Crane Counting During Aerial Surveys 101

By Jeff Drahota

Sandhill cranes still on a Platte River roost in central Nebraska, 26 March 2014. Photo by Dave Fronczak.

During the spring migration, thousands of sandhill cranes flock to central Nebraska. The timing of this migration typically starts in mid-February, peaks sometime in late March, and ends with a few stragglers that stay into May. Most of the sandhill cranes in the mid-continent population stage within the Platte River basin between Oshkosh and Central City (see Krapu et al. 2011 for more information). This provides a unique opportunity to monitor mid-continent populations by conducting breeding population estimates in Nebraska as the stage before making the last flight to the breeding grounds. This document attempts to explain how birds are counted during aerial surveys and some of the techniques that biologists utilize while conducting bird population counts. We use sandhill cranes as an example in this document.

Introduction

Counting sandhill cranes from the ground is a fairly easy task, because they are large and like to be in the open so they are easy to see. However, the area that these birds stage in during spring migration is very large with limited access so many birds would not be visible from roads. For these reasons it is impractical to try and estimate the entire population using a one-day count

with ground crews. In this case, an aerial survey is more practical for a population estimate, because it can be flown in one day and covers most of the areas where the birds concentrate. In this document, I will provide an overview of the methods associated with counting birds and provide pictorial examples to help you understand the techniques used by biologists to count birds using sandhill crane as the population of interest.

Methods

The scientific methods associated with counting wildlife populations has been debated for many years. Determining the best methods for counting is dependent on the objectives associated with the population of interest. It is important first to understand that a population estimate is different than a census. A census infers that we can determine the details of a population, such as how many male pheasants crow during a morning roadside survey. However, if our intent is to determine the total number of pheasants, including hens, a male crow count would only provide a reference to the total population of pheasants. Since the hens are secretive and well camouflaged with brown plumage, a crow count might make the most sense if we are reasonably confident that enough hens are present to provide adequate recruitment.

When we estimate populations, the common question is "what if the counts are way off?" This depends on the questions being asked prior to the survey when biologists determine how accurate and precise the counts should be. For example, do we simply need to know if the species is present or absent? For rare or very secretive species, simple presence/absence data may be all that we can get and therefore spending additional money to get more precise data would be a waste. In this case, there is a huge difference between a "zero" and "one". Using this type of precision only allows us to describe populations as common, rare, or not present. For other species, we may have objectives that require a more accurate population estimate. For common species, we rarely need to conduct an absolute count of the total population. In these surveys, we are simply trying to estimate the species abundance on a numeric scale, so that annual population estimates can be compared over time. These surveys provide trend-line data that can indicate population increases or decreases over extended periods of time, assuming the survey covers an adequate amount of the range our species of interest occupies.

Surveys generally begin as an effort to determine exactly how many of "X" species are out there, but limited time, funding, and observer experience typically dictate how accurate any survey can be. Biologists typically strive for accuracy and precision in any survey they do; however, obtaining this level of information is often costly forcing administrators to strictly focus on the sampling strategies that meet the objective specified in the survey protocol. Balancing the expense of any survey with the need for accuracy and precision is constantly debated by statisticians and administrators. In the case of long-term surveys, we typically want to detect major changes in populations with certainty. This summary will provide some techniques we use and visual depictions of what we see during the mid-continent sanhill crane survey.

General Rules to Good Estimates

When possible, write it down. Keeping track of many numbers in your head can get difficult. Use a notepad and write down information that you may need later, such as time, weather, area, etc. While counting large flocks, it may be easier to count how many times you reach 50, 100, or 1,000 birds as you progress through the flock. Many biologists use a box count (Figure 1) to keep track of many species at once over an extended period. The process is simple. Put down a dot for each bird (10 birds or other categories can be used). Once four birds have been seen, start to connect the dots with a line, as the box is competed add two diagonal lines. This gives a quick reference while conducting the survey and a quick tally at the end of the survey.

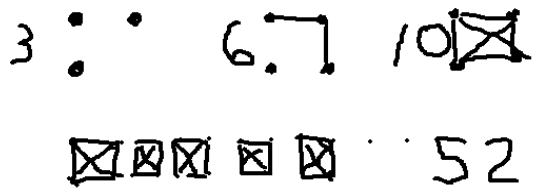


Figure 1 This figure illustrates the box-X count to ten method. Points at four corners of the box indicate the first birds counted, lines indicate the next 4 around the outside of the box, and the final two diagonal lines that complete the X conclude the count to 10 for that box.

1) When estimating, being consistent is important. The problem is that most of us do not practice counting frequently enough to know when we are likely high or low. Nevertheless, if you are consistently low or high that's okay, both low and high estimates get us closer to the mean. It is important that you as the observer understand whether or not you are typically low or high. For most of us, we are typically low by 10-20%. However, this can change greatly as the flock size increases. This is why it is important that the same observers are used to sample the same location(s) year after year, that way population estimates will be less likely due to observer error or skill.
2) Identify all of the species first. If you have flocks comprised of single species, the flock size is very straight forward. Mixed flocks require a little more time to make sure the ID is correct and the proportions of each species present are representative of actual occupancy. Many biologists prefer to estimate the percent (%) composition of a flock first, then count the entire flock, extrapolating back using the % occurrence to estimate the number of each species present. This can be done during ground surveys by writing notes down as the flock is scanned.

Bird's-Eye View at Sandhill Cranes

A small flock of sandhill cranes (SHC) can be easy to count if you are given time. The photo below provides a still image of a flock (yes, we do have snow on the ground during some surveys in late March). It is easy to count this flock one bird at a time (while moving rapidly across the area), assuming you can distinguish each individual bird.

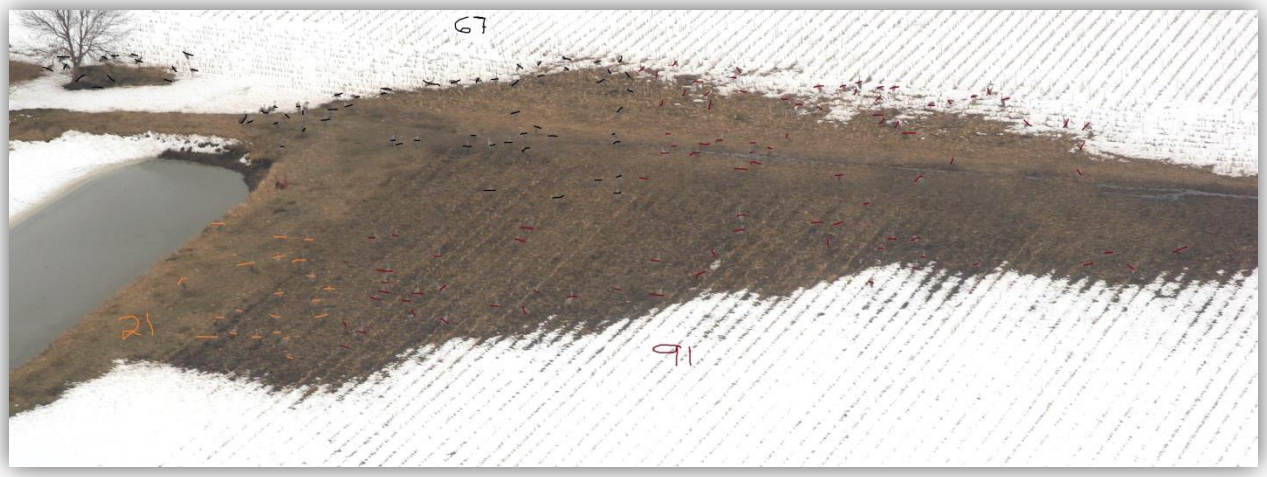
How many did you count? There is good contrast in this photo, but can you distinguish all of the birds? Let's see how you did. Did you see all of the birds (crossed off in orange) on the edge of the snow line? Did you see the four birds in the lower right corner?

Did you notice the turkeys? Hopefully you did not include any of the 18 turkeys (circled in black) in your SHC estimate.

Lighting, background contrast, and distance from the aircraft all play a role in the accurancy of each estimate. This example you would think that snow cover would provide the best background for seeing a large gray SHC. Take a look at the following photo to see if this assumption holds true. Would you agree that as long as the birds stay in the snow area they are easy to detect?

So, what happens when you have snow free areas, would you agree that your search pattern becomes very difficult? Why is this a consideration? Simply put, this is because you can quickly scan the snow areas and most of the time you can see a bird, but the areas that have no snow hide birds especially well because of the contrast. Let's review the photo below to check and see how accurate the aerial estimate was.

In this flock, the observer stated an estimate of 95 birds. Was this low or high? While counting each bird in this area, I used black, red, and orange to indicate birds detected. As I zoomed in and was only able to see portions of the flock, so for each zoomed in view, I counted the photo using a different color to keep track of each proportion.



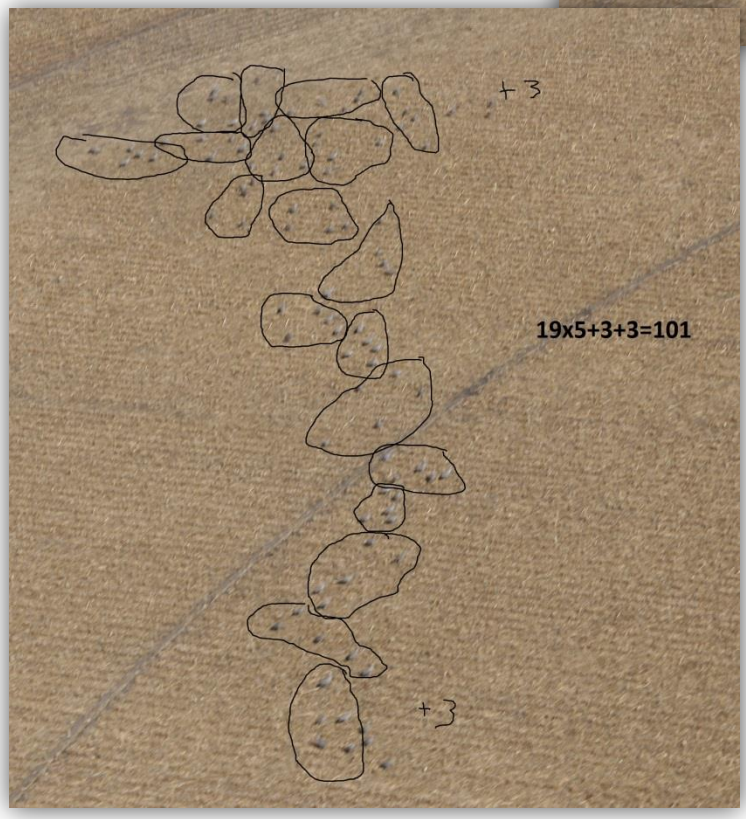
A total of 179 birds are in the area, an underestimate of 53%. Yet, consider the fact that the aircraft pass by each flock ~200 ft above ground (AGL) and at ~90 miles per hour. You can see visibility and contrast decrease the accuracy of an estimate during the survey.

What if we flew at a higher elevation? Let's take a look at the differences a couple of hundred feet AGL make. The photo to the left was taken at 1,000 AGL, good lighting makes all of the birds visible in this habitat. Do you think these birds would be visible in a cornfield? Do you think your count would be very accurate from this elevation?

Let's get down to a reasonable altitude. The photo below is at 200 ft AGL, would this be easier to count going by at 90 mph? Can you see all of the birds as they get farther from the aircraft? Of course not, so we create a transect area that extends out to ¼ mile from the aircraft. See the fence line perpendicular to the river on the left? That is ¼ mile from the aircraft.

Rapid Estimates

Granted surveying SHC from an aircraft has its challenges, but how do we actually count the birds? At low level flying 90 mph, we need a rapid assessment of the flock size. What we do is count smaller portions of the flock. Say we look at the leading edge of the flock and identify 5 individual birds; we now have a proportion of the flock of known quantity, so we simply count the remaining flock in groups of 5. In the photo to the right, count the flock rapidly using groups of 5 birds. I counted 21 groups of 5, what did you count?



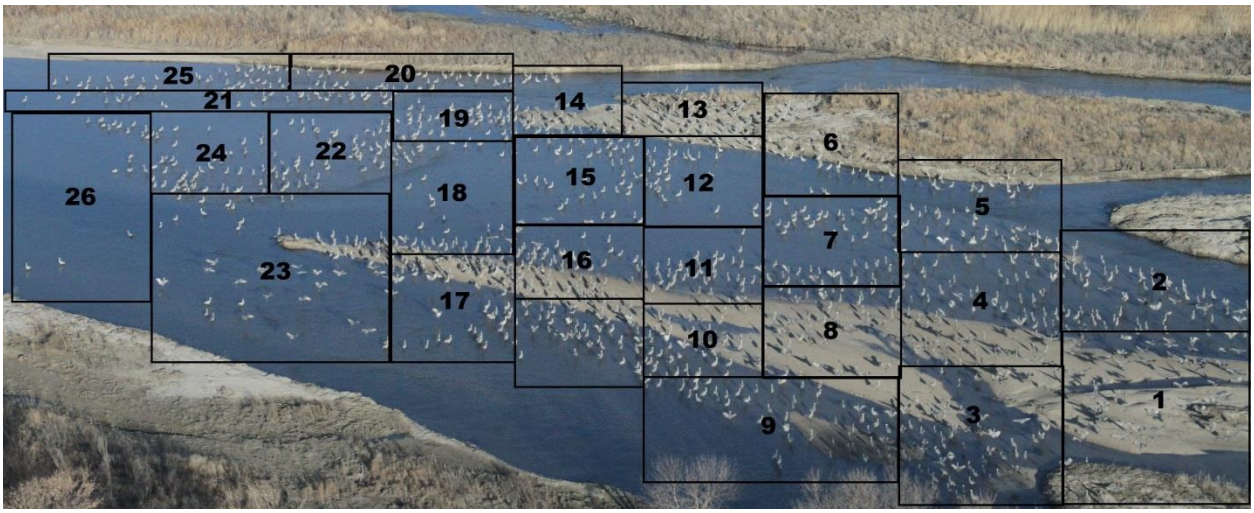
In the photo to the left, I have circled the actual groups of 5 within this flock; I have also identified the outliers as a specific number. So, there are only 19 groups of 5 (19x5) with 6 extra birds that did not fall into a group because of the way I started and finished my count for a total of 101 SHC. This is 4 birds short of my original estimate of 105 birds, but considering I did this very quickly it is pretty close, and it certainly gives us a good indication of how many birds are present. If I continued counting many flocks and maintained this accuracy, my population estimate would have very little error.

As you can see, if we break down the large task of counting into a smaller, manageable task, we actually speed up the process. Let's take a look at another flock that is a little larger and see what this is like using groups of 10. The photo below is an actual photo taken during the SHC survey. Can you see the flock tightly grouped in the grass? The pilot and the observers' jobs are to count these birds as they fly by. Use groups of 10 and see what you get, but do this quickly.

Rapidly moving across the flock, I counted 17 groups of 10 with 5 extra birds for a total estimate of 175 (without cheating). The actual count (to the right) for this flock is 170 birds, making my last two estimates + ~3%.

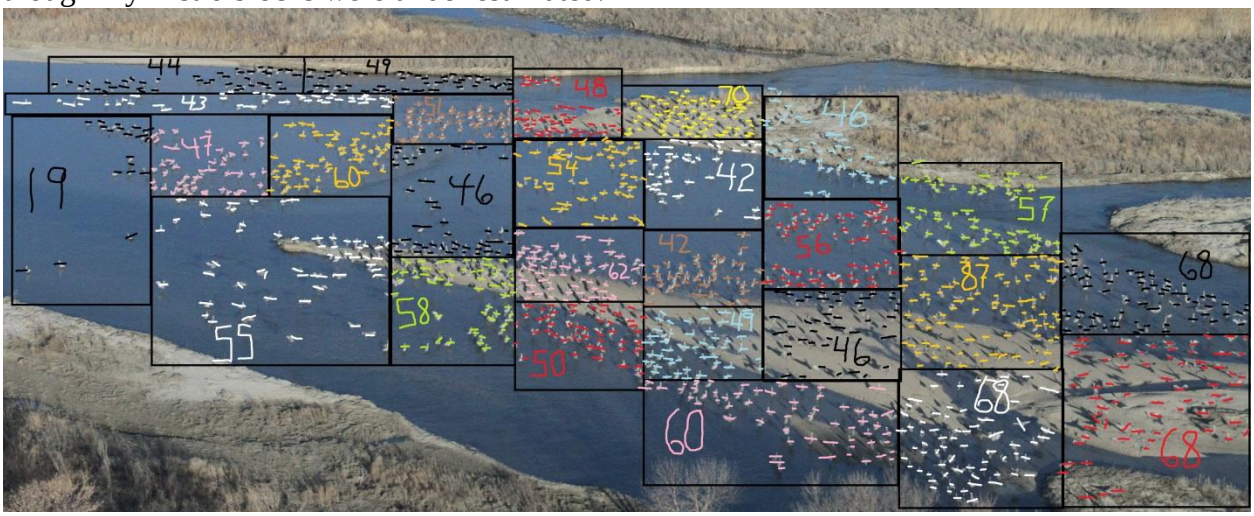
Let's look at another example of a larger flock. What I try to do in this scenario is isolate an appropriate number of birds, say 50 in this example, which allows me to move quickly across the flock. Choosing the right number of birds is important. For example, you would not want to start with groups of 5 because of the aircraft speed would move you past the flock before you could possibly count that many groups. Using too large of a number, for an example 1,000 is too high for this flock. It would not be as accurate and would add unnecessary error. We are able to use a smaller number that gets through the flock rapidly while providing a more accurate count.

For this flock I am choosing groups of 50 birds. The image in my head looks something like this:



My technique is to count from 1-27 (notice one block did not get numbered) as quickly as possible. This took me roughly 10 seconds with the first 2 seconds allowing me time to figure out what area 50 birds would occupy. In this case extrapolating the area that I am allowing for 50 birds ends up being 27 different polygons, so 50x27= 1350 SHC. Did my blocks look reasonable? Do they capture 50 birds exactly? Let's take a closer look.

The photo below shows the actual numbers in each block. Note that some are higher than 50 and some are lower. This is mainly due to the increases and decreases in density from my first block of 50 birds. If they were equally spaced and I was looking straight down, the estimate would be much closer to the actual flock size. With variation of birds in each block, errors higher and lower than 50 birds is a good indication that 50 was an appropriate group size for me to use, even though my first 6 blocks were under estimated.



How many did you count? The actual count of this flock is 1,445 birds. This is a good demonstration how easy it is for humans to underestimate the number of birds in a flock and how valuable experience is and how important consistency is.

Conclusion

These simple techniques will help you count birds that are seen from the air as well as from the ground. These techniques are not easy initially, but they do get much better with practice. You will find that as you count groups, say flock of <500 birds, you will become more confident with your estimates when you practice. You will also notice that you can increase the speed at which you can come up with a fairly accurate number.

The aerial photos included in this document provide a real example of what is actually done by Waterfowl Biologists (photo of the crew from left to right, J. Drahota – observer, current pilot T. Liddick, retired pilot J. Solberg) during the Mid-continent Population Survey of sandhill cranes that are estimated each March while staging in the Platte River valley of south-central Nebraska. And lastly, keep in mind that we use photo-corrected counts to adjust for bias and human error associated with this survey. This provides the highest level of accuracy we can expect from this survey.