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Reliability of determining adults from juvenile ducks by presence or absence of notched tail feathers in various species of North American ducks

Thomas Michael Siwarski
Louisiana State University and Agricultural and Mechanical College

RELIABLITY OF DETERMINING ADULTS FROM JUVENILE DUCKS BY PRESENCE OR ABSENCE OF NOTCHED TAIL FEATHERS IN VARIOUS SPECIES OF NORTH AMERICAN DUCKS

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Thomas Michael Siwarski Jr.
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ABSTRACT

I estimated when juvenile tail molt occurs for several commonly harvested duck species, mallards (*Anas platyrhynchos)*, northern pintails (*A. acuta*) (hereafter referred to as pintails), gadwalls (*A. strepera)*, lesser scaup (*Aythya affinis*), and redheads (*A. americana*). Tests showed that aging mallards by notched tail feathers became unreliable the earliest (early September), followed closely by pintails (mid-late September), with gadwalls being the latest of the dabbling ducks to lose reliability in aging by notched tail feathers (late November). Lesser scaup and redheads retained their notched tail feathers throughout January and the completion of hunting season. Based on initial banding and band recovery data I was able to separate birds into three age classes, juvenile (59), 1.5 years old adults (11), and adults 2.5 years old or older (23), creating a total sample size of 93 birds. From this sample of known-age banded birds I recorded five morhpometric variables including weight, wing length, bill length, tarsus length, and total length to determine if body size is related to ages over 1 year. Tests revealed that the only significant difference between the age classes was in wing length. However further tests showed that differences were not apparent between the 1.5 year old and 2.5 year old or older adults.

CHAPTER 1

INTRODUCTION

To understand different aspects of reproductive biology and population dynamics, waterfowl biologists and managers must be able to distinguish age classes within waterfowl populations (Serie et al. 1982). Having information related to the expected productivity of age cohorts along with being able to estimate age ratios are valuable tools used by managers as an annual index to continental waterfowl production (Dane and Johnson 1975, Dubovsky et al. 2002, Conn and Kendall 2004).

There are a wide variety of techniques used to age waterfowl, such as internal aging, cloacal examination, and aging based on wing or other plumage characteristics. Although many different feathers have been used to age waterfowl, the tail and wing feathers have been preferred by biologists because of the pattern and timing of the molt (Dane and Johnson 1975). Aging ducks by examination of tail feathers is simple, quick, and probably more accurate than wing aging if the tail molt has not yet occurred. However, once young birds begin replacing their juvenile plumage the characteristic notched tail feathers disappear and aging by the tail becomes unreliable. I estimated when juvenile tail molt occurs for several commonly harvested duck species, including mallards (*Anas platyrhynchos)*, northern pintails (*A. acuta*) (hereafter referred to as pintails), gadwalls (*A. strepera)*, lesser scaup (*Aythya affinis*), and redheads (*A. americana*). I determined the time of year when aging ducks by the presence or absence of notched tail feathers will be a highly accurate, straight-forward technique.

A large part of my sample of mallards came from solicited hunter-killed banded birds. Since this was a unique sample of known-aged birds along with recording tail molt

information I also recorded five morphometric variables for carcasses that were intact: weight, wing length, bill length, tarsus length, and total length. Morphological measurements such as wing length, tarsus length, and total length have been used by managers to index body size (Harris 1970, Owen and Cook 1977). Similar indices of body size have been used to compare various sex and age classes, however age classification techniques on unbanded birds only allows age separation into two age categories, juvenile or adult. The sample of known-age banded birds allowed me to collect morphometric data to see if body size was related to ages over 1 year.

CHAPTER 2

RELIABLITIY OF DETERMINING ADULTS FROM JUNENILE DUCKS BY PRESENCE OR ABSENCE OF NOTCHED TAIL FEATHERS

Introduction

Waterfowl biologists and managers rely on the ability to distinguish age classes in waterfowl to understand reproductive biology and population dynamics (Serie et al. 1982). Information related to the expected productivity of age cohorts is essential to accurately estimate the production of a waterfowl population (Dane and Johnson 1975). Estimating age ratios (ratio of juvenile to adult birds) is also a valuable tool used by waterfowl managers as an annual index to continental waterfowl production and is an important input variable for Adaptive Harvest Management (AHM) models (Dubovsky et al 2002, Conn and Kendall 2004).

There are a wide variety of techniques used to age waterfowl, such as internal aging, cloacal examination, and aging based on wing or other plumage characteristics. Although many different feathers have been used to age waterfowl, the tail and wing feathers have been preferred by biologists because of the pattern and timing of the molt (Dane and Johnson 1975). Aging ducks by the wing is the method used by the U.S. Fish and Wildlife Service at the various Parts Collection Survey WINGBEES held annually in each flyway (Dane and Johnson 1975, Krementz and Loncarich 2004). Aging ducks by the wing requires considerable training and experience; achieving great accuracy requires a large commitment of time for most biologists. In contrast, aging ducks by examination of tail feathers is simple, quick, and possibly more accurate than wing aging if the tail

molt has not yet occurred. However, once young birds begin replacing their juvenile plumage the characteristic notched tail feathers disappear and aging by the tail becomes unreliable. Although timing of tail molt has not been quantified, waterfowl biologists know that tail molt generally occurs in the fall for many North American dabbling ducks that are a major component of the total duck harvest.

I estimated when juvenile tail molt occurs for several commonly harvested duck species, including mallards (*Anas platyrhynchos)*, northern pintails (*A. acuta*) (hereafter referred to as pintails), gadwalls (*A. strepera)*, lesser scaup (*Aythya affinis*), and redheads (*A. americana*). Understanding tail-molt chronology is necessary if waterfowl biologists hope to determine age by examining tail feathers. I estimated the time of year when aging ducks by the presence or absence of notched tail feathers will be a highly accurate technique.

To assess the accuracy of distinguishing an adult from a juvenile duck by presence or absence of notched tail feathers, I first required a sample of birds large enough to accurately describe the timing of tail molt. The second critical step was to determine species, age, and gender with reliability, but not using tail molt as a criteria for age. Being certain of the age of each sample bird was essential to establish the reliability of distinguishing juveniles from adults by looking at tail feathers.

Members of the avian subfamily Anatinae molt body feathers twice annually: a prebasic (postbreeding) molt replaces alternate (breeding) plumage with basic (eclipse) plumage and a prealternate molt replaces basic plumage with alternate plumage (Humphrey and Parkes 1959). When a duckling hatches it is covered with natal down. As the duckling grows and begins to develop its tail feathers the down is pushed out of

the feather follicle by the juvenile retricies. The down feather is actually the distal tip of the new tail feather but it breaks off the rachis of the tail feather, which results in a characteristic v-shaped notch at the end of each tail feather of juvenile plumage. Juvenile birds replace their juvenile notched tail feathers during the first pre-alternate molt. Most ducks only molt their tail feathers once a year; however, timing of the molt of juvenile tail feathers varies among species. Some species molt tail feathers as early as the end of September, while other species molt them as late as February or March. From preliminary work, it appeared evident that mallards and northern pintails would be the first species to replace their juvenile notched tail feathers with adult-like feathers. Gadwalls appeared to molt their tail later, lesser scaup and redheads molt even later, possibly molting after hunting season.

The goal of this study was to estimate when aging mallards, pintails, gadwall, lesser scaup, and redheads by tail characteristics becomes inaccurate. Knowing the timing of tail molt will be a valuable tool for biologist and managers because looking at tail feathers is one of the quickest and easiest ways to determine age. Such reliable tail aging would be helpful in situations where time for training personnel is limiting, such as at banding stations or hunter check stations.

Methods

Data for this project were collected during fall/winter of 2003/2004 and fall/winter of 2004/2005. My first source of birds came from banding operations in North Dakota (J. Clark Salyer National Wildlife Refuge [NWR] and Lake Ilo NWR) during September. Birds also were obtained from hunters during the waterfowl hunting seasons in the Mississippi and Central Flyways. Hunter-killed birds became available

starting on 25 September 2004 in North Dakota and ending with the last hunter killed birds on 29 January 2005 from Mississippi. Prior to the hunting season, I was in contact with hunters in the Mississippi and Central flyway that were willing to help save duck carcasses for this research. Hunters labeled carcasses with date, county, and state where the bird was harvested. I requested that carcasses be frozen as soon as possible and kept frozen until pickup. Waterfowl hunting seasons in the southern states typically begin in mid-November when it was critical to have carcasses being saved down south. I spent November, December, and January traveling between southern states collecting carcasses from hunters.

Birds trapped at J. Clark Salyer NWR and Lake Ilo NWR were aged by experts using wing and plumage characteristics before I quantified the tail molt of each bird. Because the birds were still alive, internal aging was not possible. Hunter-killed carcasses were thawed and examined individually to determine age, sex, and species from plumage and morphology (Weller 1980). To more accurately estimate age, I examined wing molt and internal traits such as presence or absence of Bursa of Fabriscius (hereafter bursa), size and shape of oviduct or penis, and morphology of testis or ovaries. Looking at presence or absence of bursa to determine age was reliable for my birds because of the time frame of when they replaced their juvenile feathers. Data from known-age banded birds (F. C. Rohwer, R. R. Cox, and K. D. Richkus unpublished data) shows that bursa regression had not occurred prior to the first pre-alternate molt. Therefore, there is no reason to believe that I was not able to reliably identify juveniles by examining for the presence or absence of a bursa for mallards and pintails through the month of October. Because bursa regression did not occur prior to the first pre-alternate molt for mallards

and pintails, I assumed that this would also hold true for gadwalls. Diving ducks retain their bursas much later (Anderson et al. 1969) than dabbling ducks, so I assumed presence of a bursa would be a reliable method of aging diving ducks late into the hunting season. The status of the oviduct and ovaries in many birds, including ducks, is a reliable indicator of age (Anderson et al. 1969). Juvenile females have a smooth, finely grained ovary with uniformly small follicles. In contrast, adult female ovaries show variable follicle sizes with much larger maximum follicle size. Adult females also have an enlarged oviduct compared to juvenile females. Adult females will have thick-walled and convoluted oviducts compared to juveniles, which have oviducts that are thin-walled and smooth. By looking at multiple characteristics I was confident about accurately determining sex and age of each carcass.

After determining sex, age, and species, I quantified the tail molt for each carcass. I scored tail-molt first based on whether or not each feather was a notched juvenile feather or not. If a tail feather was notched, it's position was recorded. Feathers that were in the process of growing were scored as a percent grown. Tail feathers that were fully grown were noted in position but not scored for growth. Tail scoring was performed only by me to provide consistency in scoring.

Statistical Analysis

I ran a logistic regression (PROC LOGISTIC, Sas Institute Inc. 2002), bounded by 1 and 0, whether the bird had 1 or more notched tail feathers or no notched tail feathers as a function of sex, day of year (doy), and season for mallards, pintails, and gadwalls. The doy variable was derived from the date the bird was harvested. For the doy variable I set August 1 as doy 1 for all analyses. The season variable represented the

two separate hunting seasons, 2003/2004 and 20004/2005, during which I collected data. The 2003/2004 was represented as 1, while the 2004/2005 was represented as 0 for statistical analyses. From the logistic regression I was then able to predict the probability (DATA PREDICT, Sas Institute Inc. 2002) that a bird will have one or more notched tail feathers for a given day of the year. When season was included in the final model, taking a mean season (0.15) allowed me to predict the probability (DATA PREDICT, Sas Institute Inc. 2002) that a bird will have a notched tail feather for each doy in the mean season. I also ran an analysis of variance (ANOVA) (PROC GLM, Sas Institute Inc. 2002) to determine if percent of notched tail feathers varied with sex, date, and season for mallards, northern pintails, and gadwalls. I arcsin square root transformed the data on percent of notched tail feathers to improve normality.

Results

Mallards

Data were collected on 701 juvenile mallards consisting of 227 females and 474 males, with 373 having at least one notched tail feather. There were 240 birds from the 2003/2004 season and 461 birds from the 2004/2005 season. Every mallard that had notched tail feathers also had a bursa.

Logistic regression indicated that there was no significant sex or doy*sex effect on notched tail feathers, so these variables were not used in models predicting the probability of a bird having a notched tail feather. The intercept, season, and doy Wald Chi-Square values were 121.98, 32.19, and 93.77, respectively with all $P<0.0001$. The Hosmer and Lemeshow Goodness-of-fit Test resulted in a Chi-Square value of 9.7452 and $P=0.1882$. I failed to reject the null hypothesis that there is no difference between the

estimated and observed values, implying that the model's estimates fit the data at an acceptable level. The equation for predicting the probability that a juvenile mallard will have a notched tail feather in each season for a given day of the year is as follows:

$$\textbf{notched tail feather} = e^{5.46-1.31\ season-0.07doy}/1+e^{5.46-1.31season-0.07doy}$$

To predict the probability that a juvenile mallard will have one or more notched tail feathers for each doy for the average season, the mean of the two seasons (0.15) should be used in the equation (Figure 1).

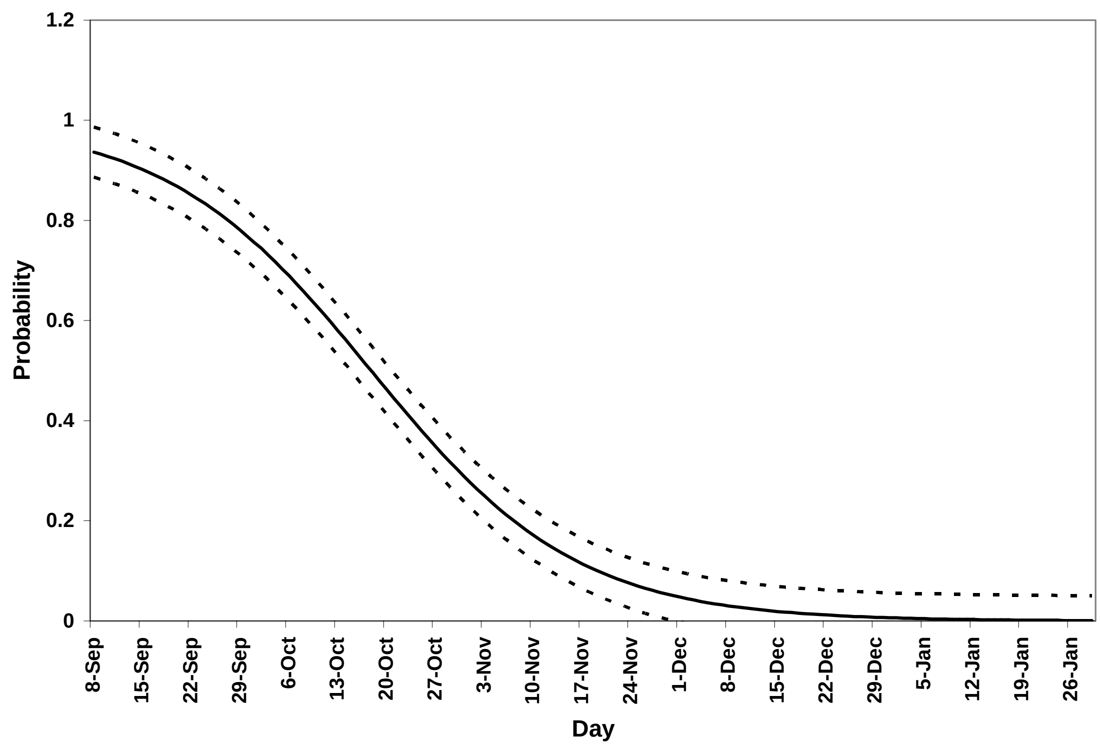

Figure 1. Probability that a juvenile mallard has one or more notched tail feathers for a given day of year. Dotted lines represent 95% upper and lower confidence intervals.

ANOVA indicated no significant sex or doy*sex effect, so these variables were not used in models predicting the percent of notched tail feathers. The intercept, season 2003-2004, and doy yielded t-values of 22.40, -5.95, and -10.95, respectively, with all $P<0.0001$. The molt chronology in 2003-2004 was earlier than in 2004-2005. The equation for predicting the percentage of notched tail feathers that juvenile mallards will have in the 2004-2005 season for a given day of the year is as follows:

Predicted % notched tail feathers = 1.05-0.007487doy

The equation predicting the percent of notched tail feathers is bounded by December 18 when all mallards are predicted to have completed tail molt. The predicted percent of notched tail feathers in juveniles went down by 0.2229 for the 2003-2004 season.

Northern Pintails

Data were collected on 73 juvenile northern pintails, consisting of 30 females and 43 males with 62 having at least one notched tail feather. There were 10 birds from the 2003/2004 season and 63 birds from the 2004/2005 season. Every northern pintail that had notched tail feathers also had a bursa.

Logistic regression indicated no significant season, sex, or doy*sex effect so these variables were not used in models predicting the probability of a northern pintail having a notched tail feather. The intercept and doy Wald Chi-Square values were 22.37 and 14.61, respectively, both with $P<0.0001$. The Hosmer and Lemeshow Goodness-of-fit Test resulted in a Chi-Square value of 10.8727 and $P=0.1443$. I failed to reject the null hypothesis that there is no difference between the estimated and observed values,

implying that the model's estimates fit the data at an acceptable level. The equation for predicting the probability that a juvenile northern pintail will have one or more notched tail feather for a given day of the year is as follows:

$$\textbf{notched tail feather} = e^{3.01-0.053doy}/1+e^{3.01-0.053doy}$$

This value can be used to predict the probability that a juvenile northern pintail will have one or more notched tail feathers for each doy (Figure 2).

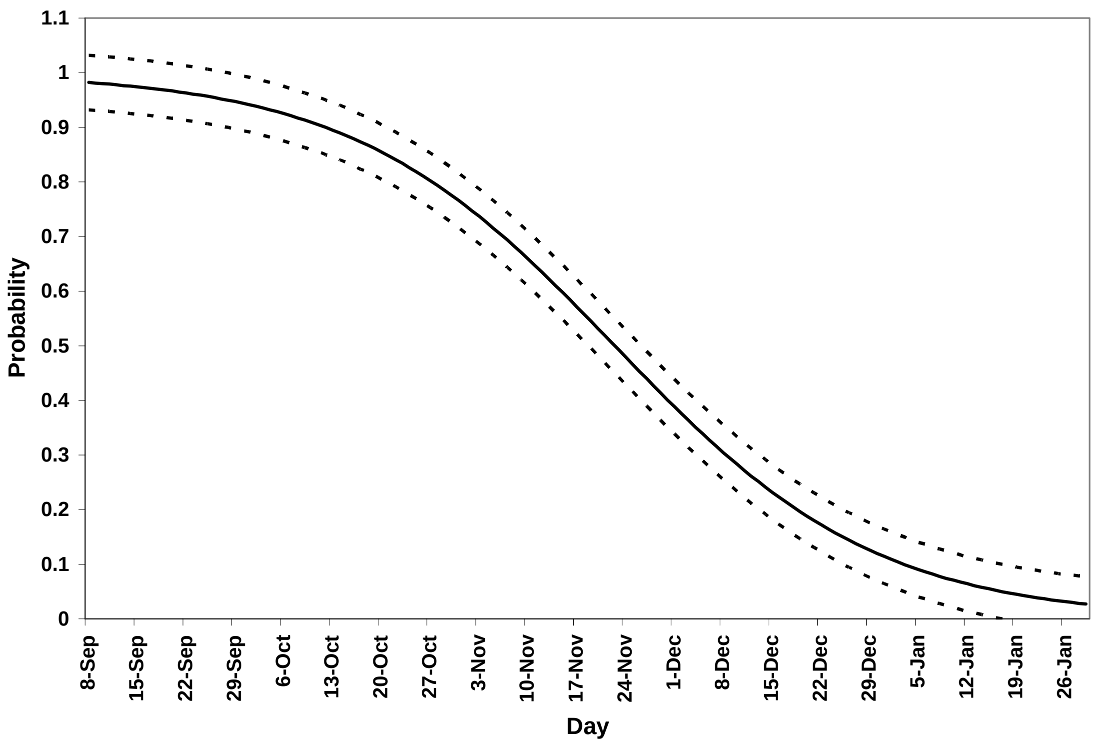

Figure 2. Probability that a juvenile pintail will retain one or more notched tail feathers for a given day of year. Dotted lines represent 95% upper and lower confidence intervals.

ANOVA indicated no significant season, sex, or doy*sex effect so these variables were not used in models predicting the percent of notched tail feathers. The intercept and doy t-values were 11.95 and -5.62, respectively, with P<0.0001. The equation for predicting the percentage of notched tail feathers that a juvenile pintail will have for a given day of the year is as follows:

Predicted % notched tail feathers = 1.72-.010945doy

The equation predicting the percent of notched tail feathers is bounded by January 4 when all northern pintails are predicted to have completed tail molt.

Gadwalls

Data were collected on 291 juvenile gadwalls consisting of 155 females and 136 males, with 275 having at least one notched tail feather. There were 44 birds from the 2003/2004 season and 248 birds from the 2004/2005 season. Every gadwall that had notched tail feathers also had a bursa.

Logistic regression indicated no significant sex or doy*sex effect, so these variables were not used in models predicting the probability of a bird having a notched tail feather. The intercept, season, and doy yielded Wald Chi-Square values of 32.1817 (P<0.0001), 8.5541 (P=0.0034), 17.6558 (P<0.0001), respectively. The Hosmer and Lemeshow Goodness-of-fit Test resulted in a Chi-Square value of 7.1462 and P=0.4138. I failed to reject the null hypothesis that there is no difference between the estimated and observed values, implying that the model's estimates fit the data at an acceptable level.

The equation for predicting the probability that a juvenile gadwall will have a notched tail feather in each season for a given day of the year is as follows:

$$\textbf{notched tail feather} = e^{7.91-2.06\ season-0.041doy}/1+e^{7.91-2.06season-0.041doy}$$

To predict the probability that a juvenile gadwall will have any notched tail feathers for each doy for the average season the mean of the two seasons (0.15) should be used in the equation (Figure 3).

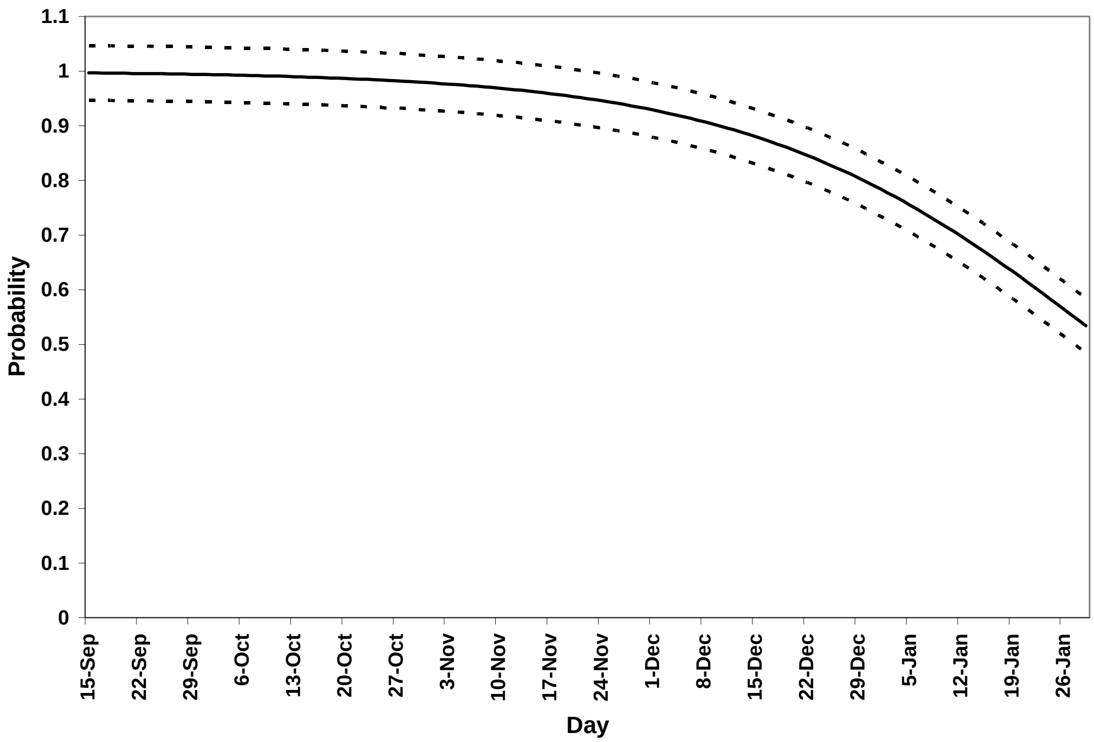

Figure 3. Probability that a juvenile gadwall will retain one or more notched tail feathers for a given day of year. Dotted lines represent 95% upper and lower confidence intervals.

ANOVA indicated no significant sex or doy*sex effect, so these variables were not used in models predicting the percent of notched tail feathers. The intercept, season

2003-2004, and doy yielded t-values of 25.68 ($P<0.0001$), -2.87 ($P=0.0045$), and -12.02 ($P<0.0001$), respectively. The molt chronology in 2003-2004 was earlier than in 2004-2005. The equation for predicting the percentage of notched tail feathers that a juvenile gadwall will have in the 2004-2005 season for a given day of the year is as follows:

Predicted % notched tail feathers = 1.87-0.008459doy

The predicted percent of notched tail feathers in juveniles goes down by 0.188 for the 2003-2004 season.

Lesser Scaup

Data were collected on 55 juvenile lesser scaup, consisting of 16 females and 39 males, with 54 having at least one notched tail feather. There were 22 birds from the 2003/2004 season and 33 birds from the 2004/2005 season. These data were collected between 3 November 2003 to 21 January 2004 and 10 October 2004 to 3 January 2005. Every lesser scaup that had notched tail feathers also had a bursa. The sample size for lesser scaup was too small for rigorous statistical analysis.

Redhead

Data were collected on 31 juvenile redheads consisting of 17 females and 14 males, with all 31 having at least one notched tail feather. There were 4 birds from the 2003/2004 season and 27 birds from the 2004/2005 season. These data were collected between 6 October to 29 October 2003 and 16 September to 28 November 2004. Every redhead that had notched tail feathers also had a bursa. The sample size for redheads was too small for rigorous statistical analysis.

Discussion

Mallards undergo tail molt the earliest of the three dabbling ducks in this study. As early as 8 September, the probability of a juvenile mallard having one or more notched tail feathers was already down to 93.7% with the probabilities falling quickly and dropping below 90% on 16 September. Northern pintails followed a similar pattern of rapid decline in presence of notched tail feathers, but the onset of tail molt is later than for mallards. On 8 September the probability of a juvenile pintail having one or more notched tail feather was 98.2%. On 16 September a juvenile northern pintail's probability of having a notched tail feather is 97.3% and does not fall below 95% until 28 September. My findings are consistent with prior work that shows molting peaks for juvenile northern pintails in October (Miller 1986). Juvenile gadwalls molt their tail feathers considerably later than mallards and northern pintails (Figure 4). The probability of a juvenile gadwall having a notched tail feather does not fall below 95 percent until 21 November. This was also consistent with prior work that shows the peak of juvenile tail molt starting late in November and continuing into December (Oring 1968). From my data on dabbling ducks there appeared to be no pattern of molt except that the two middle feathers were the last to molt.

Interspecific differences in tail molt chronology quite possibly can be attributed to differences in nest initiation date and hatch date. Mallards and northern pintails begin nesting earlier in the spring than gadwalls (Bellrose 1980), they typically hatch earlier, which allows earlier tail molt. An alternate hypothesis is that tail molt is timed to coincide with pre-alternate molt, which may precede fall or winter pair formation. By

this hypothesis molt should match to interspecific variation in timing of pairing (Rohwer and Anderson 1986).

Other studies have shown sexual differences in molt chronology for mallards (Heitmeyer 1985, and Combs et al. 1995). I found that sex did not impact tail molt in juvenile mallards.

The two species of diving ducks, lesser scaup and redheads, retained notched tail feathers considerably longer than all three species of dabbling ducks although the sample size was fairly small for both species (Figure 5). However, from these data lesser scaup appeared to retain notched tail feathers through mid January with redheads retaining some notched tail feathers at least until 28 November. Some redheads retain juvenile tail feathers as late as 7 months from hatching (Weller 1957).

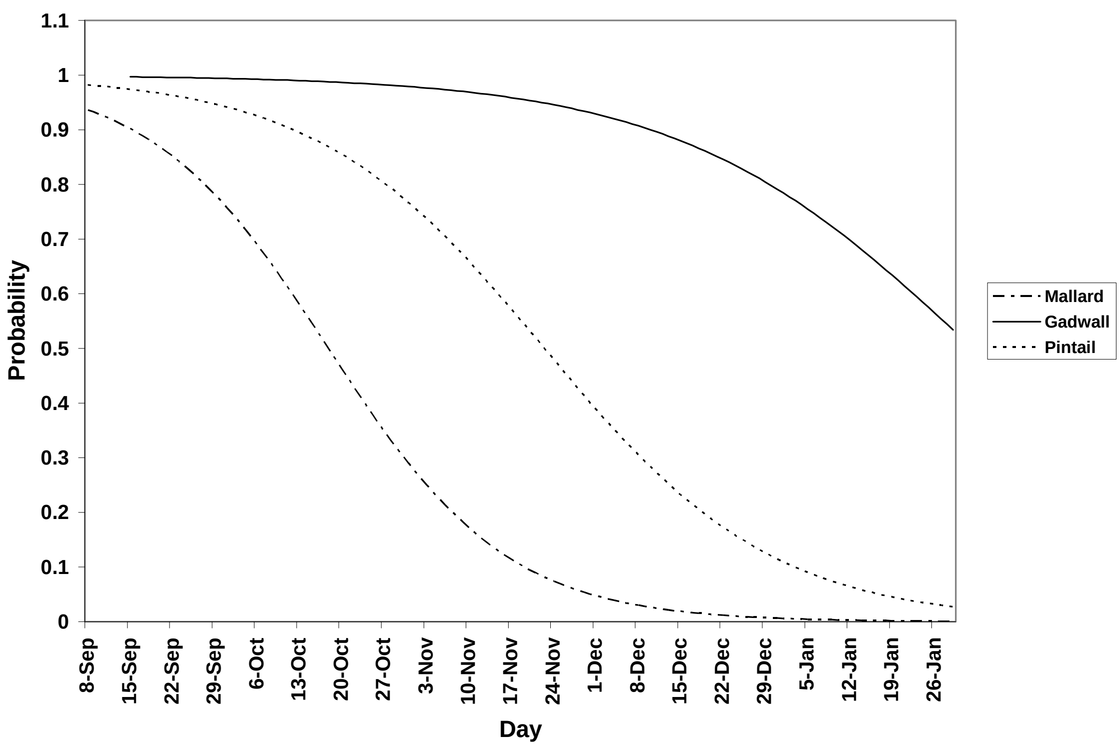

Figure 4. Probabilities that juveniles of the three species of dabbling ducks will retain one or more notched tail feathers for a given day of year.

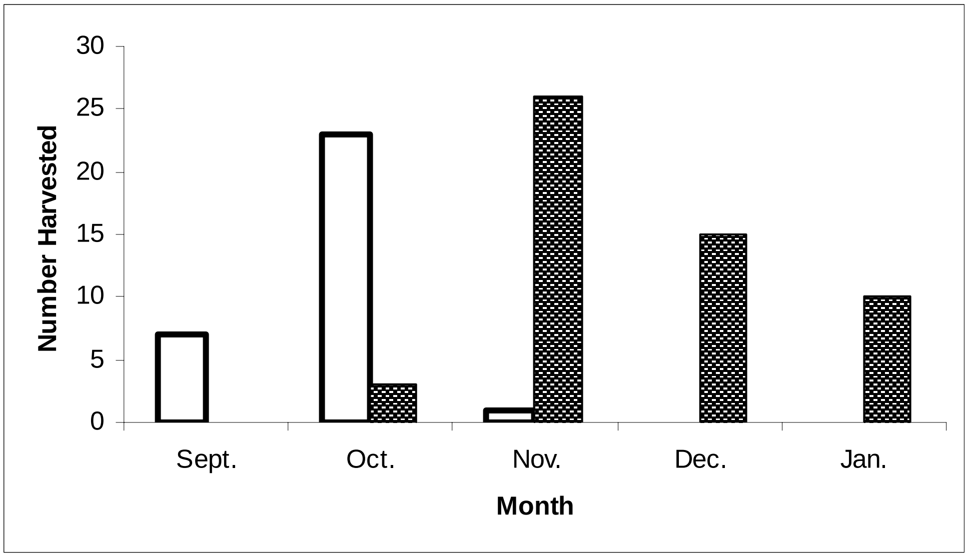

Figure 5. Number of juvenile redheads and juvenile lesser scaup (shaded blocks), with one or more notched tail feathers, harvested during each month.

Management Implications

Age class determination using wing feather characteristics is a widely accepted technique for many species of ducks (Dane 1968, Johnson 1975, Krapu et al. 1979, Wishart 1981, Serie et al. 1982, Gatti 1983), but the simplicity and reliability of aging ducks by tail feathers in the fall make this a very valuable tool (Weller 1957). Accurately aging ducks by wing feather characteristics requires a considerable amount of training and can be challenging for many managers and biologists. This study shows the aging ducks by tail feathers is reliable during certain times of the year. At late summer banding stations, where efficiency is a priority, aging ducks by tail feathers can be a very valuable tool. Mallards can be reliably aged by tail feathers into the middle of September, while pintails can be reliably aged until the end of September. Gadwalls can be reliably aged

by tail feathers late into November, which is not only useful at banding stations but can also be applied at hunter check stations.

Knowing the probability that a duck will have one or more notched tail feathers on a specific date could also be used as a tool to estimate the age distribution of a sample of birds. For example, say there is a bird kill from botulism on October 20 and we recover 500 dead mallards of which 100 mallards have one or more notched tail feathers. Based on my work we know that the probability of a juvenile mallard having one or more notched tail feathers is 0.50 for October 20, so we can estimate that 200 juvenile mallards were killed by the outbreak. This example shows how the results of this study could be used as a quick estimator of age ratios of groups of ducks.

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CHAPTER 3

MORPHOMETRIC MEASURES OF THREE AGE CLASSES OF MALLARDS

Introduction

Researchers have been using various morphological measurements such as wing length, tarsus length, and total length to index body size of mallards for many years (Harris 1970, Owen and Cook 1977). In the past, studies have used similar indices of body size to compare various sex and age classes (Byers and Cary 1991, Robb et al. 2001). However, age classification techniques limited the ability to separate birds into age classes beyond juveniles or adults. Based on initial banding and band recovery data I was able to collect morphometric data on a sample of known-aged mallards birds to see if body size is related to ages over 1 year.

Methods

From October 2003 to January 2004, I collected data for a study designed to validate the aging process used at various Parts Collection Survey WINGBEES across the flyways. I solicited hunter-killed banded mallards (*Anas platyrhynchos)*. I recorded five morphometric variables for carcasses that were intact: weight (+- 5g), wing length, bill length, tarsus length, and total length. Lengths measurements were in mm. Wing length was measured by holding the wing in the area of the radius and ulna and placing the notch tightly against the edge of a wooden block at the end of the ruler. The wing was then flattened along the edge of the ruler and length to the end of the longest primary was recorded (Carney 1992). Bill length was measured as the length of the upper mandible

from the tip of the bill to the most forward point of the nasal opening. Tarsus length was measured from the most anterior medial condyle to the round lateral edge of the articular surface where the tarsus articulates with the exterior lateral condyle of the tibia (Byars and Cary 1991). Total length was measured with the duck laying on dorsal side from the tip of the tail to the tip of the bill while extending but not stretching the neck.

At banding, birds are sexed and aged by cloacal examination and/or various feather characteristics. Birds banded as juveniles and later shot as adults would be of known age. At the Parts Collection Survey WINGBEES, wings are sexed and aged, only as female or male and adult or juvenile, using feather characteristics based on the key developed by Carney (1992). If banding information and age categorization based on experts at the WINGBEES were in agreement, then I was confident that the bird was of known age.

Statistical Analysis

Birds that were banded as juveniles and later shot by hunters (known age birds) were separated into three age classes, juvenile (59), 1.5 years old adults (11), and adults 2.5 years old or older (23), creating a sample size of 93 birds. I ran a principal component analyses to determine if wing length, bill length, tarsus length, and total length could be used as predictors of weight. I then calculated the mean weight, wing length, bill length, tarsus length, and total length for males and females of the three different age classes (Table 1). Analysis of variance (ANOVA) was used to test for differences between sex, age, and sex by age. If any significant differences resulted from the ANOVA, I ran a t-test to compare the means between the adult age classes. These statistical procedures were all done using (SPSS Inc. 1999).

Results

The principal component analyses indicated that there was no relationship between PC1 and body weight. For the pooled sample, I feel this can be attributed to small sample size. Mean weight, wing length, bill length, tarsus length, and total length for males and females of the three different age classes were calculated (Table 1). The ANOVA testing for differences between sex resulted in a significant difference for weight (F=17.23, P=<0.0001) and wing length (F=70.91, P=<.0001), but showed no significant difference for bill length (F=1.52, P=0.222), tarsus length (F=0.15, P=0.703) or total length (F=1.44, P=0.234). The ANOVA testing for differences between age classes resulted in a significant difference for wing length (F=18.95, P=<.0001), but showed no significant difference for weight (F=0.79, P=0.457), bill length (F=1.10, P=0.337), tarsus length (F=0.04, P=0.958) or total length (F=0.39, P=0.678). The ANOVA testing the sex by age interaction resulted in no significant difference for weight (F=0.59, P=0.559), wing length (F=0.20, P=0.817), bill length (F=0.90, P=0.409), tarsus length (F=0.88, P=0.419), or total length (F=0.23, P=0.792). The independent sample t-tests comparing means between 1.5 year old and 2.5 year old or older females and males resulted in no significant difference for wing length (T=-2.15, P=.060) and (T=-1.37, P=.185) respectively.

Table 1. Means for female and male mallards of different age classes.
0.5=juveniles 1.5=birds between 1-2 years old 2.5=birds over 2 years old

Age	Weight (g)		Wing (mm)		Bill (mm)		Tarsus (mm)		Total Length(mm)	
	♀	♂	♀	♂	♀	♂	♀	♂	♀	♂
0.5 Mean	1094.5	1211.8	264.9	279.5	38.4	41.7	45.5	44.5	542.1	577.3
N	21	38	21	38	21	38	20	34	21	38
Std. D	116.8	121.4	5.5	7.6	8.6	1.9	5.2	2.1	118.4	27.1
1.5 Mean	1131.7	1251.0	270.5	288.2	40.7	42.7	44.0	45.4	567.8	582.2
N	6	5	6	5	6	5	5	5	6	5
Std. D	63.7	108.2	3.1	3.7	1.8	0.8	0.8	2.1	26.0	15.6
2.5 Mean	1100.0	1296.4	275.6	292.11	41.7	41.7	44.6	45.2	562.2	579.1
N	5	18	5	18	5	18	4	16	5	18
Std. D	75.8	128.6	4.7	6.0	2.0	2.3	1.9	1.3	20.1	30.0

Discussion

Means of the morphometric variables that I observed were similar with means found in various other studies (Byers and Cary 1991, Rhodes et al. 1996, and Robb et al. 2001). There was a significant difference between the age classes in wing length. However, the t-tests revealed that age differences were not apparent between the 1.5 year old and 2.5 year old or older adults. I believe that this may be attributable to the small sample size of known-aged older birds that were used in these tests. Moreover, the sample of birds spanned the U. S. from California to Delaware and were harvested from September to January. I believe a study looking at a larger sample of known-age adults would have merit.

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VITA

Thomas Michael Siwarski Jr. was born in New Jersey but spent most of his youth in Maryland on the shores of the Chesapeake Bay. With the help of his father this is where he gained his love for the outdoors, whether it be hunting, fishing, or just spending time in nature. Growing up in this environment it did not take him long to decide that he wanted to make a career out of working with wildlife.

Thomas graduated from University of Wisconsin Stevens Point in 2003 with two Bachelor of Science degrees (wildlife and biology). During the summer of 2002 he worked in North Dakota for Delta Waterfowl where he met Dr. Frank Rohwer. Dr. Rohwer offered Thomas a graduate project working on aging techniques for ducks which landed him at Louisiana State University as a Master of Science student. Thomas defended his thesis in December of 2005. He currently lives in Cambridge, Maryland, with his fiancé, with wedding plans for June of 2007.