

Harvest and Band Recovery of Captive-reared Mallards Released by the State of Maryland, 1974–1987

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Abstract: Maryland Department of Natural Resources personnel banded 52,193 captive-reared mallard ducks (*Anas platyrhynchos*) released in Maryland from 1974–1987. Although most recoveries (91%) occurred in Maryland, ducks that survived a single hunting season, particularly males, were more likely to be recovered outside the state. Most recoveries (79%) of state-released mallards occurred during the first hunting season after release and nearly all (>99%) occurred within 5 hunting seasons. About 16% of the ducklings (Frost, environmental-conditioned ducklings, >6 weeks old) released were eventually harvested at an average cost of \$43.87 per duck bagged. We estimate that harvest of state-released ducks contribute <6% to the total duck harvest in the state.

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The decline of duck populations in the 1980s re-kindled interest among sportsmen and private groups to release captive-reared mallards. Although captive-reared mallards provide additional shooting opportunities, wildlife professionals generally agree that these releases can be potentially harmful to wild waterfowl and decrease the effectiveness of management efforts directed toward wild duck populations (Batt and Nelson 1990).

Experimental releases of captive-reared mallards made by the Maryland Department of Natural Resources (MDDNR) in 1967–70 suggested that the state's mallard harvest might be increased by about 10% with annual releases of captive-reared mallards (Stotts et al. 1971). In 1974, Maryland legislation required the MDDNR to propagate, purchase, and release captive-reared ducks with proceeds from a Maryland Waterfowl Stamp. The objectives of this legislation were to sup-

plement the harvest of wild ducks and increase local breeding stocks of mallards. Between 1974 and 1987, 266,406 mallards were released under this program. This paper examines harvest distribution and recovery rates of captive-reared mallards released by the MDDNR. The management implications of these releases are discussed.

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Methods

Captive-reared Mallard Releases

A variety of duckling types and ages and types of release have been experimented with in Maryland (Table 1). Earlier findings (Stotts et al. 1971, V. D. Stotts, unpubl. rep., Md. Wildl. Admin., Annapolis, 1980) suggested that ducklings released during the late summer had higher recovery rates than those released earlier. Therefore, most releases during 1974–87 occurred during July–August. Ducklings were released throughout the state in proportion to historic (1960–62) mallard harvest, wetland acreages, and alluvial soils. The number of mallards released has varied annually from <5,000 to 40,000. Ducklings were released in groups of 15–25 on public waters in what was believed to be the best available brood habitat. Ducklings were released by boat, wherever possible, to reduce return of ducklings to areas of human activity (i.e., marinas, boat ramps, roads, waterfront homes).

Most releases were “hard,” in that ducklings were transported to Maryland and were released within 24 hours of their arrival in the state without supplemental food

Table 1. Characteristics of captive-reared mallards banded and released by the State of Maryland, 1974–87.

Supplier/ Duckling type ^a	Age at release	Release type ^b	Years (N) ^c	Males (N)	Females (N)
FST	<7 wks	S	2	544	500
FST	<7 wks	H	1	428	507
FST	>6 wks	H	2	589	602
FEC	<7 wks	H	7	5,028	4,975
FEC	>6 wks	H	7	11,734	11,701
WWST	<7 wks	S	2	412	438
WWST	>6 wks	S	1	744	750
WWST	<7 wks	H	4	2,997	3,311
WWST	>6 wks	H	3	1,903	1,951
MMST	>6 wks	H	1	1,530	1,549

^aSuppliers: F = Frost Wildfowl Trust, WW = Whistling Wings, Inc., MM = M & M Hunting Preserve; Duckling type: ST = standard, EC = environmentally conditioned.

^bS = soft release, H = hard release.

^cNumber of years releases occurred.

or care. "Soft" released ducklings were purchased and air-freighted to Maryland at 1 day of age and were raised in a brooder house and covered pen at the release site for 5 weeks. At 5 weeks of age, the ducklings were released into a larger uncovered pen enclosing tidal wetlands. After being released, these duckling received supplemental feed for about 3 weeks.

Types and Ages of Captive-reared Ducks Released

Ducklings were purchased from 3 suppliers during 1974–87. Frost Wildfowl Trust (Coloma, Wis.) provided "standard" and "environmentally-conditioned" (EC) ducklings. "Standards" were mallards which are used in the hunting preserve industry. "Environmentally-conditioned" mallards were from the same parental stock and hatched in the same manner as "standards," but are reared with minimal human contact and protection from predators (Stotts et al. 1971). "Standard" ducklings were also purchased from Whistling Wings, Inc. (Hanover, Ill.) and M & M Hunting Preserve (Pennsville, N.J.). The age of ducklings at release varied from 4 to 9 weeks.

Marking and Banding

All mallards released between 1974–83 were alula-clipped. Wings from immature mallards harvested in Maryland and submitted to the U.S. Fish and Wildlife Service (FWS) Parts Collection Survey (PCS) were examined for clipped alulas. The proportion of total duck wings submitted to the PCS from Maryland that were alula-clipped was used to estimate the contribution of state-released mallards to the state's duck harvest. The proportion of alula-clipped wings in the PCS sample from Maryland was adjusted for alula regeneration as described by Burger et al. (1970).

Each year 10%–16% of released mallards were marked with FWS leg bands. Banded mallards were released at each size in similar proportions to the total number of ducklings.

Recovery Analysis

We examined recoveries of banded captive-reared mallards shot or found dead during the hunting season. Analyses are restricted to recovery rates and estimates of harvest rate. Harvest rate estimates were made from banding data adjusted for reporting rate as suggested by Henny and Burnham (1976). Because no accompanying sample of adult mallards were banded, survival rates for summer-released ducklings could not be calculated using the models of Brownie et al. (1977).

Recoveries of banded birds were separated into direct and indirect recoveries. Direct recovery rates were compared using the method described by Brownie et al. (1977). Standard deviations were calculated assuming a binomial distribution (Snedecor and Cochran 1980). To maintain an overall significance level of 0.05 where multiple comparisons are performed, a significance level $0.05/n$ was used, where n is the number of comparisons. Comparisons of supplier, age at release, and release type were limited to cases where only the factor under analysis varied between groups. For example, the influence of age at release was compared for

young and older ducklings of the same supplier and release type. Much of the banding analysis focuses on releases of Frost EC ducklings because these were the most common type purchased.

Results

A total of 266,406 captive-reared mallards was released during 1974–87, of which 52,193 were marked with FWS leg bands. Approximately equal numbers of males and females were banded in each combination of duckling age, supplier, and release type (Table 1). Although males (range = 1.29–4.69%) usually had slightly higher direct recovery rates than females (range = 1.03–4.60%), in no comparison were these differences significant ($P > 0.05$). Sexes were combined for all further comparisons of recovery rates.

Most recoveries (79%) occurred during the first hunting season after release and nearly all recoveries occurred within 5 hunting seasons (Table 2). Direct recovery rates of Frost EC ducklings released during 1981–87 averaged 3.9%. In hunting seasons 2–5, an average of 1.3% more of the banded birds were reported shot. Adjusting recovery rates by the reporting rate for banded mallards (32%) (Nichols et al. 1991), first season harvest rates averaged 12.2% and total harvest averaged 16.3% of the birds released.

Comparison of Supplier, Duckling Age, and Release Type

Frost EC (4.28%) and standard ducklings (6.19%) were recovered at a higher rate than M & M standards (2.47%) when released at >6 weeks of age (Table 3). Frost EC (3.78%) and standard ducklings (3.74%) had higher direct recovery rates than Whistling Wings standards (1.16%) when released at <7 weeks of age (Table 3). In neither age class did Frost EC ducklings have higher recovery rates than Frost standard ducklings (Table 3). In all 4 comparisons of age at release, recovery rates of older ducklings were greater than those of young ducklings. However, these differences were significant in only 2 comparisons (Table 3). There were no differences in recovery rates related to release type; however, sample sizes of soft-released ducklings were small.

Table 2. Recovery matrix for Frost environmentally-conditioned mallards >6 weeks of age, banded and released in Maryland.

Year banded	N banded	Year recovered									
		79	80	81	82	83	84	85	86	87	88
1979	495	34	8	8	5	2	0	0	0	0	0
1981	1,657			116	20	4	3	1	1	1	0
1982	3,036				129	40	7	4	3	1	0
1983	3,011					137	17	12	2	2	0
1984	3,045						87	17	10	5	0
1986	5,001								101	30	
1987	6,949										167

Table 3. Comparisons of direct recovery rates for captive-reared mallards of different supplier/duckling types and duckling ages^{ab}.

<i>Supplier/duckling type (Hard release, >6 wks)</i>	
FEC (4.28) vs. WWST (3.54)	NS
FEC (4.28) vs. MMST (2.47)	*
FEC (4.28) vs. FST (6.19)	NS
WWST (3.54) vs. MMST (2.27)	NS
FST (6.19) vs. WWST (3.54)	NS
FST (6.19) vs. MMST (2.47)	*
<i>Supplier/duckling type (Hard release, <7 wks)</i>	
FEC (3.78) vs. FST (3.74)	NS
FEC (3.78) vs. WWST (1.16)	*
FST (3.74) vs. WWST (1.16)	*
<i>Age at release</i>	
FST, H, >6 wks (6.19) vs. FST, H, <7 wks (3.74)	NS
FEC, H, >6 wks (4.28) vs. FEC, H, <7 wks (3.78)	NS
WWST, S, >6 wks (3.68) vs. WWST, S, <7 wks (0.65)	*
WWST, H, >6 wks (3.54) vs. WWST, H, <7 wks (1.16)	*

^aRefer to Table 1 for definitions of abbreviations.

^bDirect recovery rates in parentheses, NS = no significant difference, * = difference significant at 0.05 level.

Geographic Distribution of Recoveries

Direct and indirect recoveries of captive-reared mallards released in Maryland occurred mostly (99.7% and 94.9%, respectively) within the state. However, recoveries were recorded in 31 states and provinces other than Maryland. The Atlantic, Mississippi, and Central flyways accounted for 90.9%, 7.3%, and 1.8% of the indirect recoveries outside of Maryland, respectively. In the Atlantic flyway, Ontario accounted for 20.3% of the indirect recoveries outside of Maryland.

Males ($X^2 = 145.9$, $df = 1$, $P < 0.001$) and females ($X^2 = 15.9$, $df = 1$, $P < 0.001$) were more likely to be recovered within the state during the first hunting season after release than in subsequent years. Direct recoveries of females (6.3%) occurred more frequently outside of Maryland than direct recoveries of males (4.0%) ($X^2 = 4.6$, $df = 1$, $P < 0.05$). However, indirect recoveries of males (29.0%) occurred more frequently in states other than Maryland than indirect recoveries of females (15.2%) ($X^2 = 11.9$, $df = 1$, $P < 0.001$).

Importance of Released Mallards to State Duck Harvest

Using a direct harvest rate of 12.2% of released mallards, we estimate that state-released mallards contribute 0.9%–4.1% of the total duck harvest in Maryland (Table 4).

Alula-clipped immature mallard wings composed an average of 13.9% (range = 1.9–20.1%) of the immature mallard wings and 3.0% (range = 0.3–5.7%) of the total duck wings submitted to the PCS from Maryland. The percentage of immature, alula-clipped wings submitted to the PCS was positively correlated to the number of the ducks released ($r = 0.74$, $P = 0.015$, $N = 10$).

Since 1980 the release of older ducklings (>6 weeks) has been required by state legislation. Currently, Frost EC ducklings of about 7 weeks of age are purchased for 1992 Proc. Annu. Conf. SEAFWA

Table 4. Estimated total duck harvest^a and harvest of state-released mallards^b in Maryland, 1981–87.

Year	Total duck harvest	C-R mallards released	C-R mallards harvested	C-R mallards % of total harv.
1981	148,500	11,500	1,403	0.9
1982	106,800	17,700	2,159	2.0
1983	120,300	18,400	2,245	1.9
1984	163,600	18,000	2,196	1.3
1986	155,600	28,400	3,465	2.2
1987	119,300	40,000	4,880	4.1

^aState duck harvest from federal harvest survey.

^bHarvest of state-released captive-reared mallards estimated using 12.2% direct harvest rate.

\$5.20 each while other costs of the release program (labor, vehicles, equipment, supplies, etc.) add an additional \$1.95 for each duckling released. The average cost of a state-released mallard in the hunter's bag is \$43.87 (cost/bird bagged = \$7.15 × [1/0.163]).

Discussion

Samples of captive-reared mallards released in Maryland were marked with FWS leg bands to monitor the success of the program. However, in most comparisons made in this report, releases were not made as experiments. For example, in most years only a single supplier, age at release, and release type were used. If recovery rates varied dramatically between years, results could be affected.

Other studies have shown that captive-reared mallards have little potential for restoring breeding populations due to their low survival in the wild (Bednarik and Hanson 1965, Bailey 1979, Burger 1984). Preliminary research on 6- to 7-week-old, radio-marked, Frost EC ducklings released in Maryland suggest that late summer survival of state-released mallards is extremely low (F. C. Rowher, unpubl. rep., La. State Univ., Baton Rouge, 1992). However, limitations of our banded sample (no adults marked along with young) prohibited calculation of survival rates. Our use of recovery rates assumes that a high recovery rate is related to high survival of ducklings prior to the hunting season.

Most recoveries occurred during the first hunting season after release and nearly all recoveries occurred within 5 hunting seasons (Table 2). Recovery and harvest rates for state-released mallards were lower than those reported by Anderson (1975) for wild mallards (19%–20%) banded in the northeastern United States. They were also lower than those reported by Soutiere (1986, 1989) for captive-reared mallards (22%–35%) released on 3 private farms in Maryland. Soutiere (1989) suggested that mallards released on private farms, where supplemental food is provided until 10–20 days before the start of the hunting season, have higher survival than young mallards released on natural wetlands without supplemental food. Recovery and harvest rates of young captive-reared mallards released on private land are also

likely to be higher because of their low rate of dispersal from the release site and higher band reporting rates on these areas (Soutiere 1986, 1989). Six- to 7-week-old, radio-marked, Frost EC mallards released on state licensed shooting areas in Maryland exhibited higher survival and recovery rates than state-released mallards for these same reasons (F. C. Rohwer, unpubl. rep., La. State Univ., Baton Rouge, 1992).

Captive-reared mallards are usually recovered near the areas on which they were released (Hunt et al. 1958, Pratt 1971, Soutiere 1986). Similarly, mallards released by MDDNR were likely to be recovered in Maryland. However, males were more likely than females to be recovered in states other than Maryland after the first hunting season. Male mallards released by MDDNR that survive the first hunting season seem to be quite mobile. In contrast, Soutiere's (1986) analysis of recoveries from 3 private farms in Maryland reported no tendency for males to be recovered at more distant locations than females after the first hunting season. The greater mobility of state-released males could be a result of pairing with wild females and following them to their nesting areas. Male ducks typically follow their mate to her nesting area (Johnson and Grier 1988). Also, whereas mallards released on private farms in Maryland are often fed before and after the hunting season and food plantings are available during the hunting season, state-released mallards received no supplemental food. They would be expected to be more mobile as they dispersed from the release sites in search of food and to come into contact with wild ducks.

Maryland's duck release program is expensive. However, the \$7 that it cost to release a bird is less than the \$8–\$580 cost of producing a wild duck by means of habitat development (Lokemoen 1984). We do not advocate that a mallard release program should be a substitute for habitat development and management, since it does not address the causes of declining duck populations.

Biologists have long cited the high cost of releases, increased risk of disease transmission to wild waterfowl, influence on population surveys, and genetic swamping of closely related species, e.g., American black ducks (*Anas rubripes*) (Ankney et al. 1987, Rusch et al. 1989), as arguments against releasing captive-reared ducks. Waterfowl managers also claim that duck releases divert attention from the need for aggressive habitat conservation to correct the problem of low recruitment in wild duck populations. While we recognize these are important issues, our paper focuses on the contribution of released ducks by MDDNR to the state's duck harvest.

Releases of captive-reared mallards by state wildlife agencies and private individuals have been used, in part, to supplement the demand for duck hunting. However, as currently practiced, state-released mallards contribute little to the total duck harvest in Maryland (Table 4). With the size of recent releases (20,000–25,000/year), it is unlikely that harvest of state-released ducks exceeds 6% of the total duck harvest, even when harvest of carry-over birds is considered.

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