

Tabor Lake Bird Study

Final Report

October 2023

Written by: Susan Bennett & Taylor Spadafora



Thank-you to our partners:



Abstract

Tabor Lake is located along the Clear Creek Trail within the Wheat Ridge Greenbelt. It is managed by the Parks, Forestry, and Open Space team at the City of Wheat Ridge. The island in Tabor Lake supports a rookery for four species of colonial nesting birds: Double-crested Cormorants (*Phalacrocorax auratus*), Great Blue Herons (*Ardea herodias*), Black-crowned Night Herons (*Nycticorax nycticorax*), and Snowy Egrets (*Egretta thula*). Trees on the island appear to be failing and a new trail is proposed to encircle Tabor Lake.

This study investigated the health of the rookery on the island, nesting populations and diversity of land bird species around the lake. At the peak there were 119 Double-crested Cormorant nests, four (4) Great Blue Heron nests, three (3) Black-crowned Night Heron nests, and one (1) Snowy Egret nest. Thus, it is probable that almost 300 birds used the island in the 2023 breeding season. Approximately 44 land bird species were identified around the lake. Soil is highly impacted from bird guano and the eight (8) trees on the island show signs of decline. These data will inform Wheat Ridge decisions regarding trail construction and rookery restoration.

Introduction

Tabor Lake is a former gravel pit located along the Clear Creek Trail within the Wheat Ridge Greenbelt. The island in Tabor Lake offers a communal nesting location and provides safety and food supply for colonial nesting birds along its perimeter and at an island rookery. The Tabor Lake Rookery supports breeding populations of Black-crowned Night Herons, Great Blue Herons, Snowy Egrets, and Double-crested Cormorants.

There are numerous threats to colonial birds in a suburban setting. The increase in population of the Denver metropolitan area, specifically along Clear Creek just west of Tabor Lake has resulted in habitat loss. Residents and trail users have direct access to Wheat Ridge Greenbelt and the presence of people may add strain to the colonial bird population. Traffic and construction noise occur daily. Natural threats to colonial birds include phenomena like hail and snowstorms. The intensity of storms due to climate change can impact our wading bird populations. These storms reduce the egg and chick survival rates.

The trees at the Tabor Lake Rookery are stressed and dying. Wheat Ridge would like to restore this natural resource for the bird populations. Restoring the rookery helps protect habitat for these species and potentially increase their survival rates. In addition, restoration of the rookery will support birding and educational opportunities for the general public. This work will be part of Wheat Ridge's restoration and management plan for the Tabor Lake section of the Wheat Ridge Greenbelt.

As part of the management plan, Wheat Ridge plans to formalize a trail around Tabor Lake. This trail will replace the social trails in the area with a safe, ADA accessible trail. The trail also provides a bird blind with views of the Tabor Island Rookery and a connection between 44th Ave. and the Peaks to Plains Trail along Clear Creek in the Wheat Ridge Greenbelt. Prior to trail construction and in conjunction with the Open Space Management Plan revisions, these data will establish a baseline for the bird populations around Tabor Lake.

This study will document the status of rookery trees and soil conditions at the Tabor Lake Rookery and shoreline; determine bird population health and size; provide recommendations for habitat management during Tabor Lake Trail construction; and identify possible restoration methods for the Tabor Lake Rookery.

Project Staff

Lead – Susan Bennett

Susan Bennett is the Environmental Interpreter for the City of Wheat Ridge. Susan completed her M.S. in Mineral Resource Ecology at the Colorado School of Mines and has a B.A. in Biology from Carleton College. She is an NAI Certified Interpretive Guide, a Leave No Trace Master Educator, and a licensed science teacher. She creates and implements numerous environmental education programs for the city on topics as diverse as Leave No Trace,

embryology, Colorado pollinators, water chemistry, aquatic macroinvertebrates, and tree biology. In addition, she manages numerous conservation-oriented projects. She has over 20 years of experience in environmental consulting, project management, and preschool-college education.

Natural Resources Intern – Taylor Spadafora

Wheat Ridge requested funds from Denver Audubon’s Lois Webster fund and Denver Field Ornithologists Research Grant to help subsidize a seasonal Natural Resources Intern. Taylor Spadafora started in May 2023. She has a B.S. in Environmental Science and a minor in Biology from Colby-Sawyer College. Taylor participated in raptor banding projects and worked in environmental education programs during her college career. Taylor is leading the data collection during summer 2023.

Consultants –

Dr. Christy Carello, Professor of Biology at Metropolitan State University of Denver, developed an avian monitoring program for this study and incorporated investigation of colonial birds in her curriculum. Bird monitoring began in March 2023 with her class.

Dr. Sarah Schliemann, PhD Senior Lecturer of Earth and Atmospheric Science at Metropolitan State University of Denver, and her students collected and analyzed soil samples from the island in Tabor Lake.

James Roemmelt, Forestry & Open Space Supervisor, the arborist for the city of Wheat Ridge completed the health assessment of the trees on Tabor Island.

Colonial bird study

The colonial birds observed for this study include: Double-crested Cormorants (*Phalacrocorax auratus*), Great Blue Herons (*Ardea herodias*), Black-crowned Night Herons (*Nycticorax nycticorax*), and Snowy Egrets (*Egretta thula*). Colonial birds began returning to the Tabor Lake Rookery in early March 2023. Data collection began later that month in conjunction with Dr. Carello and the MSU ornithology class. Data collection has continued with Wheat Ridge staff throughout the breeding season in 2023.

The population counts were done at three separate locations along the south shore of Tabor Lake labeled in the figure below as A, B, and C.

Vantage sites for Colonial Bird viewing



The counts were broken down into two clusters due to the inability to see certain parts of the island from points A and C. Cluster 1 included the four trees on the southwest side of the island, while Cluster 2 included the northernmost tree and the nesting mound.

Colonial Bird Nest Clusters



At each point, multiple counts were completed until the results were within 10% of one another. At point A, a count was done for Cluster 1. At point B separate counts were done for both Cluster 1 and Cluster 2. The counts for Cluster 1 from points A and B were averaged. At point C separate counts were done for both Cluster 1 and Cluster 2. The counts for Cluster 2 from points B and C were averaged.

The number of adult cormorants was estimated by doubling the number of nesting sites. When the chicks began to fledge the nest and hunt in the water, they were counted as adults.

Colonial Bird Sampling Results

All four species of colonial waterbirds were observed nesting on Tabor Lake Island: Double-crested Cormorants (*Phalacrocorax auratus*), Great Blue Herons (*Ardea herodias*), Black-crowned Night Herons (*Nycticorax nycticorax*), and Snowy Egrets (*Egretta thula*). Breeding season started in early March 2023 with 39 Double-crested Cormorants and 12 active nests (Dr. C.A. Carello, personal communication). The lake was still frozen at that time.

During the peak of breeding season, there were approximately 119 Double-crested Cormorant nests, as well as four (4) Great Blue Heron nests, three (3) Black-crowned Night Heron nests and one (1) Snowy Egret nest. Forty-four (44) nests were located in the mound south of Tree A.

a) Double-crested Cormorants

The Double-crested Cormorants nested both in the trees, and on a large mound in the center of the island. In total, there were approximately 119 nests on the island. When our Natural Resources Intern began to survey on May 2nd, there were seventeen (17) dependent chicks. Nests were seen with anywhere from one to four chicks, but most often three chicks were seen per nest. The final chicks fledged by September 12th, but mature and immature cormorants remained on and around the island to feed.

There were three observed deaths from the observation points during the study, two of which were adult cormorants that were tangled in fishing line that was stuck in the trees or used as nesting material. The third cormorant was found on the side of the Clear Creek trail, it is unknown how that individual died. When visiting the rookery island for the soil study, nine deceased birds were found.

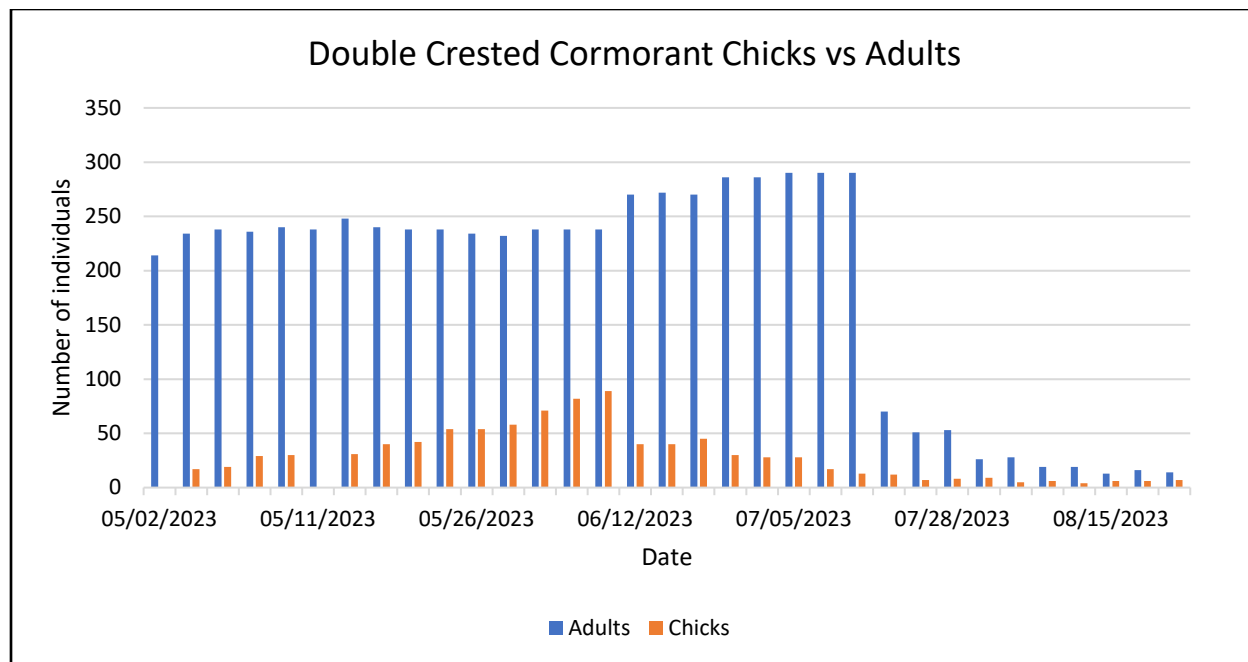
Many of the nests, including all those on the ground, show evidence of use over multiple years and exhibit an increase in height (see photo below).

Example of Double-crested Cormorant Nest Locations in Trees



Double-crested Cormorant Nest Mounds on Ground





b) Great Blue Herons

There were a total of four (4) Great Blue Heron nests on the island. The hatching dates for the Great Blue Herons spanned over the course of one month. The first chicks were already present in nest A on May 2nd. The first chicks in nest D were observed on May 8th, and the first chicks in nest C were observed on May 30th.

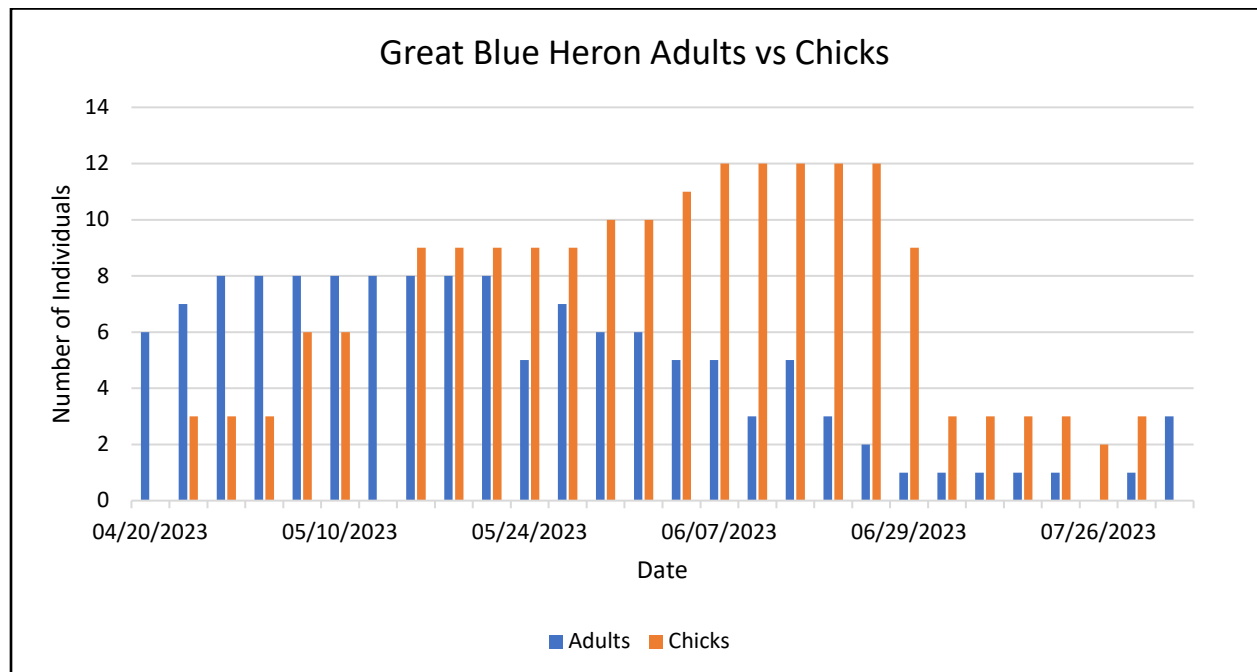
On July 14th it was assumed nest B had a failed clutch, and the nest had been abandoned.

Nest A had five (5) chicks total, with the fifth chick hatching two weeks after the rest. At the time the fifth chick hatched, several of the older chicks had already begun to develop their flight feathers and were significantly larger than the new chick. After two weeks, it was observed that the fifth chick was not growing. The larger chicks were seen trampling the smaller chick, pecking at it, and pushing it aside when feeding. On June 12th, the fifth chick was seen dead in the nest. The first observation of a chick leaving the nest was on June 21st, and by June 23rd all four chicks were seen leaving the nest and either flying with an adult or hunting on the shore.

Nest D had four chicks total. On June 14th, one of the chicks was seen on the ground beneath the nest. It appeared to have fallen out and could not yet fly back up to the nest. This chick was seen multiple times attempting to feed from adult cormorants as they were feeding their chicks. On June 20th another one of the chicks had left the nest and was observed hunting at the shoreline. All four chicks had fledged the nest by June 26th.

Nest C had four chicks total, the first two chicks were seen on May 30th, and the last two chicks were seen on June 8th. The first chick fledged the nest on July 7th, and the final chicks had fully fledged by August 4th.

Example of Great Blue Heron Nest Location



c) Black-crowned Night Herons

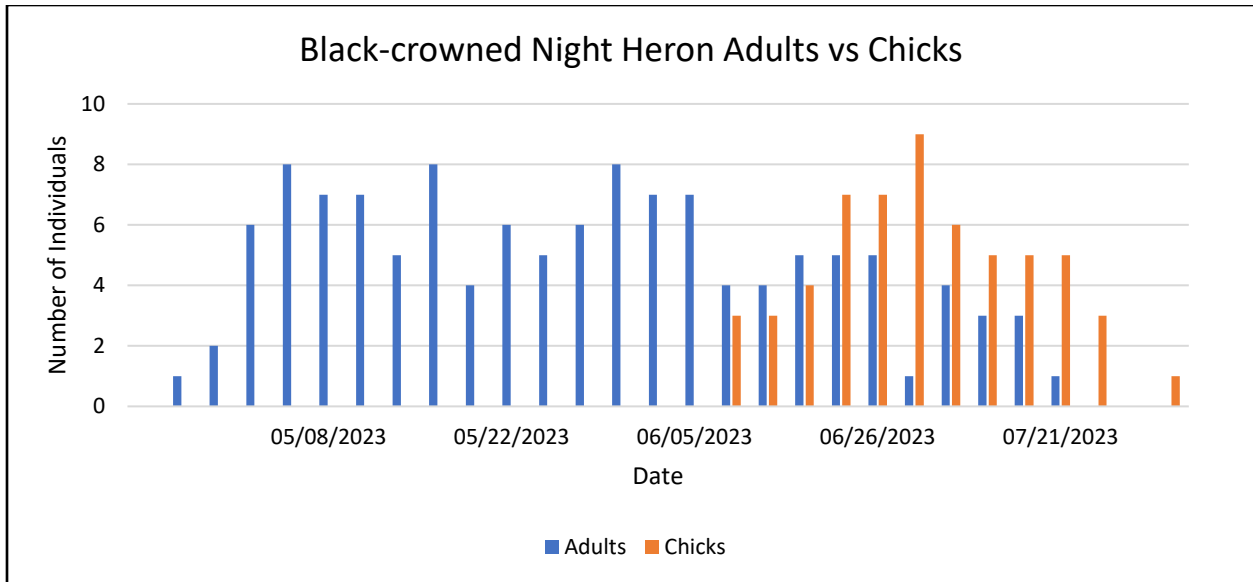
There were a total of three (3) Black-crowned Night Heron nests on the island. Two (2) nests were located in the southernmost tree on the island, and the third nest was located in the northernmost tree of the island. During the second week of May, there was an attempt by a heron to build a nest in the southernmost tree, however that attempt was abandoned during the third week of May. The first chicks observed were in nest B on June 7th, and there were three in total. On June 19th, two chicks were observed in nest A, followed by two chicks in nest C on June 21st. There were a total of seven Black Crowned Night Heron chicks.

The first chick was observed to have fledged from nest C on July 5th, with the second chick fledging shortly after on July 7th. As of July 14th, the three chicks from nest B and the two chicks from Nest A remained on the rookery. They were observed either in their nest, or close by on the ground. The final chick fledged the rookery by August 2nd.

Although there were only three nests on the island, there was one occurrence where nine mature Black-crowned Night Herons were observed on the island at one time.

Example of Black-crowned Night Heron Nest Location





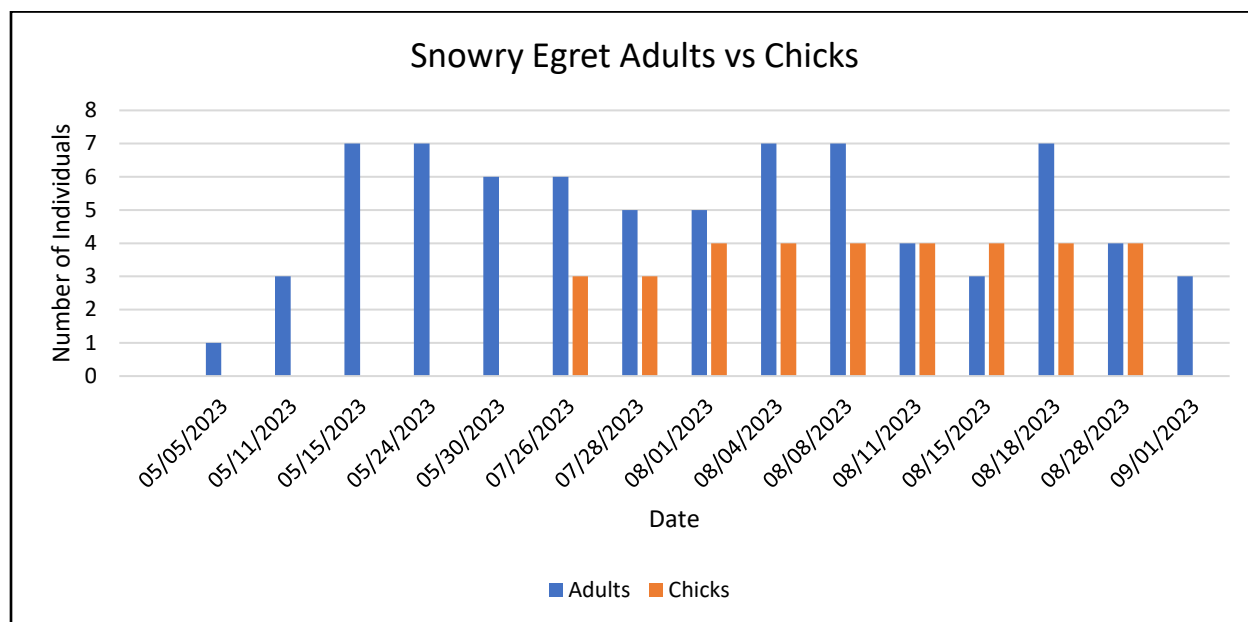
d) Snowy Egrets

There was one (1) Snowy Egret nest on the rookery, located in the southernmost tree on the island where the Great Blue Herons nested. The first hatched chick was observed on July 20th, and there were a total of three chicks in the nest. The chicks fledged by September 7th.

Although there was only one nest on the rookery, as many as twelve (12) Snowy Egrets were observed on or around the island. They were observed several times to be feeding alongside large groups of cormorants on the north shore of Tabor Lake.

Example of Snowy Egret Nest Location





Additional Observations

Other species that were observed on the island were Canada Geese, Spotted Sandpipers, and Mallards. It is unknown whether these species had nests on the rookery, they were most often seen in the heavily vegetated area on the south side of the island.

There were three predatory birds seen flying over the island including Bald Eagle, Osprey, and Red-tailed Hawk. No observations were made of any of these species actively hunting the birds on or around the rookery.

Land bird Survey

Data collection for the Land Bird study began in April 2023 in conjunction with Dr. Carello and the MSU ornithology class. The land bird sampling occurred at three locations around Tabor Lake at different times during the day, between 7:00 AM and 2:30 PM. The sampling variation accounted for the likelihood of different species being active at different times of the day. The sites were not sampled in any specific order. In addition to different time frames, the sampling was carried out in a variety of temperatures and weather conditions, heavy rain and high winds excluded.

The counts utilized a five-minute variable circular plot point count. Upon arrival at the survey location a timer was set for five minutes, and during this time minimal movement and noise were made in an effort to reduce any disturbance that occurred upon arrival. A total of three

five-minute counts were completed at each location. Any bird seen or heard during the five-minute count was recorded, along with the distance from the recorder, and the detection type (visual, auditory, wing, or drumming). The Merlin Bird ID app was used to assist with auditory detections. The data sheet used for the survey was provided by Dr. Christy Carello of MSU Denver.

Southwest Corner (Location A): The southwest corner samples were taken along the tree line north of the creek. It should be noted that several of the homes in that area have bird feeders in their yards, and many species were seen at or around the feeders.

Southeast Corner (Location B): The southeast corner samples were taken next to one of the standing elm trees off the social trail. It should be noted that the backyard of one of the nearby homes has a fake owl in one of the trees.

Northeast Corner (Location C): The northeast corner samples were taken between the social trail and the tree line bordering the lake. It should be noted that there was often loud and persistent noise coming from the businesses that border Tabor Lake to the north.

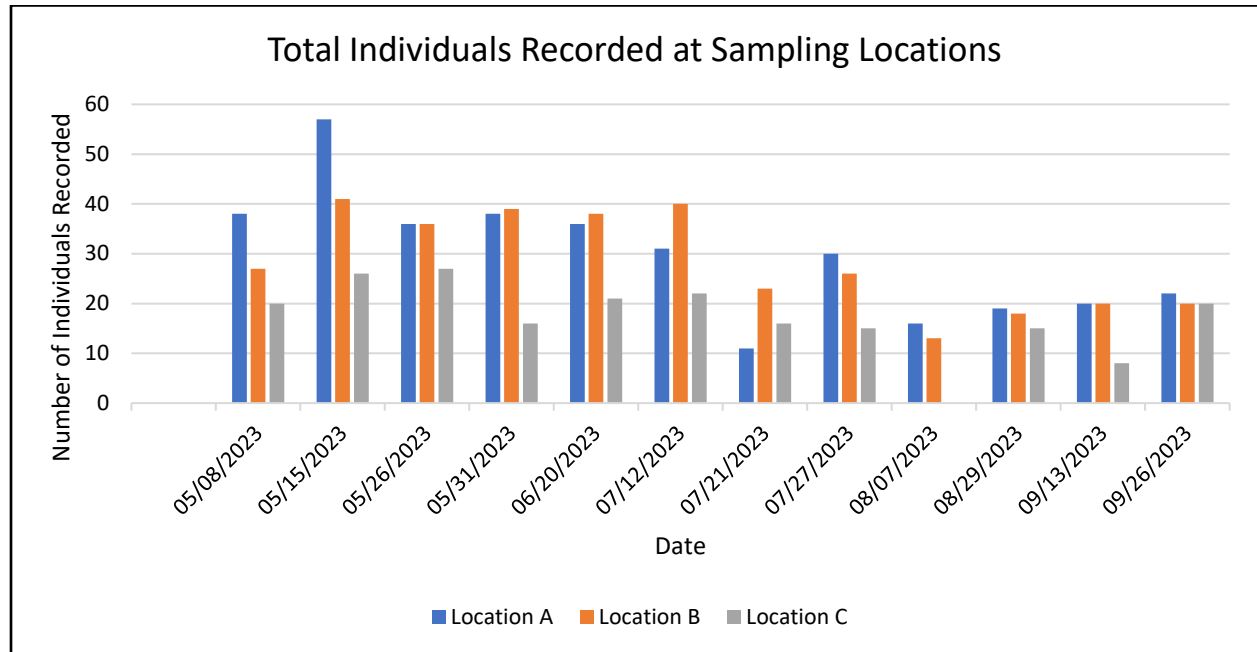
Noise from construction at the old Howard Johnsons on the north side of the lake impacted data collection and may be impacting wildlife behaviors. Data were not collected on June 7, July 5, and the week of September 18th due to construction noise and traffic; on July 11 due to high winds; and at the NE corner on July 27 due to noises from roosters.

Land Bird Sample Locations



Land Bird Survey Results

Approximately 44 species land birds were identified during the summer of 2023. Typically, the most birds and variety were identified at the south sample locations (Site A & Site B). Site C usually had the fewest birds and varieties. As Tabor Lake is located in a suburban area, there are outside factors that may have impacted the number of birds identified at each location.



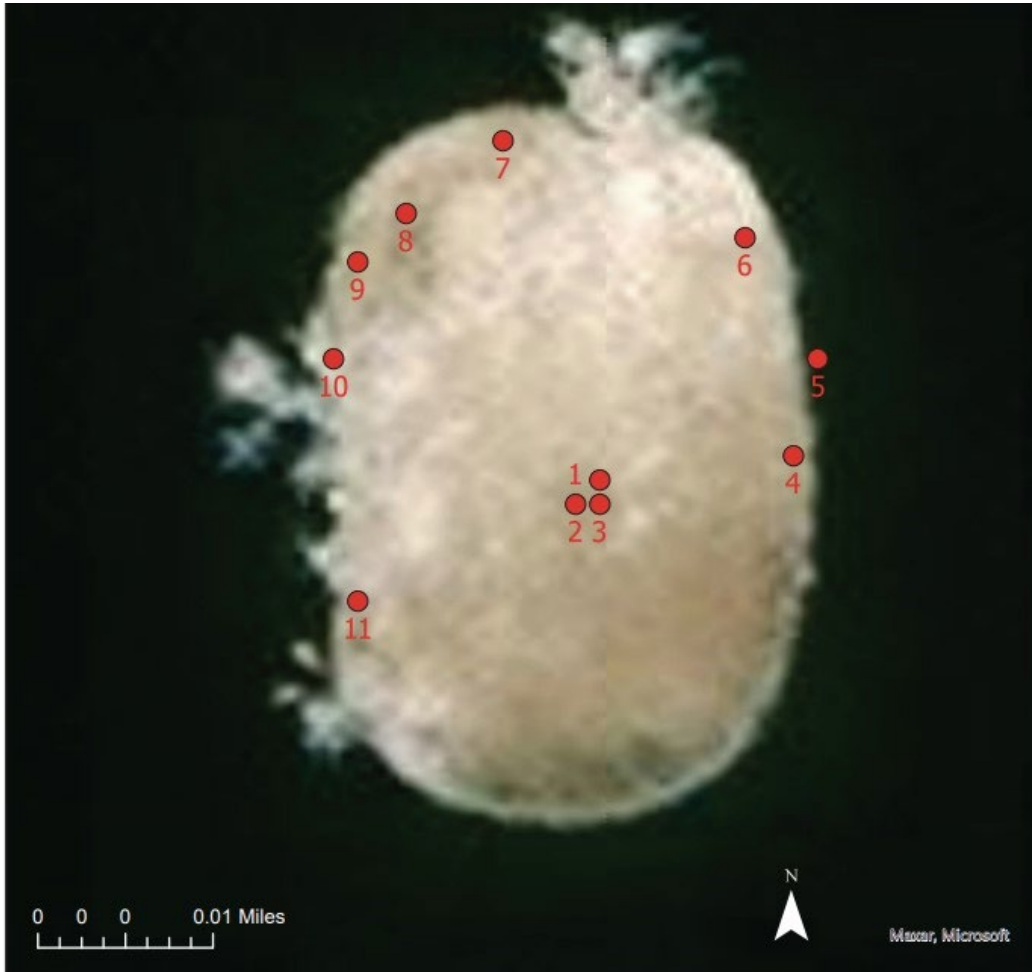
Soil sampling

Soil sampling at Tabor Lake Island occurred at the beginning of September 2023. Samples were collected using a 1-inch diameter soil corer to a depth of 15 cm. At each location, three samples were taken. Due to the rocky texture of the soil, the sampler could not always be placed deep enough into the ground, and in those scenarios more than three samples were taken in order to achieve the same approximate volume of soil for each location. Soil samples were placed in a ziploc bag that was numbered with the site number, as well as GPS coordinates. In total, eleven sites were sampled.

Site locations were chosen based on a variety of factors. The majority of the samples were taken about a meter from the shoreline and were spaced approximately one to two meters apart. The remaining samples were taken on the upper flat portion of the island that has no current vegetation. Sampling locations were based on access that tree roots would have to a water source. There were no samples taken in or directly beside the vegetated area on the south side of the island as that vegetation serves as nesting habitat for some waterfowl, and it was agreed that any revegetation in that immediate area might disturb that habitat. No

samples were collected in or directly around the mound of Double Crested Cormorant nests that sit on the ground.

Soil Sampling Locations: Tabor Lake Island, September 1, 2023



Soil Sampling Results:

Soil samples were analyzed for phosphorous, nitrogen and pH as well as soil texture. Healthy levels for soil phosphorus range from 23 to 50 ppm (Swift, 2014). Phosphorus levels in the samples from Tabor Lake Island ranged from 3.05 ppm to 4.03 ppm. These levels are considered to be deficient and probably impact the health of the plants.

Tabor Lake Island is covered with bird guano from the breeding colony. As a result, high nitrogen levels were suspected and were discovered. Nitrogen levels ranged from 5,442.75ppm

to 91,092.95ppm. These levels are multiple magnitudes above the recommended soil nitrogen levels of 40ppm (Swift, 2020). It is probable that the high nitrogen levels are impacting the health of all plants on the island.

A soil pH 6.0 - 6.5 is preferred, though many trees can tolerate up to 7.5 – 8.0 (Lerner, no date). Soil pH on Tabor Lake Island ranged from 5.79 to 6.79. These data may indicate acidification from elevated guano levels as Koh *et. al.* (2012) noted.

Soil texture was measure for each sample. Based on the USDA Soil texture triangle, the majority of the soils collected would be classified as sandy clay or sandy clay loam. Thus, the soil structure would not impede plant growth.

Select Soil Data for Tabor Lake Island

Location	mg P/kg soil (ppm)	mg N/ kg soil (ppm)	pH	sand (%)	silt (%)	clay (%)	Classification
1	3.05	13037.19	6.45	40.08	18.47	41.46	Clay loam
2	3.13	9299.10	6.08	46.23	17.38	36.39	Sandy clay
3	3.07	15606.56	6.14	60.02	10.73	29.25	Sandy clay loam
4	3.28	8942.31	5.79	47.81	17.26	34.93	Sandy clay
5	3.42	15198.84	5.92	49.36	12.15	38.49	Sandy clay
6	3.14	5442.75	5.96	51.11	14.86	34.03	Sandy clay
7	3.36	13717.98	6.08	48.40	15.00	36.60	Sandy clay
8	3.28	31445.42	6.79	51.07	15.54	33.39	Sandy clay loam
9	3.60	31422.38	6.91	48.61	16.99	34.40	Sandy clay loam
10	4.03	91092.95	6.76	52.46	15.19	32.35	Sandy clay loam
11	3.41	62411.40	6.27	48.63	12.43	38.95	Sandy clay

Tree Health Survey

In mid-September staff from the City of Wheat Ridge visited Tabor Island. At that time, all chicks had fledged. The Forestry staff reviewed tree species, canopy, height, and DBH (diameter at breast height). In addition, the number of nests on each tree were counted. Eight (8) trees are present on the island (see map). Living canopy in the trees was 50% or less for each tree. All the trees show significant levels of stress and several had evidence of beaver activity.

Two species of trees were identified on the island, Siberian Elm (*Ulmus pumila*) and Russian Olive (*Elaeagnus angustifolia*). Neither tree is a desirable species for the area and Russian Olive is considered an invasive species. The healthiest trees exist along the shore. It is presumed that the large quantity of bird guano significantly impacts the health of the trees and the trees near the water experience some flushing that removes a percentage of the guano. Specific data for each tree are listed in below.

Tree Locations on Tabor Island



Tabor Island Tree Data

Tree	Species	DBH (inches)	Height (feet)	Canopy % living	# of nests	Additional information
A	Siberian Elm	≈ 18-20"	≈ 25'	5%	32	Exposed roots and cut roots, 3 stems
B	Siberian Elm	≈ 4"	≈ 10'	75%	1	Evidence of beaver activity
C	Siberian Elm	≈ 3"	≈ 8'	75%	0	Possible sucker from Tree B
D	Russian Olive	≈ 10-12"	≈ 12'	5%	20	Some suckers
E	Siberian Elm	≈ 8"	≈ 15'	0%	4	
F	Siberian Elm	≈ 10"	≈ 18'	40%	8	3 fallen nests
G	Siberian Elm	≈ 9"	≈ 18-20'	30%	8	Evidence of beaver activity
H	Siberian Elm	≈ 6"	≈ 15'	50%	10	
	Total Trees:	8		Total nests (in trees)	83	

Example of Trees with Live Canopy (Trees B & C)



Other plants

A stand of Dogbane (*Apocynum cannabinum*) was observed on the southeast section of the island near the waterline. This plant seemed less impacted by the nutrient loading in the soil, though no data on plant health were collected. The plant is favored by numerous pollinators.

Discussion

Colonial Birds

Populations

Data indicate that over 300 colonial birds used Tabor Lake Island during the 2023 breeding season. The largest population of birds seen was the Double-crested Cormorants. Birder comments for the Tabor Island rookery suggest that populations of Double-crested Cormorants have increased while those of Great Blue Herons and Black-crowned Night Herons have decreased, though these comments have not been verified. Baker *et. al.* (2015) noted that Double-crested cormorants experienced relative breeding success, though they suggest that Black-crowned Night Herons and Great Blue Herons may be experiencing decline. This impact to heron species may be occurring at Tabor Lake Island, though additional seasons of data are needed to confirm.

There is substantial discussion in the literature regarding the increase in populations of Double-crested Cormorants. Coleman, *et. al.* (2007) and Craig *et. al.* (2012) noted that populations of Double-crested cormorants have increased rapidly in North America as these birds recolonize historic habitats. Both Marian *et. al.* (2021) and Findholt (1988) suggest that Double-crested Cormorants establish colonies in lake and waterways that humans have created. Similarly, the rookery on Tabor Lake Island is a habitat created by human disturbance.

Wires and Cuthbert (2006) suggest that cormorant populations may be returning to historic levels rather than reaching an overabundance. They note that species seen as competitors with humans, like Double-crested Cormorants, receive limited human tolerance. Marain *et. al.* (2021) suggest that cormorant populations are recovering to historic levels after a significant impact from heavy DDT use. Within the literature authors discuss the efforts to increase Double-crested Cormorant populations, efforts to limit these populations and the possibility that the larger populations are returning to historical numbers. Tabor Lake Island is an important breeding location for colonial birds in the Denver metropolitan. As a result, open space managers at the City of Wheat Ridge must choose a course based on ecological needs in the Greenbelt and public requests.

Nest locations & behaviors

The colonial birds nesting on Tabor Lake Island appeared to have different nests site preferences. Double-crested Cormorants chose dead trees, ground sites, and nest locations in the tallest trees. Great Blue Herons chose locations at the top of live trees. Black-crown Night Herons picked more secluded locations in the middle of trees. And, the one Snowy Egret nest was also situated in a mid-story location.

The literature review indicates that Double-crested Cormorants prefer dead trees while Great Blue Herons/Snowy Egrets/Black-crowned Night Herons prefer to nest in live trees. Both Koh *et. al.* (2012) and Burger & Gochfeld (1993) mention that Double-crested Cormorants prefer super-story trees. Double-crested Cormorants will only switch to lower canopy and ground nests once all the higher locations become unsuitable (Koh *et.al.*, 2012). The Black-crowned Night Herons prefer to nest in the mid-story trees/shrubs and in locations with cover (Quinn, *et. al.*, 1996 and Wyman *et.al.*, 2018). All heron nests but one Black-crowned Night Heron nest were located in live trees. Most cormorant nests were located in dead trees or on the ground. Cormorants nested in higher densities at five nests per tree while herons nested in smaller groups (Burger & Gochfeld. 1993), also a pattern seen on the island. The nesting patterns observed on Tabor Lake Island follow the locations mentioned in the literature. Any restoration plans should include a variety of nesting locations to meet the needs of each species.

Species Interactions

Burger & Gochfeld (1993) examined methods to determine if a rookery has reached capacity. They identified the following factors to consider when determining if the rookery is stable:

- i) Maintenance of suitable vegetative structure.
- ii) Maintenance of a predator-free environment.
- iii) Maintenance of negligible human disturbance.
- iv) Availability of unused, but suitable trees.
- v) Availability of unused, suitable nest sites on both used and unused trees.

Further, they suggest that land managers use three criteria to assess crowding at a rookery (Burger & Gochfeld. 1993):

- (1) The presence of unused but otherwise suitable trees within the rookery.
- (2) The presence of unused, but suitable nest sites in used trees.
- (3) The presence of suitable nest sites in or adjacent to the rookery.

Tabor Lake Island has a predator-free environment, has some suitable vegetative structure, and has negligible human disturbance. The Siberian Elms on the northeast side of the island (Tree B & C) may have some nesting sites for the heron species. However, there are almost no unused suitable nest sites or adjacent nest sites. Thus, based on the criteria from Burger & Gochfeld (1993), Tabor Lake Island is near or at capacity.

Wyman *et.al.* (2018) found that Black-crowned Night Heron populations were negatively impacted by cormorant abundance, but Great Blue Heron populations had little response to cormorant abundance. These authors were not able to conclusively link declines in wading bird abundance with cormorant abundance.

Concerns about cormorants identified in the literature include: impacts on fisheries (real or perceived), effects of guano on vegetation near nest sites and potential conflicts with other colonial species at shared breeding sites. Due to the fishing prowess of the Double-crested Cormorants, Colorado Parks and Wildlife has changed its stocking practices at Tabor Lake. Interestingly, due to their ability to quickly impact their environment, Koh *et.al.* (2012) suggest that Double-crested cormorants are a keystone species. Efforts to relieve crowding and restore the Tabor Lake Island rookery should positively impact all species.

Land Birds

A variety of land bird species were detected throughout summer 2023. Data and observations indicate that bird behaviors appear to be significantly impacted by human activities including construction, farming, and bird feeders near Tabor Lake.

Soil

High levels of phosphorus, extremely high levels of nitrogen, and reduced pH indicate advanced soil degradation from the quantity of guano on the island. Restoring the soil to appropriate nutrient levels for tree survival is unlikely with the number of birds who breed on the island. Additionally, no flushing mechanism exists on the island to moderate the quantity of guano produced annually. It is also probable that water quality in Tabor Lake is impacted by these guano levels.

Craig *et. al.* (2012) noted that, “waterbird guano introduces high concentrations of nitrogen, phosphorus, potassium, magnesium and salts in the soils.” Our data are consistent with this statement. Craig *et. al.* (2012) also noted that cormorants may disproportionately impact soil nutrients as they nest in higher densities than other colonial birds. As seen at Tabor Lake Island, these excessive nutrient levels inhibit plant growth and probably impact all trophic levels.

Trees

This is the first year the City has collected data on the colonial birds on Tabor Island. As a result, there we have no historical data for comparison. However, it is anticipated that trees will continue to decline with rookery use by Double-crested Cormorants as indicated by Koh *et. al.* (2012).

Currently, trees with the largest living canopy cover are located at the waterline on the island. It might be possible to establish native tree species at this location such as Peachleaf Willow (*Salix amygdaloides*) or Plains Cottonwood (*Populus deltoides*). To provide nesting habitat for Black-crowned Night Herons, Quinn *et. al.* (1996) suggested planting low shrubs including peachleaf willow. The City protects these species from beavers at other locations in the Wheat Ridge Greenbelt and would need to protect any new trees on the island. New trees would need additional watering to help them become established. Additional research is needed to determine if these species could be established in the soil conditions that are present.

Next Steps

2024 Sampling Season

Construction for the Tabor Lake trail should not start until the end of the 2024 breeding season, so it is possible to collect another season of data about the bird populations around the lake. Some changes proposed for the 2024 sample collection season including: recording all data immediately into eBird, surveying all birds that nest on the island, investigating fledging success in the colonial species, and reviewing historical remote sensing data.

Lake Closure

Currently, Tabor Lake is closed to boaters from March 1 to August 1 every year. Data from this study indicate that Great Blue Heron and Black-crowned Night Heron chicks fledge in early August. However, it appears that the last chicks for Double-crested Cormorants and Snowy Egrets did not fledge until early September. In addition, studies suggest that Black-crowned Night Herons are sensitive to human interactions in the rookery (Wyman *et.al.* 2018). As a result, the City may want to extend the closure to August 15 or September 1 to ensure the lake is closed to boating throughout the breeding season of these birds.

Rookery Restoration

The City of Wheat Ridge needs to review the data and determine if restoration of the rookery in natural vegetation or with artificial structures is feasible. The rookery is one of the few known within the Denver Metro area and a site frequently visited by birders. If the City chooses not to restore the rookery, it is possible the birds will choose another location in the Greenbelt that will experience similar stress and decline from heavy use during the breeding season. This behavior was seen by Koh *et. al.* (2012). Findholt (1988) suggests that the cormorants will continue to nest in protected locations when vegetation has died as long as there is a dependable food source.

Quinn *et. al.* (1996) and Meier (1980) developed artificial rookery structures and management procedures that offer suggestions for management of the Tabor Lake Island Rookery. Tabor Lake Island provides protected ground-nesting sites regardless of the vegetation status, so it is probable the cormorants would continue nesting on the island even when all the trees have died.

Trail Construction

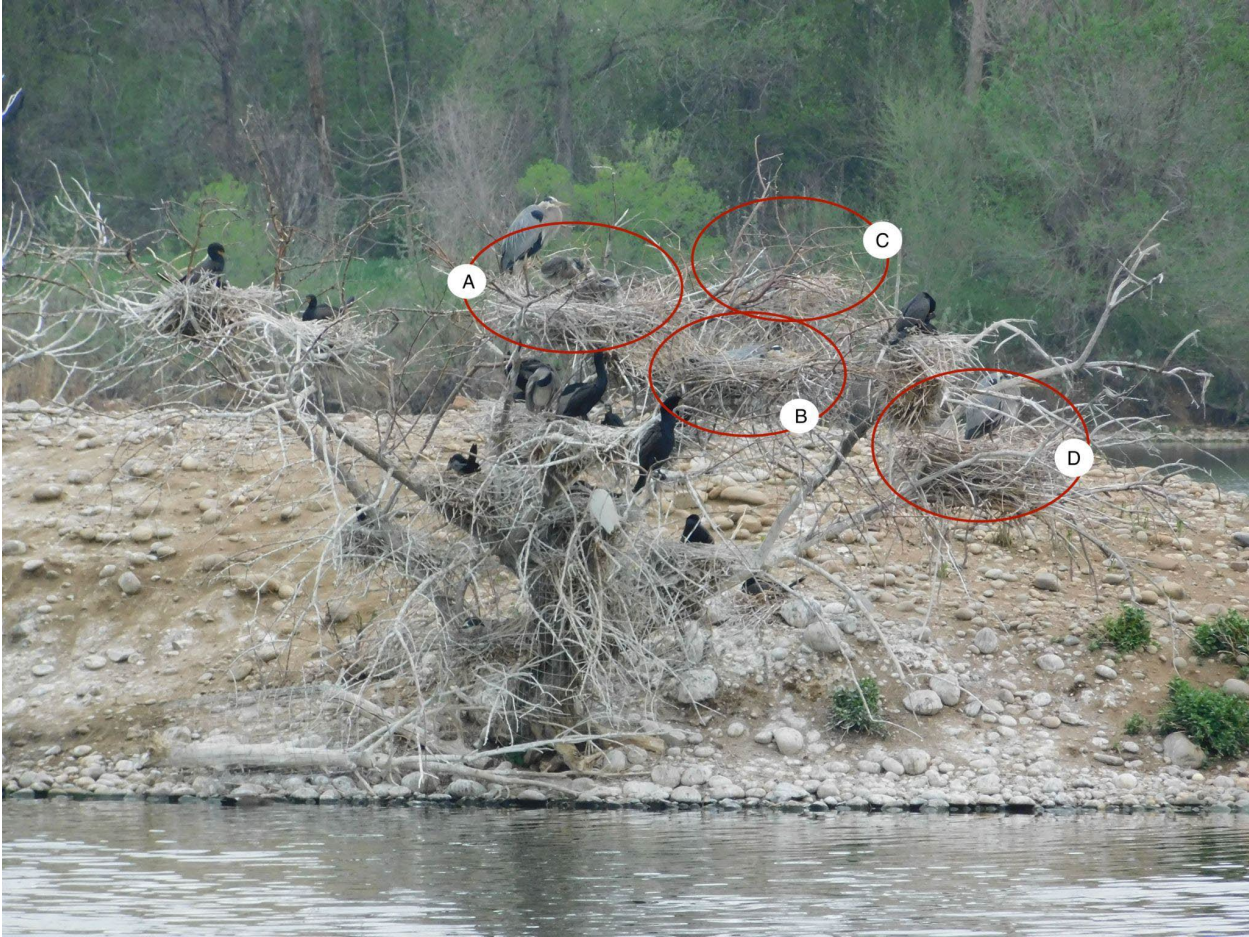
The City of Wheat Ridge is working with an engineering firm to design a trail that encircles Tabor Lake. Preliminary engineering data indicate that construction of the trail on the west side of the lake is not advised. This lack of development could be beneficial for the Great Blue Herons, Black-crowned Night Herons, and Snowy Egrets as the location would remain less disturbed and provide potential nesting location. Quinn *et. al.* (1996) suggested removing cormorant nests when they appear in unwanted locations. Additionally, Quinn *et. al.* (1996) recommend long-term population control as there are times when conservation managers need to address the issue of overabundance. To perform either of these actions, investigation of the Colorado Parks and Wildlife policies and the USFWS Public Depredation Order (50 CFR 21.48) under the Migratory Bird Conservation Act would be needed.

As part of the trail construction, there is a proposed bird blind on south shore of Tabor Lake Island. Currently, the Great Blue Herons nest in the tree (Tree D) that is located closest to the south shore. Skagen et.al. (2001) studied a rookery at Chatfield State Park near the Denver metropolitan area and the potential impacts for a newly installed wildlife viewing area. The wildlife viewing area was located approximately 75 meters from the nearest nest tree. They found that Double-crested Cormorants did not appear to be impacted. But evidence suggested that the Great Blue Herons were impacted by the viewing area as well as competition with the cormorants and loss of habitat due to windstorms. The proposed bird blind would be approximately 50 meters from the nearest nest site (used by Great Blue Herons). Unlike the viewing area at Chatfield the proposed bird blind would not be at the same elevation as the nests. However, these results and the proximity of the Great Blue Heron nesting sites suggest further study is needed prior to installing the bird blind at Tabor Lake.

Conclusion

Tabor Lake appears to be an important breeding area in the Denver metropolitan area for colonial nesting birds specifically, Double-crested Cormorants (*Phalacrocorax auratus*), Great Blue Herons (*Ardea herodias*), Black-crowned Night Herons (*Nycticorax nycticorax*), and Snowy Egrets (*Egretta thula*). Attempts should be made to maintain bird habitat on Tabor Lake Island and around the shores of Tabor Lake.

Photos - Tabor Lake Rookery



Great Blue Heron nests (Tree D)



Black Crowned Night Heron Nests (Tree D)



Black Crowned Night Heron nesting site on the far north tree (Tree A)

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