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# DECOY TRAP BIAS AND EFFECTS OF MARKERS ON REPRODUCTION OF NORTHERN PINTAILS

KARLA L. GUYN[1] AND ROBERT G. CLARK

*Department of Biology*
*University of Saskatchewan*
*112 Science Place*
*Saskatoon, Saskatchewan S7N 5E2 Canada*
*and*
*Canadian Wildlife Service*
*115 Perimeter Rd.*
*Saskatoon, Saskatchewan S7N 0X4 Canada*

Abstract.—Decoy traps have been widely used to trap waterfowl, but trap bias has rarely been examined. Likewise, researchers often radio-mark animals with the implicit assumptions that (1) radio-marked individuals are representative of the population and (2) transmitters do not alter behavior or other measures of interest. In this paper, we quantified possible trap bias, and combined effects of capture and radio-marking, on attributes and reproduction of female Northern Pintails (*Anas acuta*). We found no difference in the age distribution or size of decoy-trapped versus nest-trapped female pintails. However, radio-marked females tended to lay fewer eggs than unmarked females. When analyses were restricted to first nests only, clutch-initiation dates did not differ between radio-marked and unmarked females. The number of ducklings hatched did not differ between radio-marked and unmarked females. Although we did not detect age or size differences between birds caught in decoy traps and those nest-trapped, it is unclear if either group is completely representative of the population. However, pintails were difficult to capture with decoy traps and the method was time and labor intensive. Our results suggest that the combined effects of trapping and marking may negatively affect some aspects of reproduction in pintails.

**VICIOS EN LAS TRAMPAS CON SEÑUELO Y LOS EFECTOS DE MARCADORES EN LA REPRODUCCIÓN DE *ANAS ACUTA***

Sinopsis.—Las trampas con señuelo se han utilizado ampliamente para atrapar aves acuáticas, pero rara vez se ha examinado el vicio de estas. Igualmente, los investigadores marcan a menudo los animales con radiotransmisores asumiendo implicitamente que (1) los individuos radio-marcados representan la población y (2) los transmisores no afectan la conducta u otras medidas de interés. En este trabajo cuantificamos los posibles vicios al usar trampas, y el efecto combinado de captura y marcar con radiotransmisores en los atributos y en la reproducción de *Anas acuta*. No hallamos diferencias en la distribución de edades o tamaño de hembras de *Anas acuta* atrapadas en trampas y las atrapadas en los nidos, sin embargo, las hembras con radiotransmisores tendían a poner menos huevos que las no marcadas. Al restringir los análisis a los primeros nidos, las fechas en comenzar la camada no difieren entre hembras marcadas con radiotransmisores y las no marcadas. Aunque no detectamos diferencias en las edades o tamaños entre las aves atrapadas en trampas con señuelo y aves atrapadas en el nido, no está claro si alguno de los grupos representa la población completa. De todas formas, las aves fueron difíciles de atrapar con trampas usando señuelo y el método requirió trabajo intenso y mucho tiempo. Nuestros resultados sugieren que el efecto combinado de atrapar y marcar aves puede afectar negativamente algunos aspectos de la reproducción en *Anas acuta*.

Although true random samples are difficult to achieve, researchers

[1] *Current Address: Ducks Unlimited Canada, P.O. Box 1160 Stonewall, Manitoba, ROC 2Z0 Canada.*

should strive to obtain samples that are representative of the study population (White and Garrott 1990). Individuals often need to be captured to estimate survival, recruitment, and other population parameters, yet if individuals differ in susceptibility to trapping methods they may not be representative of the population. Decoy traps have been widely used to trap waterfowl (Rogers 1964, Anderson et al. 1980, Sharp and Lokemoen 1987, Dwyer and Baldassarre 1994), but trap bias has rarely been examined. Likewise, researchers often radio-mark animals with the implicit assumptions that (1) radio-marked individuals are representative of the population, and (2) transmitters do not alter behavior or other measures of interest (White and Garrott 1990). In this paper, we quantify possible trap bias, and combined effects of capture and radio-marking, on reproduction of female Northern Pintails (*Anas acuta*).

Radio telemetry has been frequently used in waterfowl research (e.g., Ball et al. 1975, Gilmer et al. 1977, Ringelman and Longcore 1982, Cowardin et al. 1985, Grand and Flint 1996, Cox and Afton 1997). However, transmitters may have negative effects on birds (e.g., Small and Rusch 1985, Wanless et al. 1988, Paton et al. 1991), including waterfowl (Sorenson 1989, Pietz et al. 1993, Rotella et al. 1993, Paquette et al. 1997). Back-mounted transmitters attached with harnesses (Dwyer 1972) have been commonly used in waterfowl telemetry studies, but recent evidence suggests that this method may delay nesting (Pietz et al. 1993), decrease nesting effort (Rotella et al. 1993), and reduce survival (Dzus and Clark 1996). Back-mounted transmitters attached with a subcutaneous prong (anchored backpacks) (Mauser and Jarvis 1991, Pietz et al. 1995) and abdominal implants (Korschgen et al. 1984, Olsen et al. 1992) have been suggested as possible alternatives (Rotella et al. 1993, Pietz et al. 1995). Recently, Paquette et al. (1997) compared reproductive effort of Mallards (*Anas platyrhynchos*) with anchored backpacks and abdominal implants; females with anchored backpacks devoted less time to egg laying and incubation, and initiated fewer nests.

Researchers who attempt to evaluate transmitter or marker effects often ignore the possibility that observed effects may result from a combination of trapping and marking. Cox and Afton (1998) reported that female pintails were 16 times more likely to die in the first 4 days after capture and suggested that this mortality was at least partially explained by capture myopathy. Capture myopathy results in degeneration of muscle tissue and can result from intense muscular exertion or trauma associated with restraint (Dabbert and Powell 1993).

Recent literature (Pietz et al. 1993, Paquette et al. 1997) has focused on transmitter effects in Mallards (except Garrettson and Rohwer 1996, Korschgen et al. 1996, Zimmer 1997), but effects may differ with other species of waterfowl, particularly since most are smaller than Mallards. During 1994–1996, we studied breeding ecology of pintails in southern Alberta, using decoy traps to capture females early in the spring. All decoy-trapped females were equipped with anchored backpacks for a study of pintail reproductive ecology. Because we also searched for nests of unmarked birds and captured some of these females on their nests, we had an opportunity to determine whether: (1) decoy-trapped and nest-trapped females had similar body sizes and age distributions (because these would not change after radio-marking); and (2) decoy-trapping, nasal-tagging, and radio-marking (in combination) (hereafter referred to as "radio-marked") affected timing of nesting or reproductive investment.

## METHODS

During 1994–1996, we obtained data from a 40-km$^2$ study area situated on the Kitsim Ducks Unlimited Project located near Brooks, Alberta (50°30′N, 112°3′W). Kitsim contains a main reservoir and 65 managed wetland basins. Basins are interconnected through a canal system that allows irrigation water to flow into them through the main reservoir. Depending on water availability, the basins are usually reflooded in mid-spring and late fall and some become dry by mid-summer. Female pintails were decoy-trapped (Sharp and Lokemoen 1987) during April, with trapping commencing as soon as ponds or pond edges were ice free. Traps were placed on wetlands where pintail pairs frequently were seen. To avoid capturing migrants we did not place traps on wetlands with large flocks of birds. Traps were checked every morning beginning at 0700 h and again in the evening starting at 1700 h. Therefore, 14 h was the maximum time a female could be in a decoy trap. An 8-g anchored back-pack (Advanced Telemetry Systems, Isanti, Minnesota) was attached to each female using a subcutaneous stainless steel wire (anchor), and three subcutaneous sutures (Mauser and Jarvis 1991, Pietz et al. 1995) under local anesthesia. We also attached a standard U.S. Fish and Wildlife Service leg band and nylon nasal tags (Lokemoen and Sharp 1985). Mass (nearest 10 g with a Pesola spring scale), wing chord (nearest 1 mm with a ruler), and head-bill length (nearest 0.1 mm with dial calipers) were measured for all females. The fifth secondary covert was collected and a visual classification of the middle secondary coverts (1995 and 1996 only) was recorded to classify females as second year (SY) or after second year (ASY) following Duncan (1985). After a female was removed from a trap, estimated average handling time from capture to release was approximately 0.5 h, with handling time ranging from as short as 20 min up to approximately 1 h. All procedures were approved by the University of Saskatchewan Animal Care Committee (Protocol #940149) on behalf of the Canadian Council of Animal Care.

We used two nest-searching techniques to acquire information on nests of radio-marked and unmarked females. Nests of most radio-marked females were found by telemetry. Radio-marked females were located twice daily between 0700 and 1300 h from the morning following marking until late July. A female's position was determined by triangulating from two locations using a vehicle-mounted null-array antennae system (4- or 5-element Yagi antennas; Kenward 1987). If a female was located in the same upland location for five consecutive mornings, we approached on foot with a hand-held receiving antenna to determine if she was in nesting cover and, if she was, she was flushed and we searched for her nest. When a female's nest was found, she was located daily via telemetry to verify her presence at the nest. If the nest was found during egg-laying, we revisited the nest early in incubation to determine full clutch size and to measure the eggs. Once full clutch size was determined, the nest was not revisited until termination (i.e., hatched or destroyed). Nests of unmarked females were located using an 80-m chain dragged between two ATVs (Klett et al. 1986). Nest searches began in early May, when decoy trapping had finished. We attempted to trap all upland nesting females that were still active in late incubation. We used mist nets (Bacon and Evrard 1990), Weller traps (Weller 1957), or walk-in traps (Dietz et al. 1994), and information on female size and age was obtained (as above). We failed to trap 7.6% of upland nesting females that we attempted to capture.

Each time a nest was visited eggs were counted and candled to determine incubation stage; this information was used to estimate clutch-initiation dates (Weller 1956). Full clutch size was recorded as the maximum number of pintail eggs in completed clutches. Length and width of each egg was measured with dial calipers to the nearest 0.1 mm, and egg volume was calculated with the formula of Flint and Grand (1996):

$$\text{Volume} = -0.63392 + 0.53163(\text{length})(\text{width})^2 \qquad (1)$$

If the eggs hatched, we determined initial brood size by subtracting the number of eggs that did not hatch from the last recorded clutch size.

To check for possible age-specific trap bias, the age structure of females caught in decoy traps was compared to that of nest-trapped females using a chi-square test. A size index for each trapped female was calculated by summing wing chord and combined length of head-bill. Sizes of decoy-trapped and nest-trapped females were contrasted using analysis of variance (ANOVA), accounting for yearly variation (1994–1996).

To test for combined effects of trapping and marking (radio and nasal marker) on nest-initiation date, ANOVA was performed, first testing for year effects (1994–1996). Because females with anchored backpacks have been reported to renest less frequently than females with abdominal transmitters (Paquette et al. 1997), it is possible that females with anchored backpacks renest less frequently than unmarked females. Therefore, we also re-examined effects on initiation dates by restricting the analysis to nests initiated on or before 18 May. Median nest initiation date of unmarked females was 18 May ($n$ = 244, K. Guyn, unpubl. data). Therefore, nests initiated prior to this date are likely first nests.

To test for combined effects of trapping and marking (radio and nasal marker) on clutch size, we used analysis of covariance (ANCOVA), with year and status (i.e., marked versus not marked) as main effects and initiation date as a covariate. We tested that the homogeneity of slope assumption of ANCOVA was met before proceeding. Because clutch size was not normally distributed the data were $\log_{(10)}$ transformed. Since clutch size in pintails is affected by whether the nest is the bird's first nest

TABLE 1. Size and nesting data for radio-marked and unmarked female Pintails at Kitsim, Alberta, 1994–1996.

| | Unmarked[b] | | | Radio-marked[c] | | |
|---|---|---|---|---|---|---|
| | x̄ | (SE) | *n* | x̄ | (SE) | *n* |
| Size[a] | 352.8 | (0.67) | 108 | 353.6 | (0.82) | 71 |
| Clutch initial date | | | | | | |
| 94 | 132 | (2.0) | 74 | 135 | (4.4) | 13 |
| 95 | 134 | (2.1) | 68 | 137 | (2.8) | 25 |
| 96 | 142 | (1.7) | 102 | 132 | (4.8) | 12 |
| First Nest | 122 | (0.9) | 130 | 125 | (1.6) | 30 |
| Clutch size[de] | 7.08 | (1.3) | 115 | 6.86 | (1.2) | 36 |
| Egg volume | 39.6 | (0.26) | 74 | 39.2 | (0.52) | 23 |
| Ducklings hatched[e] | 6.5 | (0.31) | 31 | 6.5 | (0.46) | 15 |

[a] Size = wing + head-bill length.
[b] Includes females nest-trapped late in incubation.
[c] Decoy-trapped in early spring.
[d] Date corrected.
[e] Upland nests only.

or a renest (Duncan 1987, Grand and Flint 1996), we conducted the same analysis using only first nests (see above). To test for transmitter effects on individual egg lengths, widths, and volumes we used nested ANOVA to account for non-independence of egg size within a clutch. The number of ducklings hatched between radio-marked and unmarked females was contrasted using ANCOVA with nest-initiation date as the covariate.

Power analyses were performed using the program NCSS Power Analysis and Sample Size (Hintze 1991). Analyses of variance were conducted using PROC GLM (SAS Inst. 1990).

## RESULTS

During 1994–1996 we caught 73 female and 806 male pintails in decoy traps. The proportion of SY and ASY females caught in decoy traps versus nest traps did not differ ($\chi^2 = 0.012$; $P = 0.91$; $n = 176$: decoy-trapped; SY = 23, ASY = 47: nest-trapped; SY = 34, ASY = 72).

Size of trapped birds did not differ among years ($F_{2,178} = 0.29$; df; $P = 0.75$) or by capture method ($F_{1,179} = 0.13$; $P = 0.71$; power = 0.99 for a 2% [7 mm] difference in size at $\alpha = 0.05$) (Table 1). When all nests were included, nest-initiation dates differed among years ($F_{2,291} = 6.62$; $P = 0.002$), therefore, analyses were conducted for each year. Nest-initiation dates did not differ between radio-marked (decoy-trapped) and unmarked females in 1994 ($F_{1,86} = 0.21$; $P = 0.65$; power = 0.24 for a 5% difference [6.6 d] in initiation date at $\alpha = 0.05$) or 1995 ($F_{1,92} = 0.58$; $P = 0.45$; power = 0.38 for a 5% difference [6.7 d] in initiation date at $\alpha = 0.05$). In 1996, average nest initiation date for radio-marked birds tended to be earlier than that of unmarked females ($F_{1,113} = 3.68$; $P = 0.06$) (Table 1). When only first nests were included (see above) clutch-initiation dates did not vary among years ($F_{2,158}$ = 0.37; $P$ = 0.69) nor between radio-marked and unmarked females ($F_{1,159}$ = 1.40; $P$ = 0.24; power = 0.86 for a 5% [6 d] difference in clutch initiation date at $\alpha$ = 0.05). Of the decoy trapped pintails that we were able to monitor closely ($n$ = 56 birds that stayed on the study site), 73% initiated nests, but we have no way of assessing whether our estimate of non-breeding (27%) is reliable.

Clutch size did not vary among years ($F_{2,215}$ = 0.30; $P$ = 0.58) but when all pintail nests were included, radio-marked birds produced smaller clutches than unmarked females ($F_{1,216}$ = 3.83; $P$ = 0.05). Some nests of unmarked females ($n$ = 66) were located on islands and, since many nests on islands were parasitized (K. Guyn, unpubl. data), full clutch sizes may have been biased high if parasitic eggs went undetected. To account for this, we restricted analyses to upland nests and found only a weak trend for radio-marked females to lay fewer eggs ($F_{1,150}$ = 2.82; $P$ = 0.09) (Table 1). When we restricted the analysis to first nests, full clutch sizes did not differ between radio-marked and unmarked females ($F_{1,114}$ = 0.95; $P$ = 0.33). Individual egg volumes ($F_{1,104}$ = 0.63; $P$ = 0.43), lengths ($F_{1,104}$ = 0.23, $P$ = 0.63), and widths ($F_{1,104}$ = 2.71; $P$ = 0.10) did not vary between marked and unmarked females. Period from capture to nest initiation for radio-marked females averaged 19.3, 24.8, and 19.5 d in 1994–1996, respectively; with no difference between years ($F_{2,33}$ = 1.18; $P$ = 0.31). Number of ducklings hatched from upland nests (corrected for date) did not differ between marked and unmarked females ($F_{1,46}$ = 0.01; $P$ = 0.93; power = 0.20 for a 10% [0.65] difference in number of ducklings hatched at $\alpha$ = 0.05).

## DISCUSSION

Despite the relatively common use of decoy traps to capture waterfowl, few studies acknowledge or investigate potential trap biases. Weatherhead and Greenwood (1981) suggested that Red-winged Blackbirds (*Agelaius phoeniceus*) captured in decoy traps were in poor condition and not representative of the population. Grand and Fondell (1994) reported that fewer older female pintails were captured in decoy traps than with rocket nets. They suggested that ASY females were either less aggressive towards unfamiliar females, more wary of decoy traps or were already incubating when they were decoy trapping. We found no difference in the age distribution or size of decoy-trapped versus nest-trapped female pintails.

Although we detected no age or size-specific effects of decoy traps, other factors should be considered before choosing this capture method. For instance, female pintails were relatively difficult to capture. We trapped 73 female pintails, but incidentally caught 161 female mallards and 806 male pintails (K. Guyn, unpubl. data). Female pintails may be more wary or less aggressive than male pintails or female mallards, making them more difficult to capture in decoy traps. We captured >10 males (not including recaptures) for every female. Male pintails are known to have weak pair-bonds, take part in extra-pair copulations and exhibit extra-pair chase behavior (Smith 1968). Grand and Fondell (1994) suggested these behavioral traits may make males susceptible to capture in decoy traps.

We likely misclassified the age of some females (Esler and Grand 1994). However, the proportion of SY to ASY females was nearly identical for decoy and nest-trapped birds, so it is unlikely that misclassification led to incorrect conclusions regarding trap bias. Given that our sample of unmarked females is derived from females nest-trapped late in incubation and that older females can be more successful breeders (Afton 1984, Dow and Fredga 1984), our sample of unmarked birds may be biased. However, since we did not detect age or size differences between females caught in decoy-traps and caught on nests, this would suggest that both samples are biased in the same direction. This is unlikely, since results from previous workers suggest that young females were more susceptible to decoy traps (Grand and Fondell 1994). Nonetheless, some caution should be taken when interpreting our results because decoy-trapped and nest-trapped birds may have differed in ways we did not assess.

Potential deleterious effects of harness-style transmitter attachments on reproduction have recently been reported (Pietz et al. 1993, Rotella et al. 1993), and many researchers have turned to anchored backpacks and abdominal implants as alternatives. We could not conduct a clear evaluation of radio transmitter effects alone with pintails, because all radio-marked females were also nasal-tagged and decoy-trapped. In 1996, clutch initiation dates differed between radio-marked and unmarked females, and upon closer examination it appears that radio-marked females did not nest as frequently later in the season. Furthermore, analysis of clutch-initiation date in 1994 and 1995 had modest power, so it would be unwise to conclude that there was no effect. Female pintails with anchored backpacks did not differ from unmarked females in first clutch initiation dates, but radio-marked birds did have reduced clutch size. However, the biological significance of a 0.22 difference in clutch size is questionable. Paquette et al. (1997) compared Mallards with abdominal implants and anchored backpacks and found no difference in median initiation of first nests, size of first clutch, or proportion of females that nested. However, females with anchored backpacks devoted less time to egg laying and incubation and initiated fewer nests.

If capture/handling did influence female behavior, it is likely related to increased risk of abandoning nests already initiated at the time of capture or a delay in nest initiation. If trapping birds resulted in abandonment of active nests, then some first nests found for radio-marked birds would have actually been renests. Since renests tend to have smaller clutches than first nests (Duncan 1987, Grand and Flint 1996) this could result in lower average clutch size for radio-marked birds. Similarly if trapping resulted in nest abandonment or a delay in nest initiation, average nest initiation dates for radio-marked females would be later. However, we found no evidence that radio-marked females delayed nest initiation.

Mallards equipped with harness-style backpacks spent less time feeding than unmarked Mallards (Pietz et al. 1993), and this could be responsible for reduced reproductive effort in radio-marked Mallards. Although we did not conduct behavior observations, several radio-marked pintails were seen pulling on their transmitters (K. Guyn, pers. obs.). Decoy trapped female mallards with similar back-mounted transmitters were found to have lower brood survival than abdominally implanted females (J. Devries, pers. comm.). They speculated that partial detachment of the back-mounted design resulted in irritation leading to reduced vigilance.

All radio-marked pintails were also nasal-tagged. Howerter et al. (1997) compared nasal-tagged and unmarked Mallards and found that although nasal-marked females tended to initiate their first nest 2–6 d later, there was no difference in the proportion that nested, number of nest attempts or nest success. They suggested that because there was only a small difference between the two groups that nasal tags not be abandoned as a marking technique. We did not find that decoy-trapped females marked with nasal tags and radios nested later than unmarked controls.

To conclude, we did not detect a trap bias with decoy traps, but pintails were difficult to capture and the method was very time and labor intensive. Our results suggest that combined effects of trapping and marking may negatively affect some aspects of reproduction in pintails. We suggest that if implants are not an alternative, the use of anchored backpacks should be carefully considered in light of study objectives.

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