Results of census for Canada geese on Bone Lake, June 20-22, 2018

Introduction and Summary
In the spring of 2018 members of the lake association on Bone Lake desired to determine the number of geese reproducing on Bone Lake as well as the number that use the lake during different seasons. They contracted with Chris Loggers, Certified Wildlife Biologist, to develop a survey method that members of the association could implement. This report presents the results of the estimates of geese that use Bone Lake in early summer.

Three teams of observers recorded geese over three consecutive days starting June 20. The results indicate that not all geese were observed each day, which skewed the calculations of the results using the classical or modified classical towards the high end. Even so, the three methods used to estimate the population yielded fairly similar results, and all were lower than expected. Based on combining the techniques, we estimate that the population size of geese using Bone Lake during the time of the census is around 27 adults and 50 goslings.

Summary of population estimates

	Adults	Goslings
Classical method	24	59
Modified classical method	23	49
Delphi method	30	45

Methods
We proposed a complete count (census) of the entire lake rather than a sample count on portions of the lake that would be extrapolated to the entire lake. For a single lake with few areas of dense vegetation in which geese could hide, a census rather than survey would provide a more precise number. Because it is nearly impossible to see and note every goose on a lake, conducting the count at least three times over a short timeframe allows for calculation of the minimum and maximum number of adult geese and goslings on Bone Lake. Multiple counts over a short time also minimizes violations of assumptions when conducting censuses, primarily that the group being counted does not experience birds coming in to or leaving the lake during the counting period. The calculated range of birds can be further narrowed by matching sightings of marked individuals or groups, in this case matching certain groups of adults and goslings in the same area on subsequent days. Because the count was limited to the lake and nearby shoreline, conducting a complete count was feasible and not overly expensive.

To identify particular areas to count, we stratified the lake into north, central and south zones; divided each zone into east, middle and west subzones; and further divided each subzone into bands (Figure 1). The first band, 200 feet wide, contained a strip of land that extended 100 feet onto the shore (to count birds grazing or resting on lawns) and extended 100 feet into the water. The second, third and fourth bands extended from 100-500 feet from shore, 500-900 feet from shore and 900-1300 feet from shore, and a final band lumped areas farther than 1300 feet from shore (Figure 1). We created a narrower shoreline band because we assumed that most activity would occur within this band and we could minimize observer error by minimizing crisscrossing. We created electronic maps (aerial images overlaid with zones, subzones and bands) of the lake in ArcGIS and exported them as georeferenced PDFs. Observers loaded these maps onto their cellphones or tablet computers and into the app Avenza PDF maps. For more information about the technique and using Avenza, see the report Estimating the goose population on Bone Lake, Wisconsin, Loggers 2018.

The census was carried out by groups of observers boating early in the morning on within a prescribed area on the lake and counting all geese observed within that area. Early mornings on calm days were chosen to maximize observation probability and minimize bird movements due to recreational boaters or other human activities. Observers used the location function in their cellphones or tablet computers to chart their locations on the georeferenced maps. Observers recorded locations and numbers of adults and goslings by dropping waypoints onto the electronic maps in Avenza as well as recording numbers and locations of geese on hardcopy datasheets for cross referencing.

Results

Each day on June 20, 21 and 22 three teams consisting of members of the lake association on Bone Lake conducted censuses of Canada geese in all zones on Bone Lake. Teams covered multiple zones and subzones. Days were clear and water conditions calm. Electronic data and copies of the hardcopy datasheets were provided to the contractor for analysis.

Table 1. Observation dates, locations, and bird numbers for Bone Lake census. Colored numbers indicate matched observations (duplicates) recorded on different days.

20-Jun						
Zones	**SubZone**	**Observer**	**Latitude**	**Longitude**	**Adults**	**Goslings**
South	SW1	JBoyd	45.521332	-92.393839	4	22
South	SW2	JBoyd	45.504723	-92.381670	2	5
Fox Ck	Fox Ck	Joey Bob	None provided		2	5
Central	CE1	KEngelbretson	45.531881	-92.382769	2	3
Central	CE1	KEngelbretson	45.532771	-92.383475	1	1
North	NE1	NBoyd	45.564492	-92.395511	1	0
Fox Ck	Fox Ck	NBoyd	45.505183	-92.373128	2	5
21-Jun						
Zones	**SubZone**	**Observer**	**Latitude**	**Longitude**	**Adults**	**Goslings**
Central	CE1	KEngelbretson	45.541353	-92.382208	1	0
North	NE2	NBoyd	45.564504	-92.394689	1	0
Central	SI2	KEngelbretson	45.529317	-92.386103	8	0
South	SW1	JBoyd	45.518714	-92.391014	4	22
South	SE1	JBoyd	45.524262	-92.380517	4	7
22-Jun						
Zones	**SubZone**	**Observer**	**Latitude**	**Longitude**	**Adults**	**Goslings**
North		NBoyd	45.562713	-92.402879	1	0
North		NBoyd	45.562502	-92.402807	2	2
North		NBoyd	45.562162	-92.402687	2	0
South	SE2	JBoyd	45.522943	-92.380181	4	7

* KML file differed from hardcopy sheet. We used the higher number of goslings for the population estimate.

Figure 1. Example of zone (North) ,subzones (NorthEast, NorthMiddle and NorthWest) and observation bands.
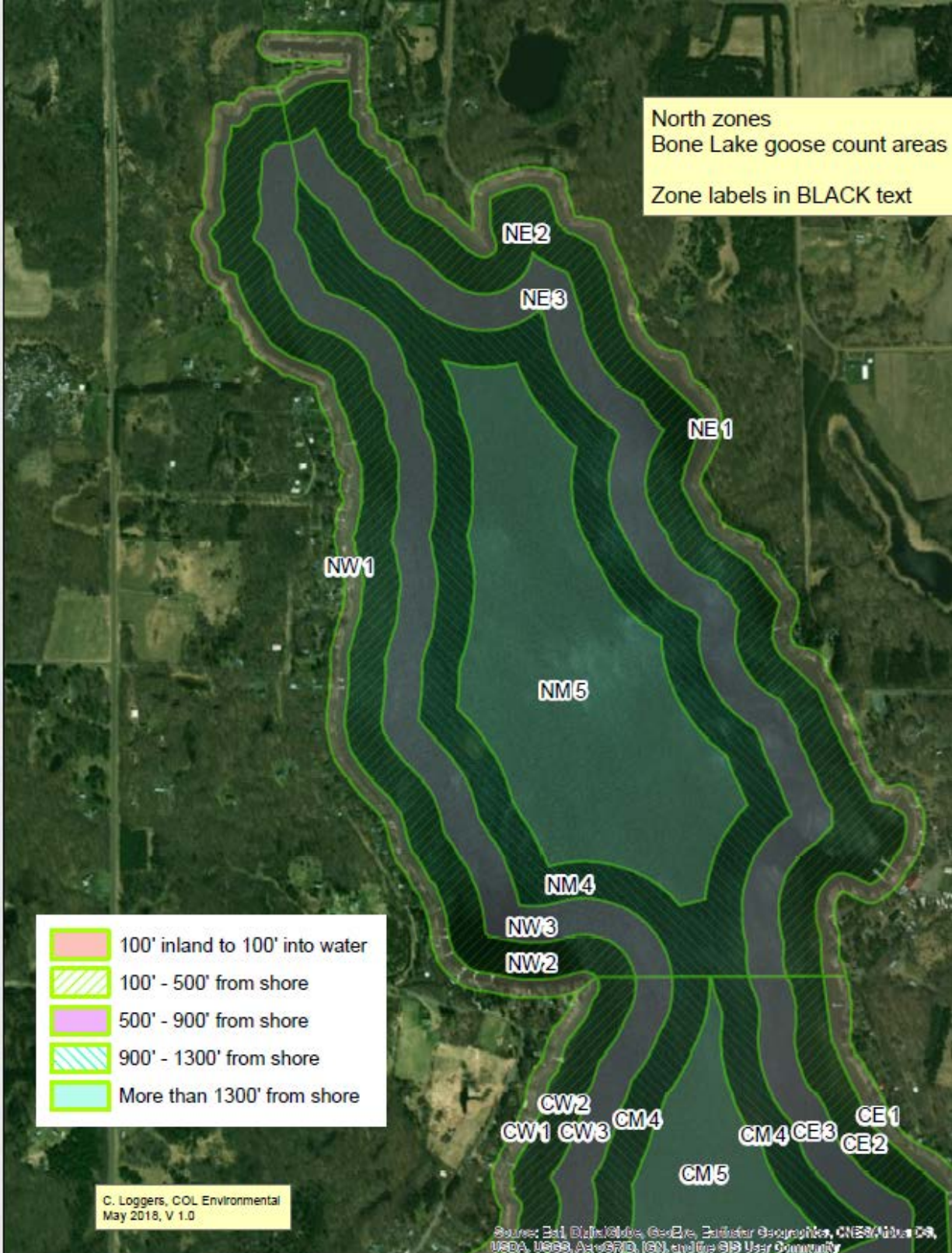
We received 3 sets of data, 2 in CSV format and 1 in KML format, all exported from Avenza. The KML file did not contain date/time stamps, some placemarks were far from Bone Lake, and all data had to be cross-referenced with hardcopy datasheets, projected in ArcMap, then data fields populated with information. Additionally, an observation recorded 3 goslings on the KML file and 5 on the data sheet, and we used higher number of goslings in our calculations. The CSV formatted data included date/time stamps and other information, and all locations corresponded with locations on Bone Lake.

On June 20 observers recorded 6 unique goose locations (the same group was counted twice on Fox Creek), 5 on June 21 and on 4 on June 22 (Table 1, Figures 2-4). The number of birds observed was far fewer than expected though conditions were excellent for counting.

We used one method to determine the minimum goose productivity on Bone Lake in 2018, and three methods to determine a range of population estimates for geese that used the lake during the census period.

Breeding birds and productivity in 2018
To determine minimum productivity we used only observations in which goslings were recorded (Table 2). We removed duplicate observations and summed the unique observations of goslings.   Birds used to calculate minimums are underlined and the sums provided at the bottom of the table. If a larger group of goslings was accompanied by more than 2 adults, we considered the number of breeding pairs to be the number of adults divided by 2. Bone Lake supported a minimum of 9 breeding pairs of geese that produced a minimum of 45 goslings.

Table 2. Observations of adults with goslings only.

20-Jun						
Zones	**SubZone**	**Observer**	**Latitude**	**Longitude**	**Adults**	**Goslings**
South	SW1	JBoyd	45.521332	-92.393839	4	22
South	SW2	JBoyd	45.504723	-92.381670	2	5
Fox Ck	Fox Ck	Joey Bob	None provided		2	5
Central	CE1	KEngelbretson	45.531881	-92.382769	2	3
Central	CE1	KEngelbretson	45.532771	-92.383475	1	1
Fox Ck	Fox Ck	NBoyd	45.505183	-92.373128	2	5
21-Jun						
Zones	**SubZone**	**Observer**	**Latitude**	**Longitude**	**Adults**	**Goslings**
South	SW1	JBoyd	45.518714	-92.391014	4	22
South	SE1	JBoyd	45.524262	-92.380517	4	7
22-Jun						
Zones	**SubZone**	**Observer**	**Latitude**	**Longitude**	**Adults**	**Goslings**
North		NBoyd	45.562502	-92.402807	2	2
South	SE2	JBoyd	45.522943	-92.380181	4	7
Totals			**(9 unique breeding pairs)**		**17**	**45**

Population estimates
To obtain an estimate of geese on Bone Lake we used a classic method, a modified classical method, and a Delphi method that considered duplicate and unique observations separately.

Summary of population estimates	Adults	Goslings
Classical method	24	59
Modified classical method	23	49
Delphi method	30	45

-Classical method estimate

For the classic method we summed the numbers of adult geese and goslings observed each day, obtained averages, and calculated the standard deviation of the census results. The exact population number has a 95% chance of being within 3 standard deviations of the average of the observations. Because the population would not be lower than the number actually observed, we used the upper range of values and estimate that the maximum number of adult geese and goslings on Bone Lake during the census period is 24 adults and 59 goslings (Table 3). Because not all birds were observed each day (for example the known duplicates were usually seen on two rather than all three of the count days), the standard deviation and thus the population estimate is probably skewed high.

Table 3. Population estimate using classical method.

	Adults	Goslings
20-Jun	12	36
21-Jun	18	29
22-Jun	9	9
Population average	13.0	24.7
Population standard deviation (SD)	3.7	11.4
Maximum population estimate (Ave + 3 SD)	**24**	**59**

-Modified classical method estimate

We obtained a more refined population estimate by removing duplicate observations (Table 4), using the classic method for the unique observations (Table 5), and combining the results (Table 6).

Table 4. Matched observations added to total

Zones	SubZone	Observer	Date	Latitude	Longitude	Adults	Goslings
South	SW1	JBoyd	20-Jun	45.521332	-92.393839	4	22
South	SW1	JBoyd	21-Jun	45.518714	-92.391014	4	22
Fox Ck	Fox Ck	Joey Bob	20-Jun	None provided		2	5
Fox Ck	Fox Ck	NBoyd	20-Jun	45.505183	-92.373128	2	5
North	NE1	NBoyd	20-Jun	45.564492	-92.395511	1	0
North	NE2	NBoyd	21-Jun	45.564504	-92.394689	1	0
South	SE1	JBoyd	21-Jun	45.524262	-92.380517	4	7
South	SE2	JBoyd	22-Jun	45.522943	-92.380181	4	7
				Total unique birds in repeated sightings		**11**	**34**

Table 5. Unique observations (no matched observations from different days)

Zones	SubZone	Observer	Latitude	Longitude	Adults	Goslings
20-Jun						
South	SW2	JBoyd	45.504723	-92.381670	2	5
Central	CE1	KEngelbretson	45.531881	-92.382769	2	3
Central	CE1	KEngelbretson	45.532771	-92.383475	1	1
21-Jun						
Zones	SubZone	Observer	Latitude	Longitude	Adults	Goslings
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North		NBoyd	45.562713	-92.402879	1	0
North		NBoyd	45.562502	-92.402807	2	2
North		NBoyd	45.562162	-92.402687	2	0
Total birds in unique observations					**19**	**11**

Table 6. Results of the modified classical method.

	Adults	Goslings
20-Jun	5	9
21-Jun	9	0
22-Jun	5	2
Unique observations average	6.3	3.7
Unique observations standard deviation	1.9	3.9
Unique observations average +3 SD	12	15
Add back in matched observations	11	34
Maximum population estimate	**23**	**49**

-Delphi method estimate

The Delphi method uses the same combination of numbers as the modified method but does not calculate a population average or standard deviation. As such it could be considered the minimum number of birds on the lake, or if one assumes that over the three day counting period all birds were observed at least once, the result could be close to the true size of the population on Bone Lake during the counts.

Table 7. Minimum population estimate using the Delphi method.

	Adults	Goslings
Repeated sightings summary (Table 4)	11	34
Unique observations (Table 5)	19	11
Minimum population	**30**	**45**

<u>Discussion</u>
The observers performed admirably and developed new technological skills that they can use to teach others and apply to subsequent censuses. Exporting the data to CSV tables prevents issues from incomplete data that arise when users of Avenza PDF maps export data using different file formats.

Because not all the same birds were observed each day, (for example the 4 adults and 22 gosling were observed on 2 of the 3 days and the 8 flying adults were only observed on 1 day) the standard deviations calculated using the classic and modified classic methods were high, which resulted in population estimates that are probably slightly higher than the true population size. However, all estimates were within 6 adults and 15 goslings and appear far lower than perceived by some landowners.

We suggest that the census be repeated during the time when the geese are molting and not as mobile. Observers should discuss amongst themselves which sightings on which days appear to be duplicates in order to decrease day-to-day variability in the estimates. At the time of counting, groups of goslings, particularly larger groups, could be easily identified. As the season progresses that ability will wane.

Does Bone Lake have a goose population problem? That's a social question with which the landowners will have to wrestle. The population estimates indicate that overall the numbers are low, but that distribution of negative goose effects could be an issue to some.

Chris Loggers
col.environmental@gmail.com
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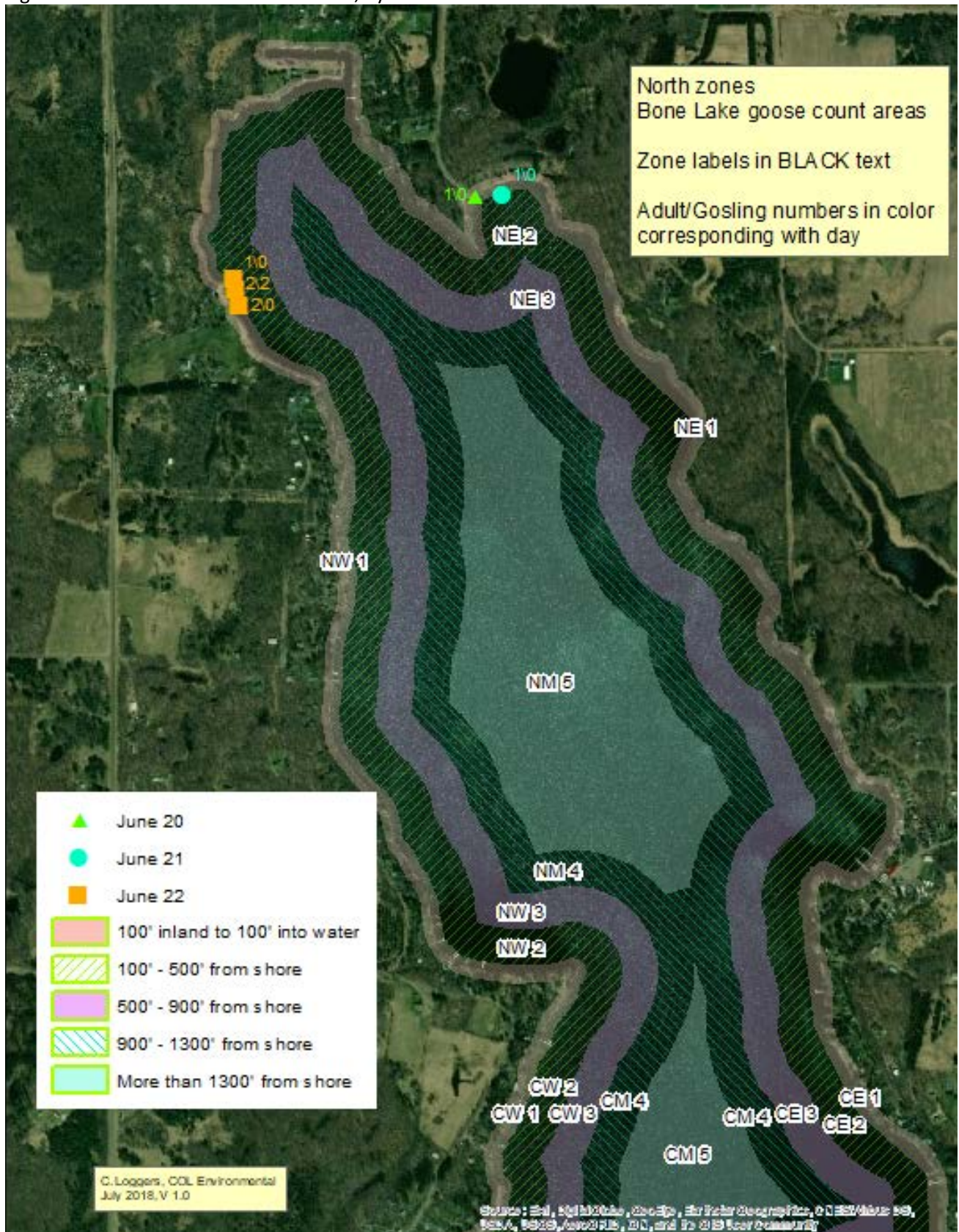Figure 2. Census results for north zones, by date.
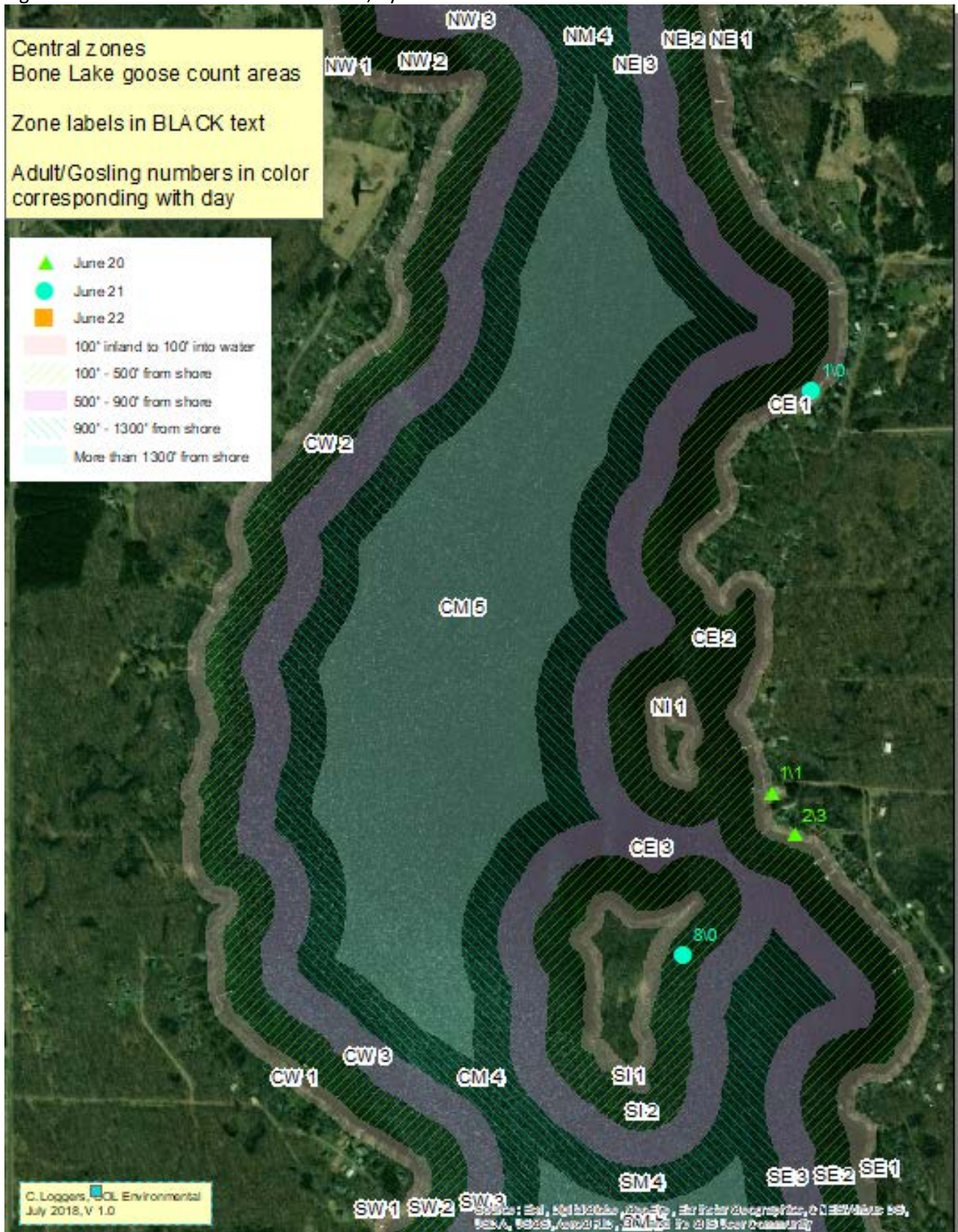
Figure 3. Census results for central zones, by date.

Figure 4. Census results for south zones, by date.