55% (n=84)
38% (n=52)
Dry All Season
Saturated/Flooded then Dry
Saturated All Season
Flooded All Season
Chi-square w/Yates' Correction, alpha=0.05
FAS: P=0.09, Df=1, χ2=2.80 SAS: P=0.31, Df=1, χ2=1.01 SFD: (small sample size) DAS: P=0.87, Df=1, χ2=0.03


Percent Nest Success vs. Distance to Surface Water
(All Nesting Attempts)
Reservoir Only - 2004-2005
Distance < or > 100 Meters
Statistics = N/A
Percent Nest Success
100%
80%
60%
40%
20%
0%
52%
0%
< 100m From Surface Water (n=269)
> 100m From Surface Water (n=0)


Productivity of Successful Nests
Based on Hydrology Immediately Under Nest
Reservoir Only - 2004-2005, All Nest Attempts
Young Fledged/Nest
3.5
3
2.5
2
1.5
1
0.5
0
2.46
2.67
2.86
2.92
Dry All Season (n=37 nests)
Saturated/Flooded then Dry (n=9 nests)
Saturated All Season (n=95 nests)
Flooded All Season (n=66 nests)
ANOVA, alpha= 0.05, P=0.04, Df=3, F-ratio=2.85


Productivity of Successful Nests
Based on Distance to Surface Water
Reservoir Only - 2004-2005, All Nest Attempts
Young Fledged/Nest
3
2.5
2
1.5
1
0.5
0
2.77
1
2.74
0
< 50m from Surface Water (n=139 nests)
> 50m from Surface Water (n=2 nests)
< 100m from Surface Water (n=141 nests)
>100m from Surface Water (n=0 nests)
Statistics = N/A; essentiallysame data set


Percent Nest Success vs. Distance to Surface Water
(All Attempts)
Reservoir Only - 2004-2005
Distance < or > 50 Meters
Percent Nest Success
100%
80%
60%
40%
20%
0%
52%
50%
< 50m From Surface Water (n=265)
> 50m From Surface Water (n=4)
Chi-square w/Yates' Correction, alpha=0.05, P=1.00, Df=1, χ2=0.00


Parastism Rates
Based On Hydrology Immediately Under Nest
All Nesting Attempts - Reservoir Only - 2004-2005
Percent Parastized Nests
100%
80%
60%
40%
20%
0%
8%
10%
18%
19%
Dry All Season (n=61)
Saturated/Flooded then Dry (n=10)
Saturated All Season (n=198)
Flooded All Season (n=136)
Chi-square, alpha=0.05, P=0.23, Df=3, χ2=4.36