Alberta NAWMP Partnership

SCIENCE STORIES

SERIES NO. 6

AT THE LEADING EDGE OF WATERFOWL ECOLOGY

DR. MITCH WEEGMAN, HIS COLLABORATORS AND HIS STUDENTS ARE IN THE VANGUARD OF RESEARCH IN WATERFOWL ECOLOGY AND STATISTICAL ECOLOGY. THEIR WORK AIMS TO HELP FOSTER SUSTAINABLE, RESILIENT WATERFOWL POPULATIONS IN OUR CHANGING WORLD.

Pintail female and her ducklings

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ADVANCING OUR UNDERSTANDING OF PINTAIL POPULATION DRIVERS

One area of Weegman's current research focuses on the "conservation conundrum" of northern pintail duck population patterns.

The populations of many other duck species tend to bounce back when wet weather cycles return and ponds once again become numerous on the Canadian Prairies and the northern Great Plains of the United States. But pintail populations have not rebounded. In fact, they have been declining for the past 30 years.

Now, through complex modelling work that is a logical expansion of many decades of pintail research, Weegman and his colleagues hope to help turn things around for these birds.

Weegman is the Ducks Unlimited Canada (DUC) Endowed Chair in Wetland and Waterfowl Conservation at the University of Saskatchewan. He is also part of a team of researchers working to advance scientific understanding of pintail population drivers and to identify conservation options to help return pintails to a healthy, sustainable level.

Collaborators on this work include Dr. Todd Arnold at the University of Minnesota, Dr. Bob Clark with Environment and Climate Change Canada (ECCC), and DUC scientists Dr. Matt Dyson, Dr. Jim Devries, and Dr. Dave Howerter.

"Some of these people have studied pintails for 30 years or more, and others are relatively new to the team. But all of us are motivated in the same way: to better understand the relationships between pintails and other dabbling ducks and their environment so we can develop more effective conservation strategies," explains Weegman.

"At the same time, we are advancing modelling techniques so other practitioners around the world can implement similar strategies to conserve populations according to their research questions. That mixture is super exciting."

TWO KEY DRIVERS

Previous studies by members of the team determined that one likely driver of Prairie pintail populations is their habit of nesting in crop stubble in early spring. This behaviour has become increasingly risky in recent decades.

Pintails often start nesting in April and early May, which is before spring seeding in most parts of western Canada. But back in the 1970s, cropland in Prairie Canada was commonly left unplanted every other growing season under a moisture-conservation practice called summerfallow. Pintails nested in summerfallow, which approximated short-grass prairie for habitat, and generally nests were undisturbed by farm machinery.

However, these days, instead of summerfallowing, most farmers use minimum tillage practices, which not only conserve soil moisture but also protect soil quality, and seed their fields every year. So, a week or two or three after pintails start nesting, farm equipment moves through the fields to plant the next crop, destroying the nests.

Another probable population driver is the effect of climate change on precipitation and temperature patterns, greatly influencing wetland habitat quantity and quality across the landscape.

MODELLING PRAIRIE POPULATION DYNAMICS

A few years ago, when Weegman was at the University of Missouri, he and the other pintail team members modelled pintail population dynamics in the Prairie Pothole Region (PPR). The PPR, which stretches from Alberta to South Dakota, is known for its exceptional waterfowl habitat.

Information about a species' productivity – the number of young produced annually – is critical for this type of model. Weegman notes that one way to assess waterfowl productivity is to use harvest data. "Every year, hunters mail in the wings of the birds they have harvested. The ratio of the adult to juvenile wings in this survey gives an estimate of productivity at a continent scale."

However, continental estimates are not sufficiently specific for the PPR model. "From a conservation delivery perspective, we wanted to know where in the Prairie Pothole Region pintail productivity was low and where it was relatively high, so we could target investments to improve productivity," he explains.

Fortunately, pintails and other waterfowl species have been intensively studied in the PPR for decades, generating remarkably strong, regionally-specific datasets from banding and band-recapture-recovery operations and from breeding population surveys.

"The strength of those data is remarkable. Over the last 60 years, hundreds of thousands of pintails have been captured and banded during Canadian Wildlife Service and U.S. Fish and Wildlife Service banding operations, right across the Prairie Pothole Region of Canada and the U.S.," says Weegman.

Using the banding data, the team calculated the age ratio of juveniles to adults banded, which provided spatially explicit pintail productivity estimates. They linked these productivity estimates with pintail survival estimates from the band-recapture-recovery data, and with pintail population size estimates from the breeding population surveys, all to the same regionally-specific scale.

Using these productivity, survival and population estimates, the team built an integrated population model to make annual estimates of pintail population dynamics for the PPR's six subregions, or ecostrata. Dr. Qing Zhao, postdoctoral researcher in Weegman's group at the University of Missouri, led this work.

Weegman and his collaborators modelled pintail population dynamics in the Prairie Pothole Region, a landscape dotted with wetlands and known for its exceptional waterfowl habitat.

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Weegman says, "Once we built that model, we could then ask questions about which demographic rates contribute most to the pintail population growth rate. And we could test hypotheses about the environmental drivers of those demographic rates; for example, how climate change and land use change explain variation in pintail survival or productivity regionally across the Prairies."

CONTINENTAL COMPLEXITIES

The Alberta NAWMP Partnership's Science Fund recently provided some funding to help the pintail team tackle the even more complicated challenge of scaling up the PPR model to a continental pintail model. This project is being led by Dr. Dan Gibson, a postdoctoral researcher with Weegman's group at the University of Saskatchewan (USask).

Developing this continental model involves bringing together datasets for three breeding regions and two wintering regions.

Breeding regions: Along with the PPR, the other pintail breeding regions are Alaska and an area north of the Prairies that is not yet well defined.

"Pintails are known to overfly the Prairies when the Prairies are dry, but we don't fully understand where they go. We know that some go to Alaska and others to an area between the Prairies and Alaska. A number of pintails have been banded in Alaska in recent years so we can get age ratios at banding and survival estimates for Alaska alongside those using banding data from the Prairies. We can also get some population survey information because the annual Waterfowl Breeding Population and Habitat Survey, or BPOP, stretches into parts of northern Canada and eastern Alaska," Weegman explains.

"However, we have very little information for the area between Alaska and the Prairies that we call the 'northern partially surveyed area.' No birds are banded there, and BPOP covers only some of northern Canada. Consequently, we have to make some assumptions about what productivity and survival are likely to be in this area."

Wintering regions: The two pintail wintering regions are in California and the lower Mississippi Valley. "The central valley of California is a traditional wintering area for waterfowl, particularly pintails. The south central part of the U.S. – historically along the Gulf Coast, Texas and Louisiana, but now stretching north into Arkansas and Mississippi – is a really large area for wintering pintails."

PULLING THE PIECES TOGETHER

Weegman sums up the data situation: "The continental model draws on an impressive amount of information for the Prairies, pretty good data for Alaska, and very little information for the northern area. And the wintering regions have banded birds but less frequently even than Alaska."

To fill the data gaps, the researchers have tapped into a wide range of data sources, melded different datasets, and made assumptions. Weegman gives the example of data gaps related to flooded rice, an important food and habitat type for pintails during winter. "Our team is very interested in how changes in the flooded rice acreage influence pintail reproductive success and survival the following summer. However, we don't have complete flooded rice information for the years in which we have excellent banding data, that is from 1961 to present. So, we have stitched together the flooded rice information we have, and we have built linear models to estimate flooded rice in the years where we don't have this information."

With the help of the one-year funding from Alberta NAWMP, the team brought together all the disparate datasets and developed the overall framework for the continent-scale integrated population model.

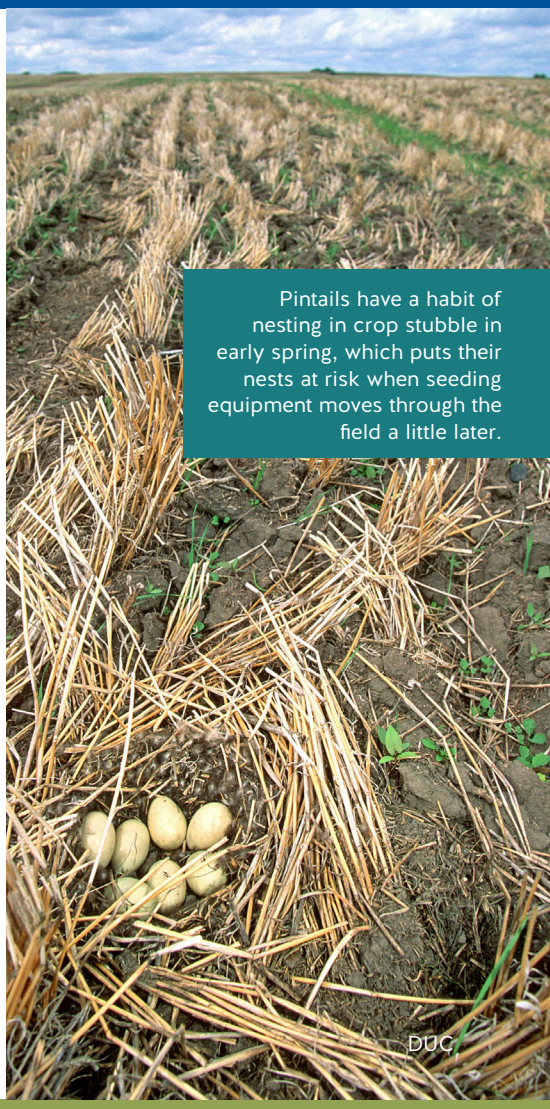
"When you are stitching together multiple breeding regions, multiple wintering regions, full movement estimates among these regions within a season and among seasons, there are few other examples across ecology. There are no roadmaps to follow," he explains.

"It has been an immense amount of work. It is really fascinating but also challenging."

At present, the researchers are conducting hypothesis testing with the model to investigate various topics such as: pintail population drivers in Alaska; the population effects of huge changes in the flooded rice acreage in California in recent decades; and how land use change and pond conditions in the PPR are connected to continent-scale productivity.

Down the road, they plan to carry out scenario-playing to explore how differences in the drivers could affect pintail populations. And then they will develop a pintail management plan that prioritizes habitat investments, considering the full annual cycle for pintails.

Long-term funders of this and other pintail modelling research include DUC and ECCC.



Pintails have a habit of nesting in crop stubble in early spring, which puts their nests at risk when seeding equipment moves through the field a little later.

ABOUT THE PROGRAM AT THE UNIVERSITY OF SASKATCHEWAN

DUC also supports Weegman's position as Endowed Chair in Wetland and Waterfowl Conservation at USask. DUC created this Chair in response to a call from conservation professionals around North America who were concerned that, as waterfowl faculty were retiring, those positions were not being filled with similar wetland and waterfowl expertise. Weegman, who began as Chair in 2021, is the first person to lead this program.

"OUR RESEARCH TEAM AND THE HUNDREDS OF PEOPLE WORKING ON THESE PROJECTS AROUND NORTH AMERICA, EUROPE, SOUTH AMERICA AND ASIA ARE PROVIDING OUR STUDENTS WITH WORLD-CLASS OPPORTUNITIES...

"Our research team and the hundreds of people working on these projects around North America, Europe, South America and Asia are providing our students with world-class opportunities to develop critical thinking and gain the skills needed to tackle pressing conservation issues such as climate change and landscape change and to develop strategies that promote waterfowl populations or increase the resilience of waterfowl populations to these changes," he says.

"Also, we are working closely with federal, provincial and state biologists to develop the ideas and then apply the results. And the students see that the science is being implemented. It is just an incredible mixture."

DELIVERING ON DREAMS

"We have a group of 11 graduate students and postdoctoral fellows right now. They are supported by a network of collaborators around the world every day. The critical thinking, money and time donated by those folks toward our projects allow us to deliver on dreams and pursue these fascinating ecological questions. We're very grateful for the partnerships and opportunities."

About half of the students are population ecologists, doing studies similar to the pintail research, but with other species that have different pinch points for their populations. For example, students are assessing how a species' survival and reproductive rates contribute towards its population growth rate, testing hypotheses, conducting scenario playing, and then developing plans for targeting conservation investments to maximize the species' survival and reproductive success.

Weegman adds, "I love the ecosystems of the north so I work quite a bit in the

DUC Endowed Chair Weegman and his research group at USask in 2024

Chris Putnam, USask

Canadian Arctic and west Greenland. Some members of our group work in those places on the population side."

Most of the rest of the students in the program are movement ecologists. "These folks are deploying tracking devices and asking questions about how very fine-scale movement and behaviour of individuals can be explained throughout the year, and how those movements and behaviours cascade to variation in reproductive success."

These movement studies involve collecting hundreds of thousands or millions of GPS positions and acceleration data points for individual birds to produce three-dimensional patterns of movement. These datasets help increase understanding of the birds' behaviour such as feeding, flying, sleeping and so on.

"When we do this for hundreds or thousands of individuals, we begin to gain a really solid understanding of the pinch points in the annual cycle where the proportion of time feeding is most limiting or the part of the landscape that contributes the most toward lower reproductive success. Those pinch points are the places where you would invest in intense conservation efforts, for instance, to boost reproductive success if that was the desired outcome."

> "OVERALL, OUR PROGRAM IS PROVIDING A WORLD-CLASS TRAINING OPPORTUNITY FOR STUDENTS, AND ADVANCING WATERFOWL ECOLOGY AND STATISTICAL ANALYSES ALL AT ONCE."
>
> – DR. MITCH WEEGMAN

As well, some students work in both population ecology and movement ecology. He says, "They are combining the properties from demographic analyses and the individual-based movement and behaviour analyses, and then blending these for joint inference about a particular or multiple waterfowl species."

Weegman concludes, "Overall, our program is providing a world-class training opportunity for students, and advancing waterfowl ecology and statistical analyses all at once. It is an exciting and incredibly enriching environment for scientific discovery and conservation application."