World Wetlands Day History Lesson: Waterfowl and Statistics

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Happy World Wetlands Day! Today we are going to dive into the two things that I think are often misunderstood about wetlands. The role that hunters and statistics have played in wetland conservation in North America. Wetlands are important (Wetlands are important [as has been discussed on Science Borealis previously](http://blog.scienceborealis.ca/celebrate-world-wetlands-day/)), and one of the reasons we have many of these wetlands today is because of hunting, because of statistics, because of people who care, a lot, about migratory waterfowl. Wetlands certainly serve many purposes beyond waterfowl habitat but a big part of wetland conservation can be told with them as the focus.

[Waterfowl](http://www.ducks.org/hunting/waterfowl-id) include many species of ducks and geese and swans. These are typically large migratory birds, many of which are also game species. For many decades researchers in Canada and the U.S. have been banding waterfowl during the breeding season to study their migration. They do this because some of these banded birds will be harvested, and when they are, the hunters will hopefully report the band number, and where they killed it. This helps us to understand how birds move at a continental level. For non-game species the recapture rate (the rate at which birds which are banded are encountered for a second time) is very low, like less then one percent low.

Hunting gives us a unique way of increasing the encounter rate of hunted species, especially across a large geographic area. Hunting has provided valuable information for decades, so lets combine the two and dive into how a number cruncher and a hunter are important parts of the same process of managing and understanding our ecological systems.

Hunters are certainly not the only group to have contributed to conservation, for instance many many wonderful ornithologist have contributed to avian conservation in many ways ([Rosalie Edge](http://www.biography.com/people/rosalie-edge-072715), [Margaret Morse Nice](https://www.pwrc.usgs.gov/bpp/Observer%20Bios/Margaret%20Morse%20Nice.pdf), [Florence Merriam Bailey](http://www.nmbirds.org/wp-content/florence-m-bailey-1.pdf), and many others) but the hunting community has contributed to wetland conservation in North America in an undeniable way and their financial contribution continues to be a big player through [conservation stamps in Canada](http://whc.org/) and the [U.S.](http://www.bsbo.org/conservation-stamps.html). Some hunting groups were among the first to call for bag limits in the early 1900's and [hunting clubs](http://winous.org/about/) continue to manage valuable wetland habitat across the continent.

First lets identify the problem, if we are going to conserve and manage a population we need to know how many are in the population and what their demographics are (percent female, percent adult, etc). There are several ways to do this, ideally we would census the population, which even with human populations in developed countries is very very challenging to accomplish, so in wildlife, unless we are dealing with a very small population, we don't census, we sample, and we infer from there. There are many ways we can sample and study, depending on our goals, budgets, the organism we are studying.

The simplest way to do this is through Lincoln-Peterson Models. First you go out and mark individual. In the case of waterfowl this is done through banding, which is a method that has been in use for over a hundred years to [study bird migration](https://labandfield.wordpress.com/2013/11/03/bird\_migration/). Then later (in this case the next summer) and capture a bunch of individuals again and see how many of them are banded. The idea is that in year 1 you have banded a certain percentage of the population, and in year 2 you'll be able to tell what percentage, because that percentage will be the individuals re-encountered in year 2. The math behind this is pretty straight forward.

(lincoln\_peterson.png)

Then you solve for the 'size of whole population'

This is the simplest form of population modeling in a marked population, and it comes with many assumptions and is not always appropriate. Through more advanced mark-recapture models we can take into account differences in how different parts of the population fare over time. Often juveniles have every high mortality rates in their first year of life, or in some species females are subject to higher mortality then males. We can also account for the adding of new individuals to a population, either through birth or immigration from another area.

We can use statistical models called 'known fate' to model the population over time. These models allow us to incorporate these records from the ends of individuals lives, and also incorporates information from birds which are recaptured each year alive. This allows us to understand how long individuals live, where they go, and how these variables change for different parts of the population (do males or females live longer?, what about different ages?).

These kinds of studies can be done at the local scale. For instance, the past year I've been working with Canada Goose data looking at the population of resident Canada Geese in Arkansas. We have banding data for 10 years from several locations across the state, we also have recapture information (birds who were banded one year and captured the next year), and data from hunted birds from across the state. We can use this data to estimate the size of the resident Canada goose population in Arkansas (resident Canada geese are geese who do not migrate, [[difference between resident and migratory geese](https://www.allaboutbirds.org/canada-goose-resident-vs-migratory/)]. Similar projects are done by agencies, organizations and students all over North America to study how populations change over time.

When you apply these methods at the continental scale you gain the information that helped us define our modern flyways, which are now administrative boundaries to help inform sustainable management of many species.

Once scientists across North America were able to monitor population trends for various waterfowl species and start to examine their connectivity they, along with many conservation organizations, including groups composed largely of hunters such as Ducks Unlimited, were able to start conserving land on the ground and doing additional work to ensure that it was being managed in a way that supports the continued sustained population of these species.

Wetlands were lost at a huge rate (~70% in settled areas of Canada, similar rates across much of the U.S.) which makes the conservation of the ones we do have really important. Across Canada and the U.S. much of our remaining wetlands are in the hands of the government at various levels, who are charged in differing ways with its continued care and management, sometimes just for waterfowl, other times for a wider suite of species. In either case this is being done on behalf of the people they represent and these properties are often available for recreation in the form of hunting, bird watching and other kinds. Managing public land is challenging, and work is constantly being done to improve it at every level. Private wetlands also serve as valuable habitat for many species and help clean our water and mitigate flooding and efforts are made through programs to coordinate and encourage multi species management on these properties so that they can aid in providing habitat for migratory birds and other wildlife.

Often though the brunt of the responsibility for providing suitable habitat can fall on government land, and makes the management of that property incredibly important and that its value to the average person, especially those who don't own large chunks of land should be high. It also requires a great deal of collaboration, since migratory birds don't just stay on one property the entire year, they likely use several if not dozens. This is where that understanding of how birds move comes in, we can figure out what habitats are being used on the landscape and that helps us to prioritize where to conserve more land, and helps us to figure out what part of the annual cycle is limiting a given population. For many migratory species this requires coordination between the Canadian Wildlife Service, U.S. Fish and Wildlife Service and other countries since these species are held in trust by everyone across their entire range and are in many cases protected by the Migratory Bird Treaty [(which is 100 years old this year!)](http://www.fws.gov/birds/MBTreaty100/).

Wetlands are important for wildlife, but provide many other vital services to society, through cleaning our water, sequestering carbon, mitigating flooding and many others. There are many ways we study wetlands and collect data to better manage and conserve them at the continental scale. Statistics and math are part of most of those and often those methods take advantage of activities which are already taking place, like hunting, to better understand our ecological processes and to manage those activities. Wetlands are wonderful systems, but if you don't often interact with them they can be easy to ignore, similar with data analysis and with the hunting community. If you are not engaged with them its easy to ignore, or to speak about in a negative way. The wetland managers, the hunters, the birders and the data crunchers are all part of this relatively large system that strives to keep our wetlands healthy and keep the wildlife around for generations to come.