

2023 Songbird Nest Box Monitoring Report
Cache Creek Nature Preserve, Capay Open Space Park, and
Granite-Woodland Reiff



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Introduction

The Cache Creek Conservancy (CCC) has been restoring areas of the lower Cache Creek watershed for more than 25 years. Over time, the CCC has implemented many restoration methods to improve the biodiversity of the watershed. One of these actions includes establishing a bird nest box program. Nest boxes are relatively inexpensive while being an effective form of monitoring breeding bird activity. Nest boxes provide nesting habitat for cavity-nesting birds, which is especially valuable since the demand for natural cavities can be higher than what is actually available (due to forest loss from human activities, fire, drought, and floods). The utilization of the boxes provides additional information about the cavity-nesting songbird species inhabiting and breeding in the area. Their presence also acts as indicators of a healthy environment, such as water, food resources, and shelter availability.

The CCC manages songbird nest boxes at the Cache Creek Nature Preserve (CCNP), Capay Open Space Park (COSP), and Granite-Woodland Reiff (GWR). At the CCNP and COSP, there are 15 nest boxes each. At GWR, a total of three nest boxes were installed for the first time in November of 2022.

Although the CCNP also hosts several other kinds of bird nest boxes, this report will only cover data that was collected from the songbird nest boxes.

Materials and Methods

CCC staff and interns monitored the nest boxes on a weekly basis. Nest boxes were carefully approached and opened. If a nesting bird was present inside, the box would be closed and left alone until the following week. Data was collected during each session and recorded on a data sheet, which was later digitized. Data collected included: species utilizing the box, status and stage of the nest (number of feathers was also recorded for Tree Swallow nests), number of eggs laid, relative temperature of the eggs (warm or cold), number of eggs hatched, number of young fledged (i.e. developed and left the box), and status of the parents (either around, in/on the box, or absent). Any other notable observations, such as parasites in the box, were also noted.

Whenever possible, approximate age of the nestlings was recorded to track their development. By the third week of development, nestlings are much more mature and restless, making them more sensitive to disturbance. Checking the boxes at this stage can result in premature fledging, in which the young birds leave the nest before they are developmentally ready. Since they are not strong enough flyers yet, survivorship is low. On the third week of development, the nest box check was skipped to prevent premature fledging. In the fourth week, the check could resume (as long as the nest box was vacant) to record the number of nestlings that successfully fledged. After fledging took place, the old nest would be left in the box for an additional week to see if re-nesting was attempted. Diatomaceous earth would be sprinkled on the nest to remove any mites left over. If there was no new nesting material added to the old nest in the following week, the box would be cleaned out. Routine nest box checks would continue from there.

Monitoring of the nest boxes took place during the cavity-nesting songbirds' breeding season, with some added time allowance before and after the breeding season, from early March to early August of 2023. Early monitoring took place to ensure the observation of any early nesting attempts, and the

latest monitoring tracked any later nesting attempts. At the CCNP and COSP, the nest boxes were checked a total of 26 consecutive weeks. They were checked for 21 weeks at GWR.

All data collected was digitized into a Microsoft Excel spreadsheet after the end of the breeding season. For each site, the total number of fledglings (nestlings that hatched and successfully left the nest) by species, and the total number of fledglings across species, was recorded. With these values, the following parameter could be calculated:

$$\text{Proportion of a given species (Pi)} = \frac{\text{total number of fledglings of a given species at the site}}{\text{total number of fledglings from the site}}$$

Once all Pi values were calculated for the species at each site, they were plugged into a natural logarithmic formula (ln) to produce a value which was multiplied by Pi again to give a species-specific diversity measurement:

$$\text{Species-specific diversity (H)} = \text{Pi} * \ln(\text{Pi})$$

After the species-specific diversity values were calculated for each species per site, they were summed to result in the Shannon-Weiner Diversity value (H). This value represents how diverse a given site is based on its species composition. The higher the value, the more species diverse the site is.

Another value that can be calculated from the Shannon-Weiner Diversity value is species evenness (E), which measures how even species distribution is at a given site (i.e. relative abundance of each species). The higher the value, the more evenly distributed the species are at the site. Evenness is calculated as follows:

$$\text{Species evenness (E)} = \frac{H}{\ln(\text{total number of species from the site})}$$

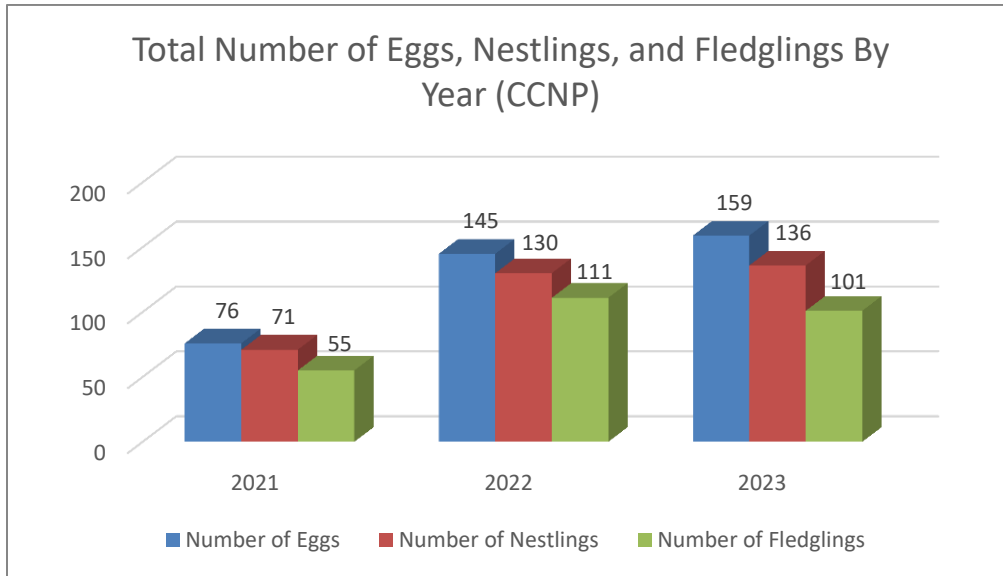
Lastly, two more data values were calculated. First was the occupancy rate of nest boxes for each site. This was calculated by dividing the number of active nest boxes (throughout the season) at a select site by the total number of nest boxes at the select site. Second was the re-nesting rate, which was calculated by taking the number of nest boxes containing a second nesting attempt of the season from a select site and dividing by the number of nest boxes with first nesting attempts from the select site.

The site-specific data values described above allows for the comparison and contrast of nest boxes at the CCNP and COSP. GWR could not be included in the species diversity and evenness calculations because there was too little data from that site (only one nesting attempt). Inferences can be made about why the cavity-nesting bird communities are the way they are, and what can be done to improve the sites to promote increased nesting songbird diversity.

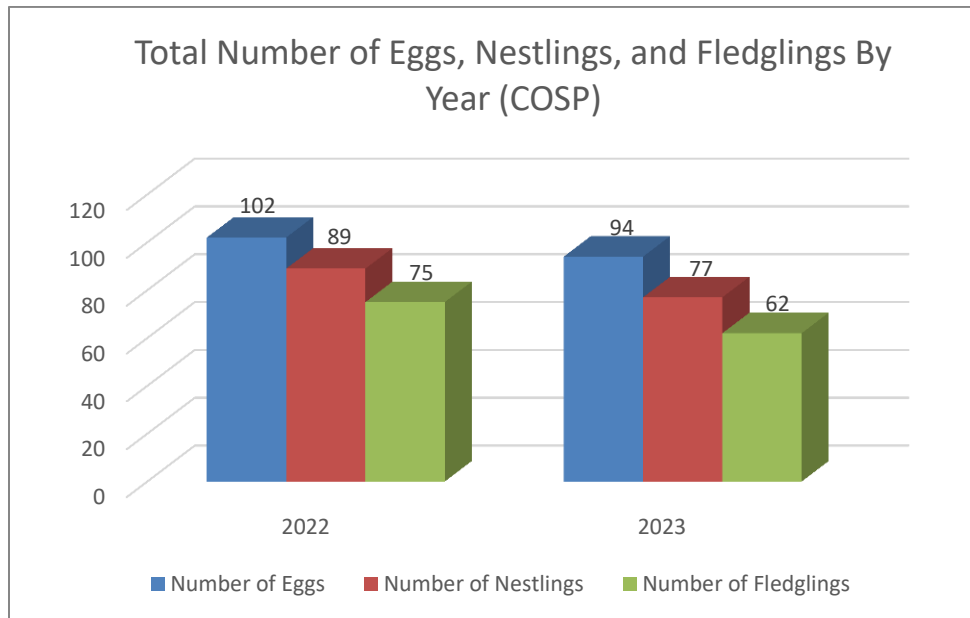
Results

Total Number of Eggs, Nestlings, and Fledglings by Year

This year, the CCNP produced 159 eggs, 136 nestlings, and 101 fledglings. This results in an overall hatching rate of 85.53% and a fledging rate of 74.26%. Data from year 2021 and 2022 are provided in the graph as well for comparison.



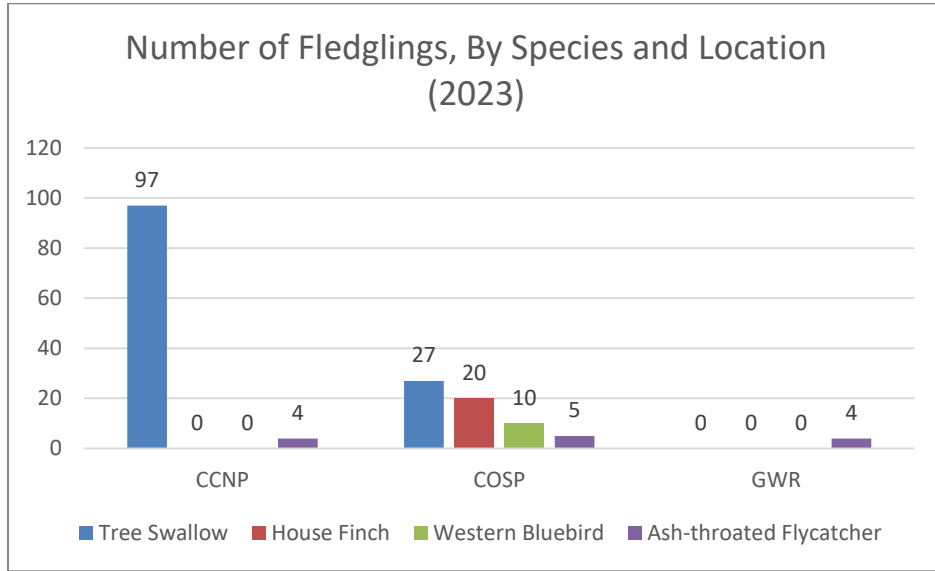
At COSP, there were 94 eggs, 77 nestlings, and 62 fledglings. This gives an overall hatching rate of 81.9% and a fledging rate of 80.5%. Data from year 2022 is provided for comparison.



At GWR, there were 4 eggs, 4 hatchlings, and 4 fledglings. 2023 was the first year collecting nest box data from GWR since the boxes were installed in November of 2022.

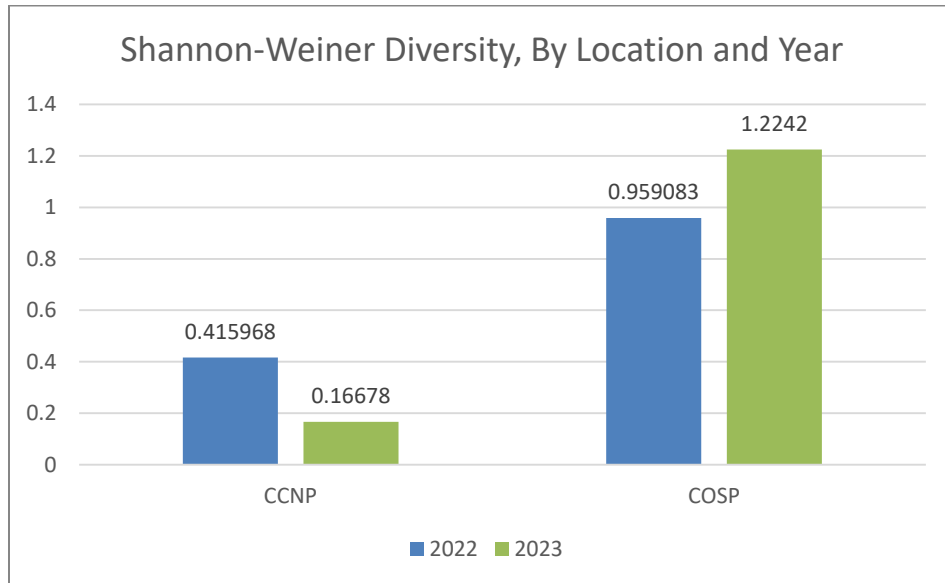
Number of Fledglings

In total, the CCNP produced 101 songbird fledglings in the 2023 breeding season (97 Tree Swallows and 4 Ash-throated Flycatchers). COSP produced 62 fledglings (27 Tree Swallows, 20 House Finches, 10 Western Bluebirds, and 5 Ash-throated Flycatchers). GWR produced 4 fledglings (4 Ash-throated Flycatchers).



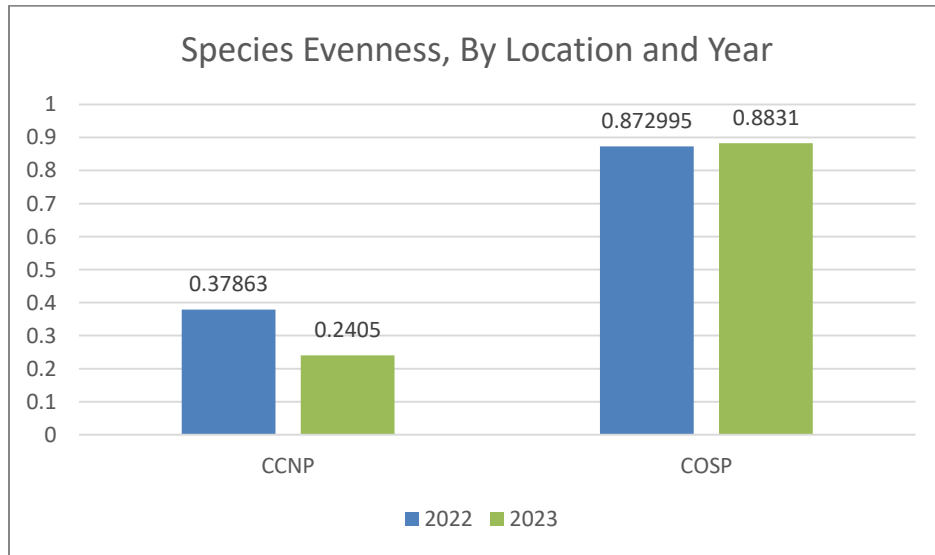
Species Diversity

For the CCNP, the diversity value produced was 0.16678. This 2023 value is lower than the 2022 value (59.91% decrease). COSP scored a larger diversity value at 1.2242. This is an increase from the 2022 value (27.64% increase).



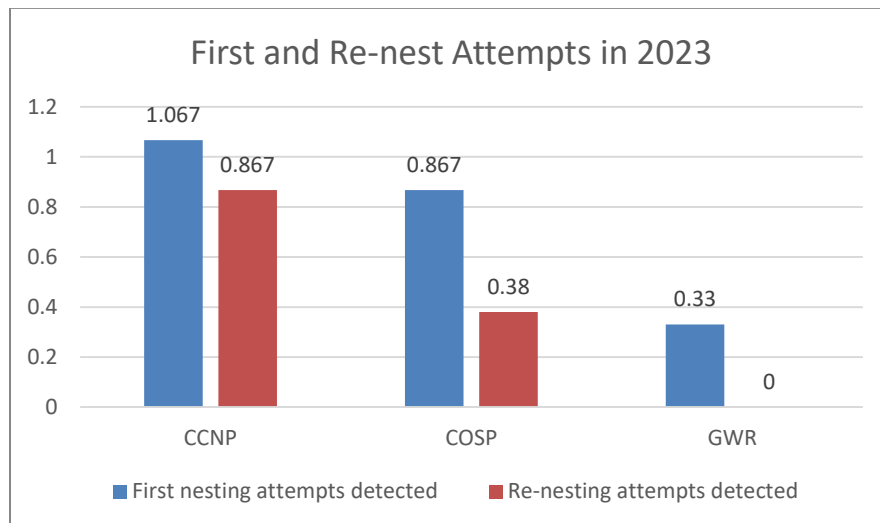
Species Evenness

The CCNP scored an evenness value of 0.2405, which is lower than last year (36.48% decrease). COSP scored 0.8831, which is slightly higher than in 2022 (1.16% increase).



First Nest Detections and Re-nesting Detections

The CCNP had all 15 nest boxes occupied during the 2023 breeding season. There was a single instance of an Ash-throated Flycatcher pair taking over a Tree Swallow nest (building a new nest and laying eggs on top of the pre-existing one). This incident was considered a “second first nesting attempt,” thus the occupancy rate is higher than 1. From the 15 nest boxes, 13 were observed with re-nesting attempts. At the CCNP, there were a total of 28 nesting attempts for the 2023 year. COSP had 13 out of 15 nest boxes occupied during the 2023 breeding season. From those 13, 5 were observed with re-nesting attempts. At COSP, the total nesting attempts was 18. 1 of the 3 boxes at GWR was occupied, and there were no re-nest attempts.



Discussion

Just as in previous years, Tree Swallows continue to make up the majority of nest box users at the CCNP, with a couple other species making up the minority. The interpretation for this is well-explained in the 2022 report (Boparai, 2022), and the same reasoning still applies (and likely will continue to in the future). In summary, the combination of the nest boxes being placed close to water, the boxes being placed relatively close to each other, and the early breeding start of the Tree Swallow makes the nest boxes at the CCNP very favorable for Tree Swallows compared to other cavity-nesting birds.

Not only did Tree Swallow box utilization remain strong, it increased in 2023. Species diversity and evenness decreased at the CCNP. 96% of fledglings were Tree Swallows in 2023, compared to 89% in 2022. It is likely that the increased presence of water, through a heavier than usual rain year, made the CCNP even more desirable for Tree Swallows. There was abundant water in the wetlands, Cache Creek, and adjacent canals and sloughs. Tree Swallows are insectivorous birds and rely on catching their food, for themselves and their young, above the surface of the water. Not only that, Tree Swallows feed on high-calcium items like fish bones, crayfish exoskeletons, and clamshells during the breeding season, which are also closely associated with water. Since the majority of the CCNP's nest boxes are located near water, it makes sense these boxes would be highly sought-out by breeding Tree Swallows. Since Tree Swallows are known to start breeding earlier in the season (compared to other cavity-nesters, like Ash-throated Flycatcher), they essentially get "first pick" on the boxes they wish to nest in.

COSP, on the other hand, exhibits much higher species diversity and species evenness. Diversity increased 27.64% in 2023 compared to last year, while evenness increased just slightly (1.16%). This finding is consistent with last year's data and can be explained by the landscape properties of COSP (Boparai, 2022). House Finch contested Tree Swallow for the species with most nestlings fledged. There were 20 House Finch fledglings compared to 27 Tree Swallow fledglings. Interestingly, Tree Swallows laid twice as many eggs as House Finch, but many Tree Swallow nestlings died before fledging. Nestling deaths will be further discussed later on. The reason for greater House Finch nesting activity at COSP is both the smaller size of the park and the difference in resource availability compared to the CCNP. A smaller park area means the boxes are located closer to each other (one nest box every 2.5 acres, compared to 8 acres at the CCNP). Territorial bird species, such as Western Bluebird and Ash-throated Flycatcher, will avoid nesting in these areas in higher concentrations since there is not enough space between the boxes to set up appropriate nesting territories. House Finch and Tree Swallow, on the other hand, are accustomed to living communally and are not territorial with others of their species. The House Finch nests in particular were always located next to each other. Lastly, COSP also has access to water via the Cache Creek and a couple lakes, but the water sources are located further from the park, making it less desirable to Tree Swallows.

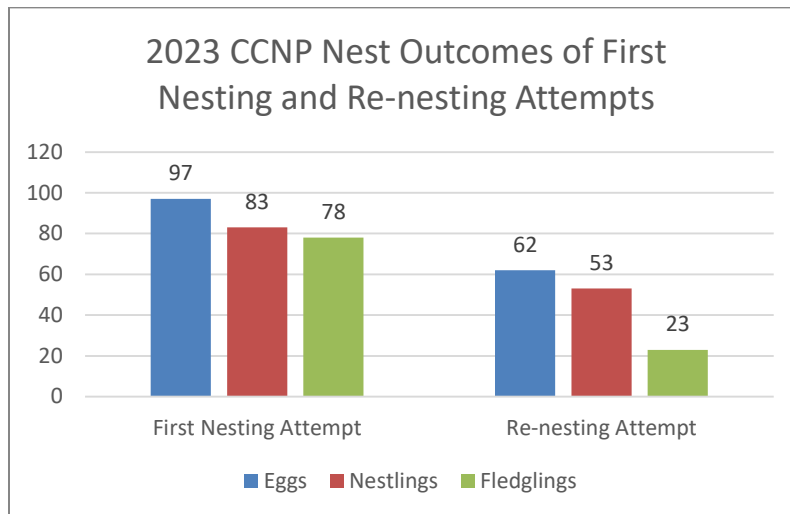
GWR is the newest nest box site, having three boxes installed in November of 2022. Only one of the three boxes was utilized. The low nest box recruitment rate (33%) is to be expected. 2023's nesting season was the first opportunity for the boxes to be used. It is not uncommon for nest boxes to take a couple years to start attracting birds (NestWatch, 2023). Once the birds start finding the boxes, recruitment will hopefully rise and more boxes can be added to GWR. Nest boxes will continue to be monitored in the 2024 nesting season to observe nest box recruitment.



From left to right: Tree Swallow, Western Bluebird, House Finch, Ash-throated Flycatcher eggs in nest.

When comparing the 2023 CCNP and COSP nesting season to 2022, a few observations can be made. Overall, the number of fledglings produced was similar to last year, though slightly less.

At the CCNP, there were more eggs laid and hatched in 2023 compared to 2022, even though there was one fewer nest box present this year. However, fewer fledglings were produced this year. The shortfall of the 2023 nesting season can be seen in the fledging rate, which is the proportion of nestlings that successfully leave the nest. In 2023, the hatching rate was 85.53% and the fledging success rate was 74.26%. This can be compared to 2022, when the hatching rate was 89.66% and the fledging success rate was 85.38%. While some hatching and fledging failure is to be expected, 2023's fledging success rate was significantly lower (85% in 2022 and 74% in 2023). Hatch rate was only slightly lower this year and can most likely be attributed to random variation. The lower fledging success rate in 2023 can be broken down even further by separating first nesting attempts and re-nest attempts.



In 2023, the first nesting attempts occurred from March 15 to May 24. From this period 85.57% of the eggs hatched and 93.98% of the nestlings successfully fledged. Re-nest attempts occurred from May 24 to August 3. Not all nest boxes experienced a second brood, but most did (13 out of 15). 85.48% of the eggs hatched and 43.40% of the nestlings fledged. The re-nest fledging success rate was markedly lower than the first nesting attempt (from 94% to 43%). The primary reason for this is thought to be the

difference in air temperature. The average high during the first nesting attempt period was 71.39°F while the second nesting attempt period's average high was 93.5°F, with many days later in the season reaching 100°F or higher. Compared to natural tree cavities, nest boxes are less insulated and are therefore more sensitive to outside ambient temperatures (Larson, 2018). Internal box temperatures can reach up to 45 degrees warmer than tree hollows (Rowland et al., 2017). Egg hatching rate may not have been impacted because most eggs were laid earlier before daytime temperatures were consistently warm. Late June is when summer temperatures began to increase, which was also the time when most nest boxes were occupied by week-old nestlings. Nestlings are particularly threatened by heat due to their immobility, rapid growth, and immature physiology (Eastwood & Peters, 2022). Considering all of the dead nestlings were found inside boxes with less shade cover, and therefore more sun exposure, heat stress is thought to be the leading factor in nestling death and the low fledging success rate.

While there were a number of heat-related nestling deaths in 2022 (74.07% fledging success rate during the re-nest period), the overall higher summer temperatures in 2023 had large impacts on fledging success rate. 2023 had summer temperatures that were on-average 2°F higher than 2022. While this might not seem like a big change, even small increases in temperature can amount to a large difference inside nest boxes, especially when temperatures are already over 100 degrees.

COSP demonstrated a similar trend, though with fewer re-nesting attempts overall (House Finches do not produce a second brood as often as Tree Swallows). Of the re-nests in 2022, the fledging success rate was 69.23%. In 2023, it decreased to 33.3%.



From left to right: Tree Swallow, Western Bluebird, House Finch, Ash-throated Flycatcher nestlings in various stages of development.

Conclusion

2023 was a successful bird breeding season, with the number of eggs, nestlings, and fledglings being comparable to 2022. The popularity of the nest boxes at the CCNP, the high diversity of occupants at COSP, and the initiation of nest box utilization at GWR are all positive outcomes of the 2023 nest box program. The high volume of breeding birds is an indicator of healthy riparian habitat.

Even in the face of success, there are always additional habitat recommendations and points of improvement that can be made. Perhaps the issue that is most prominent is heat stress within the nest boxes. With climate change and the anticipation of warmer weather in the future, it is important to address

these threats to ensure that the nest boxes remain safe nesting environments. Box modifications, such as painting the exterior a lighter shade or building an overhead shade structure, can help mitigate these concerns. Nest boxes can also be re-located so that they are placed under existing shade cover.

Boparai (2022) made the recommendation that more tree cover be added to COSP, and this recommendation remains for 2023. Mature trees act as food sources and shelter from heat and predators. Perhaps the addition of more mature trees would increase nest box occupancy rates so that all boxes are utilized, though the current rate of 86.67% is still good.

Finally, consistent nest box monitoring should continue at all sites. If nest box recruitment improves at GWR, a next logical step would be to consider adding more boxes for future breeding seasons.

Work Cited

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