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Southwestern Willow Flycatcher (*Empidonax traillii extimus*) Surveys and Nest Monitoring at the upper San Luis Rey River, San Diego County

February 3, 2014

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INTRODUCTION

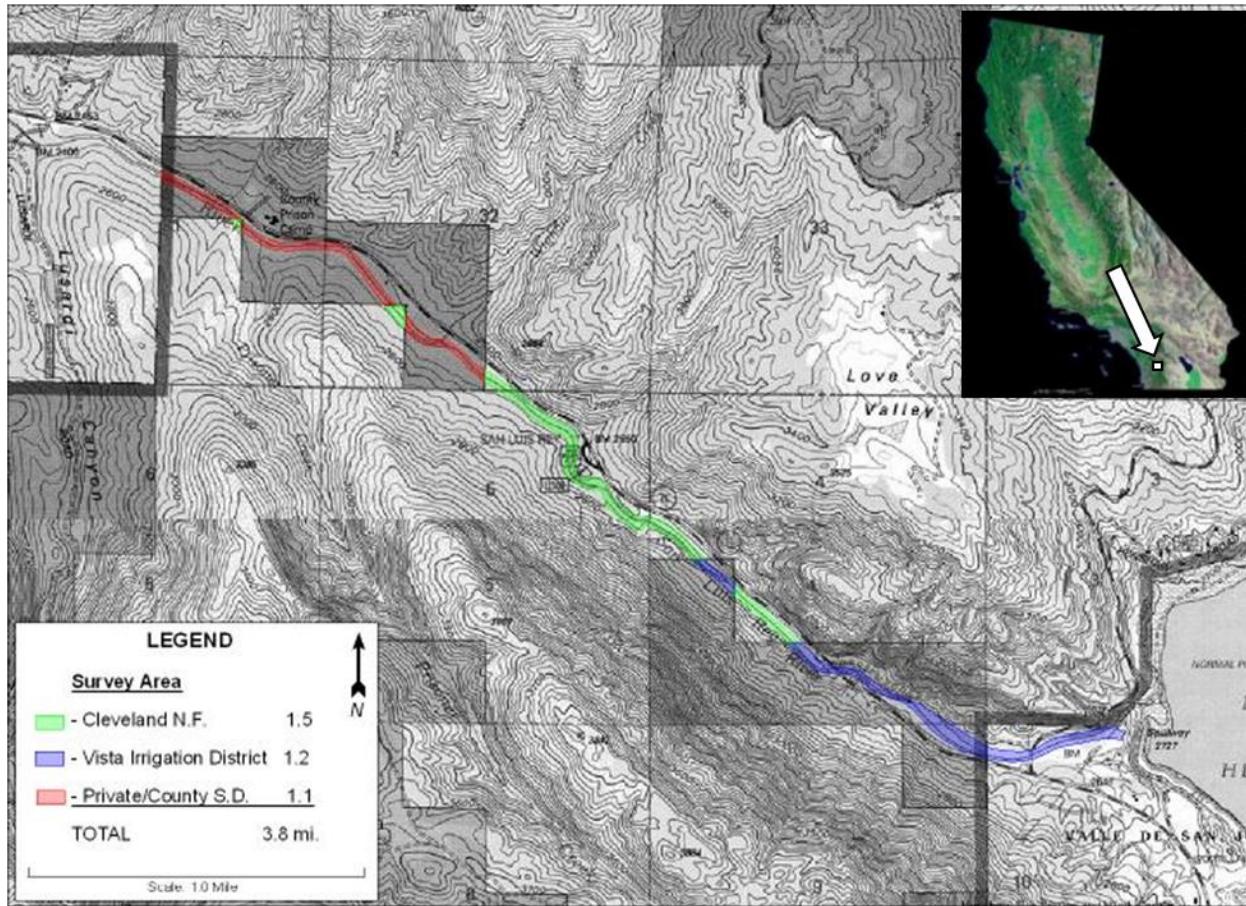
The largest population of the endangered Southwestern Willow Flycatcher (*Empidonax traillii extimus*) in California occurs along the upper San Luis Rey River, last surveyed in 2009 by Howell and Kus (2010), who estimated it to contain at least 45 individuals, with 23 males and at least 22 females. They reported this to be an apparent decline of 19% compared to the same areas surveyed by Kus et al. (1999) and Haas (2000) in 1999. The area surveyed in 2009 was approximately 6.0 km (3.7 mi) in length and included three sections: Vista Irrigation District, Cleveland National Forest, and downstream property owned privately or by the county of San Diego. Surveys that included additional private lands down to the La Jolla Indian Reservation (1993–2001) have reported 45–50 territories (Haas and Unitt 2004). Trapping of Brown-headed Cowbirds was attempted in this area in the 1990's (Winter and McKelvey 1999, Wells 1999), but very limited parasitism was observed. In 2009, no parasitism was found, but the population received only four surveys, and the contents of only two nests were seen at the egg stage. Brown-headed Cowbirds were observed during each of the four surveys, raising the possibility that parasitism could be a significant factor, but this could not be assessed.

In 2013, we resurveyed the Southwestern Willow Flycatcher population along the upper San Luis Rey River with two primary goals: (1) Intensive surveys of the Vista Irrigation District and Cleveland National Forest properties to estimate the total number of current breeding territories in this subset of the colony, and (2) Additional nest monitoring to assess the current rate of nest parasitism by the Brown-headed Cowbird. We proposed a limited number of surveys that would yield a sufficient estimate of territory numbers and sufficient proportion of nests to inform ongoing management of the population.

METHODS

Study Area

The area surveyed consisted of all riparian habitats downstream from Lake Henshaw Dam, including lands managed by Vista Irrigation District and Cleveland National Forest, as well as private properties downstream to the upper boundary of Rey River Ranch (Figure 1). Elevations range from 2,727 feet at the dam to about 2,500 feet at the lower end of the survey area. The river is bordered by Highway 76, which generally runs along the northern bank of the river.



2013 Southwestern Willow Flycatcher Survey Area & Land Ownership, Palomar Ranger District, Cleveland National Forest.

Figure 1. Map of study area illustrating three ownership sections.

Habitats along the river include emergent aquatic vegetation immediately adjacent to the river (Figure 2), such as cattails (*Typha* spp.), bur-reed (*Sparganium eurycarpum*), and bulrush (*Scirpus* spp.). Dense stands of wild rose (*Rosa californica*) and stinging nettle (*Urtica dioica*) also frequently occur right up to the water's edge, and both of these species proved to be attractive nesting sites for the flycatchers. Tree cover is typically dominated by willow such as the arroyo willow (*Salix lasiolepis*) and black willow (*Salix gooddingi*), as well as box elder (*Acer negundo*), ash (*Fraxinus velutina*), and western sycamore (*Platanus racemosa*). Farther back from the river the ground cover typically consists of blackberry (*Rubus* spp.) and poison oak (*Toxicodendron diversiloba*).



Figure 2. Habitat along the San Luis Rey River includes dense willow riparian and emergent aquatic vegetation. Photo taken 19 July, 2013.

Significant stretches of the river are dominated by coast live oak (*Quercus agrifolia*) woodland, and lack significant riparian vegetation (Figure 3). These habitats seem equally amenable to Willow Flycatchers, and numerous territories were located in areas dominated by oaks. The oaks provided an attractive nest substrate, and intervening openings between the oaks were used for foraging.



Figure 3. Coast live oak dominates significant stretches of the San Luis Rey River, and provides both suitable nesting and foraging habitat. Photo taken 19 July, 2013.

A unique aspect of the hydrology of this stretch of the San Luis Rey River is its use as a conduit for water transfers from Lake Henshaw, overseen by the Vista Irrigation District. Beginning in spring and continuing through the summer months, water is allowed to pass through the dam structure and down the river channel. During this time, the flow makes the riparian environment more mesic than it would have been otherwise, and likely has significant effects on both the riparian habitat and the suitability of the river for nesting Willow Flycatchers.

Survey Protocol

All surveys followed established protocols and were conducted under USFWS 10(a)(1)(A) permit number TE-117947-3.

Intensive surveys extended from 15 May to 31 July, to include at least three morning surveys following standardized protocols for presence/absence, with a minimum of one survey during the period of 15 May to 1 June, one survey during the period of 1 June to 24 June, and one survey during the period of 24 June to 17 July (Sogge et al. 2010). However, because of delayed permission for access, the downstream private/county section received only one survey during the second period and two surveys during the third period. For the purposes of territory mapping, two biologists were typically able to cover the entire study area within two mornings. Each territory survey was supplemented by additional observations and visits to increase precision in locations and numbers of territories and to increase chances of finding nests. The Cleveland NF and Vista Irrigation District properties received 5 full surveys to increase precision of territory estimates.

To minimize disturbance, we did not conduct intensive nest searching or monitoring. Rather, for assessment of nest parasitism, we increased our chances of finding nest locations by returning to a subsample of active territories for limited observation. For any instances of suspected or confirmed nests, we avoided approaching early nests but followed up approximately one week later to check for parasitism. Territory surveys and nest-check visits combined, the number of survey dates across the season totaled 18 (Table 1), but visits to individual territories typically ranged from 3 to 8, with a few receiving up to 12 visits.

Table 1. Survey schedule, upper San Luis Rey River, 2013

| Date | Principal Activity | # Biologists |
|--------|--------------------|--------------|
| 18-May | territory survey | 2 |
| 19-May | territory survey | 2 |
| 29-May | nest checks | 1 |
| 1-Jun | territory survey | 2 |
| 2-Jun | territory survey | 2 |
| 5-Jun | nest checks | 1 |
| 10-Jun | nest checks | 1 |
| 15-Jun | territory survey | 3 |
| 16-Jun | territory survey | 2 |
| 19-Jun | nest checks | 1 |
| 29-Jun | territory survey | 1 |
| 30-Jun | territory survey | 3 |
| 6-Jul | territory survey | 2 |
| 7-Jul | territory survey | 2 |
| 19-Jul | nest checks | 1 |

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| Date | Principal Activity | # Biologists |
|--------|--------------------|--------------|
| 28-Jul | nest checks | 1 |
| 30-Jul | nest checks | 1 |
| 5-Aug | nest checks | 1 |

Territory surveys were begun within 30 minutes before sunrise and ended by about 10:30 am, with additional behavioral observations made after territory surveys were completed. Surveys consisted of 1-2 biologists walking through the riparian habitat with a pace and pathway designed to maximize chances of seeing or hearing Willow Flycatchers while avoiding disturbance. When a Willow Flycatcher was located, a notation was made of its behavior (e.g., singing, calling, chasing, foraging, evidence of pair, nesting), and coordinates were recorded by GPS unit. For singing males observed moving up and/or downstream we typically took coordinates at the upper and lower limit. Nearest neighbors could typically be heard concurrently, but to rule out additional territories in gaps where no birds were detected within a few minutes, we broadcast a series of recorded Willow Flycatcher songs and calls for about 10-15 seconds and noted any responses or movements. If there was no response after about 1 minute (other than by neighboring birds), the broadcast was repeated. Because most of the Willow Flycatchers at this study site are unbanded, we could not determine whether or not the same birds were present at the same territories on successive visits. However, we were able to compare the consistency of mapped territory locations over all visits.

Nest locations were most often detected incidentally by sight as we were conducting territory surveys, but we also returned to territories where we suspected nesting and attempted to observe the pair from a distance while minimizing disturbance and limiting the observation time to approximately 15-30 minutes. We avoided approaching nests and suspected nest locations as much as possible, except for the purposes of checking for parasitism. Before approaching any nest, we scanned the area for corvids and raptors, and limited our time at nests to a few seconds to check its contents. Extendable mirrors allowed us to avoid leaving scent within three feet of the nest location. For all suspected nest locations, we typically marked the spot with flagging placed at least 10 m from the nest location, with approximate distance, direction, nest substrate and height, and contents (if known) noted on a nest form to be used on subsequent visits (Appendix 1).

During surveys we also noted the approximate numbers and locations of all Brown-headed Cowbirds, as well as any interactions with Willow Flycatchers, and any incidental evidence of parasitism of other species' nests within the study area.



RESULTS

Territories

Across the breeding season, we estimated the number of Willow Flycatcher territories as approximately 29, a territory defined as a singing male defending the same area on at least 2 successive visits and/or pair observed, and/or breeding confirmed. There were 9 instances of a single observation of a Willow Flycatcher outside of or adjacent to a mapped territory, so presumed to be shifting or migrating—but because these were in stretches of suitable habitat—we defined these as “potential territories,” for a total of 38. Of the 29 confirmed territories, breeding was confirmed in 17, although in 2 cases this was a nesting female without a territorial male (possible polygyny). Of the remaining 12 territories, 9 were occupied by a pair with no evidence of nests or fledglings (but nesting suspected), and in 3 territories there was only a solo singing male on repeat visits.

Of the territories with confirmed breeding, 4 territories were successful (fledglings confirmed), 8 were unsuccessful or probably unsuccessful, and 5 had an unknown outcome. Broken down by property section and excluding the single observations, there were 11 territories on the Vista Irrigation District section, 11 on the Cleveland National Forest section, and 7 on the downstream private/county section (Table 2). However, 2 of the territories on the Cleveland National Forest section were the cases of suspected polygyny (excluding these, there were 9 breeding territories on the Cleveland National Forest section).

Table 2. Summary of Willow Flycatcher territories by property section: Vista Irrigation District (VID), Cleveland National Forest (CNF), and downstream private/county (P/C).

| Territory Category | VID | CNF | P/C | Total |
|---|-----|-----|-----|-------|
| Single observation only (“potential territory”) | 4 | 3 | 2 | 9 |
| Territorial male (solo, unpaired) | 1 | 1 | 1 | 3 |
| Suspected breeding (pair) | 3 | 2 | 4 | 9 |
| Confirmed breeding (nest and/or fledgling) | 7 | 8* | 2 | 17 |
| Successful | 4 | 0 | 0 | 4 |
| Unsuccessful | 1 | 6 | 1 | 8 |
| Unknown outcome | 2 | 2 | 1 | 5 |

*2 of 8 territories on CNF section were nesting females without a territorial male.

Given the variability from visit to visit, and low percentage of birds banded, it is difficult to estimate the total number of adult birds accurately, but the range was most likely 19-29 females and 26-32 males. All territories, including potential territories with only single observations, are illustrated in Figure 4 and listed in Table 3 with details of observations.

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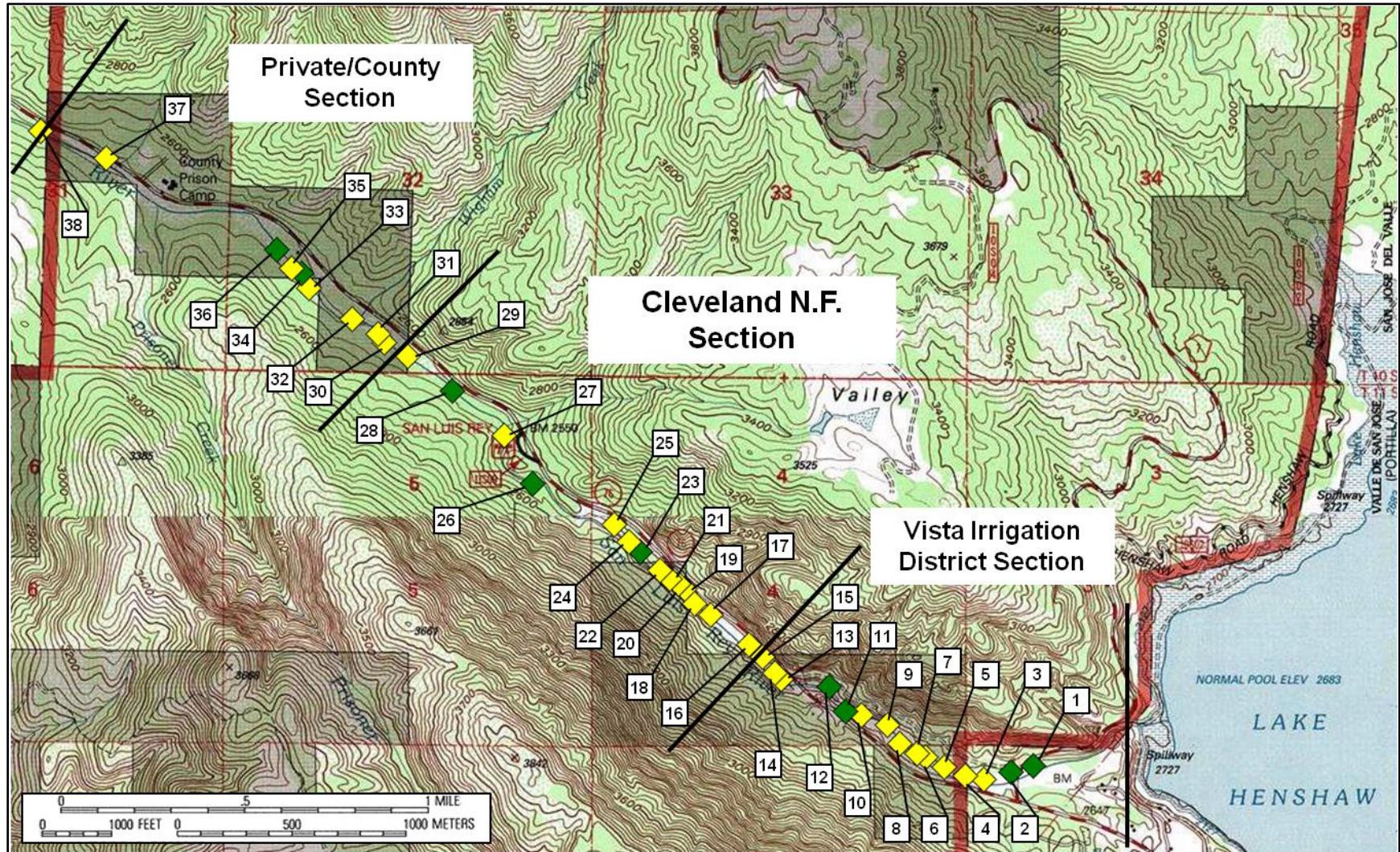


Figure 4. Southwestern Willow Flycatcher territory locations, upper San Luis Rey River, 2013. Diamonds indicate locations of approximate territory centroids (yellow=consistent/breeding territory, green=observation on a single date, a “potential territory”).



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Table 3. List of all territories (as shown in Figure 4) and approximate territory centroids (average coordinates from multiple visits and/or observers). “Potential territories” represent a single observation within suitable habitat. Sections are the Vista Irrigation District (VID), Cleveland National Forest (CNF), and downstream private/county property (P/C).

| ID | Category | Evidence | Section | Coords N | Coords W |
|----|---|--|---------|----------|------------|
| 1 | Potential territory? | Singing male only on 5/18 (no nests found) | VID | 33.24016 | -116.76805 |
| 2 | Potential territory? | Singing male only on 5/18 (no nests found) | VID | 33.23993 | -116.76907 |
| 3 | Breeding confirmed: successful | Pair (M+F unbanded), 1 nest found (B2N1), probably successful, older fledgling observed on 7/19 | VID | 33.23965 | -116.77033 |
| 4 | Breeding suspected | Singing male 4x, pair 2x 6/15 to 7/19 (no nests found) | VID | 33.23978 | -116.77120 |
| 5 | Breeding confirmed: successful | Pair (M unbanded), 2 nests found, 1st failed early (B3N1), 2nd successful (B3N2), fledglings observed 7/30 | VID | 33.24011 | -116.77221 |
| 6 | Breeding suspected | Singing male 4x, pair only on 7/28 (no nests found) | VID | 33.24049 | -116.77306 |
| 7 | Solo male | Singing male only 4x, unbanded | VID | 33.24067 | -116.77348 |
| 8 | Breeding confirmed: successful | Singing male 2x, pair 2x, fledglings observed 7/28 (no nests found) | VID | 33.24106 | -116.77430 |
| 9 | Breeding confirmed: unsuccessful | Pair (M unbanded), 2 nests found, both failed, 1st failed 6/19 (B4N1), second failed 7/19 (B4N2) | VID | 33.24177 | -116.77486 |
| 10 | Breeding confirmed: unknown outcome | Pair (at least 1 unbanded), 1 nest found (B5N1), failed on 6/30; still active on 7/28 | VID | 33.24216 | -116.77609 |
| 11 | Potential territory? | Singing male only on 5/18 (no nests found) | VID | 33.24231 | -116.77689 |
| 12 | Potential territory? | Pair only on 5/18 (no nests found) | VID | 33.24329 | -116.77763 |
| 13 | Breeding confirmed: successful | Singing male 3x, fledglings observed 7/6 (no pair observed, no nests found) | VID | 33.24358 | -116.77988 |
| 14 | Breeding confirmed: possibly successful (unknown) | Pair (M banded, F unbanded?), 1 nest found (C1N1), older nestlings on 7/6; very active on 7/19 and 7/28 | VID | 33.24381 | -116.78019 |
| 15 | Breeding suspected | Singing male 2x, pair 1x (no nests found) | VID | 33.24448 | -116.78075 |

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| ID | Category | Evidence | Section | Coords N | Coords W |
|----|---|--|---------|----------|------------|
| 16 | Solo male | Singing male (banded) and/or calling several times (no nests found) | CNF | 33.24495 | -116.78140 |
| 17 | Breeding confirmed: possibly successful (unknown) | Pair (M unbanded), 1 nest found (C3N1) just outside of mapped territory, 10-day old nestlings on 6/29, whitting on 7/6 | CNF | 33.24615 | -116.78321 |
| 18 | Breeding suspected | Pair (at least 1 unbanded), 1 nest found but possibly old | CNF | 33.24655 | -116.78397 |
| 19 | Breeding confirmed: probably unsuccessful (+ cowbird) | Pair, 3 nests found (6/1, 6/16, 7/28), first failed (C5N1), second unknown (C5N2), third cowbird egg/abandoned (C5N3) | CNF | 33.24714 | -116.78442 |
| 20 | Breeding confirmed (but polygyny?): unsuccessful | Nest building 6/1 (C6N1), failed by 7/7, pair 1x, never a singing male (possible polygyny?) | CNF | 33.24737 | -116.78469 |
| 21 | Breeding confirmed (but polygyny?): unsuccessful | Nest found 6/2 (C9N1), failed by 7/6, singing male 1x only (possible polygyny?) | CNF | 33.24755 | -116.78513 |
| 22 | Breeding confirmed: probably unsuccessful (+ cowbird) | Pair (M unbanded), 1 nest found 6/16 (C8N1) and 1 cowbird egg removed, later incubating, but probably failed | CNF | 33.24788 | -116.78560 |
| 23 | Potential territory? | Singing male only on 6/16 (no nests found) | CNF | 33.24862 | -116.78652 |
| 24 | Breeding suspected | Pair (M unbanded, F banded), no nests found | CNF | 33.24902 | -116.78703 |
| 25 | Breeding confirmed: unsuccessful | Pair, 1 nest found (C13N1) with 1 large cowbird chick on 7/30 | CNF | 33.24970 | -116.78772 |
| 26 | Potential territory? | Singing male only on 5/19 (no nests found) | CNF | 33.25132 | -116.79161 |
| 27 | Breeding confirmed: unsuccessful | Pair, 1 nest found (D1N1), failed 7/6 | CNF | 33.25323 | -116.79290 |
| 28 | Potential territory? | Calls heard only on 5/19 (no nests found) | CNF | 33.25497 | -116.79535 |
| 29 | Breeding confirmed: unknown outcome | Pair (M+F unbanded), 2 nests found, 1st failed by 6/15 (E2N1), 2nd with leaves inside 7/6 (E2N2) but pair active | CNF | 33.25636 | -116.79748 |
| 30 | Breeding suspected | Singing male 2x, pair 1x (no nests found) | P/C | 33.25688 | -116.79856 |

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| ID | Category | Evidence | Section | Coords N | Coords W |
|----|--|---|---------|----------|------------|
| 31 | Breeding suspected | Pair only on 6/15; still occupied 8/5 | P/C | 33.25724 | -116.79884 |
| 32 | Breeding confirmed: unsuccessful | Pair, 2 nests, 1st found demolished 6/30 (F4N1), 2nd late nest failed by 8/5 (F4N2) | P/C | 33.25780 | -116.80006 |
| 33 | Solo male? | Singing male 2x (no nests found) | P/C | 33.25903 | -116.80209 |
| 34 | Potential territory? | Singing male only on 6/30 | P/C | 33.25962 | -116.80246 |
| 35 | Breeding suspected | Pair 2x (no nests found) | P/C | 33.25984 | -116.80292 |
| 36 | Potential territory? | Singing male only on 6/15 | P/C | 33.26053 | -116.80360 |
| 37 | Breeding suspected | Pair, 1 nest possibly old | P/C | 33.26413 | -116.81165 |
| 38 | Breeding confirmed: unknown outcome | Pair (M unbanded), 2 nests found, first empty on 6/30 (F9N1), second possibly old | P/C | 33.26526 | -116.81474 |

Nest Monitoring

We located a total of 20 Willow Flycatcher nests (Table 4), most sighted incidentally during territory surveys. Of these, 2 were confirmed successful (fledglings observed), 15 were probably or confirmed failed, and 3 had an unknown outcome but possibly fledged. This is a low rate of apparent nest success (12-25%), with many early nests found torn or disheveled on the subsequent visit, presumably because of depredation. The high rate of depredation and our moderate level of nest checking prevented us from assessing the rate of cowbird parasitism precisely, because nests that fail early because of depredation could have been parasitized by cowbirds first, which may in turn increase the probability of depredation. Out of the 20 nests located, we could infer whether or not cowbird parasitism had occurred in only 10 nests, of which 3 were parasitized, giving a minimum rate of 30%.

Table 4. Outcomes and locations of Willow Flycatcher nests, 2013.

| Nest ID | Cowbird? | Outcome | N | W |
|---------|----------|---|----------|------------|
| B2N1 | No? | Only 1 nestling, probably fledged (older fledgling observed later) | 33.23959 | -116.77060 |
| B3N1 | ? | Probably failed (uncertain if used, later torn up) | 33.23999 | -116.77238 |
| B3N2 | No | Fledged | 33.24002 | -116.77267 |

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| Nest ID | Cowbird? | Outcome | N | W |
|---------|------------------|--|----------|------------|
| B4N1 | ? | Failed (nest torn up) | 33.24183 | -116.77515 |
| B4N2 | ? | Failed (nest torn up) | 33.24181 | -116.77477 |
| B5N1 | ? | Failed (nest disheveled) | 33.24242 | -116.77594 |
| C1N1 | No | Possibly fledged (unknown) | 33.24377 | -116.78030 |
| C3N1 | No | Possibly fledged (unknown) | 33.24575 | -116.78258 |
| C5N1 | ? | Probably failed (uncertain if used, later gone) | 33.24709 | -116.78436 |
| C5N2 | No | Possibly fledged (unknown) | 33.24709 | -116.78436 |
| C5N3 | Yes (1 egg) | Failed, when returned to pull cowbird egg, nest appeared abandoned | 33.24721 | -116.78445 |
| C6N1 | No? | Failed, clutch of 4 eggs, later torn up | 33.24736 | -116.78467 |
| C8N1 | Yes (1 egg) | Probably failed, but F incubated after cowbird egg pulled | 33.24788 | -116.78555 |
| C9N1 | No? | Failed?, clutch of 4 eggs, later 1 egg apparently abandoned | 33.24754 | -116.78516 |
| C13N1 | Yes (1 nestling) | Failed (1 large cowbird nestling) | 33.24989 | -116.78775 |
| D1N1 | ? | Failed, 2 eggs, later empty | 33.25335 | -116.79284 |
| E2N1 | ? | Failed (disheveled) | 33.25645 | -116.79730 |
| F4N1 | ? | Probably failed (uncertain if used, found torn up) | 33.25774 | -116.79991 |
| F4N2 | ? | Failed, 3 eggs, later empty | 33.25785 | -116.79987 |
| F9N1 | ? | Probably failed, uncertain if used | 33.26513 | -116.81473 |

Brown-headed Cowbirds

During each survey, the number of cowbirds detected in each section of the river was recorded. Early-season cowbird numbers, mid-May to early June, totalled as many as 20 a day seen in the riparian zone, but cowbirds were seen through the end of July. Cowbirds were most abundant in the upper stretches of the river, presumably closer to foraging areas around the grazed grasslands surrounding Lake Henshaw. Later in the season, from mid-June onward, cowbird numbers declined to 5-10 seen per day, and these were noted in all sections of the river including downstream areas farthest from presumed foraging areas.

Three nests were found to be parasitized by cowbirds. The first nest (C8N1) was found on 16 June and contained three flycatcher eggs and one cowbird egg. The cowbird egg was removed,

and the female returned to the nest to incubate. This nest was active through 6 July, but was found empty on 19 July. The second nest (C5N3) was found on 28 July (Figure 5) and contained one cowbird egg and two flycatcher eggs. The cowbird egg was removed on 30 July, but the eggs were already cold. The nest was subsequently found abandoned. The third nest (C13N1) was found 15 feet up in an oak tree with a large cowbird chick sitting in it and being fed by adults on 30 July (Figure 6). A subsequent visit on 5 August found the nest empty.



Figure 5. Nest found in coast live oak with single cowbird egg. This nest had been abandoned by the adults. Photo taken 30 July 2013.



Figure 6. Large cowbird chick sitting in a Willow Flycatcher nest in a coast live oak. Photo taken 30 July 2013.

Willow Flycatchers clearly recognize the threat posed by cowbirds, as one female flycatcher was observed chasing and snapping its bill at a female cowbird not far from its nest.

In addition to the Willow Flycatchers, two other species were observed tending cowbird fledglings. On 16 June a cowbird fledgling was observed being fed by a Song Sparrow (*Melospiza melodia*). On 29 June a noisy cowbird fledgling was repeatedly fed by adult Common Yellowthroats (*Geothlypis trichas*).

Other Nesting Observations

We observed nest-building activity as early as 1 June and first confirmed egg laying on 16 June. The latest active nests had chicks on 28 July, and all nests had fledged young or failed by 5 August.

The majority of nests were in coast live oak (59%), followed by stinging nettle (14%), rose (9%), and willow (5%), or mixture of these species (13%) (Figure 7).

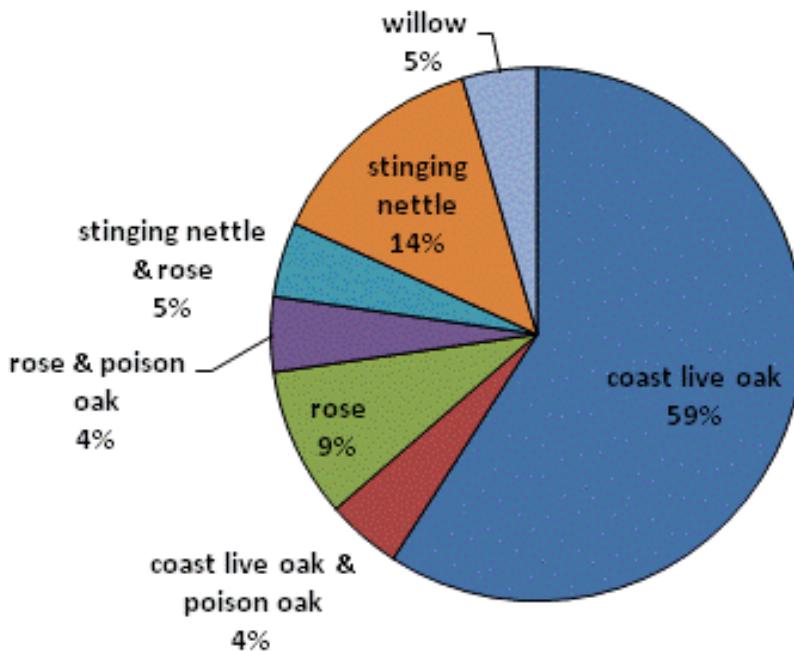


Figure 7. Substrates used for Southwestern Willow Flycatcher nests, upper San Luis River, 2013.

The majority of nests were placed low, within 1 m of the ground or water (Figure 8), fewer up to 2.5 m, and occasionally placed much higher (4.5-5.0 m) (Figure 9). About $\frac{3}{4}$ of nests were placed close to the river's edge or overhanging (Figure 10).



Figure 8. The majority of nests were placed low in vegetation close to the water's edge. In this case the nest was placed in a mixture of stinging nettle and wild rose. Photo taken 19 June 2013.

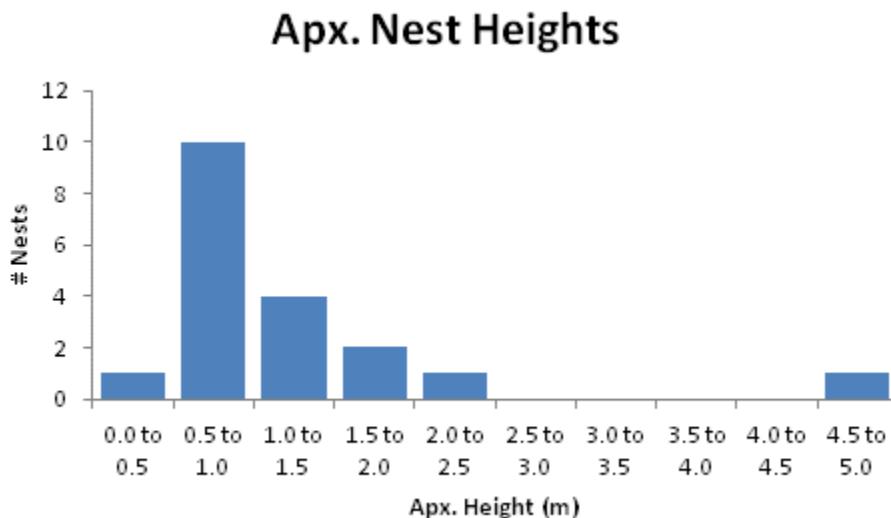


Figure 9. Estimated heights of Southwestern Willow Flycatchers nests by height category, upper San Luis Rey River, 2013.

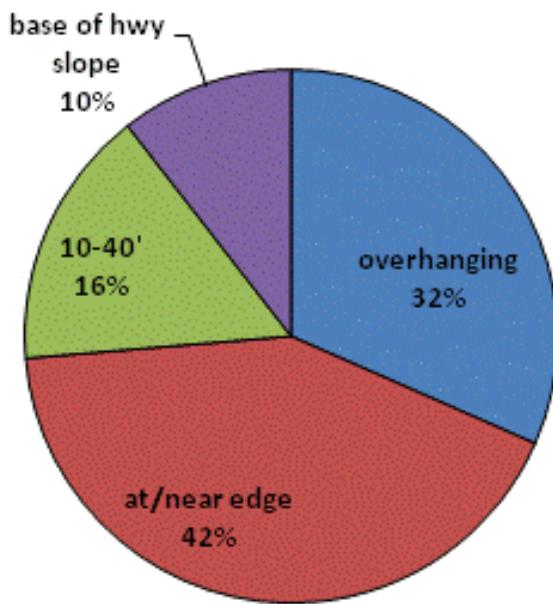


Figure 10. Southwestern Willow Flycatcher nest distance from river by category, upper San Luis Rey River, 2013. Most nests were either overhanging the river or at the river's edge.

DISCUSSION

Population Size

Using the number of males present on at least two visits to define a territory, in 2009 Howell and Kus (2010) reported 23 territories, 10 within the Cleveland National Forest section, which was an overall decline of 19% compared to 1999 (Kus et al. 1999 and Haas 2000). Using the same criteria in 2013, we documented 27 territories, 9 within the Cleveland National Forest section, which suggests a slight increase overall, although still less than in 1999 or what was reported in 1993–2001 (Haas and Unitt 2004).

Winter and McKelvey (1999) discussed the flycatcher population along the river in the mid-1990's. They stated that the number of flycatcher pairs on the Cleveland National Forest fluctuated between 18 and 24 pairs from 1994 to 1997, or approximately 25 to 30 territories when single males are added. Although this population appears relatively stable compared to other sites in California, more frequent surveys would allow a more accurate assessment of annual variation and population trends.

Reproductive Success

Although we confirmed cowbird parasitism in only 3 nests, the rate observed (at least 30%) is apparently greater than observed for this colony previously, and no parasitism was observed during the 1999 or 2009 studies (Kus et al. 1999, Howell and Kus 2010). At our survey's level of intensity, we could not determine the rate of cowbird parasitism precisely because of the high rate of depredation of nests during or soon after egg laying.

Rates of nest parasitism in other studies range from 0% at Camp Pendleton in 2005-2006 (Kus and Kenwood 2006, Kenwood and Kus 2007), 8.4-18.4% in the Sierra Nevada from 1997 to 2008 (Mathewson et al. 2012), to 22% along the Lower Colorado River from 2003 to 2012 (McLeod and Pellegrini 2013). Nest parasitism has also been found to increase the rate of nest predation (e.g., Stumpf et al. 2011), and Brown-headed Cowbirds can also act as nest predators (Arcese et al. 1995, Hoover and Robinson 2007).

At 12-25%, the rate of nest success along the upper San Luis Rey River appeared low. In 1999, 38% of nests were successful at the same site (Kus et al. 1999). In Arizona, Davidson and Allison (2003) reported a rate of success of 57% among 243 Willow Flycatcher nests. In eight studies throughout the range of the Willow Flycatcher summarized by Sedgwick (2000), nest success ranged from 28% to 69%. Along the Lower Colorado River, average nest success was 44% from 2003 to 2012 (McLeod and Pellegrini 2013). At Camp Pendleton, nest success was 52% during 2005 to 2006 (Kus and Kenwood 2006, Kenwood and Kus 2007).

Other recent studies of Willow Flycatcher nesting ecology have documented nest predation as the leading cause of nest failure (e.g., Mathewson et al. 2012, McLeod and Pellegrini 2013). Study of the predator community is recommended to inform management (Stumpf et al. 2011).

Observer effects in the form of disturbance, scent, and visual cues may introduce bias by increasing or decreasing the likeliness of nest predation and parasitism. They should therefore always be minimized for the purposes of comparative study and to avoid any reduction of nesting success.

The level of intensity of survey possible in 2013 allowed for only a moderate level of precision in the estimates of numbers of territories and rate of parasitism. A more intensive study would permit better quantification but entail more disturbance. Although many Willow Flycatcher nests can be found because they are placed along or above the water, the female's behavior is cryptic and the understory of the habitat, being dominated by wild rose, blackberry, stinging nettle, and poison oak, is difficult to negotiate. Monitoring of nests by cameras might increase precision, but a large fraction of nests fail so early in the cycle that locating each nest before it fails is inevitably difficult. However, nest cameras should reveal causes of nest failure and identify predators. If regular low-intensity population censuses are combined with less-frequent but intensive nest monitoring, it could greatly help to inform management strategies.

Reproductive success and causes of nest failure can differ greatly from year to year because of variation in weather and the predator community. Adverse weather can cause nest failure and shorten the breeding season (e.g., Mathewson et al. 2012), while drought can reduce foraging quality and alter the community and behavior of predators. Cumulative precipitation (July to June) during the 2013 season was 60% lower than the 50-year average, and the 1999 and 2009 survey years also had lower than average precipitation (Figure 11).

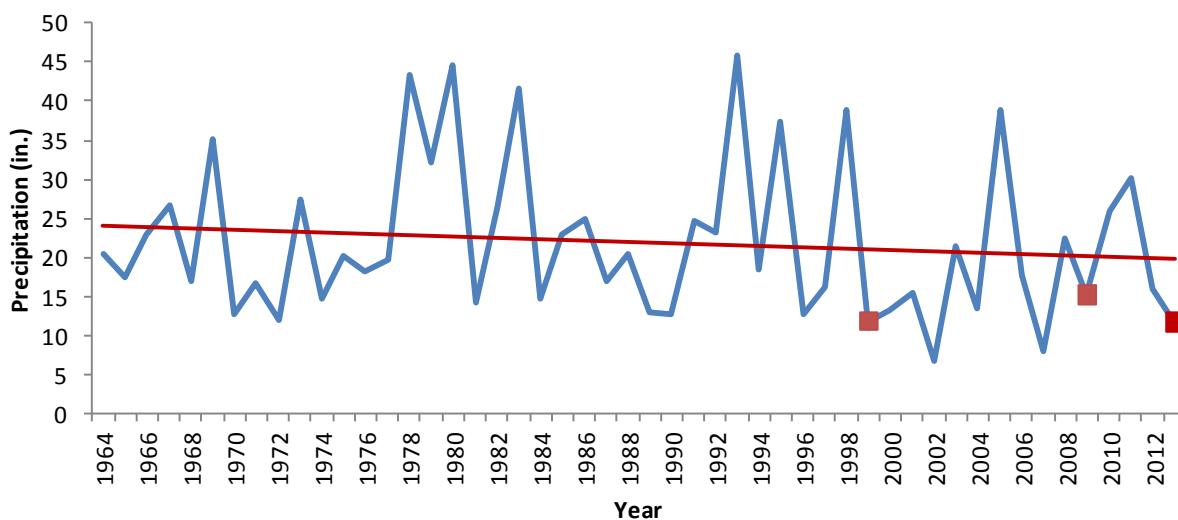


Figure 11. 50-year average precipitation (red line, cumulative July to June) was 21.9 inches. Precipitation during study year 2013 was 60% lower than the 50-year average, while 1999 was also 60% below and 2009 was 36% below. Data at a resolution of 2.5 minutes retrieved from PRISM on 28 January 2014 (<http://prismmap.nacse.org/nm/>).

Nest timing in 1999 appeared similar to that in 2013, extending from early June to late July (Kus et al. 1999). Because the Willow Flycatcher's breeding season is shorter than that of most other birds, the species' capacity for renesting is limited but likely critical when the rate of nest failure is high. The use of the San Luis Rey River as a water conduit by the Vista Irrigation District results in artificially high flows through the normally dry summer months. Although maintenance of water flow into the summer months likely mitigates the effects of drought to some extent in this system, future drought conditions may also strongly influence management decisions regarding the water flow.

Key Considerations

Water flow—During our first survey 18-19 May, the river was nearly dry with only small intermittent pools. The Vista Irrigation District did not begin to release water from Lake Henshaw through the San Luis Rey River until after the third week of May, after many of the Willow Flycatchers had arrived, and resulting in a very different hydrological regime. The birds' distribution on the first, dry survey differed considerably from that on the later, wet surveys. Because of the Willow Flycatcher's strong attachment to water it is likely that this change during the phase of territory establishment meant that the results of the first survey were of limited value. The schedule of release could affect the Willow Flycatcher's breeding success substantially, if territories are established on the basis of water flow at the time of arrival and these do not correspond to conditions later in the season, or nest failure could occur if nests are constructed too close to the river before water is released.

For example, territory numbers 1, 2, 11, and 12 (Figure 4) appeared to be abandoned after the water release, but the birds may have shifted to other territories. One monitored nest was likely lost to variations in water flow. It was found on 30 June in stinging nettle adjacent to the river. On 7 July the entire patch of nettles was wilted and dying, and the bases of their stems were under water. The nest was tilted and sagging among the wilted nettles. We tied the nest up with string to keep it from sagging further, but it was subsequently abandoned.

Sogge and Marshall (2000) and Sedgwick (2000) discussed the attraction of breeding flycatchers to habitats with standing or moving water, which may serve as an indicator of quality of foraging and possibly as a deterrent to predators. Though there is much variation in nest sites, nests are often placed above or adjacent to water where possible. Our results are consistent with this in that we found over 70% of nests adjacent to or overhanging the river. In 2013, as in 2009, a variety of substrates were used that were low and near the river's edge, and although coast live oak was the most frequently used nest substrate during both studies, these nests also tended to be placed low and near or over water (Howell and Kus 2010). The release of water from Lake Henshaw downstream beginning earlier in the season (prior to arrival) therefore has the potential to significantly increase the attractiveness of the river to breeding flycatchers. In combination, the dynamics of water flow and the availability of nesting substrate over and adjacent to water are likely key factors that influence the fitness of this population and should be considered in any future monitoring.

Cowbird parasitism—Our limited nest monitoring suggests that cowbird parasitism may be reducing flycatcher productivity in the study area, both by potentially inducing abandonment of parasitized nests, and, in at least one instance, resulting in the successful rearing of a cowbird chick. Winter and McKelvey (1999) discussed cowbird control on the river in the 1990's and concluded that despite large numbers of cowbirds being removed from the river, the effect on the flycatchers was difficult to discern as parasitism was rare during those years, and no pre-trapping parasitism data were available. In contrast, Whitfield et al. (1999) argued that cowbird trapping on the Kern River had increased the flycatcher's nest success from 23% to 39% and had increased the young fledged per female from 1.04 prior to cowbird control to 1.72 after control began; the increase subsequently leveled off as the flycatcher population entered a long-term decline. Uyehara et al. (2000) concluded that cowbird parasitism explained 44% of the variation in rates of the flycatcher's population growth along the Kern River. However, Kus and Whitfield (2005) contended that since cowbird-control programs have generally not resulted in gains in the flycatcher's population, the funding dedicated to cowbird trapping may be better spent on habitat restoration or other programs that benefit the species.

Cowbird control is probably most effective as a mitigation measure to improve the short-term productivity of endangered host species, and is recommended if baseline studies show that local parasitism rates exceed 20-30% for two or more years (Rothstein et al. 2003, Rothstein and Peer 2005). However, even low rates of nest parasitism can hinder population growth. Uyehara et al. (2000) estimated that growth of a flycatcher population was possible only if parasitism rates were below 10%. Nest parasitism can also have additive effects with other limiting factors, including increased predation risk, as documented in several studies (Stumpf et al. 2011).

Given the limited data available, it is unclear what level of effect cowbird parasitism is having on flycatcher productivity on the upper San Luis Rey River. Given the three instances of parasitism documented in this study, and the importance of this population as the largest in the state, a more detailed investigation of the parasitism rate and its effects is warranted.

Long-term Population Trends

Significant effort has been spent on the flycatcher population on the upper San Luis Rey River since at least 1994, and these studies suggest a relatively stable population. However, its long-term trends and fluctuations are still not well known. Increased frequency of surveys and long-term trend data would greatly increase the level of confidence in the value of various potential management options.

Substantial declines in other California populations of the Willow Flycatcher have been reported since monitoring was initiated over the past few decades (Sedgwick 2000), and recent declines have continued in many areas including the Sierra Nevada (Mathewson et al. 2012). Durst et al. (2008) estimated total number of breeding pairs in California at 172, occurring at 96 known sites, but with 41 sites extirpated. The population at the upper San Luis Rey River is currently the largest in California, so close monitoring of this population is essential.

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Appendix 1. Nest monitoring form used in Southwestern Willow Flycatcher surveys, 2013.

NEST MONITORING FORM

| | | |
|---------|--------------------|---------------------|
| NEST ID | DATE | SITE |
| SPECIES | METHOD | |
| SUBSTR | APX NEST HEIGHT | APX SUBST HEIGHT |

DIRECTIONS/NOTES

Rem to note: apx distance and direction of nest from flagging, flagging height and substrate, coordinates of flagging, nest visibility, how flagging should be approached, draw arrow to nest in sketch, note location of camera tool box relative to nest.

SKETCH

Especially note all evidence of possible depredation or fledging: nest damage, fragments below nest, tracks, distance of FL to nest, #, age of FL, and adult behavior. Also note description/age of nestlings. CB=# cowbird eggs or nestlings out of total. Note if camera battery, SD card changed.

