WOOD DUCKS IN NEVADA

A study to learn more about waterfowl nesting in Nevada and to develop new techniques in waterfowl management due to the unique structure of Nevada wetlands.

Annual report through January 2009

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INTRODUCTION AND BACKGROUND

Little is known about Wood Ducks in Nevada. Wood ducks are a lightly harvested species with current harvest averages about 400 birds per year within the state of Nevada. Wood Ducks nest in cavities, especially man-made nesting structures, which makes them an easy species to study and monitor, because of less time involved in searching for nests. Several state waterfowl associations have initiated Wood Duck nesting programs, with great success, as a tool to introduce the public to wildlife issues, management, and research. The primary goal of this project is to understand survival, , reproductive success, recruitment of juveniles into the breeding population, and harvest. We will address this goal using a combination of marked individuals with unique tags (such as standard and coded legbands and webtags), with subsequent encounters of those individuals (recaptures, resightings, and hunter reports), and monitoring nesting effort.

This project is unique because the potential for an intense capture-recapture-recovery is high. This population is relatively isolated from other Wood Duck populations and the habitat Wood Ducks use in and around Fallon, Nevada, is relatively limited which will increase the likelihood of large number of captures and recaptures of those individuals. The unique characteristics of the wood duck population around Fallon allows for an intense study design which has not been accomplished with any other population of ducks. The potential exists to study this population of ducks in ways no other duck populations of any species have been studied to date and this population of wood ducks will allow us to develop a study design that can be applied to other species and population of ducks in North America. For example, we are unaware of any other study which can partition survival into 9 monthly intervals. A key question in the waterfowl research community is when mortality is occurring and when in the annual cycle natural mortality is being compensated by harvest. This study has the potential to be a model system for understanding population dynamics of ducks, and most importantly, the understanding of effects of harvest on waterfowl populations.

This project originally began in 1991 by Steve and Roxanne Davis of Fallon, NV. Roxanne organized a women's chapter of Ducks Unlimited and used the funds from this organization to buy 100 plastic Wood Duck nest boxes. Steve installed these boxes immediately in various locations near the Fallon area. Discussions began in 2003 about initiating a nesting and banding program on Wood Ducks in the Fallon area and these efforts began that year. Beginning in 2004, Nevada Waterfowl Association became involved and an effort was initiated to mark ducklings on the day of hatch. More boxes have been added to the nest monitoring project every year to the present. Through the 2006 field season, this project was carried out by 3 volunteers with logistical support provided by Stillwater NWR and by donations from the Nevada Waterfowl Association. A substantial grant was awarded for this project in 2006 by the Nevada Department of Wildlife through the Heritage Grant program. This grant permitted hiring a full time technician to work on the project and to install 30 radio transmitters on Wood Ducks beginning in spring 2007, and subsequently the grant was renewed for the 2008 and 2009 field seasons. Beginning with the 2009 field season, an masters level graduate student will be conducting the field work and analyzing data. Thus this project also is providing educational opportunities for students interested in wildlife ecology and management. This project has evolved into a cooperative project between the public, the U.S. Fish and Wildlife Service, Nevada Department of Wildlife, Nevada Waterfowl Association, and the University of Nevada Reno.

GOALS OF PROJECT

1) Erect and maintain a large number of Wood Duck nesting boxes.
2) Monitor nesting boxes during nesting to record nest box use, success, incubation patterns, and production of ducklings to obtain estimates of productivity.
3) Capture and mark individuals of all ages and genders of Wood Ducks during the post-hunting, nesting, and pre-hunting seasons so that we can follow individuals throughout their lives and to obtain estimates of survival and to assess harvest rates.
4) Record body condition by measuring and weighing individuals throughout the year from capture efforts and hunter killed birds.
5) Use radio telemetry to collect information on habitat use, nest site selection, molting locations, adult female survival, breeding propensity, and brood survival.
6) Use this project as an educational tool for elementary, undergraduate and graduate students, and the general public.
7) To publicize the project and report results through magazine and newspaper articles, television, and scientific journals.

METHODS, RESULTS, AND DISCUSSION

Education and publicity

We encourage visits to our project from the public, students (both university and K-12 level), and professionals. The unique setting of this project and proximity to towns make it extremely easy to visit the project. We focus on involving the general public in helping with the project including landowners and neighbors. We also encourage school groups of all ages from elementary students to graduate students to participate in field work and data collection.

We have had several members of the public assist us in the project, including: landowners, members of the Nevada Waterfowl Association and their families, juvenile probation youth, waterfowl hunters, and birders. The entire 2006 cohort of the NRES 310 junior level wildlife class from the University of Nevada Reno conducted a field lab exercise in which they attempted to identify habitat variables that Wood Ducks used when selecting nesting boxes. In

Figure 1. Picture of University of Nevada Reno undergraduates at the end of a field trip capturing and banding ducks at the property of Larry and Trini O'Shaugnessey.

Figure 2. The Sparks, Nevada boy scout troop installing the final nesting box after building 76 boxes.

both 2007 and 2008 students from the NRES 310 and NRES 488 classes have assisted with capturing ducks (Figure 1). We have successfully had two Eagle Scouts complete their service project by building and installing Wood Duck boxes, and we anticipate another completing his project by 28 February 2009 (Figure 2). Several lectures about the Wood Duck project have been presented at both Fallon and Reno High Schools. Two graduate students has collected data from this project to satisfy requirements to complete their dissertations at UNR (see Almeida et al. *in prep*.).

We have had great success in getting students and the general public involved. A student chapter of the Wildlife Society has been formed at UNR, we are hoping to involve undergraduate students at a much higher level by having them collect data and potentially analyze data as part of their graduation requirements. The primary way we hope to involve these students is by using them to help with weekly nest checks. We hope that we can train 4 crew leaders to assist the graduate student so that all nest checks can be completed on a single day each weekend during nesting. This will allow the graduate student more time to focus on other parts of the project and allow undergraduates to gain valuable experience in collecting data and handling wildlife.

We have been contacted by many teachers at the high school level and have provided lectures and lab exercises to expose young people to natural resources right out their door. These experiences may be very important to expose future generations to wildlife and instill an interest and ethic to be concerned about the management of wild populations.

We make strong efforts to communicate our project to all audiences. We communicate with newspaper writers, television reporters, and state waterfowl organizations. We anticipate that the results of our studies will be submitted to professional scientific journals. The Wood Duck project has been featured in the Reno Gazette Journal twice in 2005, and once in 2007. Five articles have appeared in the Nevada Waterfowl Association Flyer since 2005. In September 2006, we presented some of our results at the monthly meeting of the Lahontan Audubon Society. During the 3rd week of February 2007, Chris Healy from the Nevada Department of Wildlife, came out to the project to collect footage for a spot on KOLO channel 8 which aired March 8, 2007. The Fallon Star Press ran a cover story about the project. The March 2008 edition of the California Waterfowl Association featured an article about the Nevada

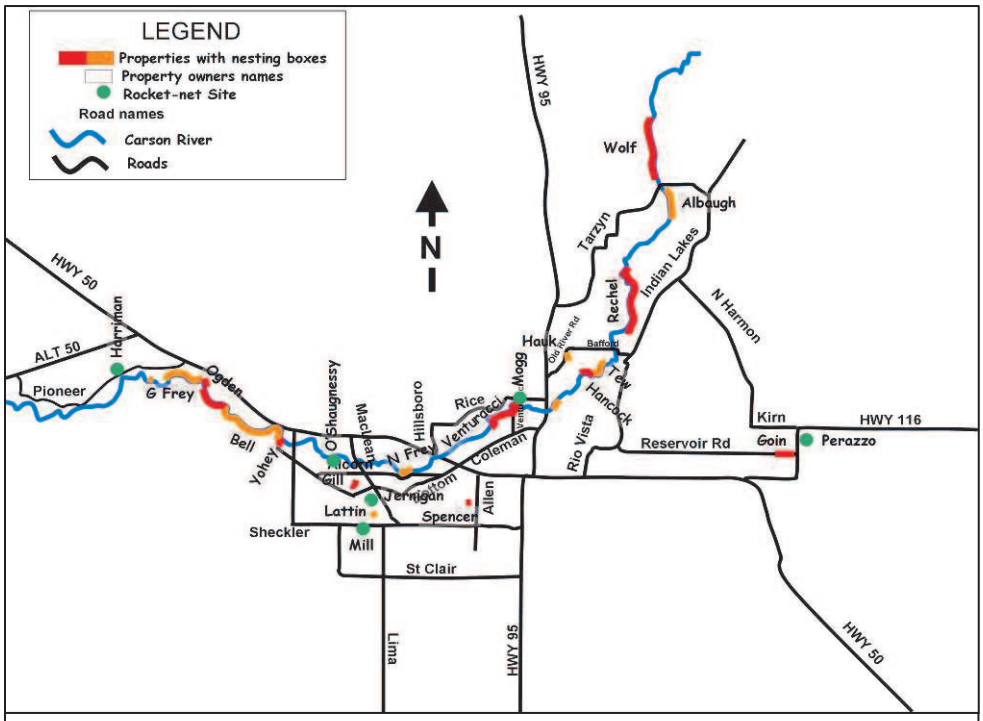

Figure 3. Map of study area near Fallon, Nevada showing locations of properties.

Wood Duck project. In spring of 2008, we had a featured article in the USFWS publication *Refuge Update* which ended up being the lead article for the USFWS-refuges website for 2 months. In September of 2008, we assisted in filming for a short 12 minute edited movie highlighting the Wood Duck project and how students from UNR are involved (NineCaribou Productions: Jake Willers). In November, 2008, a presentation was made to the monthly meeting of the Fallon Rotary club. We plan on making use of any opportunities to publicize the project.

Figure 4. Photographs of plastic and wooden nesting boxes.

Study Area

We are conducting this study along the lower Carson River in Churchill County, Nevada (Figure 3). Wood Ducks are found along the main stem of the Carson River, associated oxbow lakes, and water delivery ditches. Preferred habitat of wood ducks is associated with wooded areas, consisting primarily of cottonwood and Russian olive. All of the properties we are working on are privately owned.

Installation of Nesting Boxes

Approximately 100 plastic boxes (www.cattailproducts.com) were installed in 1991 near Fallon, Nevada primarily along the Carson River, with some boxes along drains and oxbow lakes (Figure 3). Most of these original boxes were mounted on cottonwood trees at a height of 6 to 40 feet above the ground. The remaining boxes were mounted on four inch diameter surplus steel irrigation pipe (Figure 4). All of the boxes mounted on pipes are approximately 6 feet off the ground. We will continue mounting wooden and plastic nesting boxes on these irrigation pipes as they are a deterrent to raccoons and are easy to move to new locations. We select private properties in which cooperating landowners will allow for a number of boxes to be installed (6 to 35) for efficiency in checking and monitoring. Boxes are placed in areas that likely are attractive to wood ducks and near water. Since 2003, boxes have been purchased by the Nevada Waterfowl Association, purchased through sponsors at Nevada Waterfowl Association Fundraising events, built by Boy Scout as Eagle Scout projects, or built by High School biology classes.

Approximately 100 plastic boxes were installed in the Fallon area in 1991. Many of these were still operational at the beginning of this project in 2003. Private landowners were contacted in cases where we found boxes already present and were enrolled in this project. We installed 23, 55, 100, 8, and 63 boxes in 2004, 2005, 2006, 2007, and 2008, respectively (Table 1). Wooden boxes for nesting were built and installed by Boy Scouts and High School biology classes 5 in 2006, 73 in 2007, and 108 in 2009; those students have been extremely helpful with the success of this project and they are increasing their effort each year. Presently, we have 372 boxes installed from Diversion Dam downstream to Wolf Dam (approximately 50 boxes still need to be installed at the time of this printing).

We have installed a large number of nesting boxes from the Diversion Dam downstream

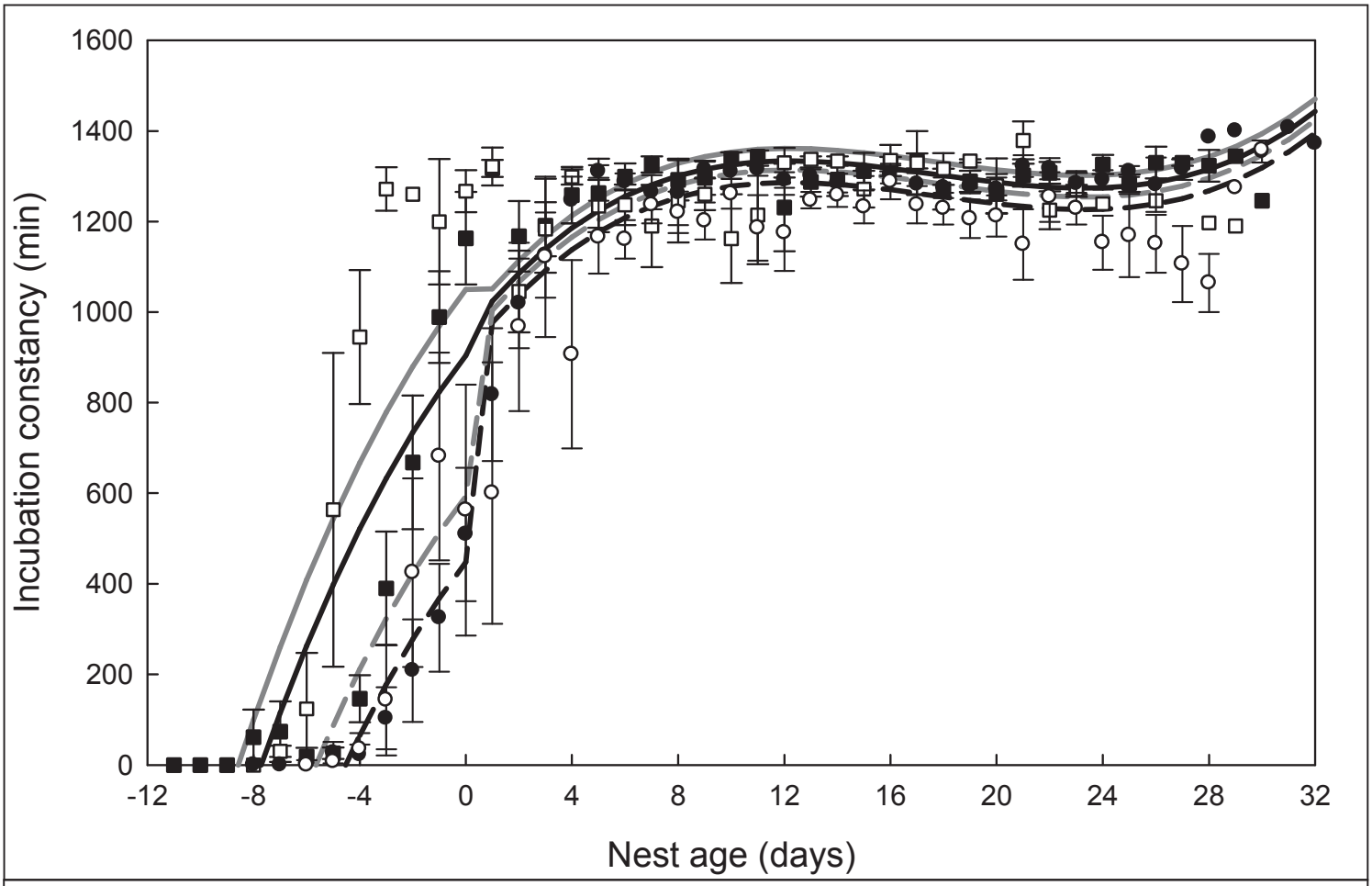

Figure 5. Daily incubation constancy of female Wood Ducks as a function of nest age in Fallon, Nevada, 2006-2007. Nest age was standardized so that age = 0 days for all nests at clutch completion regardless of clutch size. Lines represent predicted values for ASY females incubating large (solid black line) and small (dashed black line) clutches and SY females incubating large (solid gray line) and small (dashed grey line) clutches. Also shown are the means ± 1SE of the observed daily incubation constancy for ASY females incubating large (filled squares) and small (filled circles) clutches and SY females incubating large (open squares) and small (open circles) clutches. From Almeida et al. *in prep*.

to Wolf Dam. We find it difficult to envision installing more boxes as approximately 70% of this length of river has boxes almost every 100 yards. We have installed nesting boxes along several water delivery ditches. The remaining areas along the river are comprised of small parcels, which is more difficult to access as many landowners would have to be contacted.

Plastic boxes require nearly zero maintenance annually. In comparison, the wooden boxes (approximately half of the boxes currently installed) require annual maintenance and sometimes have short lifespans. For example, in a sample of 73 boxes installed in 2007, 5 have since fallen off the poles they were mounted on due to splitting of the backboards. Presently, we are conducting a study to determine if Wood Ducks prefer plastic or wooden boxes. Nonetheless, all of the wooden boxes we have were built as Eagle Scout projects, and even given the maintenance issues; it may be beneficial to continue to include Scouts and other groups to conduct these projects.

By erecting and maintaining nesting boxes, we are building an infrastructure for use in the future so that we can follow the use and productivity of Wood Ducks in Nevada. Many advantages are gained by studying birds which use artificial nesting structures. Checking nests is easier because we do not have to find the nests. That is, we know exactly where they can nest, all we have to check these potential nest sites. Some of the most influential studies examining theories of trade-offs in reproductive choices have been made by using birds nesting in artificial

nesting structures. We are unaware of such studies in Wood Ducks.

Monitoring of Nesting Boxes

We begin checking nesting boxes approximately the 3rd week of March when the first nests are initiated. We visit all nests boxes every week through the middle of July at which time all nests have hatched. At each nest check, we block the entrance to the nest box in an attempt to capture the hen. We record information such as: 1) what species may be using the box (Wood Ducks, American Kestrels, European Starlings, Western Screech Owls, and Northern Flickers), 2) clutch size, 3) Wood Duck egg measurements, 4) laying order, 5) incubation stage by candling eggs, and 6) identity of the hen. At each nest visit, we remove all European Starling nests and eggs. We also replace nesting material (wood shavings) as necessary.

By candling eggs, we can predict the hatch date. We monitor nests daily beginning on their predicted hatch dates so that we can confirm the actual date of hatch, monitor hatching success, and attach webtags to hatching ducklings (Alliston 1975). We carefully label each egg and collect measures of length and width.

We monitored 50, 53, 77, 130, 246 and 257 nesting boxes in 2003, 2004, 2005, 2006, 2007 and 2008 respectively (Table 1). In these same years, we found 9, 11, 22, 44, 57, and 99 Wood Duck nests. These nests resulted in 104, 134, 221, 507, 543, and 1002 Wood Duck eggs being laid in these boxes. Of those, 91, 98, 161, 213, 257 and 275 hatched. Across years, we have experienced an increase in the number of nesting boxes installed, the number of Wood Ducks nests found, number of eggs laid, and number hatching (Table 1).

We are hoping to enroll many undergraduates to assist in monitoring nest boxes beginning in 2009. We hope to have ~5 undergrads help during the 12 week nesting season. Potential exists for these students to use this experience as an internship or for independent study credits.

We also collect nest attendance rates of the hens by using a small data logger (i-button). I-buttons are programmed to record temperature every seven minutes. We place i-buttons in nests immediately after nest discovery and download data to a laptop computer once a week. By examining the data for peaks and drops in temperatures, we are able to measure amount of time spent on the nest by individual Wood Ducks during laying and incubation. A manuscript examining the i-button data collected on this project has been written and is currently ready for submission to a scientific jour-

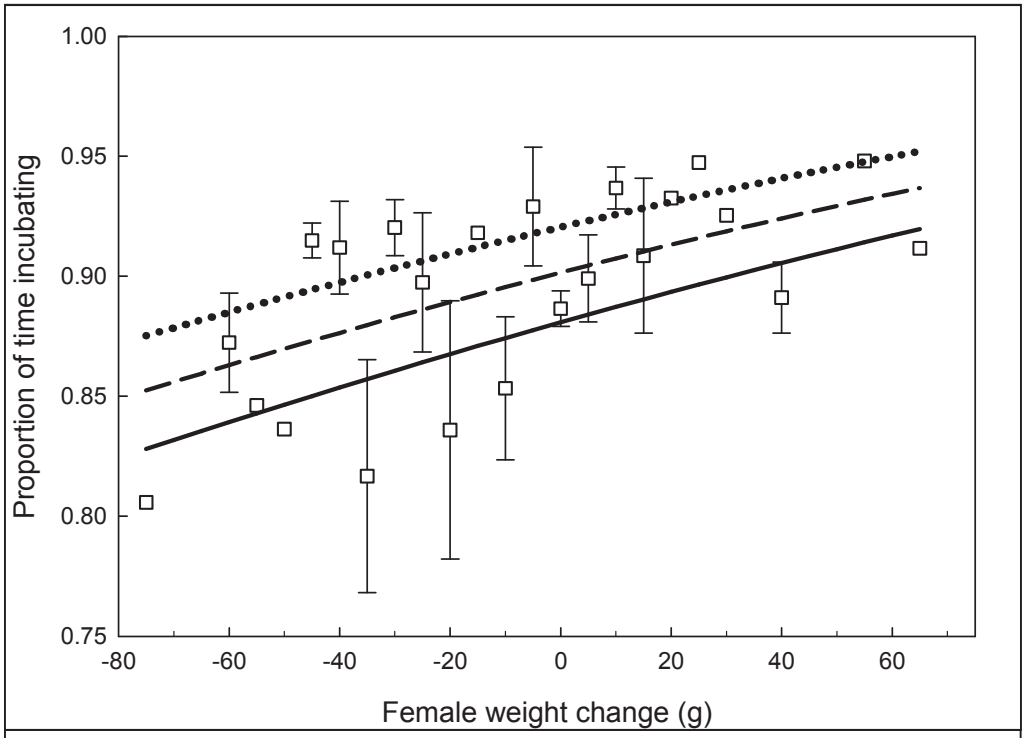

Figure 6. Proportion of time spent incubating by female Wood Ducks in Fallon, Nevada, 2006-2007, during weeklong periods as a function of female mass change and nest age. Negative values represent mass loss while positive values represent mass gain. Nest ages of 10 days (solid line), 20 days (dashed line) and 30 days (dotted line) are shown and indicate the age of the nest at the end of a weeklong period. Also shown are the means ± 1 SE of the observed time spent incubating by amount of mass lost by females (open squares). From Almeida et al. *in prep*.

nal (Almeida et al. *in prep*; *see* Figures 5 & 6). Data collection will be ongoing as these data are very inexpensive to collect.

We have had excellent success in documenting nest box use and productivity by Wood Ducks. In addition, we have marked nearly all ducklings hatching in the nesting boxes since 2006. We anticipate being able to estimate the number of recruits contributed to the local population by our efforts by installing nesting boxes. With these data, future studies may be able to examine several life-history traits influenced by nesting effort and success.

Capture and Marking of Individuals

We begin baiting sites with whole kernel corn following the close of duck season, usually late January, and continue baiting our sites through nesting and brood rearing. Baiting continues through the non-hunting seasons and concludes ten days before duck season opens (we cease all banding operations the first week of October). We have used a combination of clover leaf swim-in traps, floating walk-in traps, and air cannon and rocket nets to capture non-nesting Wood Ducks. The clover leaf traps are constructed of 1" x 2" weld wire and are approximately 4 feet tall and

Table 1. Summary of number of boxes and measures of nesting effort and success by property owner and year.

Property	Year	# Boxes	# nests	# Eggs laid	# Eggs Hatched	# marked ducklings
Albaugh	2003	9	3	35	28	0
	2004	9	1	13	13	0
	2005	14*	2*	20*	15*	11*
	2006	14*	3	32	23	22
	2007	14*	1	7	6	0
	2008	14*	1*	22*	0	0
Anglin	2003	1	0	0	0	0
Bell/Ogden/Yohey	2007	56	11	90	39	38
	2008	57	25	249	70	44
Carson River	2003	3	0	0	0	0
	2004	3	0	0	0	0
	2005	3	0	0	0	0
George Frey	2005	6	0	0	0	0
	2006	32	7	79	33	30
	2007	32	4	33	10	9
	2008	33	8	72	24	9
Norm Frey	2006	11	11	112	27	20
	2007	11	7	63	40	40
	2008	11	15	158	46	43
Getto	2003	10	3	36	30	0
	2004	10	5	58	44	16
	2005	10	5	52	48	21
	2006	13	3	20	9	0
	2007	13	2	17	7	7
	2008	13	2	11	9	8
Gill	2005	5	2	22	13	13
	2006	6	5	31	29	0
	2007	6	3	23	0	0
	2008	6	4	44	18	18
Goin	2008	5	0	0	0	0
Hauk	2008	3	1	9	0	0
Lattin Pond	2007	6	2	18	6	6
	2008	6	7	59	0	0
Mori	2003	15	0	0	0	0
	2004	19	1	8	8	0
	2005	18	2	19	19	10
	2006	21	1	10	9	0
Ogden	2006	5	0	0	0	0
	2007	5	0	0	0	0
	2008	5	0	0	0	0
Rechel	2003	12	3	33	33	0
	2004	12	4	55	33	0
	2005	15	9	86	56	25
	2006	22	14	162	98	54
	2007	22	11	105	73	72
	2008	22	13	117	42	37
S-Line	2008	1	0	0	0	0
Spencer	2005	6	4	42	25	16
	2006	6	6	63	14	13
	2007	6	2	23	18	18
	2008	6	2	20	14	14
Tews / Hancock	2007	18	0	0	0	0
	2008	18	0	0	0	0
Venturacci	2007	35	14	164	58	53
	2008	35	21	241	52	42
Wolf	2007	22	0	0	0	0
	2008	22	0	0	0	0
TOTAL	2003	50	9	104	91	0
	2004	53	11	134	98	16
	2005	77	22	221	161	85
	2006	130	44	507	213	139
	2007	246	57	543	257	243
	2008	257	99	1002	275	215
GRAND TOTAL		N/A	242	2511	1095	698

Table 2. Summary of banding effort by month and year. Columns labeled new are the number of new markers applied to Wood Ducks for that month. "Rec" corresponds to the number if unique individuals which were captured in the specific month, but were marked in a previous month. Shot refers to the number of banded Wood Ducks shot and reported in each year.

Year	Jan.		Feb.		March		April		May		June		July		Aug.		Sept.		Oct.		SHOT	TOTALS	
	New	Rec	New	Rec	New	Rec	New	Rec	New	Rec	New	Rec	New	Rec	New	Rec	New	Rec	New	Rec		New	Rec
2003							6	2	53	2	1	5	19		1						2	99	9
2004			7	2	63	11	17	8	4	5	20	2									15	111	28
2005			12	3	24	11	15	13	72	9	27	8	8	4							10	158	48
2006			44		111	29	16	23	57	18	65	13	24	3	8		8	1	7	1	27	340	88
2007	39		210	28	82	51	87	31	130	31	150	24	60	10	68	14	33	9			40	859	198
2008	56	19	112	96	139	106	30	44	161	47	103	37	113	33	142	50	133	41			117	989	473
Totals	95	19	385	129	419	208	171	121	477	112	366	89	224	50	219	64	193	51	7	1	211	2556	884

are covered with mesh netting. The floating walk-in traps have a wooden base underlain with a layer of foam. The capture portion of the floating traps are constructed of 1" x 2" welded wire and contain primary and secondary entries that prohibit escape (Figure 7). Rocket nets and air-cannons have been used in areas where landowners have been feeding birds for some time and also where we have placed bait to attract them. Lastly, we are also able to capture nesting hens and ducklings from nesting boxes.

When we capture Wood Ducks, all individuals are marked with unique markers. Ducklings which are too small for standard legbands are fitted with either a clay-filled stainless steel legband (plasticine bands; Blums et al. 1999) or webtags (Alliston 1975; Figure 8 & 9). Due to problems encountered with the use of plasticine bands, we discontinued the use after the 2007 field season. Webtags are typically used for marking ducklings in the nest box prior to departure from the nest site. However, in instances where ducklings are captured away from nest sites, if they are too small to hold a standard legband, they are fitted with a webtag. All Wood Ducks that are large enough to hold standard aluminum leg bands are fitted with such markers. Beginning in 2008, all Wood Ducks which were large enough to hold bands are also banded on the opposite leg with a 1cm tall yellow PVC band with two black engraved characters (Figure 10; we will use alternative colors once we run out of codes with a specific color). In 2008, we applied 100 nasal saddles made of yellow PVC with 2 digit black engraved characters (Figure 11). These 100 nasal saddles are an experiment to test effects of nasal saddles on survival of Wood Ducks. Nasal saddles are much easier to detect and read in comparison to the coded tarsal bands as the nasal saddles do not require individuals to exit the water to detect. Nasal saddles were placed on all nesting hens and a sample of second year (hereafter SY) and after-second year (hereafter ASY) males and females captured in the time period following nesting. We anticipate conducting a formal analysis regarding the effects of nasal saddles by July,

Figure 7. Photograph of a floating bait trap.

2009. If we find support of no effects of nasal saddles, we anticipate fitting all individuals with nasal saddles. We began using coded tarsal bands and nasal saddles to attempt to be able to identify individuals without having to physically capture them. By using spotting scopes at loafing or feeding sites, we can read these markers at distances up to 200 meters.

We determine age and sex, and measure all captured or harvested individuals. We assign ages to individuals based on the following criteria: 1) Local (L) – a duckling in its calendar hatching year that is incapable of flight (can further be broken down into Class IA through III), 2) Hatch Year (HY) – a duckling in its calendar year that is capable of flight, 3) Second Year (SY) – an adult looking bird, but based on plumage, we can determine it hatched in the prior calendar year, 4) After Second Year (ASY) – an adult looking bird, but based on plumage, we can determine that it did not hatch in the prior calendar year, and 5) After Hatch Year (AHY) – an adult looking bird, but we can not determine its hatching year. We collect the following morphological measures: diagonal tarsus, culmen, total head, 9th primary, wing chord, body, and weight.

Hunters encounter our marked birds when hunting Wood Ducks. All bands are engraved with the 1-800-327-BAND toll-free band number to facilitate reporting harvest of a banded bird to the USGS Bird Banding Laboratory. Beginning in 2008, we provided a photograph and a request to report harvest of webtagged Wood Ducks in NDOW's waterfowl hunting pamphlet (Figure 12).

We captured and marked 16, 101, 136, 244, and 215 Wood Duck ducklings on their day of hatch in 2004, 2005, 2006, 2007, and 2008, respectively (Table 4). We have reencountered 43 unique individuals originally marked as day-old ducklings; ten were reported by hunters and 33 were captured in banding operations or as nesting females. We have captured and fitted with aluminum bands 1878 unique Wood Ducks in baited walk in

Figure 8. Photograph showing different markers on adult Wood Ducks. The top band is a plasticine band which was applied when this bird was a day-old duckling. Bottom bird shows a webtag and a metal tarsal band.

Figure 9. Application of a webtag to a duckling while still in the egg.

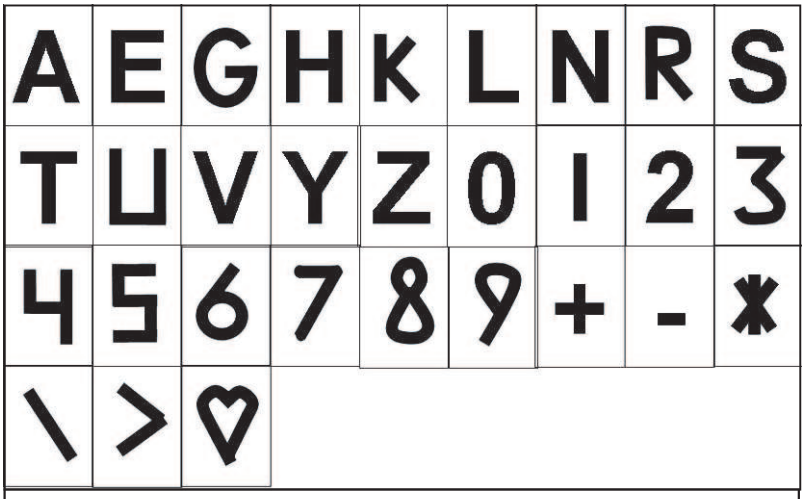

Figure 10. Letters, numbers, and symbols used on plastic tarsal bands.

Table 3. Summary of captures away from nesting boxes by property of capture 2003-2008.

	2003		2004		2005		2006		2007		2008		Total	
Property Name	new	recap	new	recap	new	recap	new	recap	new	recap	new	recap	new	recap
Albaugh	96	9	63	31	30	12	60	66	55	79			304	197
Bell									16	32	54	73	70	105
Bottom Rd									1				1	0
Golf Course							3	1					3	1
George Frey							60	85	84	102	69	74	213	261
Gill							24	30	31	50	2	8	57	88
Goin								1	17	25			17	26
Greenwell									56	10	16	5	72	15
Harriman											53	20	53	20
Hauk									8	4	1		9	4
Lattin									5	1			5	1
Mill									12	3	187	86	199	89
Mogg									146	83	60	30	206	113
Morgan							2	1					2	1
Neff										1			0	1
Norm Frey							8	5	2		5	4	15	9
Nivin			23	8	18	4							41	12
O'Shaugnessey									74	23	110	55	184	78
Perazzo									39		83	167	122	167
Rechel							26	24	22	18	7	2	55	44
S-Line Canal											27	62	27	62
Sheckler/Lattin											7		7	0
Smith									1				1	0
Stillwater											5	5	5	5
Venturacchi											7	1	7	1
Yohey									17	22	21	25	38	47
Total	96	9	86	39	48	16	183	213	586	453	714	617	1713	1347

traps, rocket nets, air-cannons, or while in the nest (Table 2 & 3). Our banding efforts have yielded a total of 884 monthly recaptures (i.e., this number takes into account repeated captures of individuals on a month by month basis). We captured an unusually large number of Wood Ducks after Spring 2007 because we hired a full-time technician who has been able to focus fully on the capture and marking of these Wood Ducks.

Two hundred and eleven marked Wood Ducks have been shot and reported by hunters. Two of these reports were of birds marked as ducklings and fitted with plasticine bands. Eight Wood Ducks which were marked with only a webtag have been reported by hunters. Most (169 or 80%) of these recoveries are from the Fallon, NV area, but we have received reports from California (31 or 15%), Idaho (9 or 4%), Utah (1 or 1%), and Montana (1 or 1%; Figure 13).

We have captured 2 Wood Ducks originally banded in the Central Valley of California, and one originally banded in central Washington. All 3 of these recaptures were birds originally marked in July or August the year prior to capture in Nevada.

We have captured and marked a total of 2,556 Wood Ducks since 2003. In addition, this project has provided a total of 884 unique monthly recaptures. Prior to the beginning of this project, only 14 Wood Ducks had been banded in Nevada. Based on reports from hunters, we now know that this population does mix with other breeding populations of Wood Ducks in the Pacific flyway. It remains unclear; however, when these movements occur and when different groups of birds use the state of Nevada. Presently, crude estimates of harvest are below those of other duck populations which suggest that harvest is not an important limiting factor in this population.

No other data set examining demographics of ducks can partition survival rates into 9 periods within the annual cycle. This

Figure 11. Photograph of an adult female Wood Duck with a nasal saddle installed.

data set includes marked birds originating from the marking of ducklings on their date of hatch, individuals older than ducklings, subsequent recaptures, resightings of colored legbands, and recoveries from hunters. Opportunities for future research are great with such a data set. Combined with our estimates of production we will be able to tease apart costs and variation originating from several different choices individuals make. Many of these factors are unexplored in ducks. Much of this unique data is due to the spatial isolation of wetlands in Nevada and the associated logistics for studying waterfowl. In a nutshell, we can follow individuals throughout their lifetimes to document reproductive effort and success along with variation in survival. This could not be accomplished with other duck populations that occur at larger spatial scales, but with our dataset those methods could be developed for other populations of ducks. Therefore, the potential results we develop with this project could have implications for management of waterfowl across North America.

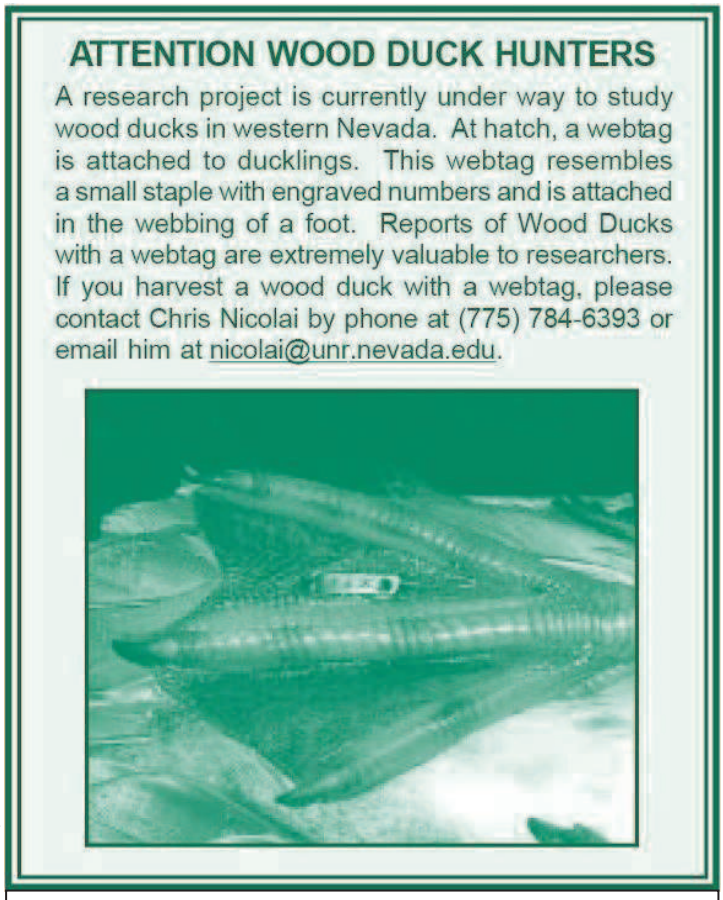

FIGURE 12. Copy of a notice to hunters to look for webtags on Wood Ducks in Nevada which was printed in the 2008-2009 Nevada waterfowl hunting regulations.

Measures of Body Condition

We use the before mentioned structural measures to obtain the first principle components (PC1) score using a principle components analysis. This allows us to capture variation in structural size and relate to it on a single linear scale. By regressing PC1 against weight, we can use the residuals as a measure of relative body condition. We can use these residual scores to examine variation in body condition among and within individuals throughout the year. We anticipate analyzing body condition data in the near future.

Radio Telemetry

We began a radio telemetry component of this study in February 2007, which ended in October 2008. Radio telemetry allowed us to obtain qualitative data on : 1) causes and timing of mortality of individuals throughout the non-hunting season; 2) breeding probability; 3) hen survival; 4) brood survival; 5) habitat use; and 6) nest site selection. By comparing our estimates of survival from radios with estimates from capture recapture data, we will be able to directly estimate effects of radios upon survival. We hope to examine our results more in depth in the near future.

We used 9.5g subcutaneous VHF radio transmitters (159-161 MHz) with an expected battery life of

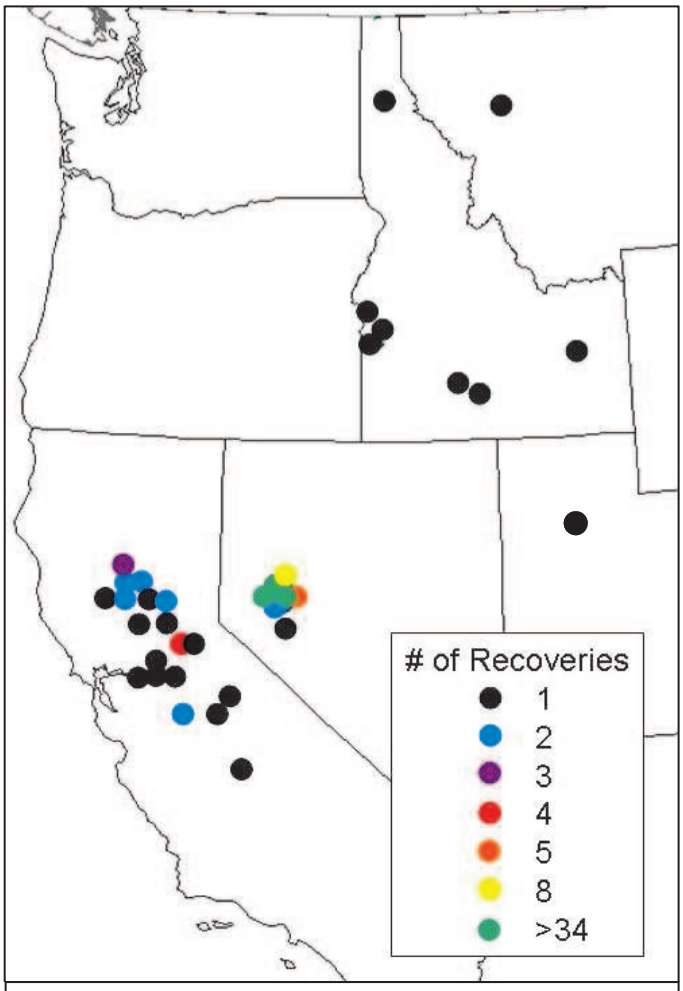

Figure 13. Map of recovery locations for Wood Ducks originally banded in the Fallon, Nevada area 2003-2009.

Table 4. Summary of the number of ducklings marked by year and marker type. Additional data is also provided depicting the number of marked ducklings subsequently encountered during banding operations and from reports by hunters. Gender cannot be determined on the day of hatch, but typically can be determined at subsequent encounters. When hunters reported shot individuals, they provided the gender of harvested birds.

				2006				2007							2008						
				Post	Nest	Pre	Shot	Post		Nest	Pre		Shot		Post		Nest	Pre		Shot	
Year	Marker type	Gender	# released	F	F		U	F	M	F	F	M	F	M	F	M	F	F	M	F	M	Encounters
2004	Plasticine	U	16	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
2005	Plasticine	U	79	1	1	0	2	0	1	0	0	0	0	0	0	0	0	0	0	0	0	5
	Webtag	U	22	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
2006	Webtag	U	136	--	--	0	1	3	1	1	0	0	0	0	1	0	0	1	0	0	1	9
2007	Webtag	U	15	--	--	--	--	--	--	--	0	0	0	0	0	0	0	0	0	1	0	1
	Plasticine	U	156	--	--	--	--	--	--	--	1	0	0	0	0	1	0	0	0	0	0	2
	Both	U	73	--	--	--	--	--	--	--	0	0	0	0	1	0	1	0	0	0	0	2
2008	Webtag @ nest	U	215	--	--	--	--	--	--	--	--	--	--	--	--	--	--	6	8	1	4	18
	Webtag away from nest	U	4	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
		F	11	--	--	--	--	--	--	--	--	--	--	--	--	--	--	0	--	0	--	0
		M	23	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	6	--	0	6

9 months (Advanced Telemetry Systems, Isanti, MN). These were installed in unmarked female Wood Ducks of both age classes (SY and ASY) as close to, but not after the first nests of the year have been initiated. We used standard sterile techniques to apply these radios. A local anesthetic (Lidocaine) was used to eliminate pain during the procedure. We created a pocket in which to place the radio under the skin on the right dorsal side of an individual between the wing and leg. An additional opening was made for the transmitter antenna to exit. Dissolvable sutures were used to close the wound and the bird is held for approximately an hour prior to release. We released all birds after surgery at the location in which they were captured.

We obtained locations for all radios weekly by using a handheld yagi antenna, roof mounted omni-directional antenna, and by use of aircraft. We searched all areas in the study area where we may find Wood Ducks. All locations were plotted on maps. Attempts were made to locate transmitters emitting a mortality signal as soon as possible to determine fate.

We installed 42 radios in 2007 and 39 radios in 2008. We obtained >150 locations annually, documented several mortalities, and identified several natural cavity nesting Wood Ducks. In 2007, we captured 2 hens incubating eggs in our nesting boxes which were originally fitted with radios from trapping operations. No hens fitted with radios were encountered in nesting boxes in 2008. Multiple hens have been captured in banding operations >6 months following implantation of radios of which only one still had a radio. We anticipate summarizing our telemetry results in the near future.

While we have had success in implanting radios, we have had limitations on collecting those data. We believe this is due to two reasons: 1) the undercutting of the banks of the rivers and delivery ditches may impair the radio signal, or 2) a basic lack of effort on the part of the technicians during the two years of the study as they are busy with other parts of the project at the same time and/or their past experience with radio telemetry. Collection of telemetry data is not easy and experience with this technique dramatically helps with the collection of useful data. We discontinued use of radio telemetry at the end of the 2008 field season. We hope to analyze the data in the near future.

ACKNOWLEDGEMENTS

This project has competed 6 field seasons with the first four seasons entirely based on

volunteer effort, and the last two with full time technicians. Naomi Baucom and Curt Kleist collected the bulk of the data in 2007 and 2008, respectively. Steve Davis and his wife Roxanne Davis deserve recognition for the initiation of an interest in Wood Ducks in the Fallon, NV area. Roxanne was instrumental in raising monies to purchase the bulk of the nesting boxes for this project. Additionally, Steve banded a lot of Wood Ducks for us from 2003 through 2007. Bill Henry, Dan Rabbers, and Matt Wilson from the Stillwater NWR have provided hundreds of hours of volunteer time to the project. Without the support of private landowners, this project would not be possible. We would like to thank the following families for allowing us to trap birds, resight bands and maintain nesting boxes on their properties: Albaugh, Bell, George Frey, Norm Frey, Getto, Gill, Goin, Greenwell, Hancock, Harriman, Hauk, Lattin, McAuthur, Mills, Mogg, Mori, Niven, Ogden, O'Shaughnessy, Perrazo, Rechel, Rowlett, Spencer, Tews, Venturacci, Wolf and Yohey. The Nevada Waterfowl Association has also provided support for trapping equipment and purchase of additional nesting boxes. This project could not be completed without the support provided by the Stillwater National Wildlife Refuge and the Nevada Department of Wildlife. Stillwater NWR provided a vehicle and associated gas, and housing for 2007 and 2008. The Nevada Wildlife Heritage Grant has allowed us to expand the project beyond what any of us have expected. The assistance we received to install radios in Wood Ducks was invaluable and was provided by Dr. Ray Cooper of Lahontan Valley Veterinary Clinic, and Drs. Sargeant and Smith from Klaich Animal Hospital. Brian Nelson (Sportsman's Warehouse, Reno) has donated several pieces of field equipment for the 2008 and 2009 field seasons. Zach Bowers (USDA-Aphis) has generously allowed us to use their air-powered cannon-net. Dr. Jim Sedinger, Dr. Kelly Stewart, Mandy VanDellen, Nova Simpson, and Chris Briggs commented on earlier versions of this report.

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