Hunter Harvest Effect on The Breeding Bird Population of Northern Pintail *Anas acuta* in North America

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Hunter harvest and the effects that it can have on population dynamics is a relationship used by wildlife professionals when making management decisions. Hunter harvest can be compensatory or additive on wildlife populations and instances where hunter harvest has been a key role in a population decline, and sometimes demise, is an occurrence studied in wildlife management. Waterfowl numbers in North America have increased 17% since 1960, but during that same time frame the Northern Pintail population has decreased 40%. Hunter harvest data has been recorded by the U.S. Fish and Wildlife Service since 1961, while they have simultaneously been recording breeding bird populations of waterfowl throughout North America. Regression analysis was used in this study to determine if a significant relationship exists between hunter harvest and the breeding bird population of Northern Pintail. Hunter harvest and the variation in breeding bird population of Northern Pintail was also analyzed to test for a relationship. While direct effects of hunter harvest on the population change of Northern Pintail were found to be insignificant (P = 0.15), hunter harvest and its effect on the variation in population of Northern Pintail were found to be significant (P = 0.01). The decline of Northern Pintail in North America is a prominent issue in wildlife management and factors influencing its population must be studied to ensure the survival of the Northern Pintail.

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Introduction

Hunter harvest of wildlife populations and the influence on population dynamics is an effective and reliable tool used to aid in the management of wildlife populations. Many aspects can affect the way a population reacts to environmental factors over time, but almost all techniques that attempt to influence change of a population over a long term, use data on how the population changes from year to year (Hofbauer and Sigmund 1998). When studying a changing population and what factors may affect the change, hunter harvest, being the most controllable variable to correct and one of the strongest factors to effect population dynamics, makes it the first variable to be looked at to determine if it is having an effect on the change in population (Arnold et al. 2016).

Hunter harvest can have a widely fluctuating effect on population change. In a 2011 study done on Willow Ptarmigan *Lagopus lagopus*, hunting mortality was studied to determine if it was compensatory or additive, and to estimate what percent of the population needed to be harvested to significantly decrease the population (Sandercock et al. 2011). At 15% harvest the hunting mortality was compensatory and at a 30% harvest the hunting mortality became additive, showing the magnitude of hunter harvest can have a significant effect on change in population at certain harvest levels.

Species extinction due to hunter harvest is not an unheard-of occurrence, most notably when it comes to game birds. The Passenger Pigeon *Ectopistes migratorius,* is the prime example of game birds that went extinct due to hunter harvest (Wenninger 1910). Before arrival of western civilization around the 1500's the population of Passenger Pigeon was estimated to be 3-5 billion individuals and made up approximately 40% of avian species on the continent of North America (Greenberg 2014). Once westward expansion began Passenger Pigeon populations began to decline, and a major population crash occurred between 1860 and 1880 due to over harvest. In 1897 Michigan became the first state to ban the hunting of Passenger Pigeon, but these efforts proved too little too late, as the last wild Passenger Pigeon was shot in Laurel, Indiana in 1902. The Passenger Pigeon was the first game bird in North American to be

brought to extinction during colonization of the continent (Greenberg 2014).

Waterfowl populations in North American have been heavily studied and tightly managed for well over 50 years. Waterfowl in North America are managed both nationally and internationally on the continent, and almost all species populations are on an incline or at an acceptably stable level over the past 40 years (USFWS 2018a). The Northern Pintail *Anas acuta* is an exception to this trend, having decreased by 40% since 1960 (Figure 1). Along with the decline in population, hunter harvest has also seen a significant decline (Figure 2). Large variation in population size from year to year can be an indicator of instability, and studies have linked this to being a possible precursor to population extinction (Legendre et al. 2008).

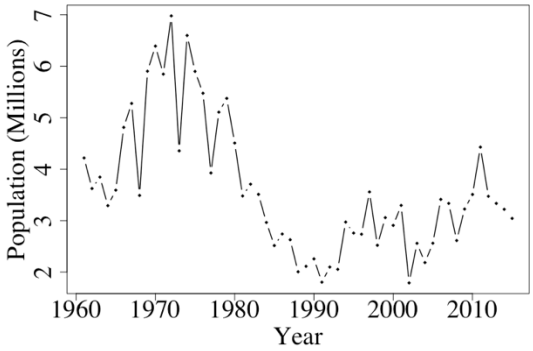

Figure 1. Year (x-axis) and the breeding bird population of Northern Pintail (y-axis).

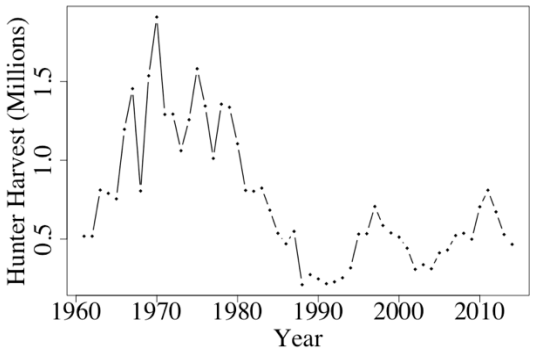

Figure 2. Year (x-axis) and the Hunter Harvest of Northern Pintail (y-axis).

North American waterfowl management has shifted in recent years in an attempt to allow for only compensatory hunter harvest mortality of all waterfowl species to stop hunter harvest from having an impact on the change in population from year to year (Nichols et al. 1995). The objective of this study is to analyze population data of Northern Pintail and hunter harvest data from 1961 to present day to determine if there is any relationship between the two. The first relationship to be analyzed will be the direct effect hunter harvest has on the positive or negative change on the breeding bird population of Northern Pintail. The second relationship to be analyzed will be the effect hunter harvest has on the variation of the breeding bird population of Northern Pintail.

Methods

Hunter harvest of waterfowl by species each year has been recorded since 1961. The Harvest Information Program (HIP) was launched in 1999 to begin surveying all those who hunted migratory game birds. The first survey system only collected data on those who purchased a Federal Duck Stamp (USFWS 2018b). Hunter harvest of Northern Pintail has decreased along with the overall breeding bird population (USFWS 2018a), peaking in 1970 at approximately 1.9 million and in recent years averaging around 500,000 (Figure 2). Collection of hunter harvest information regarding waterfowl mortality is reliant on cognitive ability of survey takers to correctly identify the number and species taken. Using survey data with extended lag times usually results in bias estimates that are lower than true values (Beaman et al. 2005). However, a consistent bias will not affect the ability to test for relationships within this study.

Each year the U.S. Fish and Wildlife Service does a survey of the breeding bird populations of waterfowl species in North America. This survey is done by aerial survey from planes with a spotter counting number of birds paired for breeding and identifying them by species. These surveys are done across breeding habitats of waterfowl in mostly northern North America. There are 77 different stratum, or survey zones, that are included and more than 15 different species (USFWS 2018a). Aerial bird surveys have been found to be reliable and consistent over the years which makes them a valuable resource for population data, even though aerial surveyors on average produce a population estimate 29% lower than true numbers (Frederick et al. 2003).

Data Analysis

Regression analysis was used to test for a relationship between hunter harvest and change in breeding bird population from harvest year to next. A second regression analysis was used to test for a relationship between the variability in breeding bird populations of Northern Pintail from spring survey to the following year and hunter harvest.

Results

The hunter harvests direct effect on the breeding bird population, whether it be positive or negative, was found to be not statistically significant ($F = 2.12$, $P = 0.15$, $R^2 = 0.03$, Figure 3).

The hunter harvest and its effect on the variance of population change was found to be statistically significant ($F = 6.36$, $P = 0.01$, $R^2 = 0.109$, Figure 4).

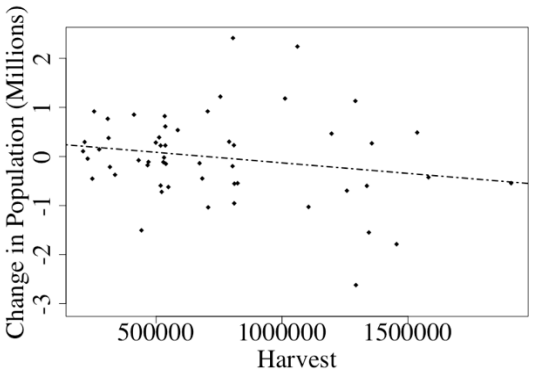

Figure 3. Harvest data of Northern Pintail (x-axis) and the change in Northern Pintail population (y-axis).

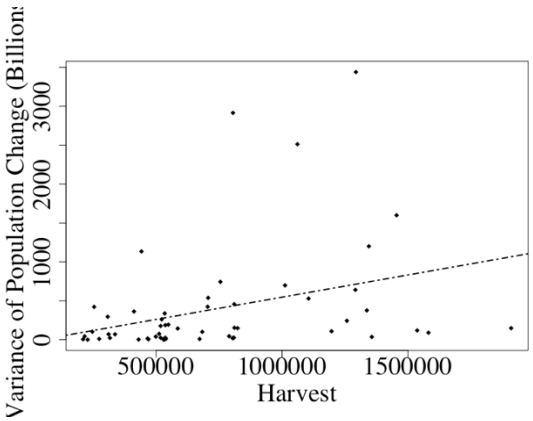

Figure 4. Harvest data of Northern Pintail (x-axis) and the squared residuals of the change in Northern Pintail population (y-axis).

Discussion

As discussed in Organ et al. (2012), wildlife is public resource and is to be managed for sustainability in the future. This means in most cases, all harvest of wildlife must be only compensatory to ensure populations are not affected by harvest mortality. As seen in the results of this study, the relationship between hunter harvest and breeding bird population of Northern Pintail is found to be insignificant. This suggests that the hunter harvest of Northern Pintail is not additive and falls in line with the North American Model (Organ et al. 2012). A study done on the survival rates and band recovery rates of Lesser Scaup *Aythya affinis*, concluded that hunting mortality played a minor role in effecting population dynamics, and goes on to suggest waterfowl managers could be less cautious with regulations built to control hunter harvest (Arnold et al. 2016).

In this study, the variation in population of Northern Pintail was significantly affected by hunter harvest. This variation whether it be positive, or negative is shown to be significantly higher when hunter harvest rates are high. As discussed in Schoener and Spiller (1997), extinction rate and temporal variation in wildlife population size have a significant relationship. In the Schoener and Spiller (1997) study, orb spider (Araneidae) species of subtropical islands were studied and a positive correlation was found. This suggests that as variation in population dynamics increases, the extinction rate also increases. With the increase in population variation of Northern Pintail, the extinction rate of populations of these waterfowl increases significantly. This can be an area of high concern due to waterfowl populations of North American being a significant economic driver for certain geographical areas. Those that host a large amount of waterfowl habitat and are a part of the migration pathways can benefit heavily on the economic income these gamebirds generate (Krutilla 1972).

With analysis of the data suggesting hunter harvest not having a direct negative impact on the population of Northern Pintail, other causes for a population decline must be examined. The next factor most often looked at when populations decline is the breeding success and nest success. A paper written on the life cycle of the Mallard *Anas platyrhynchos* in the midcontinent region looked at sensitivity, how uncertainty in an outcome can be related to uncertainty of input factors, and how vital rates affected the population growth rate (Hoekman et al. 2002). This study found that the sensitivity of population growth rate to nest success was significant and it accounted for 43% of the variation in population growth rate in the analyses. With the Mallard being in the same genus as the Northern Pintail, having behavioral and breeding traits quite similar to one another, suggests that nest success also plays a key role in the population growth rate of Northern Pintail.

Populations of wildlife regularly compete for resources and habitat. Nesting areas are also contested for between species and this is increasingly true when species tend to occupy the same niche. Interspecific competition most often

leads to the less fit species changing habits slightly to allow for coexistence of both species (Smith 2017). This interspecific competition is apparent in the case of the Mallard, Blue-Winged Teal *Anas discors*, and the Northern Pintail. These species belong to the same genus Anas, a group of dabbling ducks. These species all have similar breeding habitats, food sources, and habitat ranges making competition a significant factor in population success. The carrying capacity of North America for dabbling species of waterfowl is a total of many species combined. The population of Mallard and Blue-Winged Teal in 2015 made up approximately 52 percent of all dabbling ducks on the continent (USFWS 2018a). This shows that two of the seven species of dabbling ducks account for more than half of the continent's population. These two species are the most commonly known to most people with the Mallard being the flagship species of the midcontinent croplands and the Blue-Winged Teal being the icon of the coastal salt marshes of the Gulf of Mexico. These species being the most recognized, makes them some of the most heavily managed species. With the successful management of these species, populations have steadily increased over the years, possibly having a negative impact on the Northern Pintail population, and the populations of other less prominent species of dabbling ducks.

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