

Continued research into the Beaverhill Lake Breeding Bird Census: *On the loss of the Beaverhill Lake and the affect it has on species diversity*

By Robert MacLean

2015

Over the months of June and July 2014, Z. MacDonald and A. Roberto-Charron completed a breeding bird census within the Beaverhill Lake natural area. The purpose of the study was to identify how many different kinds of birds lived there, in what concentration they are there and how the concentration had changed since the 1992-93 study. The census was also conducted to determine each bird's concentration with the shrinking of the Beaverhill Lake. In 2015, the study described in this paper revisits the study and shows how the bird populations have changed since 2014. A total of eight surveys were conducted over the months of June and July to determine how many different breeding bird species were using the survey area for their nesting sites. The types and quantity of the birds that live there have changed since the loss of the Beaverhill Lake. The species diversity of the area is analyzed using three different procedures. These are used to show how the diversity of each bird species has changed between 1992 and 2015.

Introduction:

Being determined to be a valuable area in 1997, Beaverhill Lake has since then been host to several important censuses to show the diversity of the different bird species that live there (Krikun and Holroyd 2001). The site was declared an "Important Bird Area (IBA) by the Birdlife International" (Krikun and Holroyd 2001). However, recently the water levels of the lake have decreased. This has created several changes in the habitat's plant species, which has led to a change in the diversity of the bird species that reside in the area. Using Beaverhill Lake areas, this altering of the lake's tree and shrub species has been invaluable to scientists researching the abundance of certain birds (Priestley 2006).

The breeding bird study is conducted to evaluate the number and diversity of bird species. To create an accurate map of where each territory the birds live in, the area where the study takes place is organised into a grid. There have been several censuses completed since the area was declared important. The first census was completed by Jason Duxbury and Kevin Hento in 1992, and again completed by Jason Duxbury and Josh Bilyk in 1993. In 2004 Geoff Holroyd, Sarah Trefry, Jill Thompson and Crystal Rausch created a bird counting grid that replicated the ones used in 1992-93. This grid was used in the 2004 and 2014 studies.

This study uses the same grid pattern from previous years to show the change in diversity since the Beaverhill Lake has decreased in size. The results from this study will be compared to the 2004 and 2014 studies. The comparison between the three years will show how the species richness has changed recently. This diversity will be analyzed using species abundance as well as the three indices of species diversity: the Simpson's Index, the Shannon-Weiner Index and Pielou's Evenness Index. Both the Simpson's Index and the Shannon-Wiener Index account for species diversity and species evenness, while Pielou's Evenness Index is only an indicator for species evenness. Using these three indexes, they will show how the decreasing water levels of Beaverhill Lake have had on the diversity of the bird species.

Since the lake was designated an Important Bird Area, the water levels have fluctuated frequently. In more recent years, the lake has dried up. This has had a major impact on the areas surrounding the lake site, and has also been shown in previous studies to have affected the bird species utilizing those areas. In a study of the water levels of the lake, it was shown that "Beaverhill Lake was close to drying in 1880s and 1950s, showing it has naturally fluctuating water levels" (Priestley 2007). However, to understand the relationship between the water levels declining and the diversity of the bird species, more research must be done to determine the possible causes for the change in environment.

Methods:

The survey area for the Beaverhill breeding bird census is set up on the southeast edge of the Beaverhill Lake shoreline, the majority of the site within the woodland forest area. The southwest corner of the grid coordinates are 53°22.921'N, 112°31.439'W, 671m elevation. The grid goes north from the southwest corner for 400 meters and east for 600 meters. The grid is divided into squares which extend for 50 meters in each direction. Aspen trees take up the majority of the grid, making it a perfect environment for certain small terrestrial bird species. At the upper most portion of the grid, the treeline declines and is replaced by species of willow and other shrubs.

Bird counts are conducted by walking the designated area in a grid pattern. Unlike previous grids that were lettered A to I from west to east and 0 to 11 from south to north, the naming system was changed. There are eleven columns (from A to K) and eleven rows (numbered from 1 to 11) to make the grid, each point spread evenly by 50 meters. This pattern was a variation of the one used in the 1992 and 1993 studies. The researcher walks two or three columns each day, stopping at each point on the grid to listen for any bird species in the area to call. Other tasks include watching for birds flying overhead and searching for nests. At least eight of these censuses are required to make an accurate representation of the changes to the diversity of the area since the previous study. Returning to already walked parts of the grid once each column has been walked once is also important to determine if there is any overlap of bird calls. This would confirm more clearly that a territorial boundary was present where an overlapped call was made.

To conduct the census, each point of the grid has a blue, orange or pink ribbon tied around the trunk of a tree in the area. These points indicate the center of the 50 meter square of land. Researchers can stand close to the ribbon and face north, to map any bird calls or sightings on the grid accurately. The points at the first and eleventh numbered zones also have a metal piece placed into the trunk of the tree to indicate the boundary of the counting area. In order to walk in a straight line, researchers may use a compass or a GPS given at the Beaverhill laboratory. If the sun is out, the researcher may walk the grid using his or her shadow as a guide. Depending on the time, the shadow moves with the sun and facing south from the shadow will guide the researcher to the next location.

Eight surveys were carried out on different mornings throughout the months of June and July. The first survey was conducted on June 6th at 9:30 am. All other surveys were started between the hours of 7 and 8 am, taking two to three hours to finish. The list of eight survey dates for this year's census is

as follows: June 6, 13, 18, 20, 26, 27, 28 and July 11. There were nine surveys conducted in the 1992 census (June 23, 24, 25, 26, 27, 30, July 1, 2 and 3), eight in the 1993 census (June 8, 11, 16, 17, 21, 22, 25 and 28) (Duxbury and Holroyd 1993), six in the 2004 census (June 12, 17, 26, July 1, 5 and 6) (Priestley and Holroyd 2005) and eight surveys in the 2014 census (June 8, 16, 29, 23, 24, July 1, 2 and 6) (MacDonald and Roberto-Charron 2014). 2015 surveys were not conducted on rainy days, but sometimes just a day after the rain had fallen.

Using the data collected from the surveys about birds calling or singing, flying overhead or spotting nests within the grid, several points can be made from this census: two male birds calling adjacent to one another indicates a territorial boundary line, giving an estimate to how much territory each bird calls their own. Birds flying overhead also indicates a boundary and also may be a female flying within that territory. Nests indicate a breeding family of birds as well as if a male and female bird are seen together. The male does not have to be calling in this case.

Birds seen or heard calling across territories were recorded with a circle around their species name to represent a male who is singing. If two birds were calling simultaneously across to one another, it indicated that the territorial boundary was located somewhere in between those two birds. Those birds not calling and flying overhead were left uncircled, indicating a female of that species. Birds seen flying overhead were also given an arrow pointing from where they were spotted to where they either landed or disappeared amongst the trees. Nest sites were given a capital letter N where indicated on the grid. Tree swallows, black-capped chickadees and common ravens and crows were not included in the census recordings.

These results were analyzed using the Shannon-Wiener Index, the Simpson's Index and the Pielou's Evenness Index to show the species diversity and evenness of the grid area.

Results:

In 1992, a total of 121 nesting territories were recorded involving 14 different species of birds. The number of nesting territories declined from 121 to 88.5 in 1993 and the total number of species declined to 11. The largest difference in the number of breeding birds in the Beaverhill Bird Observatory from the two years was the decreasing number of waterfowl and the savannah sparrow species. Except for the mallard species, the northern shoveler, lesser scaup and the blue-winged teal have all declined in number. The red-winged blackbird increased from 16.5 to 17 in 1993 and the Wilson's phalarope declined from 11 to 5. All of the other species recorded showed little change.

In 2004, a total of 71 nesting territories were recorded with 15 different species of birds. The most noticeable difference in species diversity is that every waterfowl recorded in previous years except for the blue-winged teal have disappeared. The mallard, which increased in number in 1993 was not present in 2004, and the red-winged blackbird species declined from 17 to 0.5 of a nesting territory. One territory of song sparrow, Brewer's blackbird and short-eared owl were recorded, and 3 territories of least flycatcher were recorded as well. While the savannah sparrow species abundance declined slowly

from 48 to 32 in 1992 to 2004, the clay-coloured sparrow species increased from 6 in 1992 to 16 in 2004. The common yellowthroat increased in number from 2.5 in 1993 to 4 in 2004 and the yellow warbler doubled in number from 2 in 1993 to 4.5 in 2004. New species were found in the grid, including short-eared owl, song sparrow and Brewer's blackbird, and half of a territory of the marsh wren was recorded where there weren't any territories in the previous years.

In 2014, 47.5 nesting territories were recorded in total involving 16 different species. 7 new species were recorded in this year, including the black-capped chickadee, the American bittern, the gadwall and the American coot. The savannah sparrow numbers declined from 32 in 2004 to 11 and the clay-coloured sparrow species decreased from 16 to 10. Least flycatcher territories increased from 3 in 2004 to 8, while the red-winged blackbird numbers recovered from 0.5 to 2. The marsh wren and the short-eared owl were completely absent from the grid compared to 1993. No common yellowthroat species were observed in 2014, compared to 1.5 in 1992, 2.5 in 1993 and 4 in 2004. Yellow warbler numbers increased again from 4.5 to 6, while the number of territories was 2 in both 1992 and 1993.

In 2015, there were 318 nesting territories recorded in total involving 6 different species. The least flycatcher species increased from 8 in 2014 to 124, which was the greatest increase in bird species throughout each of the years. The second largest difference in numbers from previous years was the clay-coloured sparrow numbers, which changed from 10 to 80. There were 36 nesting territories of warbling vireo recorded in 2015, where there were no sightings or recordings of warbling vireo from 1992 to 2014. The yellow warbler species increased from 6 in 2014 to 61. 13 territories of savannah sparrow were recorded this year, compared to 11 in 2014. The species increased by 2 since last year, while in previous years the number was declining. 4 species of red-eyed vireo were recorded this year, with no sightings in previous years. Species such as the American harrier, the American robin and the blue-winged teal were not present in 2015.

Table 1. Total number of nesting territories observed in 1992, 1993, 2004, 2014 and 2015.

Species	1992	1993	2004	2014	2015
American Bittern	0	0	0	0.5	0
Mallard	4	6	0	0	0
Gadwall	0	0	0	0.5	0
Northern Shoveler	1	0	0	0	0
Lesser Scaup	6	0	0	0	0
Blue-winged Teal	3	0	0.5	0	0
Duck spp.	6	2	0	0	0
Northern Harrier	0	1	1	0	0
American Coot	0	0	0	1	0
Wilson's Phalarope	11	5	0	0	0
Short-eared Owl	0	0	1	0	0
Alder Flycatcher	0	0	0	1.5	0
Least Flycatcher	0	0	3	8	124
Marsh Wren	0	0	0.5	0	0
American Robin	0	0	0	0.5	0
Grey Catbird	0	0	0	1	0
Yellow Warbler	2	2	4.5	6	61
Common Yellowthroat	1.5	2.5	4	0	0
Savannah Sparrow	48	35	32	11	13
Clay-coloured Sparrow	6	5	16	10	80
LeConte's Sparrow	4	6	1	0.5	0
Lincoln's Sparrow	0	0	1	1	0
Sharp-tailed Sparrow	9	7	4	0	0
Song Sparrow	0	0	1	0	0
Red-winged Blackbird	16.5	17	0.5	2	0
Yellow-headed Blackbird	3	0	0	0	0
Brewer's Blackbird	0	0	1	1	0
Brown-headed Cowbird	0	0	0	2	0
Black-capped Chickadee	0	0	0	1	0
Red-eyed Vireo	0	0	0	0	4
Warbling Vireo	0	0	0	0	36
TOTAL	121	88.5	71	47.5	318

Indices of species diversity: Three indices of species diversity were calculated based on the data found in Table 1.

Discussion:

The continued changes in breeding bird species diversity from the 1992, 1993, 2004, 2014 and 2015 censuses are likely caused by the habitat changes throughout each year. As the water levels of the Beaverhill Lake continue to decline, the places that supported the waterfowl abundant in previous years have changed to support different species. In the first two years that the study was taken, most of the area that was within the Beaverhill Bird Observatory boundaries was marshland. These parts supported cattails (*Typha sp.*), rushes (*Scirpa sp.*) and sedges along the shoreline of the lake; however, much of the lake bed has dried up. As the lake dried up, the vegetation and foliage along the shore changed. Throughout the years, the marshland habitat that the waterfowl relied on disappeared and was replaced by a more grassland-like area. Trembling aspen (*populus tremuloides*), balsam poplar (*populus balsamifera*) and various willows (*salix spp.*) expanded in this new established environment, bringing with it new and different species adapted for such foliage. A grassland area was formed where once was mostly shoreline and marshes.

With the establishment of a new type of greenery, the type of bird species within the area is also likely to change. The species of waterfowl, such as ducks, the Wilson's phalarope, the blue-winged teal and the northern shoveler, seen in 1992 and 1993 censuses disappeared from the grid site. These species rely upon shallow water habitats for feeding and nesting sites; therefore, those such as the lesser scaup and the mallard would have to find a new environment to suit their specialized needs. The disappearance of most waterfowl species in 2004 in favour of tree dwelling birds such as short-eared owls and least flycatchers, shows how much affect the Beaverhill Lake had on what species lived in the area. The declining and eventual disappearance of the sharp-tailed sparrow, which also relies on marshland areas for breeding, can explained with the loss of the shoreline lake bed.

In the 2014 census, it was reported that a small marsh area located at the southernmost edge of the grid, which was previously dried up in 2004 by Priestley and Holroyd (2005), was re-established. No such area was observed in the 2015 census, indicating possibly that the area had dried up once again. This area was where the 2014 group found "the American bittern, gadwall, American coot and red-winged blackbird nesting territories" (Z. MacDonald and A. Roberto-Charron, 2014) were reported. All of these bird species are associated with marshland habitats, though they were not observed in the 2015 census. No other indications of a marsh were discovered within the breeding bird grid.

The species recorded to increase in the 2015 census can be shown to have increased by the change in habitat structure. The birds represented in the most recent study, such as the least flycatcher, savannah sparrow and clay-coloured sparrow, are all adapted to life in a more grassland-like environment, much like the Beaverhill Lake area has come to be. Savannah sparrows have a habitat

structure associated with a few willows and grasses, whereas the clay-coloured sparrow is much more dependent on the cover of the willows (Priestley and Holroyd, 2005). Both of these types of foliage are found near the grid in abundance and therefore it is a perfect nesting ground for these birds. From the Beaverhill Lake drying up, the species of willow that had already made a home in the area was able to spread. With this type of environment spreading, the clay-coloured sparrow was allowed to thrive, while the savannah sparrow showed little increase in number since 2014.

The new species that were found in the 2014 census were not observed anywhere in the grid for the 2015 breeding bird study. However, the continued spreading of the least flycatcher and the abundance of the clay-coloured sparrow can be attributed to the types of plants found inside the grid. With the trembling aspen and balsam poplar trees growing throughout the census site, the habitat has been changed to support more perching birds than in previous years. There were sightings of the brewer's blackbird; however, those sightings were outside of the grid and were therefore not included in the census.

The studies from previous years have been indicative of a declining population and biodiversity of birds in the grid area. The number of nesting territories recorded within the breeding bird grid has shown a steady decline from 121 in 1992, to 88.5 in 1993, to 71 in 2004 and to 46.5 in 2014; however, in this year's study it has been shown to increase in nesting territories to 318 in total. Since the last year, the species richness has gone down from 16 species to 6 spotted. However, there were a number of black-capped chickadees in the area of the grid as well as two types of woodpeckers. These were not recorded into the report because there were no territorial boundaries found while in the field, though birds from previous years, such as the Brewer's blackbird were found outside of the grid pattern.

Conclusion:

With the Beaverhill Lake drying up there is no doubt that it was a major factor in the environment structure of the surrounding area; namely, the breeding bird grid. The findings from the three indices of species diversity and evenness from previous years have shown little change from the first census in 1992. This appears to be a lingering trend as the species diversity has remained relatively the same from year to year, this year included. The number of different species of birds found in the area has gone down slightly: no sightings of bird species like alder flycatchers or brown-headed cowbirds since the 2014 census, but the number of nesting territories has gone up considerably. The number of least flycatchers, for example, shows how the environment has changed from the marshland created from the Beaverhill Lake to an area populated by trembling aspen, the habitat which the flycatchers are adapted to. Clay-coloured sparrows and savannah sparrows have also previously been shown to have increased in number because the grassland-like habitat, with a variety of willows taking control on the north end of the grid, is the preferred environment for such perching birds. The loss of the Beaverhill Lake has changed much of the area that was once marshland into a more terrestrial environment, and with that, the species of birds living there have also changed. Though the types of species have been altered since the beginning of the established study area, the species diversity and species richness has

remained generally the same. It is important to remember that the drying of the lake was of natural causes and the changing environment was also of natural succession.

Bibliography:

Cornell Lab of Ornithology. (2004). All about birds, bird guide.

<http://www.birds.cornell.edu/programs/AllAboutBirds/BirdGuide/>

MacDonald, Z. and Roberto-Charron, A. (2014). Revisiting the Beaverhill Lake Breeding Bird Census: *How the species diversity of breeding birds has changed with the disappearance of the Beaverhill Lake.*

Krikun, R.G. and Holroyd, G.L. (2001). Beaverhill Lake important bird area conservation plan. Alberta Important Bird Areas Program. Bird Life International, Bird Studies Canada, Natural Canada.

Priestley, L. (2006). Beaverhill Bird Observatory 1987 to 2006 – 20 years of monitoring.

Priestley, L. and Holroyd, G.L. (2005). Bird Population Changes in Drought At Beaverhill Lake. Report to Alberta Conservation Association.