

Survivorship and Movements of Southwestern Willow Flycatchers at Roosevelt Lake, Arizona - 2005



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EXECUTIVE SUMMARY

In 2005, USGS continued to track and band willow flycatchers at Roosevelt Lake for the 10th and final year. One of the key objectives of this 10-year demographic study was to measure the response of flycatchers to inundation when the Roosevelt Lake reservoir filled. This objective was not met until this last year, when heavy winter precipitation in 2004/2005 caused the reservoir to fill to near capacity. As a result, we were able to document the first-year response of flycatchers to habitat loss via inundation.

The runoff from the winter precipitation caused Roosevelt Lake to rise over 70 feet in early 2005, destroying or partially inundating almost all riparian patches that supported 2004 breeding territories. This loss of breeding habitat had a major impact on the breeding population of flycatchers returning from their wintering grounds, and many of our findings for 2005 are best interpreted in light of this inundation. The majority of returning flycatchers settled into semi-inundated habitats, but some used historically occupied habitat above the lake level. Banding and resighting of flycatchers in those flooded habitats presented considerable challenges to both USGS and AGFD crews. Nonetheless, we believe we were able to track all territorial flycatchers, as well as many non-territorial flycatchers. Overall, we captured and banded 42 new adult flycatchers, monitored 201 banded adults, and banded three fledglings from unknown nests. This year we recorded a 43% adult return rate and detected high levels of movement from patch to patch, with 86% of returning birds moving to different patches. By the end of the field season, 69% of all willow flycatchers at Roosevelt Lake were banded.

In 2005, 16 of the 87 hatch year birds banded in 2004 returned, a juvenile return rate of 18%. Additionally, we captured two flycatchers banded as nestlings in 2001 and 14 from 2003 at Roosevelt Lake, and documented the movement of two returning nestlings to the lower Colorado River and one to the Verde River. The detection of returning nestlings from 2001 and 2003 increased the nestling return rate from 29% to 32% and from 20% to 27% in 2001 and 2003, respectively.

We detected 111 birds that exhibited movements to other patches between 2004 and 2005, likely in response to the inundation of many formerly occupied patches at Roosevelt Lake. An additional response to the inundation was the detection of numerous flycatchers in patches that were not occupied last year, including 69 flycatchers at A-cross Road, 85 at Cottonwood Acres (a patch without flycatchers since 2000), and 58 at Tonto. In addition, we detected one adult that moved from Roosevelt Lake to the San Pedro River between 2004 and 2005, and one that moved to the Verde River at Horseshoe Reservoir.

From 1996 to 2002, the Roosevelt Lake flycatcher population increased in size, a trend that ended in 2003 due to the drought-caused reproductive failure of 2002. In 2004, it seemed that the population had recovered, with a 66% increase in flycatchers from 2003 to 2004. However, the Roosevelt Lake population was again perturbed in 2005, with a 23% decline from 2004 to 2005. It is presumed to be largely a result of the inundation and loss of habitat, although other factors certainly contributed. Regardless of the cause, it is not clear how much of the decline was due to flycatchers leaving the Roosevelt Lake area, or remaining at Roosevelt Lake but not being territorial and thus undetected. Resighting efforts throughout Arizona by USGS and cooperators did not detect a large exodus of Roosevelt Lake flycatchers, but not all areas are monitored and it may take more than a single year for displaced flycatchers to find new breeding sites and be detected.

Survivorship and Movements of Southwestern Willow Flycatchers at Roosevelt Lake, Arizona – 2005

INTRODUCTION

The southwestern willow flycatcher (*Empidonax traillii extimus*) is a small, endangered bird that breeds only in riparian habitats scattered throughout portions of the southwestern states (Marshall 2000, Unitt 1987). The flycatcher has suffered serious declines as riparian habitats have been lost or modified (Marshall and Stoleson 2000, USFWS 1993), and was listed as a federal endangered species in 1995 (USFWS 1995).

Two of the largest southwestern willow flycatcher breeding sites in Arizona are found at the Salt River and Tonto Creek inflows of Roosevelt Lake (Fig. 1). Flycatchers were first observed here in 1993 (Muiznieks et al. 1994), where they breed in patches of dense riparian habitat. These sites include a mosaic of patches, some dominated by tamarisk (*Tamarix ramosissima*), others by native willow (primarily *Salix gooddingii*), and some with a mixture of both tamarisk and willow. A long-term drought in the southwest U.S. caused the lake levels to drop, habitat to emerge from the lakebed, and flycatchers to colonize the habitat, resulting in a dramatic population increase at Roosevelt Lake from 1996 to 2004.

The U.S. Bureau of Reclamation (Reclamation) consulted with the Fish and Wildlife Service under Section 7 of the Endangered Species Act (ESA) regarding potential impacts to the southwestern willow flycatcher resulting from modifications to Roosevelt Dam. The resulting Biological Opinion required that Reclamation fund a comprehensive southwestern willow flycatcher research program that included collection of demographic data (such as birth/death rates, lifetime reproductive success, immigration/emigration, site fidelity, movement between sites, age-specific reproductive success, and longevity). Such a study required color banding flycatchers so that individuals could be identified and their movements, survivorship, and reproductive efforts tracked.

A major reason to study movements at Roosevelt Lake (and beyond) was to determine where resident flycatchers moved once their breeding habitat was inundated. At the beginning of this project, little was known about site fidelity, dispersal, or movement behavior of willow flycatchers. Therefore, there was no way to predict how individual flycatchers would respond when habitat inundation occurred. The lower San Pedro River willow flycatcher population, which is not subject to inundation, was selected both for comparison with the Roosevelt Lake population, and as an area where willow flycatchers might disperse once Roosevelt Lake filled. Since 2001, work was reduced at the San Pedro River so that USGS could focus its efforts on the rapidly growing population at Roosevelt Lake. Due to the drought, Roosevelt Lake had not inundated flycatcher breeding habitat until 2005. In 2005 the lake level rose to near capacity, inundating most 2004 breeding habitat, and causing shifts in the distribution of flycatchers at the lake. Thus, at the very end of this study, we were able to document the first-year impacts of inundation on flycatchers.

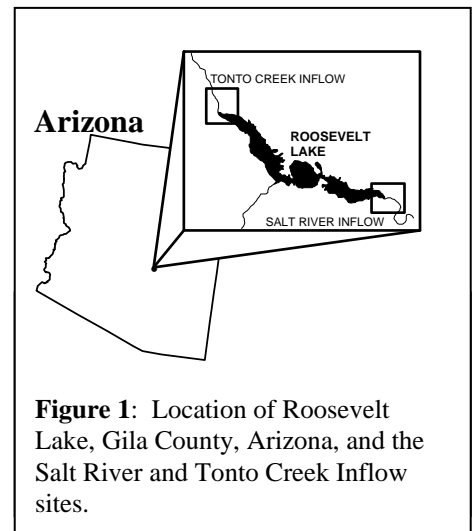


Figure 1: Location of Roosevelt Lake, Gila County, Arizona, and the Salt River and Tonto Creek Inflow sites.

The Roosevelt Lake Biological Opinion was the driving force behind the research presented in this report. Reclamation has funded this USGS-based research program at Roosevelt Lake and the San Pedro River since 1996.

STUDY AREA AND BANDING HISTORY

STUDY AREA

Roosevelt Lake was formed by Roosevelt Dam at the confluences of the Salt River and Tonto Creek in central Arizona, approximately 90 km northeast of Phoenix. Until the breeding season of 2005, willow flycatchers were found at approximately 640 m elevation at the inflows of the Salt River and Tonto Creek. Roosevelt Lake's primary purpose is to hold and retain water for downstream use. In previous years water levels have fluctuated significantly due to winter runoff spikes and rapid summer draw downs. In 2005, due to high winter precipitation, Roosevelt Lake rose to just below capacity (655 m), inundating most of the breeding habitat occupied by willow flycatchers in 2004.

From 1995 through 2004, the average surface elevation of Roosevelt Lake fluctuated but in general dropped due to lower than average precipitation in Arizona. This allowed new riparian habitat to form on the once inundated flood plain within the reservoir's conservation space (below elevation of 656 m). In 1999, willow flycatchers were first detected occupying some of this new habitat, and in breeding seasons prior to 2005 additional patches of new habitat had become occupied by breeding flycatchers. Because most of the historical flycatcher habitat was inundated in 2005, flycatchers used partially inundated and dry patches above the high water mark of 655 m. This year, the Tonto Creek Inflow site contained both partially inundated and dry patches, while on the Salt River Inflow all occupied patches were partially inundated (Fig. 2).

In past years, most of these patches were considered as separate sites (Luff et al. 2000, Paradzick et al. 2001). However, based on the high degree of observed movement among these patches both between and within years, we now consider all of the patches at each inflow area as one site. The following sections give a brief history of the patches at the Salt River Inflow and the Tonto Creek Inflow sites:

Salt River Inflow: From 1996 through 1998, all activity at the Salt River Inflow was detected at a single patch (now called Old Salt). Beginning in 1999, flycatchers were detected at additional patches at lower elevations in the lakebed. These new, younger woodlands formed a mosaic of different patch sizes, ages, and habitat composition. In 2005, the rising lake level completely submerging most of the post-1999 sites. Two patches are not included, 288 Bridge and Grapevine Boat Ramp, because we detected flycatchers at these patches only temporarily. Patches occupied historically and in 2005 are presented in order from upstream to downstream (Fig. 2):

Pinal Creek – Not on the Salt River, but within its drainage, Pinal Creek is the closest known breeding site to the Roosevelt Lake area with territorial flycatchers. Flycatchers were first discovered here in 2004. Pinal Creek is composed of approximately four-year-old dense willow and cottonwood (*Populus fremontii*) stands.

Cottonwood Acres 1 and 2 – A single territory was detected here once in 1999 and 2000. In 2005, this patch became one of the largest breeding patches at Roosevelt Lake. These two patches were inundated throughout much of the season, but most areas were dry by the end of the breeding season. Cottonwood Acres 1 and 2 are largely tamarisk with a small willow component.

Old Salt - Old Salt consists of a mature monotypic stand of tamarisk at an elevation of 644 m to 648 m. This patch was mostly inundated in 2005, with flycatchers using vegetation >2 m above the lake level.

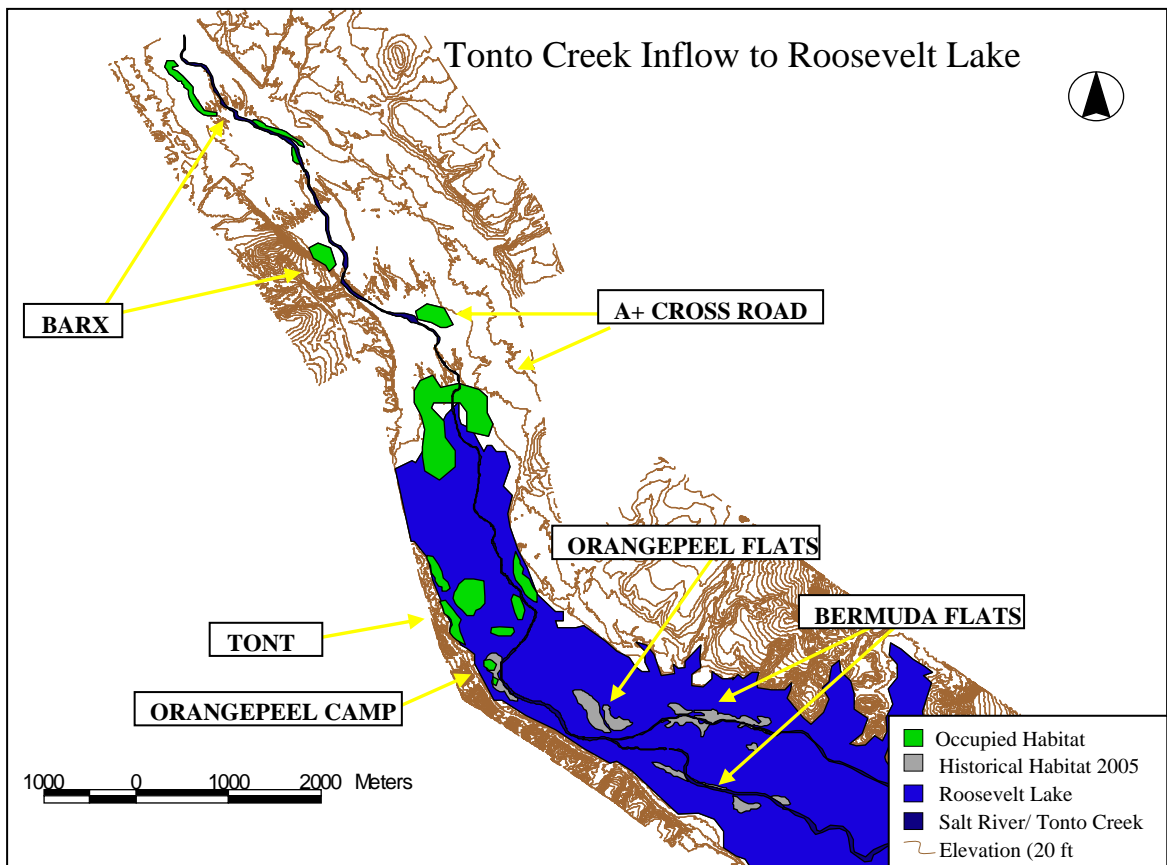
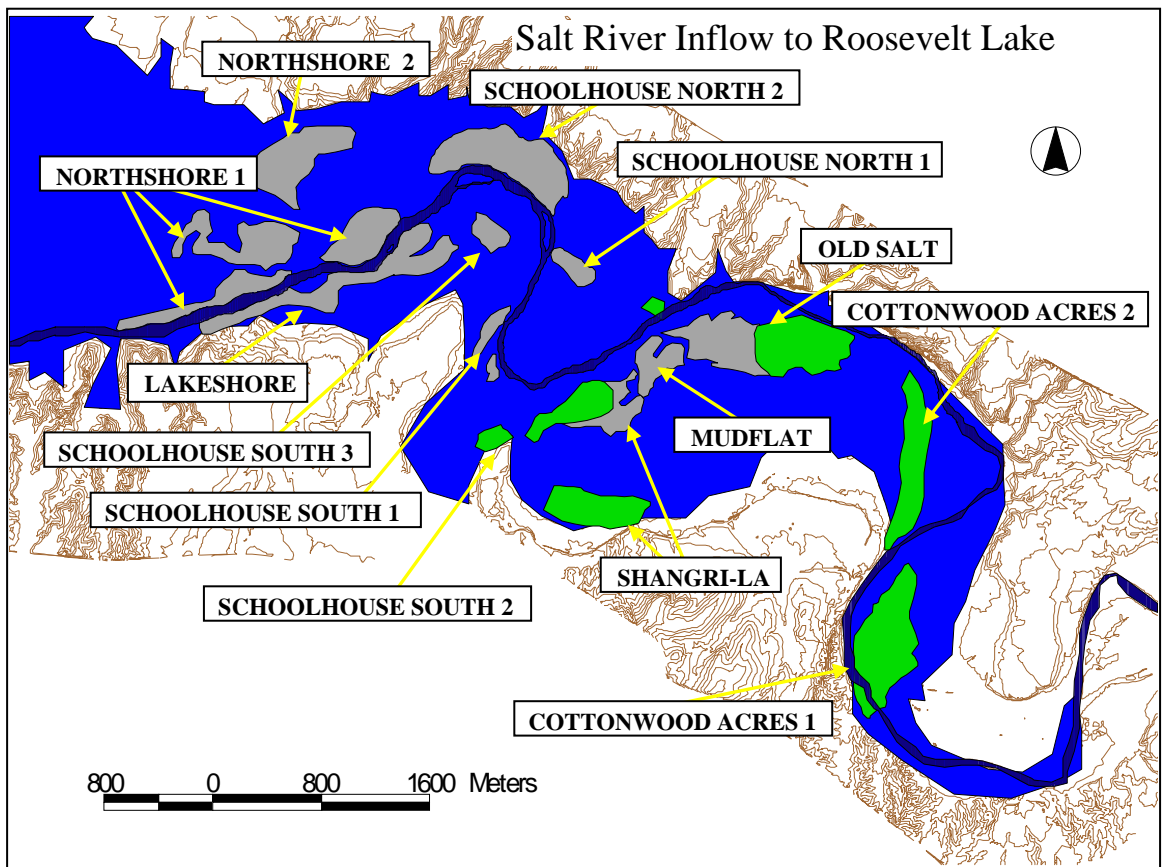


Figure 2. Location and names of willow flycatcher occupied (2005) and historic (pre-2005) habitat patches at Roosevelt Lake.

Mudflats - Flycatchers were first detected here in 1999. Mudflats was completely inundated in 2005. Prior to inundation it was composed mostly of tamarisk, with a small native component. The elevation is between 644 m and 647 m.

Shangri-la - Flycatchers were first detected here in 1999. The site is composed of willow, cottonwood, and tamarisk with an elevation of between 644 m and 646 m. In 2005, willow flycatchers used tall willow emerging from Roosevelt Lake, and partially inundated tamarisk and mesquite (*Prosopis* spp.) at the edge of the lake.

School House South 1 - Flycatchers were first noted here in 1999, but none have been detected since 2001. Now the submerged patch is composed of dead tamarisk emerging from the lake. The elevation is between 642 m and 647 m.

School House South 2 - A few birds were detected here in emergent vegetation in 2005. The patch is composed entirely of tamarisk.

School House South 3 - Flycatchers were detected in School House South 3 from 2000 to 2004. The patch has an elevation between 640 m and 642 m and was completely submerged in 2005.

School House North 1 - Flycatchers were detected in School House North 1 from 1999 to 2004, but most of the patch was completely submerged in 2005; elevation is between 639 m and 647 m.

School House North 2 - Flycatchers were first detected in School House North 2 in 2000. The patch was completely submerged in 2005; elevation is between 640m and 644 m.

Lake Shore - The Lake Shore patch, expanded in 2004 to include younger patches downstream of the original patch, was comprised of mature, monotypic willow trees. Flycatchers were detected here from 2000 to 2004 at an elevation between 635 m and 638 m. In 2005, the Lakeshore patch was completely submerged.

North Shore 1 East, North, and West, and North Shore 2 - Breeding was confirmed in North Shore 1 and 2, a large matrix of willow and tamarisk, in 2001. The elevation of these patches is between 635 m in North Shore West and 639 m in North Shore 2. These patches were completely submerged in 2005.

Tonto Creek Inflow: Until 2000, all documented flycatcher breeding activity within the Tonto drainage was at the Tonto habitat patch. As with the Salt River Inflow site, habitat in the receding lakebed began to be occupied by flycatchers in 2000. In 2005, the lake level rose to 655 m, completely submerging Bermuda Flats and Orange Peel Flats. Patches occupied historically and in 2005 are presented in order from upstream to downstream (Fig. 2):

Bar X - Flycatchers were detected breeding here from 2003 - 2005. Bar X is a series of small, narrow stands of young willows and cottonwoods 7.3 km upstream of the Tonto patch. The elevation is between 671 m and 676 m. This was one of the two dry occupied patches at Roosevelt Lake in 2005.

A-cross Road - This patch is 2.5 km upstream of the Tonto patch. Flycatchers were detected here in 2000 to 2002, and 2005. A-cross Road consists of tamarisk and some areas of tamarisk mixed with mature cottonwoods. This was the other dry patch at Roosevelt Lake in 2005; the elevation is between 654 m and 656 m.

Tonto - Tonto is the oldest patch of the Tonto Creek Inflow site, discovered in 1993 (Muiznieks et al. 1994). The Tonto patch was comprised of tall tamarisk with mature willow and cottonwood trees in most locations. Flycatchers did not use this patch in 2004. In 2005, willow flycatchers

used vegetation located above the high lake level. The elevation is between 646 m and 652 m. ***Orange Peel Campground*** - Flycatchers were first confirmed breeding here in 2000. Historically, this site consisted of willow interspersed with tamarisk and mesquite and little understory structure. Flycatchers used the tops of tall willow and tamarisk trees that were above the lake level in 2005. The elevation is between 641 m and 645 m.

Orange Peel Flats - This patch was composed primarily of dense tamarisk with an elevation between 640 m and 643 m. Flycatchers were first detected in Orange Peel Flats in 2000.

Bermuda Flats North and South – Flycatchers were first detected in Bermuda Flats in 2004. The elevation was between 632 and 636 m, and was completely submerged in 2005.

HISTORY OF THE BANDING PROJECT AT ROOSEVELT LAKE

In 1996, the USGS Colorado Plateau Research Station (USGS) and the Arizona Game and Fish Department (AGFD) began a long-term, large-scale demographic study of willow flycatchers in Arizona. AGFD continued its ongoing surveying and monitoring of new and known flycatcher breeding sites, while USGS color banded and resighted flycatchers at most of the AGFD monitored sites, as well as several other sites. From 1996 to 2005, 989 adults and 639 nestling/fledgling willow flycatchers were captured and banded by USGS across Arizona. A listing of all flycatchers banded at Roosevelt Lake since 1996 is presented in Appendix 1. An additional population genetics component of this study took place during 1996 and 1997 (Sogge et al. 1998, Busch et al. 2000, Paxton 2000).

Ten years of data collection (1996-2005) have been funded and conducted. The work conducted from 1996-2004 provides the foundation for this year's site and patch fidelity, movement, and survivorship data (Paxton and Sogge 1996, Paxton et al. 1997, Netter et al. 1998, English et al. 1999, Luff et al. 2000, Kenwood and Paxton 2001, Koronkiewicz et al. 2002, Newell et al. 2003, and Newell et al. 2005). This report summarizes results of the tenth year of fieldwork.

PROJECT OBJECTIVES

The major goal of this project is to gather detailed demographic information on the population of southwestern willow flycatchers at Roosevelt Lake. To accomplish this goal we have attempted to detect and identify individual flycatchers through banding and resighting. Monitoring these color banded birds is the only effective way to determine between-year survivorship and mortality of adults and young, immigration and emigration, site and patch fidelity, and movement between sites. Furthermore, the presence of banded birds at a site contributed to on-going flycatcher studies by AGFD, providing a more accurate assessment of the number of breeding birds and the ability to document breeding activities (e.g., pairing, nesting attempts, reproductive success) of individuals within and between years.

Specific objectives of the USGS-based demography study are to:

- (1) Collect data on between-year survivorship and mortality of adults and young, immigration, emigration, site and patch fidelity, and movement between patches and sites;
- (2) Band female flycatchers to assist AGFD seasonal fecundity study;
- (3) Determine, along with AGFD, the number of flycatchers present at Roosevelt Lake; and
- (4) Genetically determine the sex of all flycatchers.

METHODS

BANDING ADULTS

Prior to 1998, all flycatchers were banded with a uniquely numbered federal aluminum bird band and a unique combination of two plastic color bands. However, as birds were resighted in subsequent years, it became apparent that plastic bands could cause injuries to the legs of some flycatchers. Therefore, in 1998, we created anodized aluminum color bands that resolved the issues associated with plastic bands (Koronkiewicz et al. 2005). Thus, from 1998 to 2005 each captured adult was banded with a unique combination of a numbered federal anodized colored bird band on one leg, and an aluminum color band (either striped or solid) on the other leg. We attempted to recapture adults that had been previously banded with plastic bands; plastic bands on recaptured adults were removed and replaced with a unique metal band combination.

Target Netting

We used recordings of willow flycatcher vocalizations (both songs and calls) broadcast from a compact disk player to attract territorial adult flycatchers (per Sogge et al. 2001) into mist nests (see Ralph et al. 1993) set up within a known breeding territory. Target netting effort in inundated habitats in 2005 was consistent with past years due to our use of a floating mist nest technique (Pollock and Paxton, *in review*). In addition to banding, each adult was measured for wing chord, tail length, weight, and fat level in a standardized method (Pyle 1997). When possible, the gender of adult flycatchers was determined by the presence of a cloacal protuberance (male) or brood patch (female). A blood sample was taken from all flycatchers to determine gender via genetic methods (see Genetics section below).

Passive Netting

We also used a passive netting technique by placing one or more mist nets in an area and waiting for birds to fly into them without the use of playback, decoys, or other lures. In 2001, USGS conducted a passive netting pilot project and found it was an effective technique to detect non-breeding flycatchers (floaters) that are not detected with conventional survey techniques (i.e., territorial response to tape-playback). Our interest in exploring the number of floaters was the result of occasionally capturing flycatchers that could not be assigned to a nearby territory, and were never seen again in that year.

Additional objectives of passive netting were to: (1) capture individuals that might be using areas outside their noted territory, (2) detect flycatchers (banded and unbanded) not previously identified in the patch, and (3) capture flycatchers that were not responsive when using the target netting method described above.

In 2005 the majority of our passive netting efforts took place in Bar-X, A-Cross, and Cottonwood Acres 1 because the patches previously used for passive netting were completely inundated. We conducted 63 passive netting sessions that typically consisted of the equivalent of 6.5 12-meter nets run from 0530-1100, for an average of 28 net/hours per session. Nets were checked for birds every 20 minutes or less and any flycatchers caught were processed according to the methods stated in the target netting section of this report.

RESIGHTING

Resighting consists of using binoculars to determine the identity of a color banded flycatcher by observing the unique color band combination on its legs. Resighting allows researchers to detect and monitor individual flycatchers without the need to recapture them. Typically, territories and nests are the focal areas for resighting. This information can then be used to document movement, individual productivity, and gender-based behavioral patterns. Furthermore, resighting is the most reliable method for establishing the particular territory a flycatcher belongs to, as techniques used to capture adults (such as playbacks of flycatcher vocalizations) can lure in adults from neighboring territories.

All banders and AGFD field crews recorded observations of color banded flycatchers. For every resighted flycatcher, we recorded the color band combination, site, patch, specific location at the patch (using a designated territory number or GPS coordinate), the level of resight confidence, and behavioral observations. Because resighting is difficult, and misidentification of color combinations is a possibility, confirmation of the existence of individual flycatchers is based on multiple resights of each color banded individual in the same area. In inundated habitats we resighted willow flycatchers from canoes and kayaks, and while more time consuming than resighting birds from dry land, this technique was an effective means to accurately identify color combinations.

RETURN RATES AND SURVIVORSHIP ESTIMATES

Using the encounter history (whether a flycatcher was present in a given year) of banded adults through resights and recaptures, we can calculate a return rate from year to year. The return rate can be considered the minimum survivorship, since not every banded flycatcher is detected each year. A given year's return rate can increase in subsequent years because flycatchers not detected in one year may be detected in following years. Survivorship estimates are based on return rates and take into account some percentage of undetected flycatchers. Several software packages are available to calculate survivorship estimates. We used the program MARK (White and Burnham 1999) to derive the maximum-likelihood estimate of survivorship in the Roosevelt Lake population. Prior to 2003, all survivorship estimates were reported in terms of return rates.

GENETIC GENDER DETERMINATION

A genetic sample was taken from newly captured flycatchers. DNA was obtained from a small drop of blood taken (non-lethally) from willow flycatchers by clipping off the tip of one toenail, just past the vascularized tissue. This technique works well for obtaining small amounts of blood from flycatchers and other small passerines, with no discernable negative effects (Super and van Riper 1995, Bush et al. 2000). The drop of blood was stored in a small vial with 1xSSC-EDTA buffer. Samples were placed on ice in the field, and then frozen in the lab until the DNA was extracted. Gender was determined as described in Paxton et al. (2002). Gender determination makes it possible to look for gender-based differences in factors such as dispersal, site fidelity, and survivorship.

DETERMINING AGE BY MOLT PATTERNS

Pyle (1998) proposed that second year willow flycatchers can exhibit patterns of retained flight feathers (primaries and secondaries) that are not observed in older adults. While handling flycatchers during banding, each wing was inspected for retained feathers, indicated by wear and lighter color (especially on the feather spines) when compared with adjacent flight feathers. We began to evaluate this as a possible technique for aging flycatchers in 1998. After several years of evaluating returning adults and banded, second year returning nestlings, we are confident that retained feathers indicate a second year southwestern willow flycatcher. However, not all second year birds exhibited this pattern, so absence of retained feathers does not preclude the individual from being a second year bird. Thus, all flycatchers with retained feathers are aged as second year adults (SY), and those adults without the retained feathers are considered second year or older (AHY).

RESULTS

SUMMARY OF 2005 BANDING AND RESIGHTING EFFORTS

In 2005, USGS banded 39 new adult flycatchers, three fledglings from unknown nests, and recaptured 28 returning nestlings at Roosevelt Lake (Table 1). In addition, we resighted three returning nestlings from previous years that we could not catch. Overall, 69% of adult flycatchers detected at Roosevelt Lake were banded by the end of the breeding season (Table 1).

The USGS crew with the help of AGFD detected a total of 159 adult flycatchers banded as nestlings or adults in previous years, with a total of 201 banded adult flycatchers detected at Roosevelt Lake in 2005 (Table 1). The total number of adults detected at Roosevelt Lake, including unbanded birds, was 291 (Table 1). This includes three flycatchers that were banded as nestlings in previous years that we failed to catch in 2005.

Table 1: Summary of willow flycatchers banded during the 2005 breeding season at Roosevelt Lake, Arizona. Data presented for each habitat patch are number of new adult captures (number of unbanded flycatchers banded in 2005), returning nestlings (flycatchers that were banded as nestlings in previous years, and first detected in 2005), total number of banded adults, total number of adults detected (banded and unbanded), and percent of all adult flycatchers detected that were banded by the end of the season.

Patch	# New Adult Captures	# Returning Nestlings Captured	Total # Banded Adults	Total # Adult Birds Detected	% of All Birds Banded
Pinal Creek	0	1	5	13	38
288 Bridge	1	0	1	1	100
Cottonwood Acres 1	10	12	55	80	69
Cottonwood Acres 2	0	0	2	5	40
Old Salt	0	1	5	10	50
Shangri-la	1	1	14	21	67
School House North 1	0	1	1	2	50
School House South 2	0	0	4	5	80
Grapevine Boat Ramp	0	0	0	1	0
Bar X	12	4	22	29	76
A-cross Road	18	4	59	69	86
Tonto	0	2	38	58	66
Orange Peel Campground	0	2	4	6	67
Totals	42	28	201*	291*	69

*total is less than the sum because 9 flycatchers were territorial in more than one site

SITE-BY-SITE BANDING RESULTS AT ROOSEVELT LAKE

Salt River Inflow

In 2005, the USGS and AGFD field crews detected 138 adult willow flycatchers at the Salt River Inflow patches, representing 47% of the flycatchers detected at Roosevelt. Details on each banded bird are presented in Table 2, which contributed to the total number of flycatchers detected being 138 birds (87 banded, 46 unbanded, one nestling from 2004 that we failed to catch in 2005, and four unconfirmed banded individuals). We detected 73 territories consisting of 37 monogamous territories, 26 polygamous territory pairs and 10 territories with unpaired males.

At the Salt River Inflow, the USGS banding crew captured 12 new adult flycatchers, recaptured 22, and with help from AGFD resighted the 53 other banded known returning flycatchers (Table 2). We could not determine the band combinations of four flycatchers at the Salt River Inflow.

Cottonwood Acres 1 supported 57% of the flycatchers found on the Salt River Inflow. Cottonwood Acres had not been occupied since 2000, and prior to 2005 never had more than a single territory. Shangri-la accounted for 16% of the Salt River birds, while the Northshore and Lakeshore patches, which previously supported the majority of flycatchers, were entirely submerged.

Table 2: Banded willow flycatchers detected at the Salt River Inflow, Roosevelt Lake, Arizona, in 2005. Data presented for each habitat patch are date first banded, federal bird band number, color band combination, age in 2005, sex, territory occupied in 2005, capture status (new capture, recapture or resight), type of movement (adult between-year or natal between-year, unless otherwise noted as a within-season movement), patch moved from (in 2004, unless otherwise noted), and distance moved (in km).

Patch Name	Date Banded	Federal Bird Band Number	Color Band		Age 2005	Sex	2005 Territory	Status	Between Year Movement	Patch Moved From	Distance Moved (km)
			Left Leg	Right Leg							
Pinal Creek	6/30/2003	1710-20314	VV	DY	TY	M*	76	Recapture	Natal	School House North 2 (2003)	17.0
	6/4/2004	2280-96668	GG	DD	ASY	M*	20	Resight	Adult	North Shore 2	17.8
	7/22/2003	2290-24256	GK	GG	4Y	M*	30	Resight	Adult	Shangri-la	15.1
	6/20/2004	2290-24265	GG	ZW	ASY	F*	46	Resight	Adult	Shangri-la	14.9
	6/6/2004	2350-24250	DRD	KK	ASY	F*	76	Recapture	Adult	Lake Shore	17.3
Highway 288 Bridge	5/17/2005	1490-89776	VV	VY	AHY	F*	1**	New	N/A	N/A	N/A
Cottonwood Acres 1	6/29/2003	1490-89764	WDW	VV	TY	F*	13	Resight	Adult	Shangri-la	2.8
	6/28/2003	1490-89784	VV	GW	TY	M*	69**	Recapture	Natal	Orange Peel Flats (2003)	28.6
	7/9/2003	1490-89844	VV	RZ	TY	M	449/49	Recapture	Natal	North Shore 1 North (2003)	5.3
	6/18/2003	1490-89877	YDY	VV	TY	F	25**	Recapture	Natal	Shangri-la (2003)	3.0
	6/19/2003	1490-89886	ZKZ	VV	TY	M	36/45	Recapture	Natal	North Shore 1 North (2003)	5.5
	6/27/2001	1490-89913	ZZ	KGK	6Y	M*	47/69	Resight	Adult	North Shore 1 North	5.6
	8/1/2004	1490-89918	ZZ	VG	SY	U	15**	Recapture	Natal	Shangri-la	2.4
	6/12/2005	1490-89926	VV	ZZ	AHY	F*	35	New	N/A	N/A	N/A
	6/26/2001	1490-89934	ZZ	KYK	6Y	F	82	Resight	Adult	North Shore 1 West (2003)	5.1
	7/1/2004	1490-89937	KOK	ZZ	SY	M*	50	Recapture	Natal	North Shore 1 North	5.5
	6/20/2001	1490-89950	ZZ	OK	5Y	F	60	Resight	Adult	North Shore 1 North	5.7
	6/17/2004	1490-89985	ZZ	OZ	SY	M*	67	Recapture	Natal	Shangri-la	2.7
	6/30/1998	1590-97540	VV	RY	A8Y	F*	36	Resight	Adult	Shangri-la	2.7
	6/22/1999	1590-97543	VV	WG	A7Y	M*	58	Resight	Adult	Shangri-la	2.7
	6/22/1999	1590-97544	VV	RD	A7Y	M	100	Resight	Adult	Shangri-la	2.6
	6/5/2001	1710-20243	OD	ZZ	A5Y	F*	37	Resight	Adult	Shangri-la	2.7
	6/3/2001	1710-20264	OO	VV	A5Y	F	16	Resight	Adult	North Shore 1 West	5.4
	6/1/2001	1710-20461	VYV	ZZ	A5Y	M	157/13	Resight	Adult	Shangri-la	2.9
	7/16/1998	1710-20473	ZW	ZZ	A8Y	M*	156	Resight	Adult	Shangri-la	2.9
	5/4/2001	1710-20497	ZZ	YW	A5Y	M	46	Recapture	Adult	School House North 2	4.0
5/18/2001	1710-20500	WG	ZZ	A5Y	F	47	Resight	Adult	School House South 3 (2003)	4.5	
7/16/2005	1710-20608	KK	ZRZ	HY	M	15**	New	N/A	N/A	N/A	
6/16/2000	1710-20611	GV	KK	A6Y	F	30	Resight	Adult	Shangri-la (2002)	2.8	
7/26/2002	1740-51720	XX	OD	A4Y	M	556/56/65	Resight	Adult	Orange Peel Flats	28.8	

Patch Name	Date Banded	Federal Bird Band Number	Color Band		Age 2005	Sex	2005 Territory	Status	Between Year Movement	Patch Moved From	Distance Moved (km)
			Left Leg	Right Leg							
Cottonwood Acres 1	6/26/2002	1740-51775	XX	VY	A4Y	F	153	Resight	Adult	School House North 2	4.5
	5/18/2002	1740-51818	XX	YK	A4Y	M*	151	Resight	Adult	Shangri-la	2.4
	6/30/2001	1740-51866	UNB	KK	5Y	F	46	Recapture	Natal	Shangri-la (2001)	3.0
	7/21/2000	2210-57002	KK	OK	6Y	M	25	Recapture	Adult	North Shore 1 East	5.1
	7/27/2001	2210-57059	KV	KK	5Y	F	151	Resight	Adult	Lake Shore	4.9
	7/25/2003	2280-96653	GG	WVW	4Y	F	45	Resight	Adult	Shangri-la (2003)	2.6
	6/16/2005	2280-96661	GG	VW	SY	M*	17	New	N/A	N/A	N/A
	6/15/2004	2280-96677	GG	ZO	TY	M*	14	Resight	Adult	Lake Shore	4.4
	5/8/2004	2280-96694	WK	GG	ASY	M*	60/21	Resight	Adult	Shangri-la	2.8
	6/21/2000	2290-24202	GG	KY	6Y	M*	0	Resight	Adult	School House South 3 (2003)	5.9
	6/16/2005	2290-24208	GW	GG	AHY	F*	17	New	N/A	N/A	N/A
	7/15/2003	2290-24216	GG	VK	ATY	F	65	Resight	Adult	North Shore 1 North	5.3
	7/11/2003	2290-24225	KD	GG	ATY	M	21/53	Resight	Adult	Lake Shore (2003)	4.6
	5/31/2003	2290-24251	GG	DW	ATY	F	157	Resight	Adult	Shangri-la	2.9
	6/1/2003	2290-24252	KYK	GG	ATY	F*	556	Resight	Adult	Shangri-la	2.4
	6/11/2003	2290-24253	KY	GG	ATY	F	449	Resight	Adult	Shangri-la	2.7
	6/17/2004	2290-24263	ZWZ	GG	ASY	M*	57	Resight	Adult	North Shore 2	6.1
	6/2/2003	2290-24281	GG	DWD	ATY	F	3	Resight	Adult	North Shore 1 North	5.6
	6/13/2003	2290-24323	DD	KWK	4Y	M	11	Resight	Adult	North Shore 1 North	5.8
	6/12/2005	2290-24345	DD	RKR	AHY	M*	48/448	New	N/A	N/A	N/A
	5/15/2003	2290-24346	OWO	DD	ATY	M	35	Recapture	Adult	School House North 2	4.9
	6/21/2004	2350-24024	GW	ZZ	SY	M*	63**	Recapture	Natal	Shangri-la	4.9
	6/18/2004	2350-24026	WK	ZZ	SY	M*	4	Recapture	Natal	School House South 3	4.7
	7/4/2004	2350-24030	ZZ	ZO	SY	F*	57	Recapture	Natal	School House North 2	5.1
	7/14/2004	2350-24061	ZZ	KZ	SY	F*	25	Recapture	Natal	North Shore 1 East	5.0
	7/4/2005	2350-24159	GG	RD	AHY	U	25**	New	N/A	N/A	N/A
	5/10/2004	2350-24165	KO	GG	ASY	M*	15/3	Recapture	Adult	North Shore 1 North	5.4
6/8/2005	2350-24218	KRK	KK	AHY	M*	154**	New	N/A	N/A	N/A	
7/16/2005	2350-24219	RGR	KK	AHY	F*	15**	New	N/A	N/A	N/A	
7/16/2005	2350-24251	ZK	KK	HY	U	15**	New	N/A	N/A	N/A	
6/12/2005	2350-24428	NN	VV	AHY	M*	150**	New	N/A	N/A	N/A	
Cottonwood Acres 2	6/27/2003	1490-89854	VV	GG	TY	M*	40	Resight	Adult	Lake Shore	4.3
	6/19/2004	2290-24264	GG	YWY	ASY	F*	40	Resight	Adult	North Shore 1 North	5.3
Old Salt	6/27/2003	1490-89858	VV	VK	TY	M*	55	Recapture	Natal	North Shore 1 East (2003)	3.2

Patch Name	Date Banded	Federal Bird Band Number	Color Band		Age 2005	Sex	2005 Territory	Status	Between Year Movement	Patch Moved From	Distance Moved (km)
			Left Leg	Right Leg							
Old Salt	6/20/2001	1490-89954	YKY	ZZ	5Y	M	30/103	Resight	Adult	School House North 2	2.6
	7/19/1999	1710-20298	YKY	VV	7Y	M	30/25	Resight	Adult	Old Salt	0.4
	6/15/2002	2280-96676	RZ	GG	TY	M*	30	Resight	Adult	Lake Shore	3.2
	6/26/2003	2290-24240	GG	DR	ATY	F*	53	Resight	Adult	School House North 2 (2003)	3.0
Shangri-la	7/14/2001	1490-89802	VV	WRW	A5Y	F	42	Resight	Adult	North Shore 1 North	3.3
	6/27/2003	1490-89836	VV	WY	TY	M*	85 ¹	Resight	within-season	School House North 1	0.9
	6/19/2003	1490-89883	KRK	VV	TY	M*	73/101	Resight	Adult	Bermuda Flats North	25.1
	5/22/2000	1710-20603	KK	WW	A6Y	M*	52 ¹	Resight	within-season	Tonto	27.9
	6/13/2000	1710-46327	KK	DY	7Y	M	11	Resight	Adult	Shangri-la	0.1
	6/3/2005	1740-51622	VV	KY	AHY	M*	15	New	N/A	N/A	N/A
	8/7/2002	1740-51723	OKO	XX	A4Y	M*	74/774	Resight	Adult	North Shore 1 North	2.4
	6/16/2002	1740-51779	XX	DYD	A4Y	F	774	Resight	Adult	North Shore 1 West	2.4
	6/16/2002	1740-51791	GRG	XX	A4Y	M*	160	Resight	Adult	North Shore 2	3.4
	7/30/2000	2210-57010	WGW	KK	6Y	F	101 ¹	Resight	within-season	Tonto	27.6
	6/5/2001	2280-96671	GZ	GG	TY	M*	44	Resight	Adult	Bar X	33.1
	7/17/2001	2290-24320	DYD	DD	5Y	M	31	Resight	Adult	North Shore 2	2.8
7/14/2004	2350-24019	ZZ	WGW	TY	F*	85	Recapture	Natal	North Shore 2	2.6	
7/30/2004	2350-24166	RG	GG	TY	F*	73	Resight	Adult	Bermuda Flats North	24.5	
School House North 1	6/27/2003	1490-89836	VV	WY	TY	M*	10 ¹	Recapture	Natal	Shangri-la (2003)	0.8
School House South 2	6/30/2003	1490-89774	KD	VV	TY	M*	80 ¹	Recapture	within-season	Orange Peel Campground	26.7
	5/7/2004	2290-24203	RW	GG	ASY	M*	80/158	Resight	Adult	Orange Peel Campground	26.8
	6/16/2001	2290-24315	DRD	DD	5Y	M	86**	Resight	Adult	North Shore 1 North	2.3
	7/5/2004	2290-24341	DD	WDW	ASY	F*	80	Resight	Adult	Bermuda Flats North	24.8

Color band color codes: X=silver, V=violet, Z=gold, K=black, D=blue, G=green, O=orange, R=red, W=white, N=bronze, and Y=yellow

Age: HY=1st year, SY=2 years, AHY=2 years or older, TY=3 years, ASY=3 years or older, 4Y=4 years, ATY=4 years or older, 5Y=5 years old, A4Y=5 years or older, 6Y=6 years, A5Y=6 years or older, 7Y= 7 years, A6Y=7 years or older, 8Y=8 years, A7Y=8 years or older, A8Y=9 years or older

Sex: F=female, M=male, U=unknown * Birds sexed in the field

** Not confirmed as territorial

¹ Territorial in more than one patch, first record refers to between year movement and second record indicates within season movement

/ territories with slashes denote polygynous male

Tonto Creek Inflow

In 2005, USGS and AGFD detected 162 adult willow flycatchers at the Tonto Creek Inflow, accounting for 53% of the birds at Roosevelt in 2005. Table 3 includes details on 162 birds (123 banded, 34 unbanded, two returning nestlings from a previous year that we failed to catch in 2005, and 3 unknown banded individuals). We detected 89 territories consisting of 41 monogamous pairs, 37 polygamous territories, and 10 single males.

At the Tonto Creek Inflow, the USGS banding crew captured 30 new flycatchers, recaptured 42, and along with AGFD resighted the remaining 51 adults banded in previous years (Table 3). We could not determine the band combinations of three flycatchers at Tonto Creek.

A-cross Road and Tonto supported the majority of the birds at the Tonto Creek Inflow in 2005, with 43% and 36%, respectively. Neither of these patches were occupied in 2004. Bar-X and Orange Peel Campground, both occupied in 2004, supported the remaining 17% and 4% of the flycatchers, respectively.

Table 3: Banded willow flycatchers detected at the Tonto Creek Inflow, Roosevelt Lake, Arizona, in 2005. Data presented for each habitat patch are date first banded, federal bird band number, color band combination, age in 2005, sex, territory occupied in 2005, capture status (new capture, recapture or resight), type of movement (adult between-year or natal between-year, unless otherwise noted as a within-season movement), patch moved from (in 2004, unless otherwise noted), and distance moved (in km).

Patch Name	Date Banded	Federal Bird Band Number	Color Band		Age 2005	Sex	2005 Territory	Status	Between Year Movement	Patch Moved From	Distance Moved (km)
			Left Leg	Right Leg							
Bar X	6/28/2003	1490-89781	VV	WKW	TY	F*	46	Resight	Adult	North Shore 2	28.7
	6/27/2003	1490-89825	KK	VV	TY	F*	907 ¹	Recapture	Natal	North Shore 1 East (2003)	32.0
	6/19/2001	1490-89933	RGR	ZZ	5Y	M	20	Resight	Adult	North Shore 2	27.4
	7/16/2004	1490-89967	ZZ	RG	SY	F*	83	Recapture	Natal	North Shore 1 West	31.5
	6/27/2003	1710-20313	OW	VV	TY	M*	6	Recapture	Natal	Shangri-la (2003)	33.9
	5/23/2005	1740-51618	YY	VV	AHY	M*	152/301	New	N/A	N/A	N/A
	6/28/2005	1740-51619	KOK	VV	AHY	F*	89	New	N/A	N/A	N/A
	7/31/2000	2210-57014	KK	DD	6Y	F	152	Resight	Adult	North Shore 1 North	29.8
	5/24/2005	2210-57085	KO	KK	AHY	F*	300 ¹	New	N/A	N/A	N/A
	6/6/2004	2280-96683	GG	VV	ASY	M*	300	Recapture	Adult	Lake Shore	30.3
	6/27/2004	2290-24229	ZRZ	GG	ASY	F*	88	Resight	Adult	Bar X	1.4
	5/27/2005	2290-24342	DD	YWY	AHY	M*	95**	New	N/A	N/A	N/A
	6/8/2005	2290-24363	OO	XX	AHY	M*	83**	New	N/A	N/A	N/A
	6/28/2004	2350-24013	KGK	ZZ	SY	M*	61	Recapture	Natal	School House North 2	30.6
	6/22/2005	2350-24170	GG	OWO	AHY	M*	901	New	N/A	N/A	N/A
	6/22/2005	2350-24171	VWV	GG	AHY	F*	20	New	N/A	N/A	N/A
	7/3/2004	2350-24191	RGR	GG	ASY	M*	88	Recapture	Adult	Bar X	1.4
	7/26/2005	2350-24220	KK	KZK	AHY	F*	94**	New	N/A	N/A	N/A
	5/17/2005	2350-24229	KK	KK	AHY	M*	83	New	N/A	N/A	N/A
	5/26/2005	2350-24230	KK	VG	AHY	M*	7	New	N/A	N/A	N/A
7/13/2005	2350-24247	KK	YK	AHY	U	88**	New	N/A	N/A	N/A	
5/26/2005	2350-24402	NN	DD	AHY	F*	7	New	N/A	N/A	N/A	
A-cross Road	7/7/2005	1490-89724	RG	VV	SY	F*	343	New	N/A	N/A	N/A
	6/13/2005	1490-89725	GG	VV	AHY	F*	601	New	N/A	N/A	N/A
	7/17/2005	1490-89777	VV	OK	SY	F*	92**	New	N/A	N/A	N/A
	6/24/2003	1490-89814	KGK	VV	TY	F*	93**	Recapture	Adult	Orange Peel Campground	3.2
	6/27/2003	1490-89827	YRY	VV	TY	F*	52	Recapture	within-season	Verde River	52.3
	6/27/2003	1490-89838	VV	YY	TY	M*	74	Recapture	Natal	Shangri-la (2003)	29.5
	6/5/2002	1490-89927	ZZ	GK	A4Y	F*	93	Recapture	Adult	North Shore 1 North	26.2
	6/19/2001	1490-89931	GKG	ZZ	5Y	F*	55	Recapture	Adult	Lake Shore (2002)	27.0

Patch Name	Date Banded	Federal Bird Band Number	Color Band		Age 2005	Sex	2005 Territory	Status	Between Year Movement	Patch Moved From	Distance Moved (km)
			Left Leg	Right Leg							
A-cross Road	6/26/2001	1490-89936	RYR	ZZ	A5Y	M	156	Recapture	Adult	Orange Peel Campground	3.4
	7/1/2004	1490-89946	KR	ZZ	SY	M*	55**	Recapture	Natal	North Shore 1 North	26.2
	5/17/2001	1710-20219	DO	ZZ	AHY	M	6	Recapture	Adult	School House South 3 (2003)	28.6
	6/18/2001	1710-20250	ZG	ZZ	5Y	F	155	Resight	Adult	Bermuda Flats South	6.1
	6/26/2001	1710-20271	VV	WO	A5Y	F	156	Recapture	Adult	Orange Peel Campground	3.4
	6/23/1999	1710-20280	VV	KD	A7Y	M	84**	Recapture	Adult	Shangri-la	29.2
	6/30/1999	1710-20288	VV	RYR	7Y	M	84/66/65	Recapture	Adult	North Shore 1 North	26.6
	7/28/1999	1710-20561	DO	VV	7Y	F	15	Resight	Adult	Orange Peel Flats	4.2
	7/27/2005	1710-46173	KK	WKW	AHY	F*	875**	New	N/A	N/A	N/A
	7/27/2005	1710-46174	KK	WGW	HY	U	350	New	N/A	N/A	N/A
	6/30/2002	1740-51748	XX	KG	A4Y	F	77	Resight	Adult	School House South 3	28.3
	6/4/2002	1740-51786	XX	WDW	A4Y	F*	70	Recapture	Adult	North Shore 1 West (2002)	26.5
	7/15/2002	1740-51787	OD	XX	5Y	M	16	Resight	Adult	Bermuda Flats South	6.2
	6/19/2002	1740-51820	WZ	XX	A4Y	F	46	Recapture	Adult	Orange Peel Campground	4.5
	6/7/2005	1740-51844	KK	RD	AHY	M*	15	New	N/A	N/A	N/A
	7/6/2000	1740-51858	OK	KK	6Y	M*	70/55	Recapture	Adult	Old Salt (2001)	30.0
	6/16/2000	1740-91967	KK	GK	A6Y	F*	84	Resight	Adult	School House North 2 (2003)	27.5
	6/20/2004	2210-57029	KK	RKR	ASY	M*	343	Recapture	Adult	North Shore 1 East	26.3
	6/20/2004	2210-57036	GZ	KK	TY	M*	8	Resight	Adult	North Shore 1 West	26.4
	7/19/2004	2210-57315	DD	OWO	ASY	M*	76**	Recapture	Adult	Bermuda Flats North	4.7
	7/16/2004	2210-57328	KG	GG	ASY	F*	76	Resight	Adult	Bermuda Flats North	4.4
	6/2/2004	2280-96667	RK	GG	TY	M*	601	Recapture	Adult	School House South 3	28.4
	6/5/2002	2280-96672	OWO	GG	TY	F*	57	Resight	Adult	Bar X	4.1
	6/3/2004	2280-96679	VK	GG	ASY	M*	57 ¹	Recapture	Adult	Orange Peel Campground	3.0
	6/6/2004	2280-96688	GG	RKR	TY	F*	74	Resight	Adult	Lake Shore	27.3
	6/7/2004	2280-96689	GG	WRW	ASY	M*	7**	Recapture	Adult	North Shore 1 West	27.6
	6/6/2004	2290-24275	GG	WD	ASY	F*	350	Recapture	Adult	Orange Peel Flats	4.0
	6/21/2004	2290-24290	VY	GG	ASY	M*	80	Resight	Adult	Bermuda Flats South	5.0
	6/2/2002	2290-24301	DD	WZW	A4Y	M	76/875	Recapture	Adult	North Shore 1 North	26.5
	6/1/2001	2290-24310	VYV	DD	A4Y	M	5	Recapture	Adult	Bermuda Flats South	4.6
	6/25/2003	2290-24311	DD	YDY	ATY	M*	155	Recapture	Adult	North Shore 1 East	27.5
	6/4/2004	2290-24316	DD	WOW	ASY	M*	77	Recapture	Adult	Lake Shore	27.5
	6/25/2003	2290-24325	YGY	DD	ATY	M*	55/52/152	Recapture	Adult	Lake Shore	26.8
6/6/2004	2290-24339	YWY	DD	TY	M*	92	Recapture	Adult	School House North 1	28.3	

Patch Name	Date Banded	Federal Bird Band Number	Color Band		Age 2005	Sex	2005 Territory	Status	Between Year Movement	Patch Moved From	Distance Moved (km)
			Left Leg	Right Leg							
A-cross Road	7/6/2005	2290-24347	OKO	DD	SY	M*	93	New	N/A	N/A	N/A
	7/7/2005	2290-24349	DD	GRG	SY	F*	343**	New	N/A	N/A	N/A
	7/11/2005	2290-24350	DD	VWV	SY	M*	46**	New	N/A	N/A	N/A
	6/21/2005	2290-24360	XX	OW	SY	F*	552	New	N/A	N/A	N/A
	7/16/2004	2350-24033	ZZ	DR	SY	F*	875	Recapture	Natal	Orange Peel Campground	3.2
	6/21/2005	2350-24163	WV	GG	SY	F*	6	New	N/A	N/A	N/A
	6/21/2005	2350-24164	GG	KGK	SY	M*	202/7	New	N/A	N/A	N/A
	6/21/2005	2350-24169	VYV	GG	SY	F*	202	New	N/A	N/A	N/A
	6/16/2004	2350-24179	WGW	GG	ASY	M*	57/71	Resight	Adult	North Shore 1 East	27.2
	7/3/2005	2350-24183	ZO	GG	AHY	F*	152	New	N/A	N/A	N/A
	6/29/2005	2350-24187	WYW	GG	AHY	F*	66	New	N/A	N/A	N/A
	7/3/2005	2350-24188	GG	RK	AHY	F*	92	New	N/A	N/A	N/A
	7/7/2004	2350-24194	OR	GG	ASY	F*	52	Recapture	Adult	Bermuda Flats North	4.2
	8/1/2004	2350-24249	GKG	KK	ASY	F*	56 ¹	Resight	Adult	Bermuda Flats North	4.8
	7/10/2001	2350-24401	RK	NN	5Y	M	600	Recapture	Natal	Shangri-la (2001)	29.5
7/22/2005	2350-24405	ZK	NN	AHY	F*	66**	New	N/A	N/A	N/A	
6/7/2005	2350-24436	NN	WV	AHY	F*	600	New	N/A	N/A	N/A	
Tonto	7/27/2003	1490-89732	VV	YV	TY	F	201	Resight	Adult	Bermuda Flats North	3.2
	6/27/2003	1490-89825	KK	VV	TY	F*	79 ¹	Resight	within-season	Bar X	6.1
	5/20/2001	1490-89908	ZZ	YO	A5Y	M	59/2	Resight	Adult	Orange Peel Flats	1.4
	7/29/2004	1490-89948	ZZ	YR	SY	F*	752	Recapture	Natal	Bermuda Flats South	3.9
	7/29/2004	1490-89958	ZZ	OO	SY	F*	12	Recapture	Natal	Bermuda Flats South	4.0
	6/9/1998	1590-97527	WW	VV	A8Y	F*	59	Resight	Adult	Tonto (2003)	< 0.1
	7/24/1999	1710-20305	VV	DO	A7Y	M	11/201	Recapture	Adult	Shangri-la	28.0
	5/22/2000	1710-20603	KK	WW	A6Y	M*	18 ¹	Resight	Adult	Shangri-la	28.0
	6/18/2000	1710-20696	KK	RG	A6Y	F*	51	Resight	Adult	Orange Peel Campground	0.8
	6/16/2002	1740-51745	DK	XX	A4Y	F	68	Resight	Adult	Shangri-la	28.0
	6/28/2002	1740-51800	XX	GRG	A4Y	M	3/79/154	Resight	Adult	Orange Peel Flats	2.2
	6/15/2000	1740-91966	KK	KD	A6Y	M	251	Recapture	Adult	Old Salt (2003)	29.4
	7/30/2000	2210-57010	WGW	KK	6Y	F	10 ¹	Resight	Adult	School House North 2 (2002)	26.47
	6/9/2004	2210-57022	ZG	KK	ASY	M*	752	Resight	Adult	North Shore 1 East	25.9
	6/30/2004	2210-57023	ZRZ	KK	TY	F*	31	Resight	Adult	Bermuda Flats North	2.3
6/30/2004	2210-57024	YDY	KK	ASY	M*	69	Resight	Adult	Bermuda Flats North	2.8	
5/24/2005	2210-57085	KO	KK	AHY	F*	99 ¹	Resight	within-season	Bar X	5.7	

Patch Name	Date Banded	Federal Bird Band Number	Color Band		Age 2005	Sex	2005 Territory	Status	Between Year Movement	Patch Moved From	Distance Moved (km)
			Left Leg	Right Leg							
Tonto	7/15/2002	2210-57302	XX	WGW	A4Y	M	99	Resight	Adult	Lake Shore (2002)	25.9
	7/22/2002	2210-57305	XX	ZKZ	A4Y	M	1	Resight	Adult	North Shore 1 North	24.7
	6/14/2001	2210-57307	DD	OKO	A5Y	M	13/47	Resight	Adult	North Shore 1 North	25.3
	6/3/2004	2280-96679	VK	GG	ASY	M*	60 ¹	Resight	within-season	A-cross Road	6.1
	6/9/2004	2280-96696	GG	WR	TY	M*	51/161	Resight	Adult	Shangri-la	27.3
	6/12/2003	2290-24234	GG	RY	ATY	M	19	Resight	Adult	Orange Peel Flats	2.0
	6/15/2003	2290-24236	GG	DYD	ATY	F	1	Resight	Adult	Orange Peel Flats	1.9
	6/27/1999	2290-24246	KV	GG	A7Y	M	64/68	Resight	Adult	Shangri-la	28.0
	5/24/2004	2290-24247	GG	WK	ASY	F*	2	Resight	Adult	Orange Peel Flats	2.0
	7/27/2003	2290-24283	GG	YK	ATY	M	200	Resight	Adult	North Shore 2	24.6
	6/21/2004	2290-24296	WOW	GG	ASY	F*	200	Resight	Adult	Bermuda Flats South	2.8
	7/17/2004	2290-24299	RZR	GG	ASY	M*	12	Recapture	Adult	Bermuda Flats South	4.0
	7/7/1999	2290-24306	RGR	DD	7Y	M	10/450	Resight	Adult	North Shore 1 North	22.2
	7/15/2004	2290-24317	RDR	DD	TY	M*	81	Recapture	Adult	Bermuda Flats North	2.2
	5/29/2002	2290-24322	KOK	DD	A4Y	M	756	Resight	Adult	North Shore 1 North	24.7
	7/3/2003	2290-24340	YWY	DD	TY	M*	550**	Resight	Adult	Bermuda Flats South	3.6
	7/5/2004	2350-24186	GG	VY	ASY	F*	13	Resight	Adult	Bermuda Flats North	2.6
	7/5/2004	2350-24193	RY	GG	ASY	F*	78	Resight	Adult	Bermuda Flats North	3.3
	7/29/2004	2350-24235	RZ	KK	ASY	F*	756 ¹	Resight	within-season	Orange Peel Campground	0.8
	7/31/2004	2350-24248	KK	YVY	TY	M*	90/250	Resight	Adult	Bermuda Flats North	3.2
8/1/2004	2350-24249	GKG	KK	ASY	F*	250 ¹	Resight	within-season	A-cross Road	1.9	
Orange Peel Campground	6/30/2003	1490-89774	KD	VV	TY	M*	800 ¹	Recapture	Natal	North Shore 1 East (2003)	25.2
	5/18/2000	1710-20671	KK	WY	A6Y	M	0/163	Resight	Adult	Orange Peel Campground	0.1
	7/15/2004	2290-24318	DD	UNB	SY	F*	0	Resight	Natal	Bermuda Flats North	2.5
	7/29/2004	2350-24235	RZ	KK	ASY	F*	163 ¹	Resight	Adult	Bermuda Flats South	3.6

Color band color codes: X=silver, V=violet, Z=gold, K=black, D=blue, G=green, O=orange, R=red, W=white, N=bronze, and Y=yellow
Age: HY=1st year, SY=2 years, AHY=2 years or older, TY=3 years, ASY=3 years or older, 4Y=4 years, ATY=4 years or older, 5Y=5 years old, A4Y=5 years or older, 6Y=6 years, A5Y=6 years or older, 7Y= 7 years, A6Y=7 years or older, 8Y=8 years, A7Y=8 years or older, A8Y=9 years or older
Sex: F=female, M=male, U=unknown * Birds sexed in the field
** Not confirmed as territorial
¹ territorial in more than one patch, first record refers to between year movement and second record indicates within season movement
/ territories with slashes denote polygynous males

2004/2005 ADULT SURVIVORSHIP

Survivorship is defined as the number of individuals that survive from the end of one breeding season to the beginning of the next breeding season. Survivorship is estimated from the number of banded flycatchers present in one year that are detected in the following years (return rate), and is based on resights and recaptures of banded individuals. However, it is known that a certain number of individuals that are alive in a particular year are not detected. Therefore, our return rates are minimum numbers, with actual survivorship some higher, unknown percent.

Although true survivorship is unknown, it can be estimated based on the return rates and an estimate of how many birds may have been present but were not detected. In our 1996 to 2002 reports, we presented only return rates; these numbers are still useful for comparisons with past years, especially at the patch level. In 2005, 116 of 276 banded adult flycatchers at Roosevelt Lake in 2004 returned to the same or a different breeding location. Thus, the overall 2004-2005 adult return rate was 42% (Table 4). The calculated maximum-likelihood survivorship estimate for 2004/2005 was slightly higher at 50% (95% C.I.: 42-58%).

Table 4: Willow flycatcher return rates at Roosevelt Lake, Arizona, from 2004 to 2005, organized by site and patch. A return rate is the percent of the total number of banded adult flycatchers per patch present in 2004 that returned (to any patch) in 2005.

2004 Site	2004 Patch	# Banded Adults 2004	# from 2004 Detected in Any Patch in 2005	% Return Rate
Salt River Inflow	Old Salt	2	1	50
	Mudflats	2	0	0
	Shangri-la	35	21	60
	School House South 3	6	2	50
	School House North 1	5	1	20
	School House North 2	9	4	67
	Lake Shore	22	9	41
	North Shore 1 East	19	5	26
	North Shore 1 North	42	18	43
	North Shore 1 West	18	4	22
	North Shore 2	19	7	37
	Salt River Inflow Totals:		179	73
Tonto Creek Inflow	Bar X	14	5*	36
	Orange Peel Campground	15	8	47
	Orange Peel Flats	10	8	80
	Bermuda Flats North	39	15	38
	Bermuda Flats South	19	8	42
	Tonto Creek Inflow Totals:		97	44*
Overall Totals		276	116*	42

*Includes one adult that moved to San Pedro

2004/2005 ADULT PATCH FIDELITY

Patch fidelity is defined as the percent of adult banded flycatchers that return to the same breeding patch used the previous year. There are two ways to calculate patch fidelity. Commonly, it is calculated by dividing the number of banded birds that returned to their breeding patch in the present year by the total number of banded birds at the patch in the previous year. Another method is to calculate patch fidelity by using only those adults known to have survived from the previous year to the present year (Percent of Returning With Patch Fidelity). This is sometimes a better estimate of patch fidelity since it considers only those birds that had a choice between returning to the same patch and moving to a different patch. Many patches occupied in 2004 were not available to birds in 2005 due to the complete inundation of patches at lower elevations. Considering only sites available for birds to return to, we found that 7% of adults returned to the same breeding patch in 2005 that they occupied in 2004 (Table 5). Considering only those birds that returned and were detected in 2005, 14% of those adults showed patch fidelity by returning to the same breeding patch they occupied in 2004 (Table 5).

Table 5: Willow flycatcher patch fidelity at Roosevelt Lake, Arizona, from 2004 to 2005, organized by site and patch for those patches occupied in 2004 and available in 2005. Percent patch fidelity is the number of *all banded adults present in 2004* that returned in 2005 to the same patch they occupied in 2004, whereas percent of returning with patch fidelity only considers those banded *adults that returned and were detected in 2005*.

Site	Patch	# Banded Adults 2004	# Returned to Same Patch 2005	Patch Fidelity (%)	% of Returning With Patch Fidelity
Salt River Inflow	Old Salt	2	1	50	50
	Shangri-la	35	1	3	5
	School House North 1	5	0	0	0
Salt River Inflow Patch Fidelity:		42	2	5	8
Tonto Creek Inflow	Bar X Road	14	2	14	40
	Orange Peel Camp	15	1	7	13
Tonto Creek Inflow Patch Fidelity:		29	3	10	23
Total:		71	5	7	14

2004/2005 ADULT SITE FIDELITY

We now consider the patches within each of the Salt River Inflow and Tonto Creek Inflow drainages as components that collectively constitute a single site; thus, average patch fidelity is not true site fidelity. Site fidelity is the return rate of flycatchers to a site, in this case, either Salt River Inflow or Tonto Creek Inflow. In 2005, the site fidelity at Salt River Inflow and Tonto Creek Inflow was 21% and 36%, respectively. If the two inflows to Roosevelt Lake are combined and considered as one site, then the Roosevelt Lake site fidelity was 42% (Table 6). If only the banded birds that returned to Roosevelt Lake in 2005 are considered, the site fidelity is 96% for Roosevelt Lake (Table 6).

Table 6: Willow flycatcher site fidelity at Roosevelt Lake, Arizona, from 2004 to 2005. Table includes the number of banded, territorial adults in 2004, the number of those that returned to the same site in 2005, percent site fidelity of all banded birds in 2004, and percent of returning territorial banded birds that showed site fidelity.

Site	# Banded Adults 2004	# Returned to Same Site 2005	Site Fidelity (%)	% of Returning With Site Fidelity
Salt River Inflow	179	38	21	52
Tonto Creek Inflow	97	35	36	84
Roosevelt Lake Site Fidelity	276	115	42	96

2004/2005 ADULT MOVEMENT

Between-year, Within-patch Movement

Within-patch movement is defined as the relocation of a territorial flycatcher from one territorial area to a new territorial area within a breeding patch. Because flycatcher territories vary in size and precise territorial boundaries were not mapped, flycatchers were considered to have moved only if they were resighted or recaptured >50 m from the previous year's resight/capture area or nest location. Between-year movement within patches is defined as the relocation of a flycatcher within the previous year's breeding patch. Since most previously occupied habitat was entirely submerged in 2005, only five flycatchers returned to the same patch they inhabited in 2004, and all five moved >50 m from their previous year's territory (Tables 2 and 3).

Between-year, Between-patch Movement

Between-patch movement is defined as flycatcher movement from one breeding patch to another breeding patch, and may occur between and within years. Year to year movement between patches may occur within and between drainages, the latter being less common. Here we define all riparian systems which drain into Roosevelt Lake as one drainage; this includes both the Salt River and Tonto Creek sites. In order to detect movements away from Roosevelt Lake, we resighted willow flycatchers at the Verde River and White Mountains, and reviewed Arizona Game and Fish Department resight data from San Pedro River sites. We also received information from SWCA about two flycatchers banded as nestlings at Roosevelt Lake which moved to the Lower Colorado River (Table 10).

In total, we detected 111 2004/2005 between-year between-patch movements by adult flycatchers (Fig. 3). One hundred ten of these were within-drainage movements, while one was a between-drainage movement, to the San Pedro River (Table 7). We also observed 13 other between-year movements by birds detected in previous years but not in 2004 (Tables 2, 3, and 7).

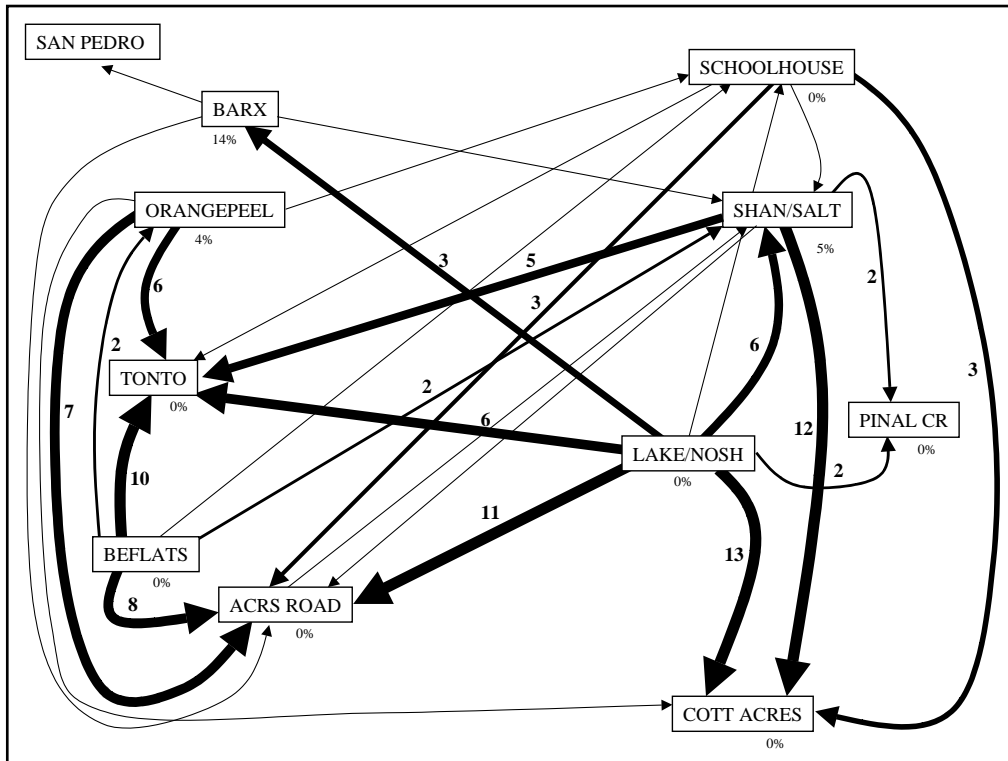


Figure 3. 2004-2005 Adult between-year, between-patch movement. Relative thickness of the lines represents relative numbers of movements, with thicker lines representing more movement, and vice-versa. Straight arrows denote movements between Tonto Creek and Salt River whereas curved arrows represent movements between patches in the same drainage. Numbers in parentheses indicate 2004-2005 percent patch fidelity. Combined patches in this figure are North Shore and Lake Shore (LAKE/NOSH), Shangri-la and Old Salt (SHAN/SALT), Bermuda Flats North and South (BEFLATS), Orange Peel Campground and Orange Peel Flats (ORANGEPEEL), Cottonwood Acres 1 and 2 (COTT ACRES), School House North 1 and 2 and School House South 1, 2, and 3 (SCHOOLHOUSE), single patches in the figure are San Manuel Crossing (SAN PEDRO), Bar X (BARX), Tonto (TONTO), A-cross Road (ACRS ROAD), and Pinal Creek (PINAL CR).

Between-year, Between-drainage Movement

Between-year, between-drainage movements occur when a flycatcher is detected in different drainages in different years. We detected two between-years, between-drainage movements in 2005. These movements covered an average of 103 km (Table 7).

Table 7: Adult willow flycatchers initially banded at Roosevelt Lake that exhibited between-year, between-drainage movements in 2005. Included are patch detected in 2005, patch detected in 2004 (unless otherwise noted), the distance moved, federal bird band number, color combination, age in 2005, and sex.

Patch Detected in 2005	Patch Detected in 2004	Distance Moved (km)	Federal Bird Band Number	Color Band		Age in 2005	Sex
				Left Leg	Right Leg		
San Manuel Crossing	Bar X	150.4	2290-24228	YDY	GG	ASY	F*
Verde River (Horseshoe Reservoir)	Shangri-la (2001)	55.6	1740-51900	KK	RDR	A5Y	U

*birds sexed in the field

Same-year, Within-patch Movement

Same-year within-patch movements occur when a flycatcher that defended a territory moves within the same breeding season to a different territory within the breeding patch. Thirteen flycatchers were detected moving within-patch during the 2005 breeding season, for an average of 393 meters (Table 8).

Table 8: Adult willow flycatchers at Roosevelt Lake, Arizona, that exhibited same-year, within-patch movement in 2005. Included are patch detected in 2005, the distance moved, federal bird band number, color combination, age in 2005, and sex.

Patch	Distance Moved (km)	Federal Bird Band Number	Color Band		Age 2005	Sex
			Left Leg	Right Leg		
Cottonwood Acres 1	0.5	1490-89985	ZZ	OZ	SY	M*
	0.4	1710-20473	ZW	ZZ	A8Y	M*
	0.4	2290-24225	KD	GG	ATY	M
	0.1	2290-24323	DD	KWK	4Y	M
	0.4	2350-24428	NN	VV	AHY	M*
Old Salt	0.1	1490-89954	YKY	ZZ	5Y	M
	0.1	1710-20298	YKY	VV	7Y	M
Shangri-la	0.5	1710-46327	KK	DY	7Y	M
Bar X	1.2	2290-24342	DD	YWY	AHY	M*
	0.5	2350-24013	KGK	ZZ	SY	M*
A-cross Road	0.3	1740-91967	KK	GK	A6Y	F*
Tonto	0.2	1710-20603	KK	WW	A6Y	M*
	0.4	1710-20603	KK	WW	A6Y	M*

*Birds sexed in the field

Same-year, Between-patch Movement

We documented an unusually high number of same-year, between-patch movements in 2005, with nine in Tables 2 and 3. Those nine were birds that had multiple resights for a period greater than one week. However, we documented a number of additional flycatchers that were detected via resights or captures at a particular place for a short period of time, before moving to another location. These additional flycatchers suggest that there was a large degree of movement of flycatchers from patch to patch, presumably searching for a new breeding area. In total, we documented 28 same-year, between-patch movements in 2005, covering an average of 11.9 km (Table 9).

Table 9: Adult willow flycatchers at Roosevelt Lake, Arizona, that exhibited same-year, between-patch movement in 2005. Included are patches detected in 2005, the distance moved, federal bird band number, color combination, age in 2005, and sex (*birds sexed in the field).

Patch First Detected	Patch Later Detected	Distance Moved (km)	Federal Bird Band Number	Color Band		Age 2005	Sex
				Left Leg	Right Leg		
Cottonwood Acres 1	A-cross Road	32.2	1490-89854	VV	GG	TY	M*
	Cottonwood Acres 1	1.2	1490-89854	VV	GG	TY	M*
Old Salt	Cottonwood Acres 2	1.5	1490-89854	VV	GG	TY	M*
	Shangri-la	1.7	1710-46327	KK	DY	7Y	M
		1.6	1740-51791	GRG	XX	A4Y	M*
	Tonto	29.4	1740-91966	KK	KD	A6Y	M
Shangri-la	Cottonwood Acres 1	3.2	1590-97543	VV	WG	A7Y	M*
		0.8	1590-97543	VV	WG	A7Y	M*
		2.3	1740-51791	GRG	XX	A4Y	M*
School House North 1	Shangri-la	0.9	1490-89836	VV	WY	TY	M*
School House South 2	Orange Peel Campground	26.7	1490-89774	KD	VV	TY	M*
Bar X	Tonto	6.1	1490-89825	KK	VV	TY	F*
		5.7	2210-57085	KO	KK	AHY	F*
A-cross Road	Cottonwood Acres 1	32.2	2280-96694	WK	GG	ASY	M*
	Tonto	1.9	1740-51800	XX	GRG	A4Y	M
		2.0	2210-57302	XX	WGW	A4Y	M
		2.0	2280-96679	VK	GG	ASY	M*
		3.6	2290-24350	DD	VWV	SY	M*
		1.9	2350-24249	GKG	KK	ASY	F*
Tonto	A-cross Road	3.5	1740-91966	KK	KD	A6Y	M
		1.8	2210-57023	ZRZ	KK	TY	F*
	Cottonwood Acres 1	30.4	2280-96679	VK	GG	ASY	M*
	Old Salt	28.8	1740-91966	KK	KD	A6Y	M
	Shangri-la	27.9	1710-20603	KK	WW	A6Y	M*
		27.6	2210-57010	WGW	KK	6Y	F
Orange Peel Campground	A-cross Road	4.3	1710-20671	KK	WY	A6Y	M
	Tonto	0.8	2350-24235	RZ	KK	ASY	F*
Verde River	A-cross Road	52.3	1490-89827	YRY	VV	TY	F*

First Year Survivorship and Movement

In 2004, we banded 87 nestlings at Roosevelt Lake. We recaptured 14 of these banded nestlings in 2005 (Table 10), and resighted (but did not catch) two additional 2004 banded nestlings, and one from 2003. Thus, the 2004-2005 first-year return rate (based on the 16 known returning nestlings) was 18%. In addition, two returning flycatchers banded as nestlings in 2001 and 14 from 2003 were recaptured in 2005, including two that were present on the lower Colorado River, and one that was present at Horseshoe Lake on the Verde River before moving to Roosevelt Lake at the end of the season (Table 10). The detection of these pre-2004 returning nestlings increases the return rate estimate for 2001 nestlings from 29% to 32%, and 2003 nestlings from 20% to 27% (Newell et al. 2005). Based on these 2005 return rates, we calculated maximum-likelihood 2004/2005 survivorship estimates of 34% (95% C.I.: 21-52%).

Table 10: Willow flycatcher nestlings banded in previous years that were first captured in 2005. Table includes natal banding patch, natal year banded, patch detected in 2005, the distance moved from natal banding patch, federal bird band number, color band combination, natal banding date, and sex.

Natal Banding Patch	Natal Year Banded	Patch Detected in 2005	Distance Moved (km)	Federal Bird Band Number	Color Band		Natal Date Banded	Sex	
					Left Leg	Right Leg			
Shangri-la	2001	Cottonwood Acres 1	3.0	1740-51866	UNB	KK	6/30/2001	F	
		A-Cross Road	30.0	2350-24401	RK	NN	7/10/2001	M	
	2003	A-Cross Road	29.5	1490-89838	VV	YY	6/27/2003	M	
		Bar X	40.0	1710-20313	OW	VV	6/27/2003	M	
		Cottonwood Acres 1	3.1	1490-89877	YDY	VV	6/18/2003	F	
		School House North 1	0.8	1490-89836	VV	WY	6/27/2003	M	
	2004	Cottonwood Acres 1	Lower Colorado River	444.0	1710-20312	BG ¹	VV	6/27/2003	U
				2.4	1490-89918	ZZ	VG	8/1/2004	U
				2.7	1490-89985	ZZ	OZ	6/17/2004	M
				4.9	2350-24024	GW	ZZ	6/21/2004	M
School House South 3	2004	Cottonwood Acres 1	4.7	2350-24026	WK	ZZ	6/18/2004	M	
School House North 2	2003	Pinal Creek	17.0	1710-20314	VV	DY	6/30/2003	M	
	2004	Bar X	31.1	2350-24013	KGK	ZZ	6/28/2004	M	
		Cottonwood Acres 1	5.1	2350-24030	ZZ	ZO	7/4/2004	F	
North Shore 1 East	2003	Bar X	32.0	1490-89825	KK	VV	6/27/2003	F	
		Old Salt	3.2	1490-89858	VV	VK	6/27/2003	M	
		Orange Peel Camp	25.2	1490-89774	KD	VV	6/30/2003	M	
		Verde River (Horseshoe)	79.1	1490-89827	YRY	VV	6/27/2003	F	
		Lower Colorado River	350.2	1490-89889	BV	PU ²	6/26/2003	U	
	2004	Cottonwood Acres 1	5.0	2350-24061	ZZ	KZ	7/14/2004	F	
North Shore 1 North	2003	Cottonwood Acres 1	5.3	1490-89844	VV	RZ	7/9/2003	M	
			5.5	1490-89886	ZKZ	VV	6/19/2003	M	
	2004	A-Cross Road	26.2	1490-89946	KR	ZZ	7/1/2004	M	
		Cottonwood Acres 1	5.5	1490-89937	KOK	ZZ	7/1/2004	M	
North Shore 1 West	2004	Bar X	31.5	1490-89967	ZZ	RG	7/16/2004	F	
North Shore 2	2004	Shangri-la	2.6	2350-24019	ZZ	WGW	7/14/2004	F	
Orange Peel Campground	2004	A-Cross Road	3.2	2350-24033	ZZ	DR	7/16/2004	F	
Orange Peel Flats	2003	Cottonwood Acres 1	28.6	1490-89784	VV	GW	6/28/2003	M	
Bermuda Flats South	2004	Tonto	3.9	1490-89948	ZZ	YR	7/29/2004	F	
			4.0	1490-89958	ZZ	OO	7/29/2004	F	
Bermuda Flats North	2004	Orange Peel Campground	2.5	2290-24318	DD	UNB	7/15/2004	F*	

¹SWCA light blue over green metal band

²SWCA light blue over violet metal band on left leg and pumpkin service band on right leg with new band number: 2370-39955

AGE STRUCTURE

We definitively aged 86 of the 201 (43%) banded willow flycatchers at Roosevelt Lake in 2005 using the retained feather aging method and tracking returning banded nestlings. The age structure of flycatchers at Roosevelt Lake in 2005 resembled that of 2003, with a relatively large proportion of TY birds (Fig. 4).

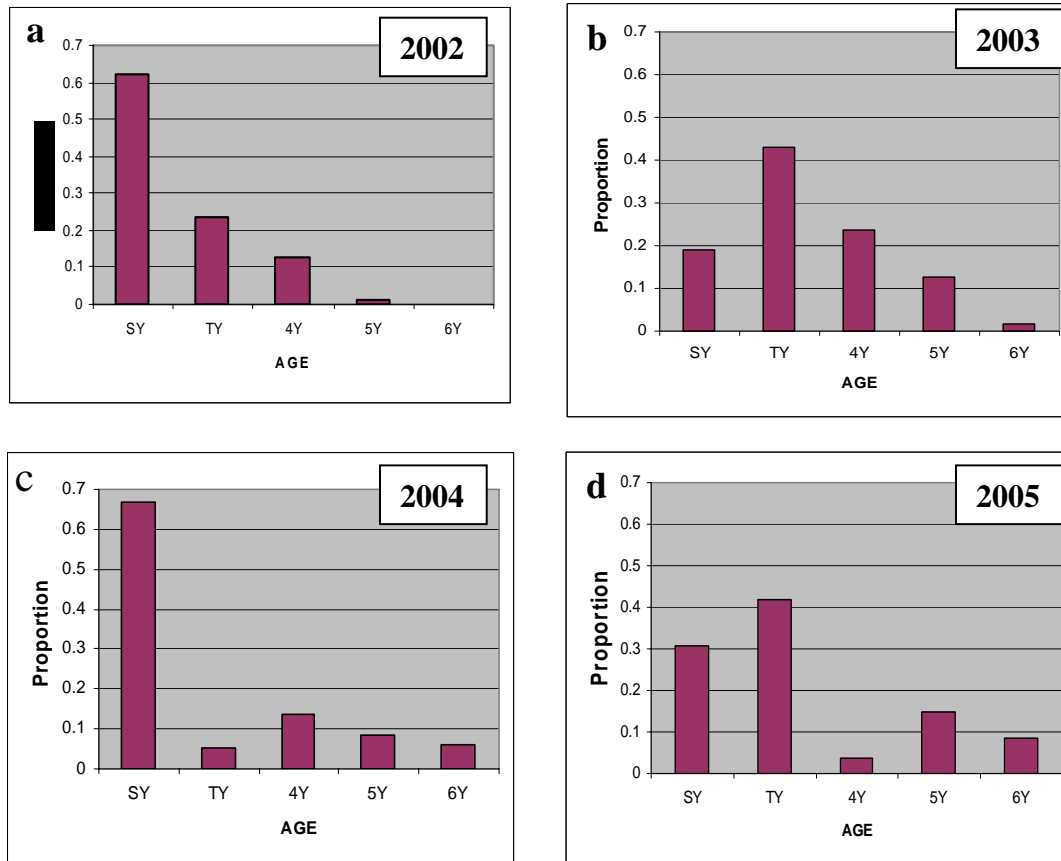


Figure 4: Age structure of the known-age population of willow flycatchers at in (a) 2002, (b) 2003, (c) 2004, and (d) 2005, based on adults of known age. Ages are as follows: **SY**=2 calendar years of age, **TY**=3 calendar years of age, **4Y**=4 calendar years of age, **5Y**= 5 calendar years of age, **6Y**=6 calendar years of age.

DISCUSSION

The effect of the inundation of Roosevelt Lake due to heavy run-off following the winter of 2004-2005, and the subsequent partial to complete inundation of many patches occupied by willow flycatchers at Roosevelt Lake in 2004, shaped many of the patterns observed in 2005. The loss of suitable breeding habitat that supported the majority of the adult flycatcher population in 2004 was the most dramatic and direct effect of the inundation. This drastic loss of habitat appeared to have two primary impacts on the willow flycatcher population at Roosevelt Lake: first, a 23% decrease in population size (Fig. 4) and secondly, the recolonization of formerly utilized breeding patches, although certainly other factors contributed besides inundation.

The reduction in the willow flycatcher population at Roosevelt Lake in 2005 followed a year of high nest productivity unlike the only other previous decline (2003). We detected five birds that dispersed to drainages such as the Verde, San Pedro, and Lower Colorado Rivers in 2005, suggesting that some of the population loss may be accounted for by dispersal to other drainages. We also detected 25 birds through passive netting that we were unable to confirm as territorial, suggesting that an unknown portion of the remainder of the population loss may be accounted for by birds present at Roosevelt Lake as undetected floaters.

Many patches that were not completely inundated were still impacted by the high lake level, resulting in dramatically different habitats from past years. Flycatchers occupied patches ranging from those that were partially inundated with only the tops of tall trees exposed above the lake, to those that contained a matrix of muddy islands surrounded by open water, to patches on dry land that had experienced intense scouring of the river channel. Some of the patches occupied in 2005 were not occupied in 2004 (A-cross Road and Tonto), and some have not been utilized by flycatchers since 2000 (Cottonwood Acres 1 and 2). We also observed the first cases at Roosevelt Lake of flycatchers utilizing upland habitats dominated by mesquite. Two territories were placed in semi-flooded mesquite patches on the Salt River Inflow side, and several territories on the Tonto Creek side, A-cross and Bar X patches, had territories adjacent to mesquite. For those territories adjacent to mesquite, flycatchers were seen occasionally singing from the habitat, and possibly foraging. In addition, the telemetry study documented numerous incidences of mesquite use by resident flycatchers (see Cardinal et al. 2006). The variety of habitats utilized in 2005 points to the flexibility in terms of habitat selection for the southwestern willow flycatcher and the dynamic nature of riparian habitats across much of its range.

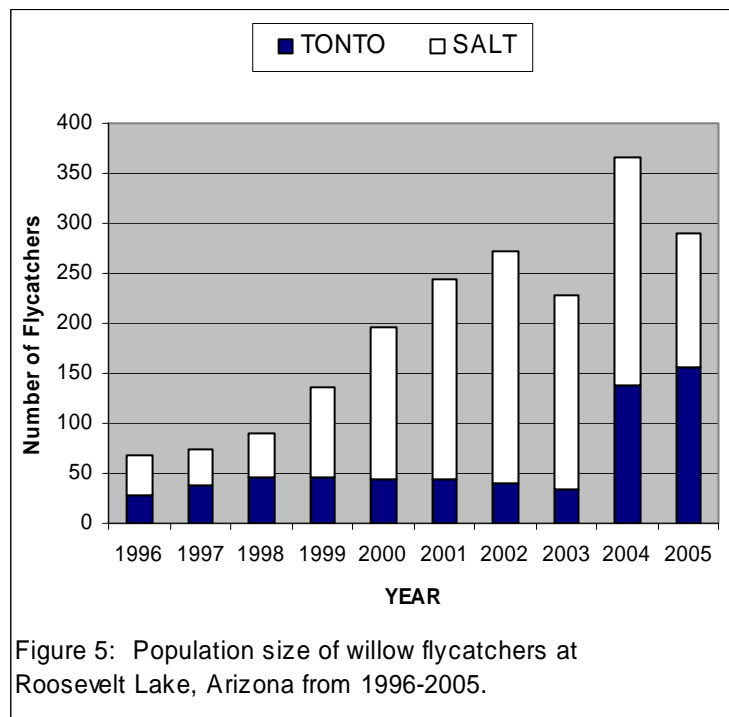


Figure 5: Population size of willow flycatchers at Roosevelt Lake, Arizona from 1996-2005.

2005 BANDING AND RESIGHTING EFFORTS

In 2005, resighting was conducted primarily at Roosevelt Lake, but also included visits to other sites by USGS, including the Verde River and White Mountains. To detect movements from Roosevelt Lake to other breeding sites, we coordinated with AGFD for information along the lower San Pedro River site, and SWCA regarding flycatchers along the lower Colorado River and adjacent drainages. Banding and resighting at Roosevelt Lake in the semi-inundated habitats presented many challenges, but in the end we were confident that we had detected all territorial (and some non-territorial) flycatchers. Forty-two new adult flycatchers were captured and banded in 2005, and 69% of the flycatchers detected were banded. This is lower percentage of banded birds than in previous years, and reflects our shifting priority to resighting in this logistically difficult year. Additionally, our efforts to capture and band new adults declined through the season due to 2005 being the last year of this research and the low probability that future resighting efforts would be conducted at Roosevelt Lake. For the same reason, nestlings were not banded in 2005. However, we detected a record 31 returning nestling in 2005, adding to our understanding of juvenile dispersal patterns.

ADULT SUVIVORSHIP, SITE FIDELITY, PATCH FIDELITY AND MOVEMENT

Survivorship

The 2004 to 2005 yearly adult return rate was 43%. This is the lowest return rate documented at Roosevelt Lake, with the average return rate from 1998 to 2004 being 61% (range: 59-69%, Table 12). However, return rates do not equate to survivorship, with some of the “mortality” birds being alive but not detected. Given the large displacement that the inundation caused, and the apparent reduction of breeding habitat, some flycatchers presumably survived but went undetected. Thus, we believe that most of the lower than normal return rate is a function of failure to detect a substantial number of surviving flycatchers, whether due to dispersal away from Roosevelt Lake or non-territorial behavior. In 2002, the year of a severe drought and “displacement” impacts on flycatchers, we observed a 46% return rate (Koronkiewicz et al. 2002), but the detection of 32 additional birds in 2003 raised that estimate to 63%. The long-term impact of the 2005 inundation on survivorship will be difficult to project, given the end of tracking banded flycatchers. Even the maximum likelihood survivorship estimate of 50%, which takes into account the probability of not detecting some percentage of the surviving flycatchers, was still lower than past years.

Table 11: Adult willow flycatcher survivorship estimates for Roosevelt Lake, Arizona, 1998-2005. Data presented for each between-year period is the return rate, survivorship estimate, and the upper 95% confidence interval. In all cases the return rate was greater than the lower 95% C.I.

Year	Return Rate (%)	Survivorship Estimate (%)	Upper 95% C.I. (%)
1998/1999	58	67	80
1999/2000	53	58	68
2000/2001	69	73	81
2001/2002	66	69	77
2002/2003	62	65	72
2003/2004	59	68	78
2004/2005	48	50	58
Average	59	64	73

Each year we detect flycatchers that were not detected the previous year. This year we detected seven flycatchers at Roosevelt Lake that were detected in 2003 but not 2004, and two birds detected in 2002 but not 2003 or 2004, and one bird not detected since 2001. Recalculating the return rates for those years by including these individuals increases the 2002-2003 return rate from 53% (Newell et al. 2003) to 62%, and the 2003-2004 return rate from 56% (Newell et al. 2005) to 59%.

Site and Patch Fidelity

Flycatchers that survive the winter and return to the breeding grounds have a choice between returning to the approximate area where they bred the year before, or to move to a new breeding location. Based on banding results from 1997 to 2005, we know that a high number of flycatchers moved to different breeding patches and sites from one year to the next (Paxton et al. 1997, Netter et al. 1998, English et al. 1999, Luff et al. 2000, Kenwood and Paxton 2001, Koronkiewicz et al. 2002, Newell et al. 2003, Newell et al. 2005). Prior to 2001, we presented site fidelity (returning to the same site) and movement among sites based on definitions of most habitat patches being separate sites. However, a site may best be defined by the movement patterns of flycatchers, which has been considerable among patches. Therefore, since 2001 we have considered all patches within the Salt River Inflow as one site, and all patches within the Tonto Creek Inflow as one site. For the highest resolution, we have presented the return patterns by patch, which can be compared with pre-2001 "site"-level (now patch-level) site fidelity data.

Over the last eight years (1997-2004), average patch fidelity rates ranged from 30% to 44% (Paxton et al. 1997, Netter et al. 1998, English et al. 1999, Luff et al. 2000, Kenwood and Paxton 2001, Koronkiewicz et al. 2002, Newell et al. 2003, Newell et al. 2005). Because most of the breeding patches in 2004 were inundated, 2005 patch fidelity was very low (7%). However, with the more encompassing definition of site adopted in 2001, the site fidelity for Roosevelt Lake was 42% in 2005 (117 of 276 territorial banded birds from 2004). Calculating site fidelity as the number of flycatchers returning to a site divided by the total number of banded birds present at that site the year before is convenient for a comparison among sites and to other studies, but it does not differentiate between fidelity based on mortality versus choice. Because this study encompasses all known occupied willow flycatcher areas at Roosevelt Lake, most local movements are readily detected. Thus, it is instructive to look at an alternate calculation of site fidelity – based on the number of birds known to have *survived*, thus having the choice between site fidelity or movement. In this calculation, 14% (5 of 37) of known surviving territorial adults returned to the same breeding patch and 96% (117 of 122) to the same site in 2005.

Adult Movement

This year we observed a higher than normal amount of between-year movement at Roosevelt Lake, a necessary response to the loss of 2004 habitat. Due to inundation, most patches occupied in 2004 became either unavailable or drastically reduced, and in 2005 nearly every returning bird exhibited a between-year movement. We documented 110 adult between-year between-patch movements in 2005, compared to 5-60 per year, 1999 to 2004 (English et al. 1999, Luff et al. 2000, Kenwood and Paxton 2001, Koronkiewicz et al. 2002, Newell et al. 2003, Newell et al. 2005). Two adult between-year between-drainage movements were observed this year, one from Roosevelt Lake to the San Pedro River and one to the Verde River at Horseshoe Reservoir.

We detected 41 same-year movements in 2005; 13 within-patch and 28 between-patch. This compares with 0-21 per year, 1999 to 2004 (English et al. 1999, Luff et al. 2000, Kenwood and Paxton 2001, Koronkiewicz et al. 2002, Newell et al. 2003, Newell et al. 2005). It is possible that birds moved more than normal as they searched for suitable habitat, given the loss due to the inundation.

The level of movement has significant implications to the genetic structure of these sites, site tenacity, and response to habitat modification and/or destruction. This level of population movement and resultant genetic mixing helps explain the patterns of high genetic diversity within, and low population structuring (e.g., low reproductive isolation) among willow flycatcher populations in the Southwest (Busch et al.

2000). These types of movements also provide a reminder that flycatchers may view sites, corridors, and habitat patchiness and isolation differently than we typically do.

Detection of continuous movement of flycatchers throughout the breeding season, both within and between sites, underscores that surveys throughout the breeding season are essential for accurate population estimates of breeding willow flycatchers. In fact, accurate population estimates in large, densely populated breeding sites may require intense color-banding and tracking of individual birds. Additionally, our data has indicated that areas within suitable habitat that are unoccupied early in the breeding season may become occupied later as flycatchers resettle territories. Furthermore, the presence of a flycatcher at a territory throughout the breeding season does not mean that it is the same individual, as reshuffling and replacement of individuals has occurred. Although a flycatcher territory may be occupied in consecutive years and have nearly identical territory boundaries in both years, it may not be occupied by the same willow flycatcher.

AGE STRUCTURE

We have detected changes in the age structure of willow flycatchers at Roosevelt Lake over the years (Koronkiewicz et al. 2002, Newell et al. 2003, Newell et al. 2005). The age structure in 2002 and before was composed of relatively young flycatchers, characteristic of a growing population. Presumably due to the effects of an extreme drought, there was little known flycatcher breeding productivity in 2002 (Smith et al. 2003), so in 2003 the age structure was noticeably older due to the loss of a cohort of second year birds. In 2004, following a highly productive year in 2003, the age structure became slightly bi-modal, with a large SY component (61% of the new captures in 2004 were known to be SY birds) and a smaller 4Y peak (the residual pattern from the 2003 age structure). Nest productivity was also high in 2004, thus we expected to see an age structure in 2005 with a large cohort of SY birds. However, in 2005, we observed the largest proportion of age TY individuals, similar to 2003. The loss of suitable breeding habitat due to the inundation of Roosevelt Lake may have led to the low recruitment of young birds in 2005. Older more experienced flycatchers have displaced young birds from remaining suitable habitats at Roosevelt Lake, thus these young birds may have been forced to different drainages or relegated to a largely undetected floater population, similar to 2002 when conditions were poor due to drought.

NESTLING SURVIVORSHIP AND MOVEMENT

We did not band nestlings in 2005, as this was the last year of the project. In the previous five years, we banded on average 78 nestlings per year (Luff et al. 2000, Kenwood and Paxton 2001, Koronkiewicz et al. 2002, Newell et al. 2003, Newell et al. 2005). The high number of nestlings banded and the intensive efforts to recapture them in subsequent years allows us to estimate survivorship of juveniles at Roosevelt Lake.

This year, we recaptured 18% of the 87 hatch year birds we banded in 2004. In addition, we resighted two other 2004 returning nestlings at Roosevelt Lake, resulting in a 2004 cohort return rate of 18%; this percentage is low compared to previous years because returning nestlings frequently are not detected until they reach age TY. The survivorship estimate for each year increases as flycatchers banded as nestlings in that year are detected in subsequent years.

Table 12: Juvenile willow flycatcher survivorship estimates for Roosevelt Lake, Arizona, 1998-2005. Data presented for each between-year period is the return rate, survivorship estimate, and the upper 95% confidence interval. In all cases (except 2004-2005), the return rate was greater than the lower 95% C.I. Detection probability was fixed at 0.5% for all years.

Year	Return Rate (%)	Survivorship Estimate (%)	Upper 95% C.I. (%)
1998/1999	22	42	82
1999/2000	32	24	40
2000/2001	30	38	53
2001/2002	32	41	53
2002/2003	33	41	92
2003/2004	27	34	46
2004/2005	18	34	52

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