Effects of Backpack Radio Packages on Mass of Captive-reared Mallards Released in Maryland

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Abstract: Radio telemetry has been an invaluable technique to study waterfowl ecology, but impacts of radio packages on ducks have not been experimentally assessed during the non-breeding season. We tested the hypothesis that backpack-style radios with 2 body harness loops influenced the body mass dynamics of 8-week-old captive-reared mallards *(Anas platyrhynchos)* released in Maryland in August. We attached mock radio packages and visual markers to 477 experimental ducks and visual markers only to 582 control birds. Half of experimental and control birds were released on a tidal marsh and received no additional care. Mean body mass of both experimental and control birds released at the tidal marsh decreased over a 3-week interval after release, but mass loss of experimental birds (10.2 g/day) was greater than controls (4.5 g/day). We released the remaining birds on a private Regulated Shooting Area (RSA) where grain was provided for several weeks after release. Among the latter birds, experimental mallards gained less mass (7.7 g/day) than mallards with only visual markers (10.5 g/day). This is the first study of free-ranging, but captive-reared, mallards during the non-breeding season that used an experimental protocol to test effects of radio packages on ducks. Our results parallel studies of free-ranging wild birds during the breeding season in showing that backpack harness radios were detrimental to mallards. We believe there is substantial risk that backpack harness radios influence attributes that biologists are trying to assess using telemetry.

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Wildlife researchers often use radio telemetry to measure productivity or survival of individual animals, particularly in mobile species like waterfowl. Until recently, most telemetry studies of dabbling ducks used back-mounted radio packages that attached with 2 harness loops described by Dwyer (1972). These transmitter attachments have been used extensively in studies of mallards (Cowardin et al. 1985; Reinecke et al. 1987, 1992; Dugger et al. 1994), northern pintails (*A. acuta*, Miller et al. 1995, Cox and Afton 1997) blue-winged teal (*A. discors*, Rohwer 1985), and most other dabbling ducks in North America (Longcore et al. 1991, Gammonley and Kelley 1994, Sayler and Willms 1997).

Uncertainty about potential negative impact of radio packages on animals under observation has been a concern with telemetry studies. Obtaining reliable measures of survival, movements, or reproduction without using telemetry has made it difficult to assess impacts of radio packages on population parameters in waterfowl. Early attempts to assess the impact of radio packages examined behavior of ducks with and without radio packages. Captive mallards and blue-winged teal with Dwyer (1972) backpack harnesses consistently spent more time preening, lost weight, and spent less time in water than birds not fitted with harnesses (Greenwood and Sargeant 1973, Garrettson et al. 2000). Wild mallards with backpacks also spent less time in water, less time feeding, and more time preening than birds without radios (Pietz et al. 1993). Theses behavioral changes motivated the search for alternative radio packages that had less effect on marked birds. Surgically implanted transmitters initially were developed for diving ducks (Korschgen et al. 1983, Olsen et al. 1992) which could not tolerate harness attachments (Perry 1981). External radios without harnesses include back-mounted radios that attach with glue and subcutaneous sutures (Wheeler 1991) or with a stainless steel barb inserted under the skin combined with subcutaneous sutures (hereafter termed anchor backpacks; Mauser and Jarvis 1991, Pietz et al. 1995).

Field evaluations of harness backpacks, glue and suture, and anchor backpacks suggested that harness backpacks substantially reduced reproduction in mallards (Rotella et al. 1993) and blue-winged teal (Garrettson and Rohwer 1998). Glue and suture radios had poor retention times (Houston and Greenwood 1993) and thus have rarely been used in recent years. Currently, researchers working with breeding ducks avoid using backpack harnesses because anchor backpacks or implant radios have fewer impacts on reproductive output (Rotella et al. 1993, Pietz et al. 1993, Paquette et al. 1997).

Unfortunately, the effort devoted to assessing impacts of radio packages has not been extended to ducks during the non-breeding season, when individuals often move great distances (Reinecke et al. 1987, Cox and Afton 2000). These large-scale movements probably have been responsible for continued use of Dwyer (1972)-style backpack harnesses to study dabbling ducks in winter. The long movements of wintering birds lead researches to use somewhat heavier backpack radios that have greater power output.

As part of a large-scale project on captive-reared ducks, we had the opportunity to examine effects of backpack radio packages on mallards during autumn in Chesapeake Bay marshes in Maryland. We tested the hypothesis that backpack harness radios affected mass dynamics of 8-week-old mallards that were captive-reared and released at a private Regulated Shooting Area (RSA) and a tidal brackish marsh. We tested this hypothesis by comparing experimental birds marked with both nasal disks (Lokemoen and Sharp 1985) and backpack harnesses with control birds marked with nasal disks.

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Methods

We constructed mock backpack harness radios complete with a whip antenna (26cm). Each package was 2.8 cm long and 2.5 cm wide and composed of dental acrylic that enclosed a small piece of lead to create a package that weighed 15.4 ± 0.8g. The backpack was attached to the back of the duck with a harnesses so the front of the package was positioned just behind the leading edge of the wings. We made harness straps of flexible tygon tubing (2.0-mm diameter) with copper wire (0.7-mm diameter) inside the tubing. The front loop encircled the body just in front of the wings and a second loop encircled the body just behind the wings. We modified the traditional Dwyer (1972) attachment procedure by intertwining the 2 body loops on the ventral side of each duck. This modification allowed the package to be fitted more loosely than a Dwyer (1972) mount and kept the radio from shifting toward the duck's neck. We also made each body loop independently adjustable. This modified harness reduced preening time of captive ducks compared to standard Dwyer harnesses where the body loops were not intertwined (F. Rohwer, unpubl. data). Radio packages were applied by only 2 individuals that had attached over 500 radio packages to ducks in telemetry studies. We fitted mock radios so approximately 3 cm of space occurred between the radio and the duck's back when the harness was stretched. Experimental birds also were banded and marked with nasal disks (Lokemoen and Sharp 1985) so each bird was individually identifiable. Control birds were marked only with bands and nasal disks. We randomly assigned individual birds to experimental or control treatment until all mock radios were attached. Procedures followed Louisiana State University Agricultural Center Institutional Animal Care and Use Committees guidelines (A91-18).

All birds released were captive-reared mallards 8 weeks of age. Released birds had mixed parentage of game-farm and wild stock because female parents were game-farm stock held in open-top pens that typically mated with wild free-flying drake mallards. Captive-reared birds had plumage and morphology that we could not distinguish from wild mallards at the time of release or when recovered anytime during the fall. Released mallards had achieved approximately 80% of typical fall weights of mallards (Bellrose 1980) and were about 1 week from attaining flight. Birds were captured in rearing pens, driven from Wisconsin to Maryland in 24 hours, placed in a large outdoor pen, and were sexed, marked, weighed, and measured within the next 8 hours. We then released half of the marked birds at a public marsh and the other half at a private RSA. In 1992, birds were released in the second week of August whereas in 1993 birds were released the third week of August. The public marsh was a segment of Fishing Bay Wildlife Management Area (FBWMA) in Dorchester County, Maryland, which is a tidal, brackish marsh with limited accessibility. The segment of FBWMA used for releases had essentially no human activity outside of the waterfowl hunting season. Birds released on this site received no care following release (Smith and Rohwer 1997). In contrast, mallards released on the private RSA were provided with daily supplemental grain until 2 weeks before the opening of hunting season in late October (Smitih and Rohwer 1997). The RSA was primarily brackish marsh but had some upland crops that were not harvested at the time of this work. We opportunistically collected as many marked birds with and without mock radios as possible 17–24 days after release at both RSA and FBWMA sites (Table 1). Each bird was weighed (±5g) after collection and examined for harness effects on their plumage and skin.

We used a 3-way analysis of variance (PROC GLM, SAS Inst. 1990) in a completely randomized design to test effects of treatment (experimental vs. control), year 1992 vs. 1993), and gender on change in body mass. Because exposure time varied from 17–24 days among birds, we used individual mass loss or gain per day as our metric for mass change. Initially we fitted models that included main effects and all interactions, but dropped non-significant (P>0.05) terms using a backward elimination process to form progressively simpler models. We used least squares means (LSMEANS) to report mean change in body mass among significant effects. We could not statistically test for site effects because we only had 2 release sites and no replication of each type of release site. Means in text are reported ±1 standard error.

Results

We released 477 experimental and 582 control birds and subsequently collected 33 experimental and 37 control birds (Table 1). Mean mass of experimental (850 ± 4.6 g) and control birds (851.5 ± 4.6 g) were similar prior to attachment of mock radio packages ($F_{1,1059}$ = 0.04, P = 0.85). Likewise, mass of birds released at FBWMA (851.7 ± 5.0 g) did not differ from mass of birds released on the RSA (850.1 ± 4.0 g; $F_{1,1059}$ = 0.06, P = 0.80). Mass loss occurred among both experimental birds and control birds at FBWMA. However, experimental birds lost an average of 10.2 ±1.2 g/day, whereas control birds lost only 4.5 ± 1.5 g/day ($F_{1,28}$ = 7.91, P = 0.009). Body mass prior to release of males recovered at FBWMA appeared to be greater than mean body mass of all males at release, but other release groups did not show this effect (Table 1). There was no difference in mass loss between genders or years and no interactions were significant at FBWMA (P > 0.05).

Mass gain of mallards released at the RSA was influenced by gender ($F_{1,37}$ = 5.22, P = 0.028) and treatment type ($F_{1,37}$ = 6.08, P = 0.018), but year and all interactions were non-significant (P > 0.05). Control birds gained 10.5 ± 1.0 g/day,

Table 1. Mean body masses ±1 SD of visually-marked mallards with (radio) and without (visual) mock backpack radio-transmitters released and recovered at Fishing Bay Wildlife Management Area (FBWMA) and a private Regulated Shooting Area (RSA) in Dorchester County, Maryland, August 1992 and 1993.

	FBWMA				RSA			
	Radio		Visual only		Radio		Visual only	
Sex/body mass[a]	*N*	$\bar{x}$ ± SD (g)[a]	*N*	$\bar{x}$ ± SD (g)[a]	*N*	$\bar{x}$ ± SD (g)[a]	*N*	$\bar{x}$ ± SD (g)[a]
Males								
Body mass at release	109	885.8±105.9	113	922.7±123.1	119	895.3±93.3	191	880.0±95.6
Body mass at recovery	5	814.0±74.3	4	773.3±137.9	10	1029.3±87.9	10	1157.5±114.9
Initial body mass of recovered males	5	1036.0±16.4	4	836.7±115.9	10	835.5±90.4	10	862.0±114.6
Females								
Body mass at release	149	793.9±90.1	165	784.4±88.9	100	842.7±68.1	113	836.8±87.9
Body mass at recovery	8	661.3±65.8	13	740.7±107.1	10	971.2±95.7	10	969.5±90.7
Initial body mass of recovered females	8	796.9±52.3	13	823.2±85.7	10	835.0±78.4	10	776.5±113.7

a. Arithmetic mean body masses.

whereas experimental birds gained 7.7 ± 0.8 g/day. Male mallards gained more mass per day (10.6 ± 1.0 g) than did females (7.6 ±0.7 g) at the RSA.

Collected experimental birds on both the RSA and FBWMA had feather wear on their back beneath the radio package. We never recovered or observed an experimental bird that had entangled either their bill or a foot in the harness loops, although backpacks on FBWMA became quite loose when birds lost weight. In a companion study (Smith 1999) we monitored 390 mallards with functional radios of the same design and never recovered a bird entangled in the harness. Likewise, all recovered radios had remained centered on the duck's back.

Discussion

Our results suggest that backpack harness radios have detrimental effects on captive-reared mallards released in traditional wintering habitat. We chose release sites for the captive-reared birds that represented 2 contrasting situations where captive-reared mallards had been released on a large scale (Smith and Rohwer 1997). Both sites are used during the winter by both wild waterfowl and released captive-reared mallards. Site effects were dramatic; both the nasal-marked and harnessed birds released on the tidal marsh (FBWMA) lost mass, whereas similarly marked birds released at the RSA gained mass. At both sites radio packaged affected mass dynamics. At FBWMA, mallards with radio packages lost more than twice the mass as birds that were only marked with visual tags. In contrast, at the RSA where birds were fed after release and where there was substantial habitat management to produce duck foods (Smith and Rohwer 1997), experimental birds gained mass at a slower rate than control birds. At FBWMA we had difficulty finding any marked birds and the few experimental males collected appeared to be the heaviest birds released (Table 1) suggesting that only the heaviest males with mock radios survived to be collected.

We had a limited opportunity to observe behavior of marked mallards, but our qualitative assessment was that birds with mock radios did not show obviously different behavior than birds that were only visually marked. The only apparent difference in behavior was elevated preening rates among experimental birds. Experimental birds did not have bare skin under the radio package as often occurs with Dwyer style radio packages worn for several months.

In a companion study, survival rates (Kapland and Meir 1958) of captive-reared released mallards with functional backpack transmitters were low among birds released on adjacent tidal marsh in FBWMA (Smith 1999). Estimates from that study suggest that 90% of mallards on the FBWMA suffered mortality within 2 months following release in August but prior to hunting season. We suspect that these estimates of mortality were biased upward due to radio effects. We never had band recoveries of either functional or mock radio-marked birds outside of the county of release, suggesting emigration was unlikely. In contrast, survival estimates (Kaplan and Meier 1958) for radio marked birds released on several RSAs in the region were above 90% for the 2-month period following release and prior to hunting season (Smith 1999).

High survival rates of radio marked mallards released at RSAs suggested that backpacks had a minimal influence on survival among ducks that had an abundant supply of food (Smith and Rohwer 1997). Two telemetry studies of mallards during the nonbreeding season have failed to detect any or substantial mortality other than hunting, suggesting that backpack radios can have minimal impacts on survival (Reinecke et al. 1987, Dugger et al. 1994).

The extent of radio effects has been a concern of waterfowl ecologists for several decades. Some attempts to evaluate effect of radios suffered from a lack of unmarked controls (Gilmer et al. 1974, Bergmann et al. 1994). Although our work was conducted in wintering habitat, the findings reinforce recent analyses of impacts of backpack harness radios (Dwyer 1972) on wild ducks during summer. Rotella et al. (1993) investigated breeding effort of radio-marked mallards and detected less nesting effort by birds fitted with backpack harnesses as compared to females with implanted radios. Pietz et al. (1993) found that mallards fitted with backpacks during the breeding season foraged less and spent less time in wetland habitats than mallards without backpacks. Finally, mallards with implant radios had a greater annual return rate to a Saskatchewan breeding site than females with backpack radios (Dzus and Clark 1996). Our results add credence to the idea that backpack harnesses may have negative impacts on free-ranging mallards. It seems unlikely that mass of the package creates the problem because anchor and implant radios often weigh as much as backpack radios. We suspect that the harness causes most of the radio effects. We recommend the use of implant radios because they appear to minimize radio effects (Paquette et al. 1977, Garrettson and Rohwer 1998). If range affects choice of radio design, as in studies of highly mobile migratory or wintering ducks, then use of anchor radios would maximize range and minimize radio effects.

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