Songbird Nestbox Monitoring Report

The Importance of Consistent Monitoring

Years 2021 and 2022

A Tree Swallow pair perched on a cottonwood tree at Cache Creek Nature Preserve
Photo by Cache Creek Conservancy

Submitted to:
The Cache Creek Conservancy

Submitted by:
Harnawaz “Twig” Boparai
boparai@cachecreekconservancy.org
Cache Creek Conservancy
34199 Co Rd 20
Woodland, CA 95695

Introduction

The Cache Creek Conservancy (CCC) has been involved with restoration work in the lower Cache Creek Watershed for more than 25 years. During that time many different restoration methods were used to restore the biodiversity in the watershed. One such method that is rather inexpensive and effective is installing nestboxes for breeding birds. Nestboxes are a great restoration tool as they provide breeding habitat for cavity nesting birds that have limited natural cavities (in the form of tree limbs breaking and woodpecker excavated holes on trees) due to forest loss by humans activities (like forest cuttings), but also floods, droughts, and wildfires. There are different types of nestboxes ranging from small nestboxes for cavity nesting songbirds to larger nestboxes for owls, other raptors and waterfowl.

This paper focuses on the songbird nestboxes at the Cache Creek Nature Preserve (CCNP). There are 16 songbird nestboxes spread throughout the CCNP, on average located about approximately 160 feet apart from one another. These nestboxes are meant to be used by native cavity nesting songbirds during the spring and summer (early March – late July typically). Native songbirds that most commonly use these nestboxes are Tree Swallows, Ash-throated Flycatchers, House Wrens, and Western Bluebirds. Occasionally (although less frequently) other native songbirds will use these nestboxes such as House Finches, White-breasted Nuthatches, and Oak Titmice.

Measuring success of a songbird nestbox program can be determined by how frequently they are being used by songbirds, how large the clutch is, how many eggs hatch, how many young leave-fledge the nest, and how frequently birds re-nest (having another clutch) in the same season. All these data values are easy to calculate with regular monitoring. In recent years, monitoring methods have been inconsistent. This study documents one season where there was inconsistent nestbox monitoring and another season when consistent nestbox monitoring occurred. This study shows how monitoring consistently affects data.

Materials and Methods

In 2021, restoration staff and interns conducted nestbox monitoring on 15 of the 16 songbird nestboxes at CCNP. The 16th nestbox was monitored in the study due to inconvenient accessibility. The nestboxes were monitored on six occasions that season: February 4 (for a pre-season check), May 20, June 10, July 1, July 22, and July 28. The monitoring sessions were not scheduled. As there was no dedicated monitoring intern team, the days in which the monitoring was performed were incidental. Nonetheless, consistent data collecting methodology was used during these six monitoring sessions, the data was recorded on data sheets detailing the number of eggs in the nest, the status of the nest, the species nesting in the nestbox, the number of dead and live young in the nest, and the status of parent birds nearby.

In 2022, restoration staff and interns conducted nestbox monitoring on all 16 songbird nestboxes at CCNP. In addition to a marginally larger sampling size, the nestboxes were monitored on a more frequent basis. Nestboxes were checked every week and a standard monitoring protocol was in place. In addition to the data gathered in previous years (number of eggs, status of the nest, species nesting in the nestboxes, number of live and dead young, and status of parents nearby) two additional

data points were added, the nest stages (indicated by the level of nesting material and the development of the nest cup), and the approximate age of the nestlings. Approximate age of nestlings is a valuable datum value as checking nestboxes with nestlings that are well-developed can result in the nestlings leaving the nest early, known as pre-mature fledging. Another outcome of checking nestboxes with well-developed nestlings is it can cause them to stress out and potentially die in the nestbox. To prevent these events from happening, the 2022 monitoring protocol would skip nestboxes that contained nestlings in their third week of development after hatching. The third week in nestling age is when nestlings get very restless and is typically when they start leaving the nest. After the third week passed, the staff and interns would check the nestbox on the fourth week to see if the nestlings successfully fledged (Graham 2006 and Truan 2021). If nestlings were still present in the nestbox and/or peeking their heads outside the nestbox after the third week, staff and interns would skip the nestbox again to not stress the nestlings.

Tree Swallow nestlings in their first week of development after hatching from the 2022 season
Photo by Harnawaz Boparai

The nestboxes were monitored for 22 weeks in 2022 starting in late February and ending in late July. These boxes were checked once a week on these following dates: February 28, March 8, March 17, March 22, March 31, April 7, April 14, April 21, April 28, May 5, May 12, May 21, May 28, June 2, June 9, June 17, June 24, June 30, July 7, July 14, July 21, and July 28.

The data from the 2021 and 2022 nestbox seasons were compiled on separate excel spreadsheets to calculate the total number of nests for the season, the number of eggs that hatched, the number of nestlings that fledged, the total sum of eggs produced from the nestbox season, how frequently re-nesting occurred, and the average clutch size for each season. All data values calculated

were then compared to the alternate season for differences in values. The equation used to compare difference in the average clutch sizes is referred to as a T-test. It solves for the variable t, the test statistic. If there was no significant difference between the two average clutch sizes, then weekly nestbox monitoring does not yield more accurate data compared to incidental nestbox monitoring. If there was significant difference, then consistent weekly nestbox monitoring is vital to getting accurate estimates of cavity nesting songbird data. The T-test formula is as follows:

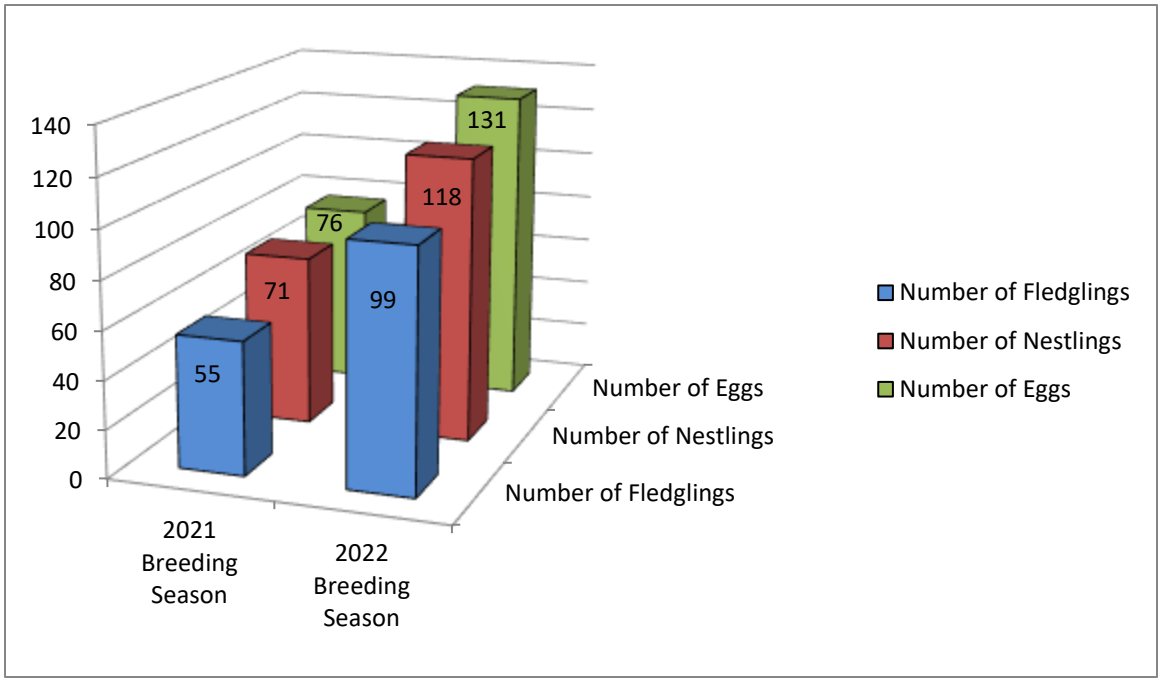
$$t = \frac{(x_1 - x_2)}{\sqrt{\frac{(s_1)^2}{n_1} + \frac{(s_2)^2}{n_2}}}$$

X1 is the average clutch size from the 2021 breeding season. X2 is the average clutch size from the 2022 breeding season. S1 is the standard deviation in clutch sizes from the 2021 breeding season. S2 is the standard deviation in clutch sizes from the 2022 breeding season. N1 is the sampling size of clutches from the 2021 breeding season. N2 is the sampling size of clutches from the 2022 breeding season. A critical value was also calculated using the degrees of freedom (both sample sizes from 2021 and 2022 subtracted by 2) and selecting a confidence level (in this study a 95 percent confidence level was used)

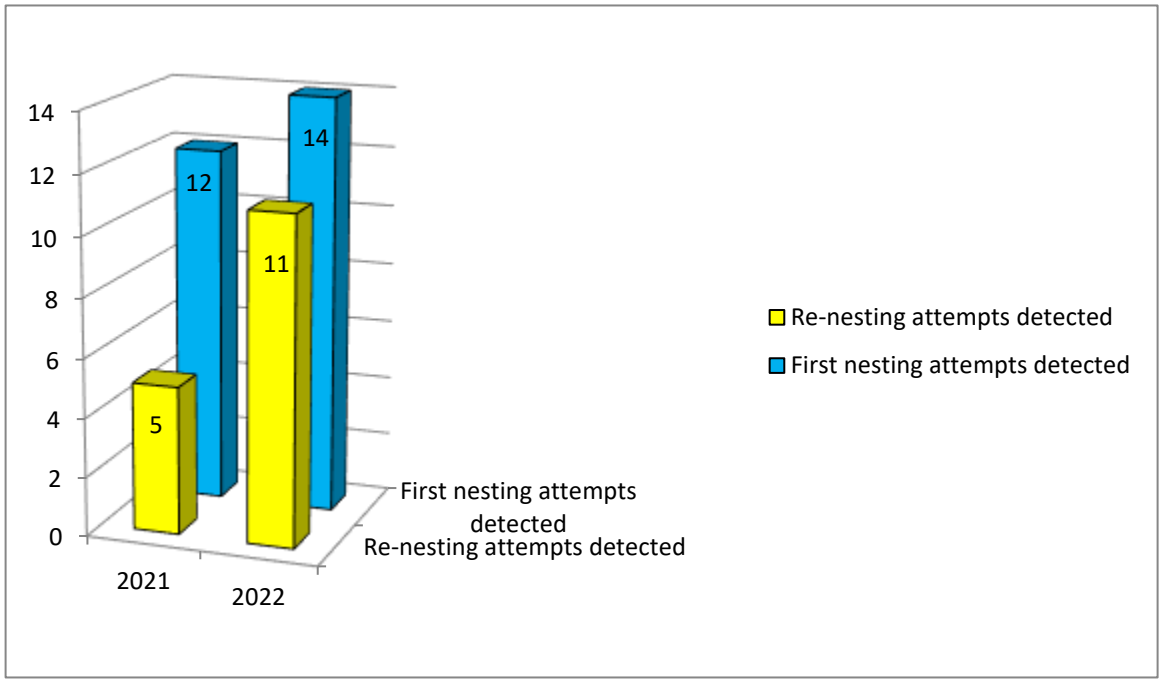
For comparison purposes, Tree Swallows (*Tachycineta bicolor*) were the species of cavity nesting songbird used to calculate all these nesting data parameters as they are the dominant cavity nesting songbird species at the CCNP. They also frequently re-nest if the opportunity is present. Both 2021 and 2022 saw large numbers of Tree Swallows nesting at the CCNP.

Results

Total Number of Eggs, Nestlings, and Fledglings. From the 2021 data sheets, it's estimated that 76 Tree Swallow eggs were produced at the CCNP. From those 76 eggs, 71 hatched, and from those 71 nestlings, 55 fledged and left the nest. These numbers were put in Excel which produced a hatching success rate of 93.42 percent and a fledgling success rate of 77.46 percent. From the 2022 data sheets, it's estimated that 131 Tree Swallow eggs were produced at the CCNP. From those 131 eggs, 118 hatched, and from those 118 nestlings, 99 fledged and left the nest. Like the 2021 data, these numbers were put in Excel which calculated a hatching success rate of 90.08 percent and a fledgling success rate of 83.90 percent.

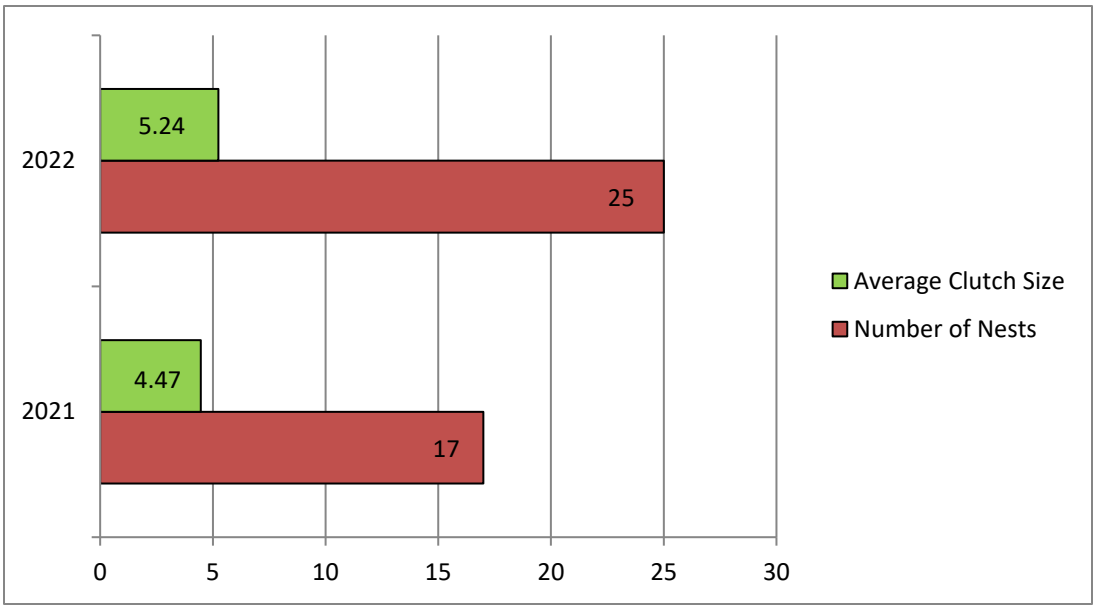


First Nest Detections and Re-nesting Detections. From the 2021 data sheets, 12 Tree Swallow nests were detected for the first nesting attempts of the season, and 5 more were detected during the re-nesting phase of the breeding season. And from the 2022 data sheets, 14 Tree Swallow nests were detected for the first nesting attempts of the season, and 11 more were detected during the re-nesting phase of the breeding season.



Average Clutch Size and T-Test comparison. The estimated average clutch size for 2021 was 4.47 eggs per clutch. The estimated average clutch size for 2022 was 5.24 eggs per clutch. The variance in clutch sizes for 2021 is 1.144 eggs, and the variance in clutch sizes for 2022 is 0.902 eggs. Lastly, the sample

size for each year is the total number of Tree Swallow clutches from the season (both first nesting and re-nesting attempts summed together). The sample size for 2021 is 17 nests, and the sample size for 2022 is 25 nests. All of these values plugged in give a test statistic value of 2.29. The critical value for this T-test is 2.021 as the degrees of freedom are 40 (both sample sizes subtracted by 2) and the confidence level is 95 percent. The standard for T-Tests is when the test statistic value is greater than the critical value there is significant difference between the two means being tested. In this case, the test statistic value 2.29 is greater than the critical value 2.021. Therefore there is a statistical significant difference between the average clutch size of 2021 and the average clutch size of 2022.



Discussion and Conclusion

The 2022 data provided more robust estimates of overall nesting data than the 2021 data. There were more eggs, nestlings, fledglings, and nesting attempts detected by the observers. Additionally the 2022 data showcased a lower hatching success rate, but a higher fledgling success rate. The lower hatching success isn't a dramatic decline (93.42 percent to 90.08 percent) given the number of eggs and nests produced for both years.

The more significant difference is the fledgling rate (77.46 percent in 2021 and 83.90 percent in 2022). There are several possibilities why mortality was higher in 2021 than 2022. One explanation is increased daytime temperatures; overheating is a concern for hatchlings as they can't regulate their internal body temperature until they are over 2 weeks in age. However, daylight temperatures were fairly similar for both breeding seasons. Another explanation is water availability. Tree Swallows heavily rely on water not just for hydration purposes, but their preferred prey (for offspring principally) are insects that use water for their larval stages such as mosquitoes and even marsh-oriented species of moths (Mengelkoch et. al 2004). However the unique problem with this explanation is that there was a greater amount of water both in the CCNP's wetland area and Cache Creek in 2021. 2022 saw a dramatic loss of water at the CCNP, resulting in the wetland area losing all its water by August 2022.

Approximately half of the wetland was dry at the beginning of the 2022 breeding season. The

2022 breeding season had less water than the 2021 breeding season, yet less mortality. Rainfall is another factor as 2021 had approximately 5 inches of rainfall, while 2022 rainfall was 11 inches. Rainfall doesn't directly affect the birds, but it does affect aquatic insect productivity which is a valuable food source for Tree Swallows (Drake and Martin 2020, Lytle et. al 2008). Another explanation for the fledgling rate difference is 2022's drying conditions prompted more aquatic insects to disperse towards the creek. This possibility has been observed in other North American systems with drying ponds where aquatic insects will travel as much as 780 feet to find a long-term body of water (Boersma and Lytle 2014). Breeding birds in 2022 could have taken the opportunity to feed on dispersing aquatic insects that attempted to leave the drying wetland and were dispersing towards Cache Creek.

The last possible explanation for the increased fledgling mortality in the 2021 breeding season is human activity. Observers in 2021 may have been checking the nestboxes while the Tree Swallow nestlings were in their third week of development. This is a crucial period that is avoided in most standard nestbox monitoring protocol as it can result in the nestlings prematurely fledging/leaving the nestbox or stressing to death inside the nestbox. In theory, a combination of rainfall affecting aquatic insect activity and avoiding the third week of monitoring individual Tree Swallow nests led to reduced mortality for the 2022 season.

In conclusion, my findings show that regular weekly nestbox monitoring provides more robust and accurate data estimates of reproductive rates in cavity nesting birds. Therefore, it is recommended that the Cache Creek Conservancy approach future nestbox projects with the newly organized monitoring program with protocols. This program has a better understanding of how cavity nesting birds are successfully breeding in the lower Cache Creek watershed. This analysis of biological activity serves as a success for the Conservancy's restoration projects to aid in the design and efficacy of new projects in the future.

Literature Cited

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