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Survival, Behavior, and Movements of Captive -Reared Mallards Released in Dorchester County, Maryland.

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SURVIVAL, BEHAVIOR, AND MOVEMENTS OF CAPTIVE-REARED MALLARDS RELEASED IN DORCHESTER COUNTY, MARYLAND

A Dissertation

Submitted to the Graduate Faculty of the
Louisiana State University and
Agricultural and Mechanical College
In partial fulfillment of the
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in

The School of Forestry, Wildlife and Fisheries

By
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B. S., Auburn University, 1985
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To Donna who sacrificed so that I could pursue my own interest. To Benjamin and Nina who have known me only as a student, may we always be students together.

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ABSTRACT

Private landowners with regulated shooting areas (RSA) and the Maryland Department of Natural Resources (DNR) have released up to 120,000 hand-reared mallards (Anas platyrhynchos) a year. Duck harvest on Wildlife Management Areas (WMAs) included 30, 18, and 6 percent state mallards and 6, 10, and 4 percent RSA mallards in 1991, 1992, and 1993, respectively. Kaplan-Meier survival estimates for radio-marked mallards released on RSAs were 81-85% for mid-August to mid-October, but declined to 32.5% ± 13.7 (95% C.I.) by the end of the hunting season in 1992 and 54.3% ± 22.8% in 1993. Hunting accounted for 71% of all mortalities of RSA mallards in 1992 and 45% in 1993. Survival of DNR mallards at 7 weeks post-release was 23.0 ± 10.6% and 28.4% ± 17.8% for 1992 and 1993. Supplemental feeding of mallards released by DNR appeared to increase ($P < 0.001$) their survival to 7 weeks post-release (survival = 0.915 ± 0.10). This result suggests that the low survival of mallards released by DNR was the result of energetic and/or nutritional deficiency. RSA mallards preferentially use the habitat on the RSA where they were released ($P<0.01$). Characteristics of the source RSA affected the choice of property types used, although the source RSA was always among the most preferred types. Home range sizes and maximum distances moved from the release site were positively related to the size of the source RSA ($P<0.05$). Mallards released on RSAs composed primarily of marsh habitats moved farther and had larger home ranges than those released on upland properties ($P<0.05$). I recorded pair status and origin of 772 American black ducks (Anas rubripes) and 4,960 mallards in 1992

and 1993. Black ducks paired earlier than mallards, and wild mallards paired earlier than released captive-reared mallards. Pairing was highly assortative, only 3 of 229 female black ducks (1.3%) were paired with drake mallards. Three of 492 paired female mallards were paired with hybrid black duck x mallard males. In contrast, there were 8.4% hybrids among the black duck population based on hunter bag checks at WMAs. There was also assortative mating between wild and captive-reared mallards.

CHAPTER 1

INTRODUCTION

Captive propagation and release of wildlife has been a common reaction to declining populations. The goals of release programs have included efforts to increase populations, introduce or reintroduce a species to an area where it did not occur, or supplement hunter bags. Effectiveness of restocking with captive-reared birds has varied. Captive-reared Canada geese (Branta canadensis) have been successfully used in restocking programs (Nelson 1963, Lee et al. 1984). Captive-rearing is also an important technique in restoring endangered species (Cade et al. 1988, Pickett et al. 1989). However, restocking attempts using captive-reared birds have been unsuccessful for many other species, including turkeys (Mileagris gallopavo) (Leopold 1944), northern bobwhites (Colinus virginianus) (Roseberry et al. 1987) and the prairie grouse (prairie chickens Tympanuchus cupido pinnatus, T. c. attwateri, T. pallidicinctus, sharp-tailed grouse T. phasianellus and sage grouse Centrocercus urophasianus) (Toepfer et al. 1990).

Large-scale release programs involving captive-reared waterfowl in the United States began in 1934 in New York and gradually spread to other states (Burger 1971, Hunt et al. 1958). The Maryland Department of Natural Resources began releasing hand-reared mallards (Anas platyrhynchus) (HRM) in 1974 using funds from the sale of a state duck stamp that were legislatively designated for that purpose (Hindman et al. 1992). The number of mallards

released in each county was determined by wetland acreage, historical harvest, and Maryland duck stamp sales. Nearly a third of the 5,000 to 40,000 mallards released annually were released in Dorchester County, on Maryland's Eastern Shore.

The release of hand-reared mallards by private groups increased after 1985, when federal regulations (50 CFR 21.13) were interpreted as allowing the operator of a state registered regulated shooting area (RSA) to retain ownership of HRM after they are released. Hunters on an RSA could then harvest marked HRM without regard to federal bag limits. Operators of RSAs in Maryland have released 45,000 to 100,000 HRM per year (Soutiere 1989, L. Hindman, pers. comm.) and 71 of 131 Maryland RSAs in 1994 were in Dorchester County.

This concentration of DNR and RSA releases has been at least partially responsible for the three-fold increase in mallards counted in Dorchester County during mid-winter. There is concern that HRMs will negatively impact wild waterfowl populations through competition for food (Ankney et al. 1987) or breeding habitat (Merendino et al. 1993), and by increasing hybridization with American black ducks (Anas rubripes) (Heusmann 1974; Ankney et al. 1987, 1989; Rhymer and Simberloff 1996). Wildlife professionals are also concerned that HRM releases can decrease the effectiveness of management efforts directed toward wild waterfowl populations (Batt and Nelson 1990, Chapter 2).

Objectives of this study were to examine factors that affect the potential of HRMs in Maryland to fulfill their purpose and to affect wild waterfowl population.

I monitored the waterfowl harvest on local Wildlife Management Areas and RSAs and the perceptions of local hunters and RSA operators on the effectiveness of the HRM releases. I also examined the survival and movements of the HRM using radio telemetry. Behavioral observations were made to determine pair composition and timing of pairing among American black ducks, HRM, and wild mallards.

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CHAPTER 2

PERCEPTIONS OF RELEASES OF CAPTIVE-REARED MALLARDS, WITH EMPHASIS ON AN INTENSIVE PROGRAM IN MARYLAND

INTRODUCTION

The release of captive-reared mallards has historically been a popular response to declining waterfowl populations. In the early 1990's, Maryland was the only state to have a legislatively mandated mallard release program and to have a large private release program in state licensed Regulated Shooting Areas (RSAs [Maryland annotated Code 10-906]). At their peaks in the late 1980's, the Maryland Department of Natural Resources (DNR) and private groups released about 40,000 and 100,000 mallards per year, respectively. Dorchester County had the highest number of mallard releases on RSAs (82,000 birds [L. Johnson, pers. comm.]) and on public wetlands (7,400 birds in1991 [L. Hindman, pers. comm.]) in Maryland.

Maryland Department of Natural Resources

The DNR began operational releases of mallards in 1974 under a legislative mandate that authorized Maryland's duck stamp. Fifty percent of the proceeds from the sale of state duck stamps were earmarked for the DNR mallard release program, with the goals of improving local hunting and, secondarily, to increase local production (Hindman et al. 1992). DNR released up to 40,000 birds annually between 1974 and 1993, when the program was ended. DNR purchased 5-7 week-old ducklings that were nonstop trucked to

Maryland (24 hours), unloaded, given access to water, and distributed to releases sites within 24 hours. Birds were released in groups of up to 400 per site in late July to mid-August on estuarine marshes. They received no supplemental food or care after release (Hindman et al. 1992).

Regulated Shooting Areas

Regulated Shooting Areas are private properties where captive-reared birds are banded, released, and harvested by RSA owners and their guests (Maryland DNR Title 08, Subtitle 03, Chapter 09). The U.S. Fish and Wildlife Service (USFWS) allows such regulated releases under Federal Regulation 50 CFR 21.13. Releases on RSAs may be of flighted or free-flying mallards. The flighted mallards are typically released from a tower and shot immediately; whereas the free-flying mallards are released weeks to months before shooting takes place. Released mallards must be toe clipped before four weeks of age and banded or marked in some other approved manner. Prior to issuance of an RSA permit, the DNR is responsible for determining that the operation of an RSA will not conflict with any reasonable prior public interest. RSAs must be ≥ 50 acres (20.2 ha) to have flighted mallard releases and ≥ 200 acres (80.9 ha) to release and harvest free-flying mallards or upland game.

The most commonly stated goals of RSA operators are to improve hunting for themselves and their guests, relieve hunting pressure on wild ducks, to provide habitat for wild waterfowl, and to increase the local breeding population. RSA permittees and their guests are allowed to take marked birds by shooting, without regard to state and federal bag limits. For RSA hunters, this bag limit

exemption includes mallards marked and released on any RSA in Maryland. Sunday hunting, which is illegal in Maryland, is allowed on RSAs, but only for flighted mallards due to inability to differentiate wild vs. captive-reared mallards.

Release of captive-reared mallards on RSAs became widespread in Maryland after a federal opinion in 1985 allowed liberated captive-reared birds on a registered property to remain the property of the landowner. Prior to this ruling, some individuals, RSA operators and others, released mallards, but such birds were counted as part of the normal bag limit when harvested. The number of RSA permits in Maryland increased from 15 in 1985 to 132 in 1990 (Fig 2.1). In 1994, 71 of 131 active RSAs in Maryland were in Dorchester County. This concentration of RSAs may have been responsible for the increasing mallard populations in mid-winter surveys (Maryland DNR) from 1985 to 1992 in Dorchester County (Fig. 2.2).

I report on the characteristics of the RSAs in Dorchester County and their affect on hunters on RSAs, non-RSA private properties and Wildlife Management Areas in the county. I also summarize the status of mallard releases and opinions of biologists regarding mallard releases in other states.

METHODS

Harvest Surveys

We checked waterfowl bags at exit points of Dorchester County Wildlife Management Areas for two days during each of the three segments of

Figure 2.1. The number of Regulated Shooting Area permits in Maryland; 1980-1994.

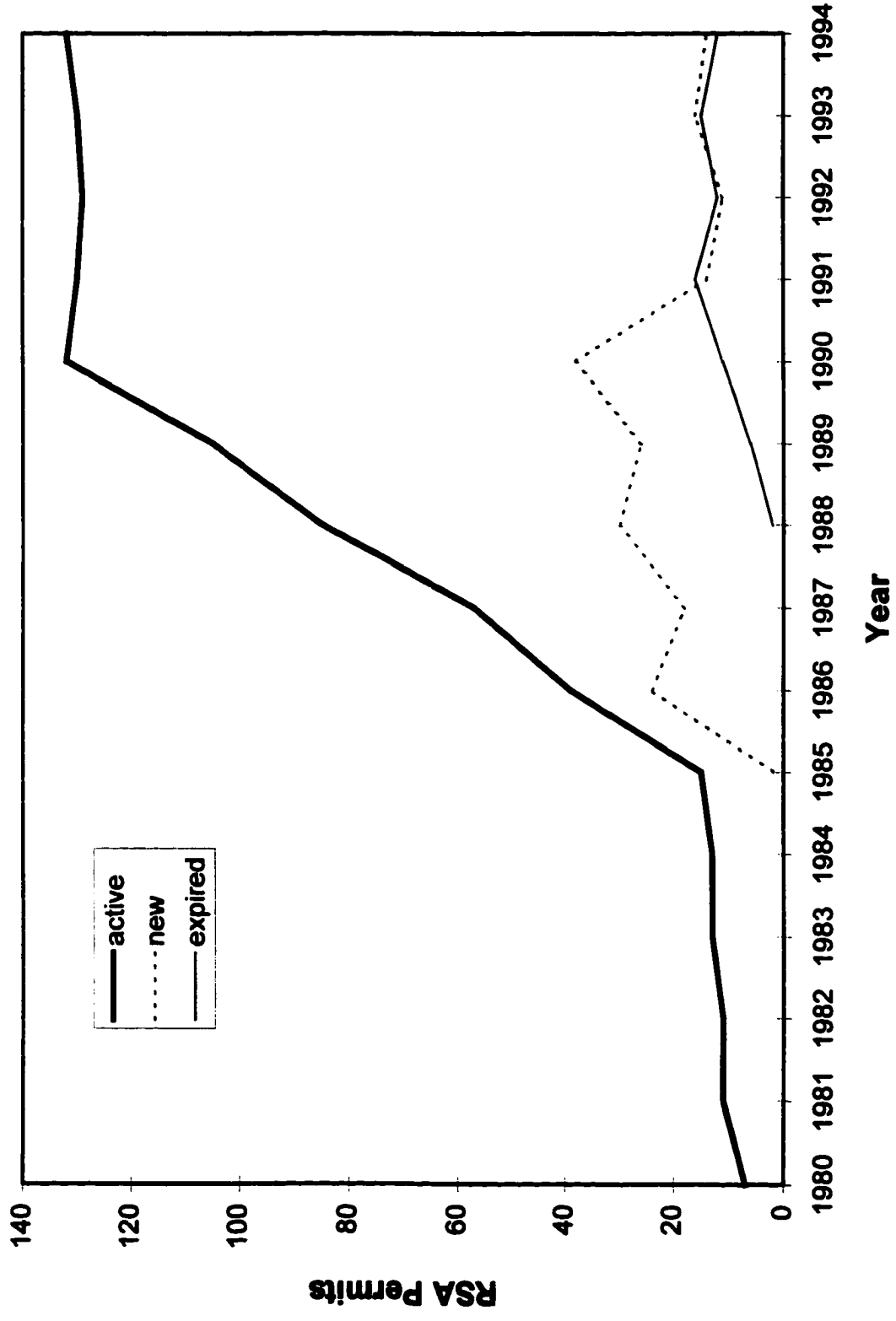
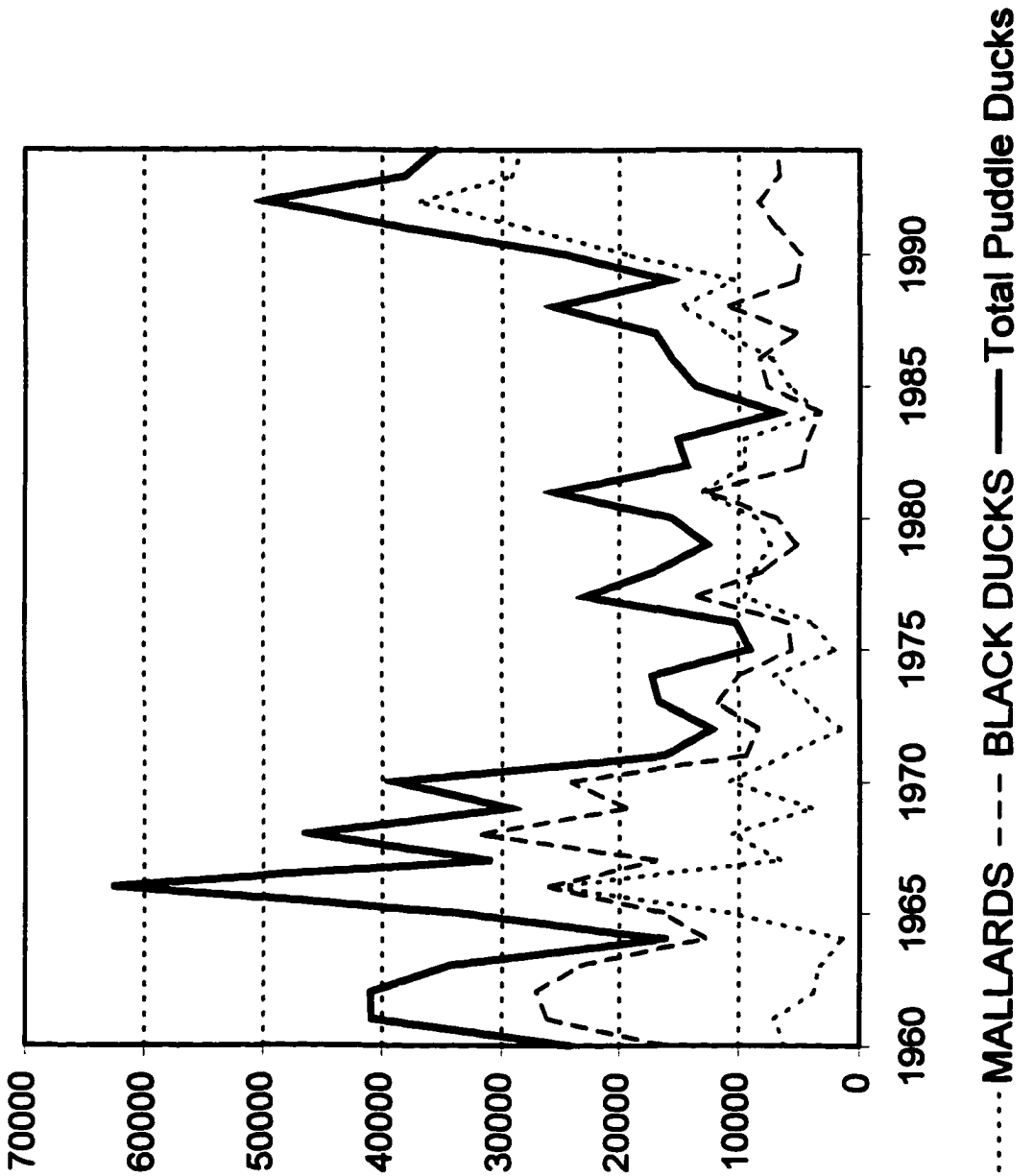


Figure 2.2. Midwinter waterfowl surveys of Dorchester County, Maryland; 1996-1984.



Maryland's waterfowl seasons (October, November, and December) in 1991-93. We recorded species and sex and examined all mallards for bands and/or toe clips. State mallards prior to 1993 were toe clipped and banded with state bands. In 1993, state mallards had both halux removed, but were not banded. Some state mallards in 1993 may not have been double toe clipped and therefore would not be identifiable. RSA mallards had one hind toe clipped and were banded with private bands that varied between RSAs.

Mail Surveys

Surveys were mailed to Dorchester County hunters and RSA owners to solicit opinions about the release programs. Dorchester County hunters were identified while monitoring exit points from Wildlife Management Areas in 1992 (as above), Maryland Duck Stamp sales (only hunters who reported Dorchester County address), and contact cards placed in blinds on private properties accessible by boat. These three lists included 435 individual hunters. A second copy of the survey was mailed to non-respondents two months after the first survey was mailed. I promised anonymity to respondents except for a code placed on each survey so that I could determine who had responded. Survey questions that had inquired about harvest had 5 answers with ranges of numbers that respondents could circle. Questions about how duck releases influence the quality of hunting had 5 answers ranging from strongly positive to strongly negative. Questions about whether RSAs should be subject to bag limits, should the state release ducks, and would you or have you hunted on an RSA had yes or no answers. Hunters could respond yes or no when asked

whether RSAs meet the following goals: removed pressure from wild ducks; provide habitat for wild ducks; boost wild mallard populations; and improve hunting around RSAs. Hunters could rate the importance (1-5) of the following impacts of released mallards: breeding with black ducks; increasing predator populations; competing with wild ducks; have low survival; and, spread disease to wild ducks. Hunters from the Maryland duck stamp list were asked "Are you associated with an RSA" and possible answers were "owner, employee, club member or guest." Questions of RSA operators dealt only with RSA mallards and included questions about numbers of birds released and their RSA size and management. Prior to the hunting season, I requested that RSA owners keep records of their harvest. The questionnaire for state waterfowl biologists focused on regulatory issues in their state and the potential effects of releases, but had two additional potential effects to rate (5 point scale of importance), namely: released mallards breeding with wild mallards; and, makes sportsmen believe releases enhance regional populations. Chi-square test were used to test for differences in hunting experience, harvest, and opinions between the 3 sampled groups surveyed and between hunters, RSA operators, and state flyway biologists.

RESULTS

Harvest

I examined 1,980 waterfowl from 1,987 hunters on WMAs. Captive-reared released mallards were a major portion of the harvest on Maryland wildlife management areas (Fig. 2.3) and RSAs. State-released mallards were 25

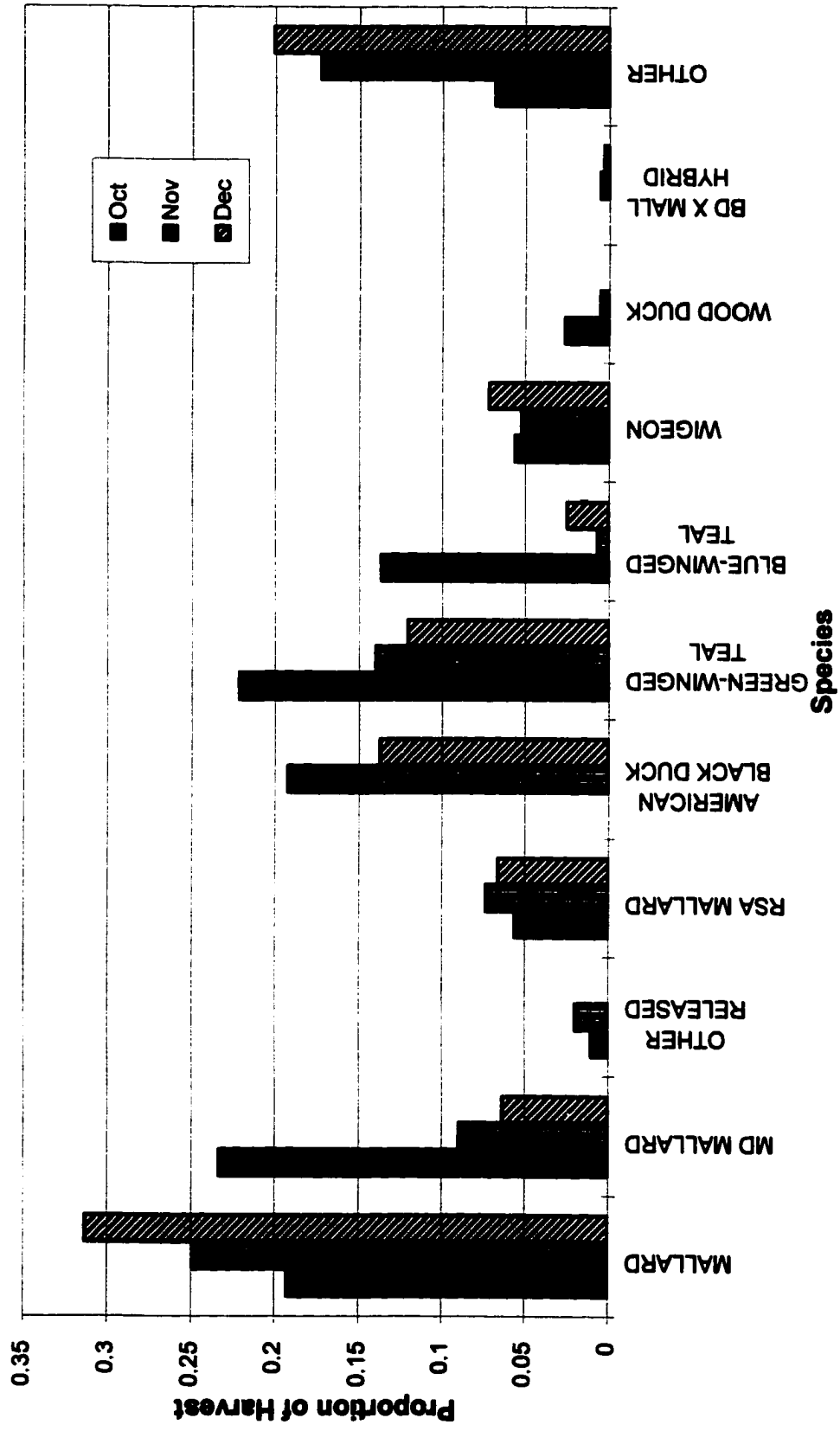
percent of the harvest during the 2-day October segment of the hunting season, but decreased to 10 and 7 percent in November and December, respectively (Fig. 2.3). There was also a decrease in the proportion of state mallards in the bag and in the total harvest of state mallards each year from 1991 to 1993. State mallards were 30, 18, and 6 percent of the harvest in 1991, 1992, and 1993, respectively. RSA mallards were 6, 10, and 4 percent of the harvest on the WMAs in 1991, 1992, and 1993, respectively.

Mail Surveys

Hunter survey. I received 265 responses, 48 percent of the 3 original lists of hunters. The 3 sampling frames differed only in frequency of hunting in Dorchester Co. and ducks harvested. Hunters from the WMA list hunted public land in Dorchester Co. more often ($P < 0.001$) and private land in Dorchester Co. less often ($P < 0.001$) than hunters from the other 2 frames. They also had begun hunting in Dorchester Co. more recently ($P = 0.001$), although 59 percent had been hunting in Dorchester Co. ≥ 6 years. WMA hunters also killed fewer total waterfowl, state-released mallards, and RSA-released mallards ($P < 0.01$). The opinion's of these three groups did not differ regarding the state mallard releases ($P > 0.05$). However, the hunters from the duck stamp list were more likely to feel that RSAs have had a negative impact on their hunting than WMA hunters or those from private blinds ($P < 0.01$).

Of the 49 respondents from the Maryland duck stamp sale list, 11 were associated with RSAs. Ten of the eleven respondents who were associated with an RSA in some way (club member, guest, or employee) had killed ≥ 5

Figure 2.3. **Proportionate harvest of ducks on Wildlife Management Areas in Dorchester County, Maryland, 1991-1993.**



RSA Mallards. Nine of these eleven (82 percent) had killed ≥ 20 ducks during the last season. Only 13 percent of the 38 hunters with no association to an RSA killed ≥ 20 ducks. Hunters associated with RSAs and those not associated with RSAs did not have differing opinions (Chi square, $p>0.1$) regarding the effects of the release programs or whether RSA hunters should have a limited bag.

Of the non-RSA hunters, 64 percent (n=253 respondents) felt that RSAs had a positive affect on the quality of their hunting and 49 percent (n=265) at least occasionally focused their hunting near an RSA. Sixty percent (n=264) said they would be interested in hunting on an RSA. The majority (>60 percent) felt that the RSAs were effective in achieving their goals, but 68 percent felt that RSA hunters should be subject to bag limits. Fifty two percent killed no RSA mallards during the previous season, but 18 percent killed ≥ 5 RSA mallards. Most hunters (68 percent of 257) felt that the state release program had a positive affect on the quality of their hunt. A majority (79 percent of 262) were in favor of the state continuing the release program, although 50 percent of respondents (n=265) did not kill a single state-released mallard during the previous season. Eleven percent killed ≥5 state mallards the previous season.

The potential for diseases to be spread to wild populations was perceived by hunters as being the most serious problem with mallard releases, with 43 percent (n=251) considering disease to be very serious (Table 2.1). Only 27 percent (n=249) felt that the potential for hybridization with American black ducks was a serious concern.

Table 2.1. Percent of respondents that believe the following potential results of mallard releases are a serious concern.

Survey group	Black Duck hybridization	Increase Predators	Competition with Wild Waterfowl	Low Survival of Releases	Spread of Disease	Hunters' belief that releases will boost populations	Breeding with wild mallards
Hunters	26.9	17.5	11.5	35	43.4	--	--
	n=249	n=251	n=252	n=250	n=251	n=0	n=0
RSA operators	11.5	53.6	4	--	25.9	--	--
	n=26	n=28	n=25	n=0	n=27	n=0	n=0
State Flyway Biologist	30.4	2.27	6.8	11.1	63	47.9	29.2
	n=46	n=44	n=44	n=45	n=46	n=48	n=48

RSA operator survey. Owners of 31 of 64 RSAs active in Dorchester County in 1992 responded to our surveys. The average size of the RSAs in Dorchester County was 529 ± 416 acres (214 ± 169 ha) (mean ± SD). These RSAs totaled 23,952.5 acres (9,693 ha), which included 776 acres (314 ha, 3.2 percent) of crop land and 1,215 acres (491 ha, 5 percent) of impoundments dedicated to waterfowl management. Thirteen RSAs that provided records had released 13,050. Other than mallard releases, predator management was the most common management practice on RSAs, with 78 percent of RSA managers using some form of predator management, typically trapping of raccoons (Procyon lotor) and red fox (Vulpes vulpes). RSA mallards were 81 percent of the ducks harvest on surveyed RSAs that had released free-flying mallards. This figure is supported by limited counts I made on RSAs and at a local picking house where RSA mallards were >95 percent of the RSA harvest. Our counts were made during the December season when teal (Anas crecca and A. discors) and wood ducks (Aix sponsa) had migrated out of the area.

Nine of 29 RSA owners felt that RSAs should be subject to some bag limit. The response from these 9 to the question "What bag limit would you consider to be too low to be worth the expense and trouble to continue to operate an RSA?" was 5.5 ± 2.0 (mean ± S.D.). The response to this question from the 20 who felt there should be no limit was 7.2 ± 5.2 (mean ± S.D.). Half of the RSA owners answered that they would quit releasing mallards if they lost the

bag limit exemption on released mallards, while 30 percent indicated that they would not change their operations in any way.

Technical section survey. Flyway technical section representatives from the 49 continental states responded to a survey about mallard releases in their state. Eleven states outlaw releases of any type. Twenty-nine states offer licenses that allow the release of captive-reared mallards, but 7 of these allow only tower shoots. Of these, 27 allow the harvest of released mallards without bag limit restrictions. Nationwide, about 2,191 properties are currently licensed to release mallards in 22 states. Many permits are in Minnesota (1,108), Texas (301), and Indiana (46), where permits allow release of both upland game and waterfowl, so it is unknown how many permittees release mallards. RSA and duck releases are most prevalent in the Atlantic Flyway (Table 2.2). Records of the number of mallards released are lacking in most states, but estimates indicate that at least 278,000 mallards are released annually in the U.S. Half of these are released in flighted shooting operations and, although records are lacking, most of these mallards are likely harvested.

Factors that most concerned flyway biologist about releases of captive-reared mallards were hybridization, spread of disease, and their influence on hunter's attitudes (Table 2.1). Spread of disease was most often (64 percent, n=48) given as a serious concern in all flyways. A second issue that was frequently (48 percent) a serious concern was that releases would make "sportsmen believe that released ducks can enhance regional populations." Concern over hybridization with American black ducks was highest in the

Table 2.2. Captive-reared mallard regulations and releases by flyway from survey of the flyway technical section biologist in each state.

						Releases			
Flyway	States	Offer licenses for release	Bag exemption offered	RSAs (permits)	Outlaw all releases	Non-licensed	Flighted	Stocking	Total releases
atlantic	17	13	13	548	1	66500	100830	54775	222105
mississippi	14	8	7	1184	2	2500	27300	8501	38301
central	9	4	4	321	3	500	2200	0	2700
pacific	9	4	3	11	4	0	11235	1800	13035

Atlantic and Mississippi flyways with 47 and 31 percent, respectively, listing these as very important concerns. Conversely, concern about released mallards breeding with wild stock mallards was highest in the central flyway where 44 percent of biologist responded that it was a very important concern.

The concerns of flyway biologist and hunters differed in several aspects (Table 2.1). The flyway biologist were more concerned about the affect of releases on wild waterfowl populations. They were more concerned about released mallards hybridizing with black ducks (χ^2 = 10.4, df = 4, P = 0.034) and the spread of disease (χ^2 = 15.7, df = 4, P = 0.003). Hunters were more concerned about increases in predator populations (P < 0.001) and the low survival of released mallards (P < 0.001).

RSA operators were more concerned than hunters and state biologist about releases increasing predator populations (χ^2 = 34.9, df = 6, P < 0.001). RSA operators were less concerned than hunters and state biologist that mallard releases would increase hybridization with black ducks (χ^2 = 20.1, df = 6, P = 0.01) or cause outbreaks of disease (χ^2 = 14.0, df = 6, P = 0.029). Concerns about released mallards competing with wild waterfowl were low and did not differ among groups (χ^2 = 7.6, df = 8, P = 0.469).

DISCUSSION

Hindman et al. (1992) used band recoveries and information from the U.S. Fish and Wildlife Service Parts Collection Survey to examine the contribution of state releases to the statewide waterfowl harvest. State mallards constituted

less than 5 percent of the bag during the early 1980's. Because of the concentration of releases, it is not surprising that I found that state mallards are a larger portion of the harvest in Dorchester County, MD. This concentration probably also improved hunter attitudes about the DNR and RSA release programs. It is doubtful that people who hunt areas that did not receive large releases would have the same attitudes.

State-released mallards primarily were harvested in the October season. Mallards that survived to the October season were relatively tame and were probably quite vulnerable to hunting mortality (Brakhage 1953, Schladweiler and Tester 1972). Many hunters commented about the state mallards' lack of fear of boats or people and how they decoyed easily. The decrease in the state-released mallards harvested between years was probably due to the lower numbers released in later years. This decrease in harvest of state-released mallards suggests that state releases do not have a long term effect on harvest and harvest of state birds depends on continued releases. A similar decline in harvest was observed in Maine after releases terminated in 1974 (Corr and Spencer 1977). Hindman et al. (1992) found that 79 percent of the recoveries of state mallards occurred in the first hunting season after release.

Although state mallards were a small component of the harvest on WMAs, hunters in the area had a positive impression of the program. Many people hunted Dorchester County WMAs only during the October season (pers. obs.) and are therefore likely to have an opportunity to kill a state mallard. Their opinions were likely to be shaped by the high harvest of state-released mallards

during this season. We only recorded a hunter's name the first time we encountered him, so I could not separate respondents who hunted only during the October season from those who hunted all three seasons. The impression of hunters on public land toward the RSA programs was also favorable though few people on public land harvested RSA mallards. The impressions of hunters from the state duck stamp list differed in accord with their harvest of RSA mallards. Those who harvested more RSA mallards were more likely to have a favorable opinion of the RSA program.

The differences between opinions of hunters and flyway biologist may reflect the basis of their concern. Biologist were more concerned about factors such as hybridization and disease that affect wild populations. Hunters were more concerned about increased predator populations and the survival of released mallards, which are factors related to the effectiveness of the releases.

The number of RSA permits in Maryland appears to have stabilized at about 130 operations (Fig. 2.1). The number of permits allowed to expire has approximately equaled the number of new permits issued annually since 1991. The number of mallards released annually has decreased from a peak of about 100,000 in the late 1980s to 38,000 in 1993 (L. Hindman, pers. comm.). The Maryland DNR mallard release program ended in 1993, largely due to high mallard mortality prior to the hunting season (Chapter 3).

Private release programs have not become established in several states where licenses are available. The restriction of hunting time (Delaware),

location (Louisiana), or other parameters appears to limit the popularity of releases in some states. Several states that allow releases also discourage such licensing. Interest in releases appears to be lacking in other states (Tennessee and Washington). In the states where licenses are issued, there is little monitoring of releases or harvest on registered properties.

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CHAPTER 3

SURVIVAL OF HAND-REARED MALLARDS RELEASED IN MARYLAND: STATE AND PRIVATE RELEASES

INTRODUCTION

Captive propagation and release of wildlife has been a common reaction to declining populations. Goals of releases include attempts to increase populations, species introductions or reintroductions, or supplement hunting opportunities. Captive-reared Canada geese (*Branta canadensis*) have been successfully used in re-introduction programs (Nelson 1963, Lee et al. 1984). However, other restocking attempts with captive-reared birds generally have been unsuccessful for many species, including turkeys (*Mileagris gallopavo*) (Leopold 1944) and northern bobwhites (*Colinus virginianus*) (Roseberry et al. 1987). Large scale release programs involving captive-reared waterfowl in the United States began in 1934 in New York and gradually spread to other states (Burger 1971, Hunt et al. 1958).

Releases of hand-reared mallards have been made by the Maryland DNR and private organizations or individuals since the late 1940's. Large numbers of hand-reared mallards (HRM) have been released in Dorchester Co. on Maryland's Eastern Shore each year since 1985 (Smith and Rohwer 1997). These releases were due primarily to the proliferation of Regulated Shooting Areas (RSA) after 1986 when it became legal for RSA operators to retain ownership of marked HRM on their property. RSA owners and their guests can

harvest HRM without regard to bag limits. Maryland RSAs released 45,000 to 100,000 HRM per year from 1986 to 1995 (Soutiere 1989, L. Hindman pers. comm.). In 1994, 70 of the 130 RSAs in Maryland were in Dorchester County on Maryland's Eastern Shore.

Soutiere (1989) estimated annual survival of banded RSA mallards at 0.19 and 0.33 for males and females, respectively. Releases of 100,000 HRM per year could result in 26,000 released birds surviving to their first breeding season. Stanton et al. (1992) estimated a survival rate of 25% between March and August for radio-tagged female HRMs released on a single RSA in Kent County, Maryland.

In addition to private releases, the Maryland DNR has released 5,000 to 40,000 mallards each year between 1973 and 1991 (Hindman et al. 1992). Primary goals of this release program were to improve hunting opportunity and increase local breeding stock. Distribution of these releases was determined by wetland acreage, historical harvest, and Maryland duck stamp sales, so nearly a third of these releases were made in Dorchester Co.

Success of private and state releases of HRM and their potential for effects on wild waterfowl populations depends on survival of released mallards. My goal was to estimate and compare survival of state and private mallards, and to examine factors affecting survival of HRM released on RSAs and Wildlife Management Areas in Dorchester Co., Maryland during the first 6 months after release. In 1993, I examined the potential for a supplemental feeding program to increase survival of DNR mallards.

METHODS

I released radio-tagged HRM south of U.S. highway 50 in Dorchester County, Maryland, during 1991-1993. This area had the greatest concentration of DNR and RSA release sites and numbers of ducks released. Much of this research was done at 2 areas traditionally used as release sites for large numbers of DNR Mallards. One was estuarine marsh in Fishing Bay Wildlife Management Area (FBWMA), which boarders the Chesapeake Bay. A second site, the brackish upper end of the Blackwater River, was used in 1991 and 1992.

In 1991, I held 46 DNR mallards for 2 weeks prior to release to allow them to gain weight prior to attachment of radio transmitters. These birds were released on 5 and 12 August 1991 along with other DNR mallards. In 1991, I also selected 2 RSAs, one adjacent to each state release site, and radio-tagged 25 HRM at each site. This marking was done in September and early October.

In August, 1992, I radio-tagged 87 DNR birds that were immediately released with all other state HRMs at FBWMA and the Blackwater River. I also randomly selected 6 RSAs within 9 km of the state releases sites and radio-tagged 10 HRMs at each site in August. In 1993, I radio-tagged 99 DNR birds that were released in August. I also radio-tagged 10 HRM at each of 6 randomly selected RSAs in August. In total, 170 HRM were radio-tagged on 14 different RSAs in the 3 years of this study.

In 1992 and 1993 all radio-tagged HRM were 6-8 weeks old and were donated by Frost Game Farm, Coloma, Wisconsin. Use of Frost birds during 1992 and 1993 for both state and private releases eliminated potential variation in survival due to source of the birds or their marking time. Frost Game Farm was the supplier of HRMs for the state release program and for several RSAs during this study.

All 1993 releases of state HRM were at FBWMA at two sites separated by 6 km. In the treatment area, 49 radio-tagged HRM were mixed into a total release of 400 HRMs, all of which were free ranging but were provided with food through September (DNR-fed). A combination of duck-grower and corn were provided for the first 2 weeks after release, and then corn alone was provided until the end of September. Every 2 days, about 2 days worth of food (115 g/bird/day) was placed on platforms in open water near the release site. The control release site had 50 radio-tagged HRM mixed into a total release of 400 DNR mallards. This group, like typical DNR releases, received no additional food after release.

Survival analyses were based on data from mallards fitted with Dwyer type (Dwyer 1972) radio-telemetry packages (Appendix E). Transmitters weighed 19-21 grams, had an expected life of 180 days, had a range of 1-5 miles from a ground based receiver, and were equipped with mortality sensors that caused the signal pulse rate to double when the transmitter remained motionless for 4 hours. The status of all birds was monitored every 1 to 4 days, depending on current mortality rates, through the middle of February. When a

signal could not be received by monitoring from the ground, I searched using fixed-wing aircraft to increase signal reception range (Gilmer 1981). Transmitters sending a mortality signal were investigated as soon as possible to determine condition of the bird. I recorded location, carcass condition, and probable cause of death if any evidence was available.

I analyzed survival with the program LIFETEST (SAS Institute, Inc. 1989), which used the Product-Limit survival method to estimate survival (Kaplan and Meier 1958). The Product-Limit method allows right censoring for individuals that do not remain a part of the study for the entire period of interest. I right-censored individuals on the day when I had our last radio contact. August 19 was set as the time origin because it was after the latest date of release of DNR mallards in all years and the RSA birds in 1992 or 1993. The end of the study period was January 16 (150 days) of each year because this was after the hunting season in all years and only one mortality was observed after this date. Only mortalities detected through telemetry methods or working transmitters returned by hunters were considered observed mortalities in survival estimates. The date of death for all mortalities was set at the date a mortality signal was first heard or when the signal was lost for a transmitter that we later recovered from a carcass. The later criterion was used because death of an individual with a functioning transmitter often would result in the transmitter being on the ground or under water or mud, which reduced the effective range of the transmitter.

Log-rank and Wilcoxon tests were used to examine survival distributions. Log-rank probabilities are reported unless otherwise specified. These tests generally yield similar results, but the Wilcoxon test is more sensitive to differences in survival distributions early in the period of interest, and the log-rank is affected more by the latter part of the observation period (Cox and Oakes 1984). Condition index (mass (g)/tarsus (mm)) and sex were evaluated as covariates of survival.

I assayed fat content of ulnar marrow (Ringelman et al. 1992) of carcasses with intact wing bones and from samples of RSA, DNR, and DNR-fed mallards that I collected 2-3 weeks after release. A negative test result indicated that ulnar lipid was below 5%. Marrow fat is the last reserve to be used, so a negative result indicated that total lipid reserves were critically low (Ringelman et al. 1992).

Return of functioning and failed transmitters by hunters allowed us to estimate the number of transmitters that failed during the study period (Table 3.1). I assumed that hunter returns were random samples from the population at the beginning of the hunting season and that sampling method was independent of whether the transmitter was functioning. Estimates of transmitter failures on RSA and DNR mallards were done separately because most transmitters on the RSA mallards were new, but most transmitters in the DNR and DNR-fed mallards were refurbished.

Table 3.1. Fate of radio-tagged mallards released in Maryland, 1991-1993.

	MDS[a]	MDS-fed	RSA	ALL
mortality	119	10	54	183
survived season[b]	0	0	9	9
hunter killed	2	2	24	28
censored	51	26	66	143
transmitter failure	7	7	5	19
transmitter failure/ hunter returned	4	4	12	20
Total radio-tagged sample	183	49	170	402

[a]MDS = Maryland duck stamp mallards, RSA = Regulated Shooting Areas Areas and MDS-fed are duck stamp Mallards given supplemental food.

[b] Season ended January 16.

RESULTS

Survival differed among RSA, DNR, and DNR-fed mallards ($P < 0.0001$). Comparison of the survival distributions for 3 years of DNR releases revealed no differences between years ($P = 0.834$; Table 3.2). In general, survival of DNR mallards was poor (Fig. 3.1). Survival at 4 weeks post-release for all 3 years combined was 36.7%. Survival at 31 October (about 10 weeks post-release) was 20.6%; estimates beyond this date are suspect because of the low number of birds at risk. The survival distribution of DNR-fed (Fig. 3.1) mallards was significantly higher than survival of control DNR-released birds ($P < 0.001$). RSA survival distributions for all 3 years were not different ($P = 0.324$). However, comparison of survival distributions on RSAs between 1992 and 1993 approached significance ($P = 0.064$). The p-value for the log-rank test was lower than the Wilcoxon test ($P = 0.18$), which suggests that the differences in the survival curves were primarily later in the season. None of the variables tested as covariates (sex, year, and condition) had a significant affect ($P > 0.13$) on survival distributions of RSA, DNR, or DNR-fed mallards in the full model (Table 3.2).

Hunting mortality curves for the RSA, DNR, and DNR-fed mallards were not significantly different ($P = 0.987$, Table 3.3, Fig. 3.2). Likewise, none of the two-way comparisons between treatments were significantly different (Table 3.3, $P > 0.8$). Hunting was responsible for a mortality rate of about 12% of the DNR, DNR-fed, and RSA mallards by the end of October. At the end of the

Table 3.2. Log-rank tests of survival of Maryland Mallard release programs in Maryland, 1991-1993.

Comparison	Log Rank p-value
Inter-annual	
DNR[a]: 1991 vs 1992 vs 1993	0.834
RSA[b]: 1991 vs 1992 vs 1993	0.130
Years Pooled	
DNR vs DNR-fed[c] vs RSA	0.000
DNR vs RSA	0.000
DNR-fed vs RSA	0.244
DNR vs DNR-fed	0.000
DNR: Male vs Female	0.256
DNR-fed: Male vs Female	0.455
RSA: Male vs Female	0.607
All releases- Male vs Female	0.361
YEARS SEPARATE	
DNR	
1991: Male vs. Female	0.324
1992: Male vs. Female	0.735
1993: Male vs. Female	0.544
DNR-fed	
1993: Male vs. Female	0.455
RSA	
1992: Male vs. Female	0.865
1993: Male vs. Female	0.436

[a] DNR = Maryland duck stamp mallards
[b] RSA = Regulated Shooting Areas
[c] DNR-fed are duck stamp mallards given supplemental food.

Figure 3.1. Survival with 95% confidence intervals for Regulated Shooting Area (RSA), Maryland Department of Natural Resources (DNR), and Maryland DNR-fed (DNR-fed) hand-reared mallards released in Dorchester County, MD. Data for 1991, 1992 and 1993 are combined for RSA and DNR. The only year for the Maryland DNR-fed treatment was 1993. Arrows indicate beginning of the three waterfowl hunting seasons in Maryland.

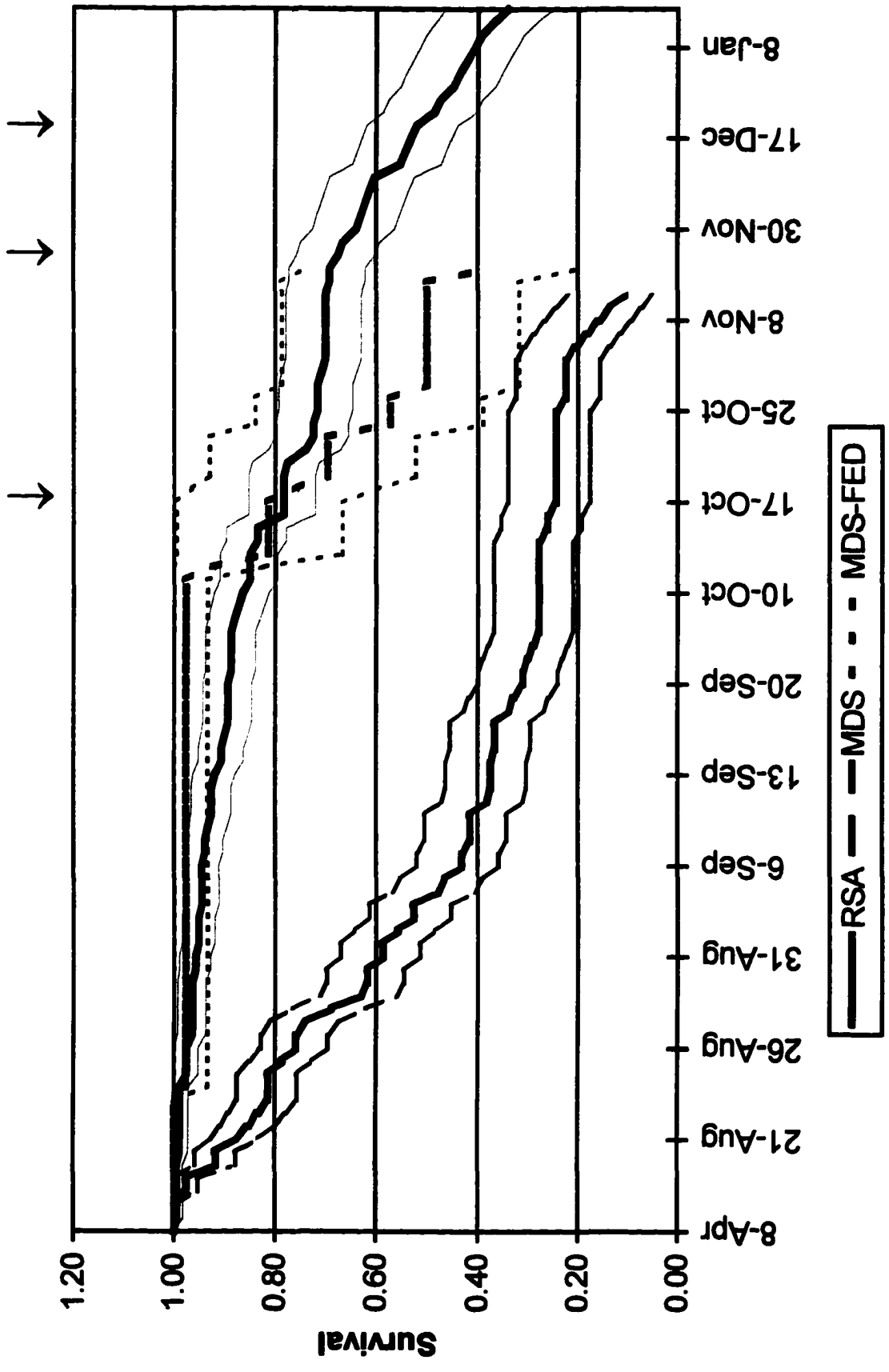

Figure 3.2. Affect of harvest on survival of Regulated Shooting Area (RSA), Maryland Department of Natural Resources (DNR), and Maryland DNR-fed (DNR-fed) hand-reared mallards released in Dorchester County, MD.

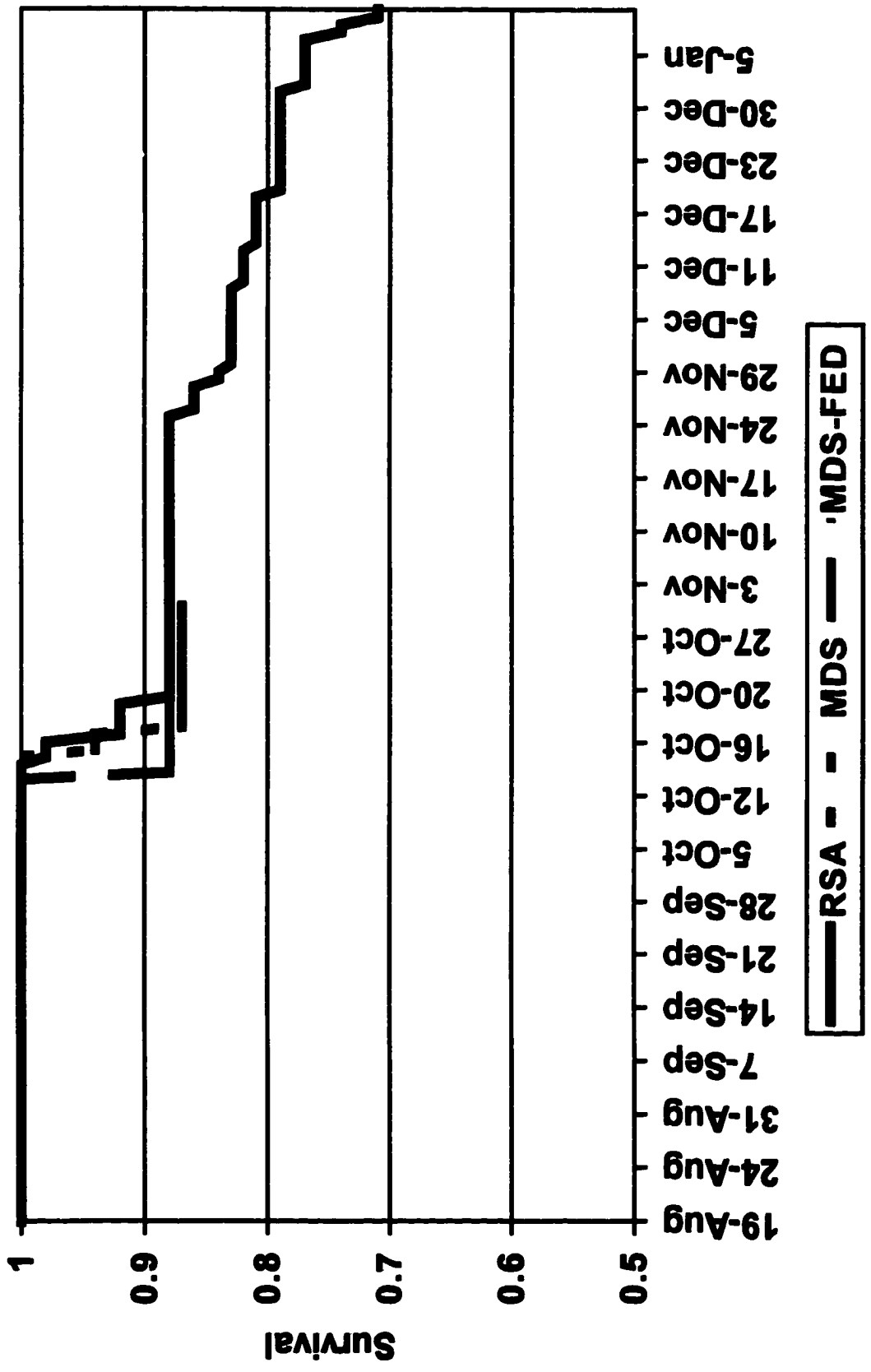

Table 3.3. Log-rank tests of hunting mortality of Maryland Mallard programs. MDS = Maryland duck stamp mallards, RSA = Regulated Shooting Areas and MDS-fed are duck stamp Mallards given supplemental food.

Comparison		Log Rank p-value
Inter-annual		
	MDS: 1991 vs 1992 vs 1993	0.478
	RSA: 1991 vs 1992 vs 1993	0.357
1991 - 1993 Combined		
	MDS vs MD-fed vs RSA	0.987
	MDS vs RSA	0.996
	MD-fed vs RSA	0.866
	MDS vs MD-fed	0.962

hunting season in January, hunting mortality was 28.5% of RSA mallards. Estimates of hunting mortality of DNR and DNR-fed birds are based on only 2 observed mortalities of the few radio-tagged individuals that survived to the hunting season (Table 3.1).

Although hunting mortality of the DNR and DNR-fed groups were the same, a lower proportion of DNR mallards survived until the October hunting season and were therefore available for harvest ($P = 0.001$, d.f. = 2). For 3 years combined, only 17 of 183 DNR radio-tagged mallards were at risk for the October hunting season, while 16 of 49 DNR-fed mallards were at risk at this time in 1993.

Analysis of ulnar fat content from DNR mallards collected and found dead indicate that their lipid reserves were low. All of the mallards collected on RSAs (n=35) and from the DNR-fed group (n=9) yielded levels above 5%, while 95.4% of collected DNR birds (n=36) were near starvation with low marrow lipid values ($P < 0.001$). Fat was depleted in 87.5% of the un-fed DNR mallards located after death.

I estimate that 46.9 ± 5.62 ($\pm$ S.E.) and 46.9 ± 3.81 ($\pm$ S.E.) of transmitters failed for RSA and DNR mallards, respectively. This resulted from failure rates of 0.33 on RSA and 0.69 on the DNR mallards at risk at the start of the October hunting season.

DISCUSSION

Survival distributions of the DNR and RSA mallards differed markedly. Survival of DNR mallards was poor, with particularly high mortality recorded during weeks 2-6 after release. The RSA mallards had higher survival through the season, with 31% of the deaths being hunting related. Mortality on the RSAs peaked during each of the hunting seasons (2 days in mid-October, 2 days in November, and mid-December through early-January; Fig. 3.1). The mortality of the DNR-fed group peaked in mid-October, which was 2 weeks after I stopped providing supplemental food.

I suspect that energetic or nutritional deficiencies contributed to the high mortality of DNR mallards. Survival of HRM previously was related to the quality of the release habitat (Schladweiler and Tester 1972). Survival and condition of DNR birds released on FBWMA appeared to be improved by supplemental feeding in 1993, but only as long as food was provided. Survival of the DNR-fed group at the end of September, when feeding was stopped, was 97.6% compared with 21.9% for the 1993 DNR un-fed mallards. Survival of the DNR-fed group dropped to 49% on 25 October, with known hunting mortality accounting for only 25% of this decrease. Stanton et al. (1992) also found decreased mortality of after-hatching year HRM females at an RSA when supplemental food was available, but that work involved older females during spring and summer.

In 1993, the control DNR mallards were the only group with depleted fat in the marrow of their ulnae. Although starvation probably was a contributing

factor in the high early mortality of the DNR group, it was not necessarily the direct cause of death. Depleted fat reserves make birds more susceptible to predation and exposure (Ringelman et al. 1992). Carcasses were subject to being scavenged (D. Smith, unpublished data), which makes determination of the cause of death difficult, but 13 of 32 carcasses recovered in 1993 were intact, suggesting that the cause of death was not predation. It is not known if released mallards were not able to forage effectively because of lack of instinctual or learned behaviors (Brakhage 1953, Schladweiler and Tester 1972) or if food was not available in sufficient quantity for the density of released mallards.

Censored individuals in this study fell into two categories: known transmitter failures, or cause of loss unknown. Unexplained losses could be the result of undetected transmitter failures, submersion of or damage to the transmitter due to mortality of the individual, or emigration of the individual. Our estimate of transmitter failures accounts for about half of the censored RSA and DNR mallards. Sixteen of the 20 (80%) mallards with failed transmitters shot and reported by hunters had previously been censored with the cause unknown. These account for 41.6% of all radio-tagged birds shot and reported (n=48). I doubt that emigration is the cause of many cases of unexplained censoring because I detected no long-distance movements by aerial radio tracking and no hunter-shot birds were reported from remote locations.

Hindman et al. (1992) used first-year band returns for DNR mallards to estimate that 15.6% were harvested by hunters within 5 years of release. This

result suggests that half of the mallards that survived to the October hunting season (about 28%) were harvested. This is similar to Schladweiler and Tester's (1972) estimate of 56% hunting mortality for radio-tagged, hand-reared mallards at risk at the start of the hunting season. In our study, however, there were 17 radio-tagged DNR mallards at risk for the October hunting season, yet only 2 were killed by hunters. The number of individuals at risk fell to 2 before the November split, so discussion of harvest pressure or survival beyond October is not possible. Feeding of DNR mallards increased survival to the hunting season and improved harvest of released birds, but probably not long-term survival. Regular feeding visits made DNR-fed birds quite tame and may have increased their susceptibility to harvest.

Mortality appeared to be independent of structural size and mass at the time of release. Pollock et al. (1989) found that although survival of after-hatching year American black ducks (*Anas rubripes*) was related to a condition index (mass / wing length), survival of first-year black ducks was not related to condition. Because the mallards in this study were measured at an age of rapid growth, the condition index may confound true condition and age. However, it appears that causes of mortality were independent of size of the individual at the time of release.

The number of DNR and RSA mallards alive at the end of the season can be estimated from the number of HRM in each release and the survival estimates. Approximately 50,000 HRM were being released annually in Maryland in the early 1990's (L. Johnson, pers. comm.) and with survival at

37.5 ± 4.9% (± S.E) I predict that 18,750 mallards survived the hunting season each year. In 1991, DNR released 20,000 mallards in their last year of large scale releases. With a 20.9 ± 4.4% (± S.E.) survival I predict that 4,180 DNR mallards survived to the October hunting season. If the 20,000 DNR mallards were given supplemental food after release and had a survival rate of 49.8% ± 12.4 (± S.E.), then 9,960 individuals might have survived to the end of October. However, it is improbable that this number of HRM would be released with supplemental feeding due to the added cost of food and labor. I estimated a cost of $3.25 per mallard released for building feeding platforms in the marsh and providing 0.23 kg of food/bird every 2 days for 40 days.

MANAGEMENT IMPLICATIONS

I believe that release of captive-reared mallards, as was practiced by the Maryland DNR, is not sound wildlife management because the majority of released birds were dead long before the hunting season. In spite of this, DNR mallards constituted 5-10% of the harvest on the Wildlife Management Areas where mallards were released (Smith and Rohwer 1997). The lack of alternative ducks can explain the impetus for release of captive-reared ducks. Mallard releases on RSAs have been more successful in terms of making birds available for harvest during the hunting season. Direct feeding on RSAs after release and planting of crops to provide food appears to ensure high survival of released mallards until the hunting season. Large numbers of privately

released mallards survive the hunting season, but the ecological impact of these ducks remains to be examined.

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CHAPTER 4

PAIR COMPOSITION OF AMERICAN BLACK DUCKS AND MALLARDS IN AN AREA WITH LARGE-SCALE MALLARD RELEASES

INTRODUCTION

American black duck (hereafter black duck) populations have decreased for more than 50 years despite management efforts to reverse the trend (Grandy 1983, Kirby 1988, USFWS and CWS 1998). Many hypotheses proposed to explain the decline of black ducks focus on potential negative interactions with mallards. Black ducks may compete with mallards for food (Ankney et al. 1987) and breeding habitat (Merendino et al. 1993). Hybridization with mallards is another potential threat for the smaller population of black ducks (Heusmann 1974; Ankney et al. 1987, 1989; Rhymer and Simberloff 1996).

Reasons for the eastward expansion of mallards are unclear, but release of captive-reared mallards in eastern states is one explanation. Releases of mallards have occurred in Maryland for decades, but the size and number of releases increased dramatically after 1986, when regulatory changes allowed increased harvest of captive-reared mallards (Smith and Rohwer 1997). A maximum of 120,000 captive-reared mallards have been released in Maryland each year since 1986 (Soutiere 1989), which has apparently increased resident mallard populations (Smith and Rohwer 1997). These releases primarily occur in estuarine marshes of Chesapeake Bay on the Eastern Shore of Maryland. Although some black ducks nest in this area (Stotts and Davis 1960), it is probably more important as a black duck wintering area (Bellrose 1980).

Mallard releases may increase opportunities for interspecific pairing because both species form pair bonds during winter (Rohwer and Anderson 1988), and the frequency of interspecific pairs may be related to the number of available mallards (Johnsgard 1967, Brodsky and Weatherhead 1984). If hybridization increased because of mallard releases, then I would expect to see a higher proportion of mixed pairs and hybrids in an area of intense mallard releases (D'Eon et al. 1994).

I examined pair composition in Dorchester County, Maryland where mallard releases have been common (Smith and Rohwer 1997). I also quantified the timing of pairing among black ducks, captive-reared mallards, and wild mallards, because that timing influences mate choice (Brodsky and Weatherhead 1984).

METHODS

The study sites included Blackwater National Wildlife Refuge (BNWR) and privately owned Regulated Shooting Areas (RSA) in Dorchester County, on Maryland's Eastern Shore. Most releases of mallards occur on RSAs (Smith and Rohwer 1997), which are private lands where captive-reared mallards may be harvested without regard to bag limits. RSAs often have abundant food and cover, and they offer attractive habitat for wild ducks as well as released mallards. The Maryland Department of Natural Resources (DNR) released mallards on Wildlife Management Areas in Dorchester County (Smith and Rohwer 1997). No mallards were released on BNWR, although released mallards made extensive use of the refuge. Released mallards were

purchased from a variety of sources and typically were released on RSAs at 6-7 weeks of age.

Five of 72 RSAs in Dorchester County were selected randomly for observation in 1992 and 6 of 77 were selected randomly for observations in 1993. All had released birds in the year of study. Sites were sampled monthly from September through February with one site observed per day. Waterfowl on most sites were observed with a spotting scope from a vehicle. On a remote area of BNWR observations were made from a permanent tower.

Behavioral observations were made from sunrise to 1000 and 1530 to dusk; mallards typically were inactive from 1000 to 1530 (pers obs). Individuals were selected randomly for observation by pointing the spotting scope at a group, then choosing the individual closest to the center of the field. Other individuals in the group were then observed systematically while keeping track of previous subjects to avoid selecting them again. I terminated observations of a group when I could no longer keep track of which individuals had been included. I usually observed 30-50% of the individuals in a group. The pair status of all black ducks was assessed. I scored birds as paired if female inciting, sustained proximity to a member of the opposite sex, following of a male by a female, or mate defense was observed (Stotts 1958, Johnsgard 1960). Individuals were categorized by sex, origin (captive-reared or wild), pair status, and, if paired, species and origin of pair partner. Mallards with a leg band were assumed to be captive-reared because of the large number of RSA and Maryland DNR mallards released in Dorchester County, which were all

banded. Only 2 of 460 (0.4%) wild mallards in hunter bag checks were banded, while all 312 captive-reared mallards were banded (all captive-reared mallards are identifiable in-hand because their hind toe is removed as ducklings). Mallards were classified as captive-reared or wild only if both legs could be observed for bands because of comfort movements or because the duck was out of water. Other mallards were categorized as unknown origin. Males were classified as hybrids in 1993 if I observed plumage characteristics of both species (Morgan et al. 1984).

I used 4-way contingency tables to examine independence of pairing chronologies between 2-way combinations of banded mallards, wild mallards and black ducks using log-linear models with maximum-likelihood estimation (PROC CATMOD, SAS Institute, Inc. 1989). All analyses included the factors location (RSA or BNWR) and month (September through February). Adjacent months were pooled when sample size was small: September with October, November with December, and January with February. Where interactions were significant, one of the factors in the interaction term was removed from the model. If the 4-way interaction pair status*species*month*location was significant (i.e., $P < 0.05$), I analyzed 3-way tables for each location (RSA or BNWR) separately. If the 3-way interaction pair status*species*month was significant, I analyzed 2-way tables within months and locations. Where month was significant, I tested for independence of origin and pair status by month using Chi-square or Fisher's exact test if expected values were low (PROC FREQ, SAS 1989).

I used a 3-way contingency table to test for independence of the origin (wild or captive-reared) of mallard males paired with mallard hens of different origin on RSAs and BNWR. This analysis used a log-linear model with maximum-likelihood estimation (PROC CATMOD, SAS 1989).

I determined harvest composition on Wildlife Management Areas in Dorchester County by checking hunter bags at the only available access points for 2 days at the beginning of the 3 segments of each hunting season in 1992 and 1993. Hybrids were identified by plumage, including green on head, white on primaries, red on chest, curl in tail, black rump, and retrix coloration (Morgan et al. 1984). Post-season sex ratios were estimated in early February 1995 on 7 RSAs where mallards were concentrated on limited open water due to a hard freeze.

RESULTS

Frequencies of Mixed Pairs and Hybrids

I collected data from 339 and 433 black ducks in 1992 and 1993, respectively (Appendix F). Three of 159 (1.9%) paired female black ducks had a male mallard as a mate. One interspecific pair observed in 1992 involved a wild male mallard; the origin of the male in the other 2 mixed pairs was not determined. Three of 492 (0.6%) paired female mallards had a mate that was a hybrid black duck x mallard. One of the 2 female mallards with a hybrid mate in 1993 was a wild hen; the origin of the other 2 mallard females in mixed pairs was unknown. None of the mallard females I observed were paired with a male black duck.

I classified 8 of 160 wild free-ranging male black ducks (5%), whose plumage was observed in detail in 1993, as hybrids. Hunter bag checks in 1992 and 1993 identified 7 hybrids among 83 birds (8.4%).

Mallard Origin and Pair Composition

I collected data from 2,720 and 2,240 mallards in 1992 and 1993, respectively. In 1992 and 1993 combined, the origin of 1,306 male and 1,048 female mallards was determined. Most mallards were captive-reared (47%) or of undetermined origin (42%), and only 511 (11%) were wild. Mate origin was not independent of female origin as shown by the 3-way contingency table of female origin, male origin, and location (RSA vs. BNWR) (χ^2 = 56.88, P < 0.0001, Fig. 4.1). For 144 paired mallard females of captive-reared origin I identified the origin of their mates: 124 captive-reared male mallards (86.3%); 19 wild male mallards (13.0%); and 1 hybrid male black duck x mallards (0.7%) (Fig. 4.1). In contrast, the 95 wild female mallards I observed had wild male mallards as mates in 72 cases (75.8%) and captive-reared males as mates in only 23 cases (24.2%) (Fig. 4.1).

Pairing Chronologies

This study encompassed the period when mallards and black ducks form pairs, so it is no surprise that month influenced pair status (Figs. 4.2, 4.3, and 4.4). Comparisons between the pairing chronologies of wild mallard hens and black duck hens were simplified by the absence of 4-way or 3-way interactions between location, species, month, and pair status (all χ^2 < 5.50, $d.f.$ = 1 to 3, all

Fig. 4.1. Observed frequency of pairs between captive-reared and wild mallards in 1992-93 and 1993-94. A: Blackwater National Wildlife Refuge (BNWR), Dorchester County, Maryland. B: Dorchester County Regulated Shooting Areas (RSA).

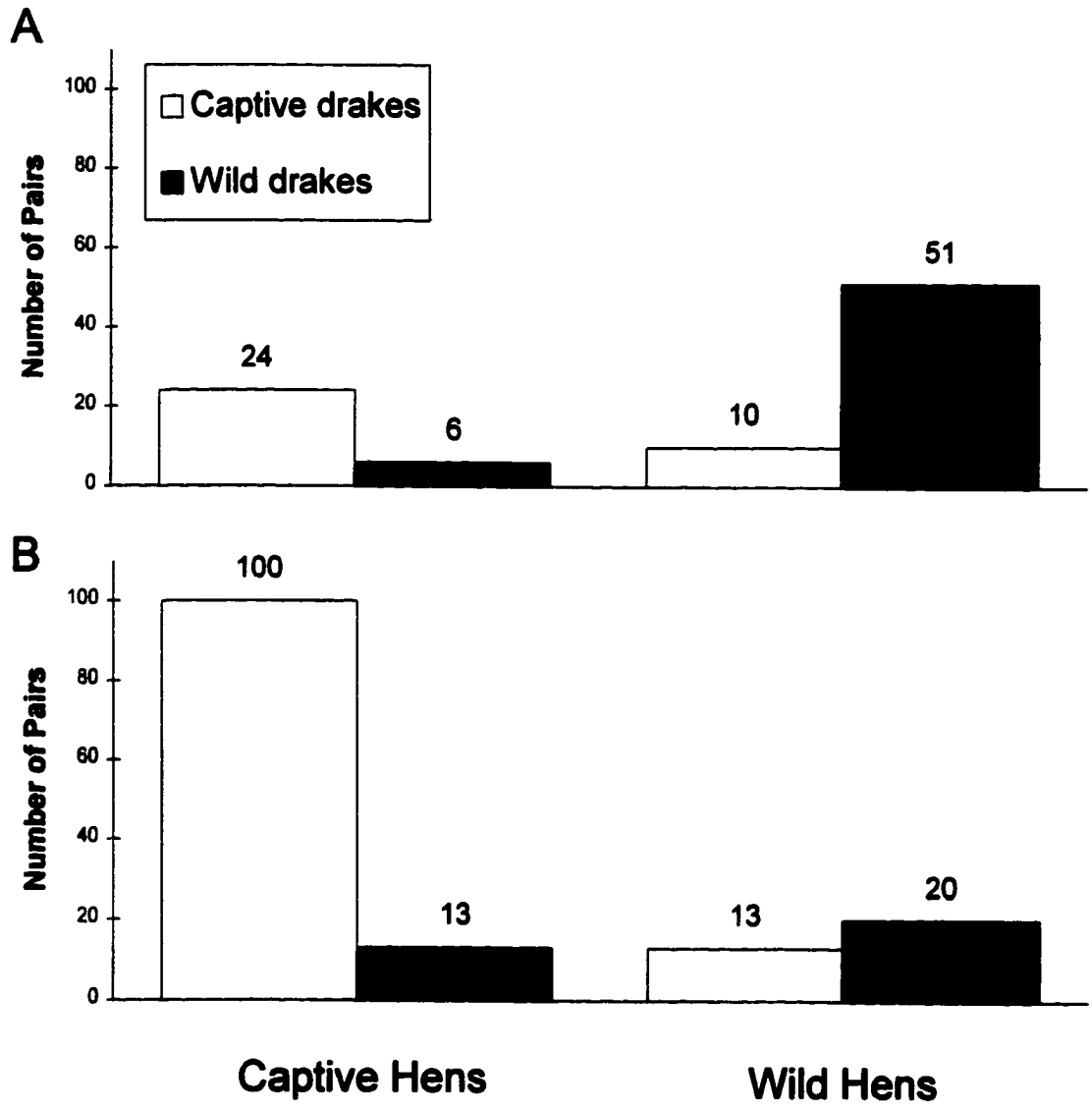


Fig. 4.2. Percentage of male and female black ducks paired by month during 1992-93 and 1993-94 at Blackwater National Wildlife Refuge (BNWR) and Regulated Shooting Areas (RSA) in Dorchester County, Maryland. A "*" above a bar indicates a month that was merged with the following month due to sample size.

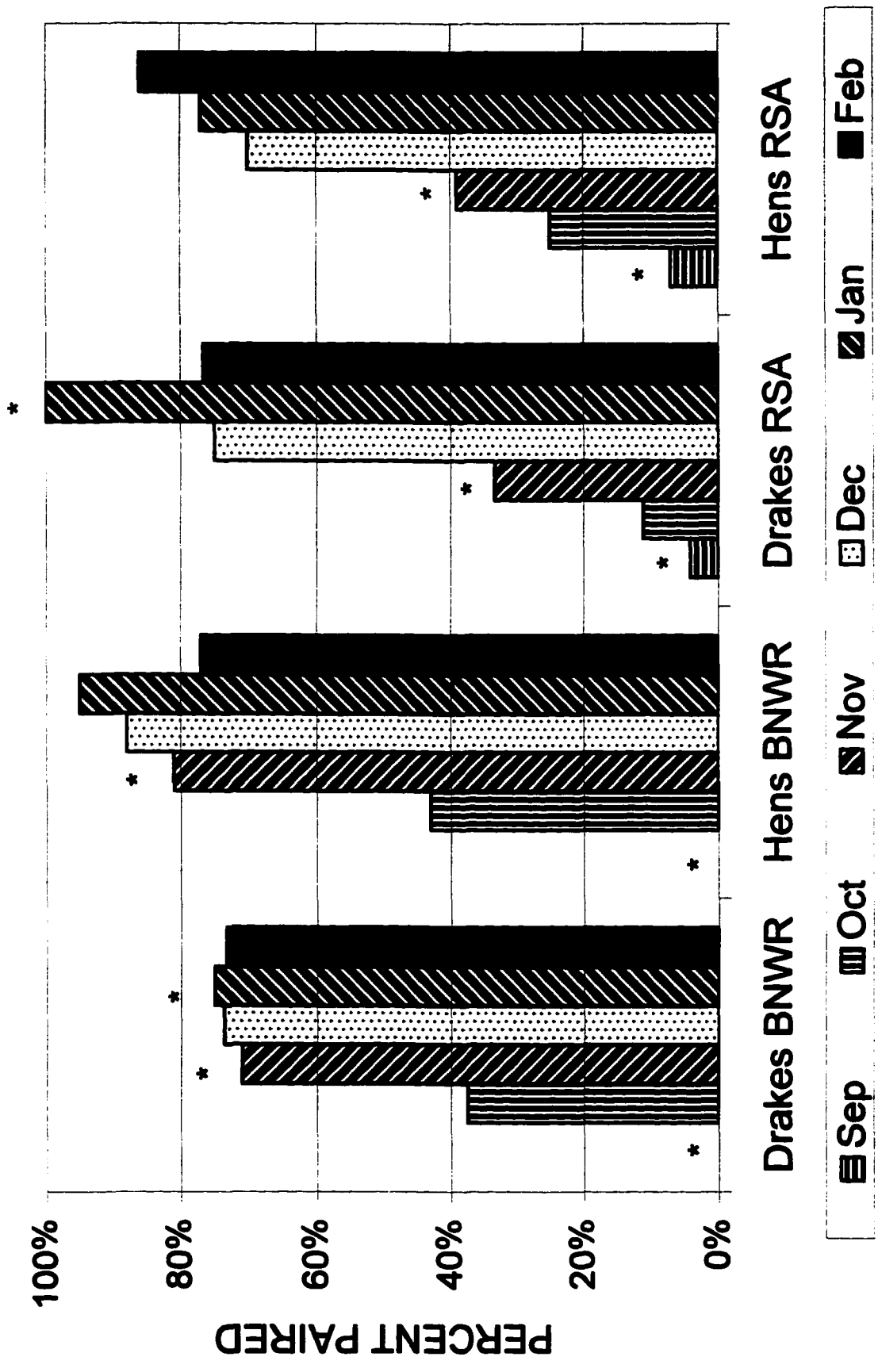


Fig. 4.3. Percentage of released captive-reared and wild mallard females paired by month during 1992-93 and 1993-94 at Blackwater National Wildlife Refuge (BNWR) and Regulated Shooting Areas (RSA) in Dorchester County, Maryland. A "*" above a bar indicates a month that was merged with the following month due to sample size.

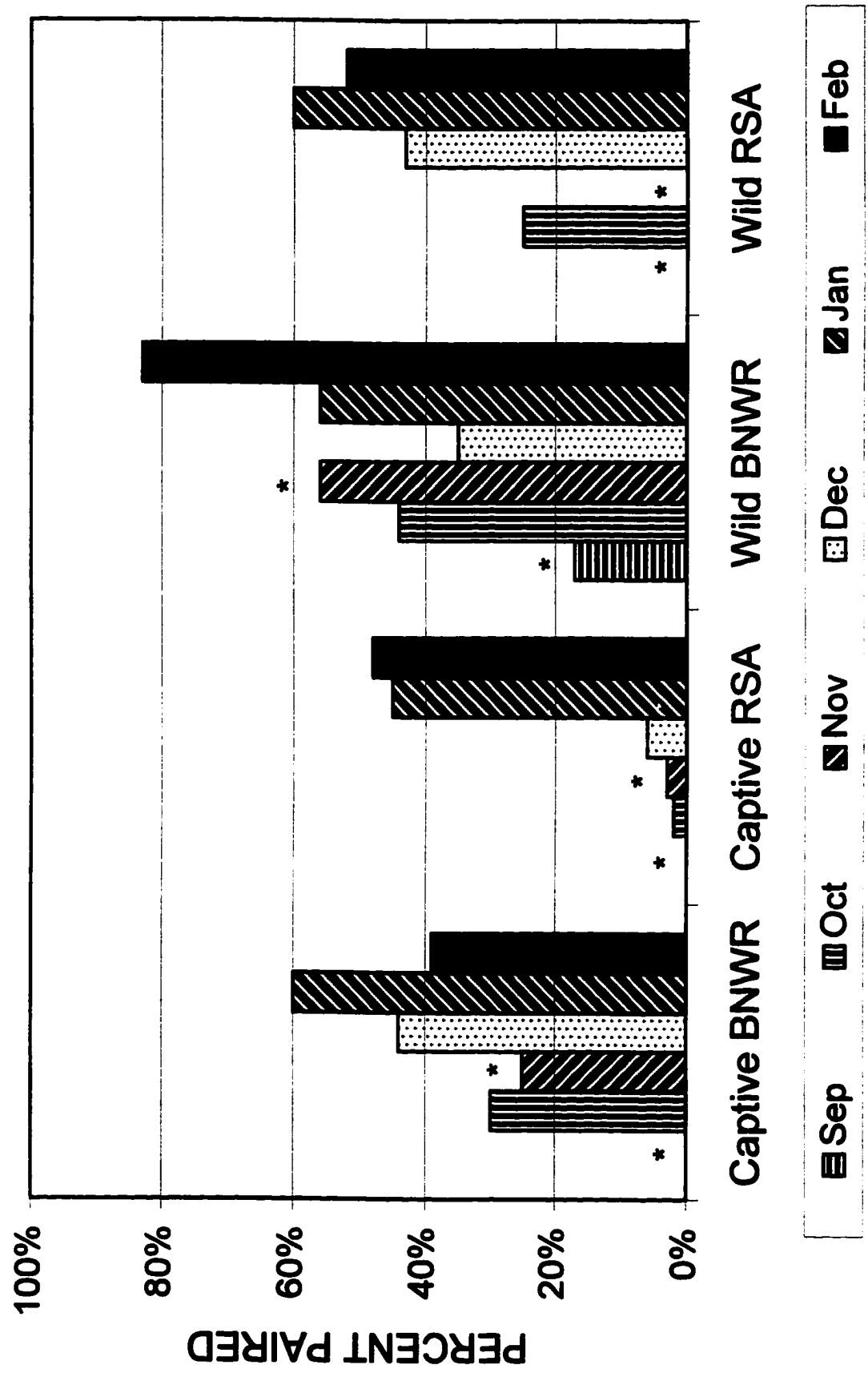
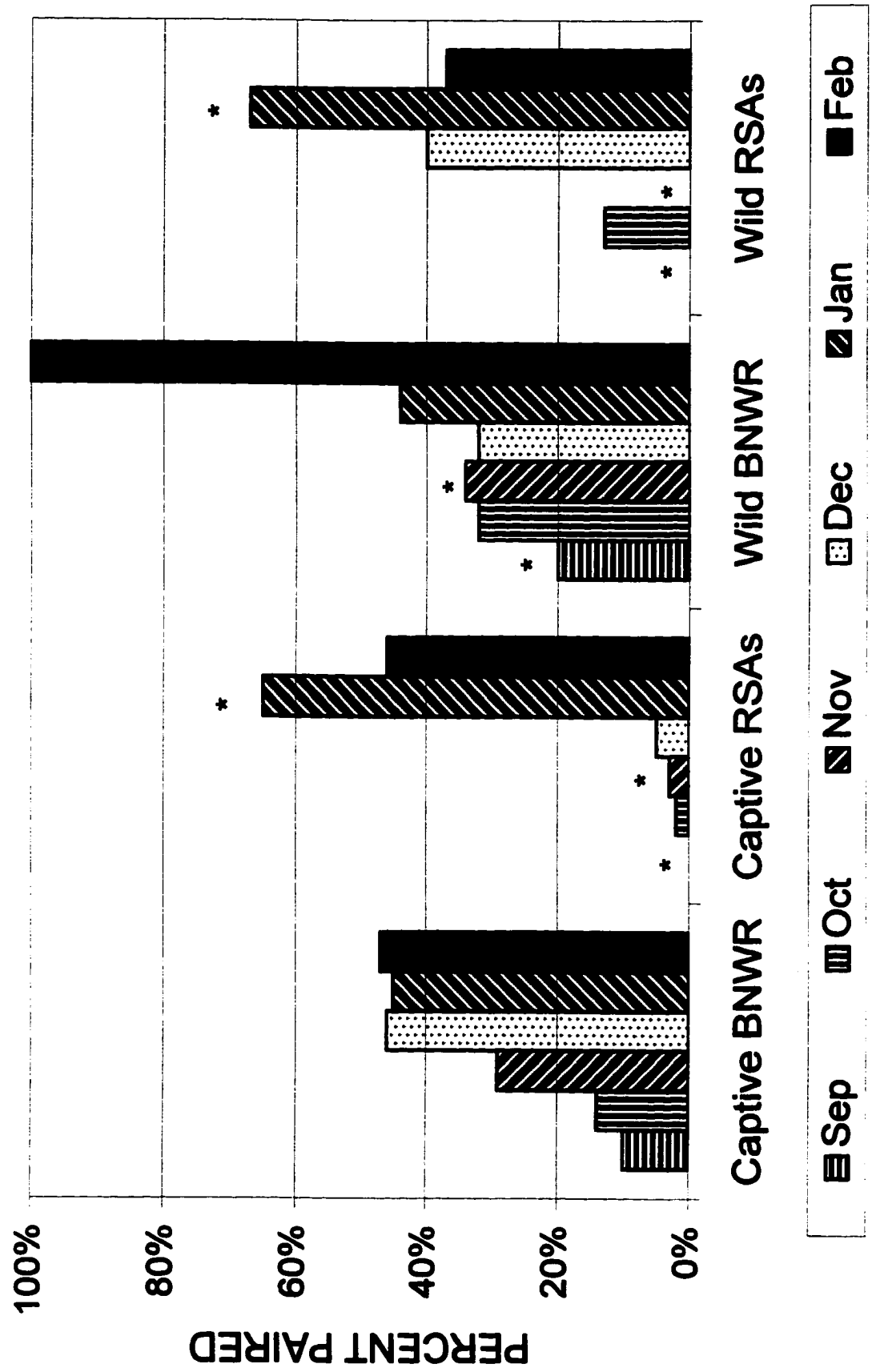


Fig. 4.4. Percentage of released captive-reared and wild mallard males paired by month during 1992-93 and 1993-94 at Blackwater National Wildlife Refuge (BNWR) and Regulated Shooting Areas (RSA) in Dorchester County, Maryland. A "*" above a bar indicates a month that was merged with the following month due to sample size.



P > 0.1). Black duck hens paired earlier than wild mallard hens (χ^2 > 7.76, d.f. = 1, P < 0.005) with 76% and 82% of female black ducks paired by February, 1993 and 1994, respectively (Fig. 4.2). In contrast, only 49% of wild mallard females were paired by February (Fig. 4.3). Comparisons of black duck females and captive-reared mallard females were complicated by a significant interaction between pair status, month, location, and species (χ^2 = 28.25, d.f. = 4, P < 0.0001). Black ducks paired earlier than captive-reared females at both locations (χ^2 > 27.07, d.f. = 1, P < 0.0001).

Comparisons of pairing by wild and captive-reared mallard females lacked significant interactions (all χ^2 < 6.62, *d.f.* = 1 to 3, *P* > 0.085). Wild mallard females were paired earlier than captive-reared mallards (χ^2 = 15.02, *d.f.* = 1, *P* = 0.0001, Fig. 4.3). Captive and wild female mallards paired earlier at BNWR than at RSAs (χ^2 = 13.57, *d.f.* = 1, *P* = 0.0002), and month was significantly related with pairing status (χ^2 = 44.14, *d.f.* = 3, *P* < 0.0001, Fig. 4.3).

Black duck and mallard females of all origins were paired earlier at BNWR than at RSAs (Figs. 2 and 3). This effect was significant for captive-reared hens in monthly tests for October (χ^2 = 28.31, *P* < 0.001), November (χ^2 = 14.61, *P* < 0.001), and December (χ^2 = 22.05, *P* < 0.001). For wild mallard females and female black ducks the earlier pairing on BNWR was only significant in November (χ^2 = 6.97, *P* < 0.008, and χ^2 = 10.88, *P* < 0.001, respectively), which was the month with the greatest pairing activity (Fig. 4.2 and 4.3). When all mallards were pooled the earlier pairing on BNWR was

significant for all months from September to February (all $\chi^2 > 8.2$, *d.f.* = 1, all $P < 0.004$).

Pairing patterns were more complex for males because of significant 3-way interactions in all analyses (all $\chi^2 > 6.39$, *d.f.* = 2, $P < 0.041$). Male black ducks paired earlier than wild mallards on BNWR ($\chi^2 = 15.40$, *d.f.* = 1, $P = 0.0001$) and RSAs ($\chi^2 > 6.39$, *d.f.* = 2, $P < 0.041$). Captive-reared mallards paired later than black ducks ($\chi^2 = 4.76$, *d.f.* = 1, $P = 0.03$), but not wild mallards ($\chi^2 = 0.00$, *d.f.* = 1, $P = 0.98$) on BNWR (Figs. 2 and 4). Comparisons including captive-reared mallards on RSAs were not made due to 3-way interactions ($P < 0.04$). Pairing of male black ducks occurred earlier on BNWR than on RSAs only in November ($\chi^2 = 0.002$, $P < 0.002$).

Distribution of Mallards

The proportion of mallards on BNWR of wild origin decreased dramatically in January and February, while the number of mallards at BNWR increased (W. M. Giese, unpubl. data). The proportion of wild mallards on RSAs increased from 2% in October to 25% in February, while the number of mallards on RSAs peaked in early December (n = 13,055) and declined by the end of December (n = 10,849) and February (n = 8,119). The sex ratio of mallards was 1537:1729 (male:female) with an estimated population of 5,750 mallards on 7 RSAs in February, 1995. Sex ratio of black ducks in pairing observations during 1992-93 and 1993-94 was 331:299 (male:female).

DISCUSSION

Mixed Pairs and Hybrid Frequencies

Our study suggests a discrepancy between the frequency of mixed pairs (1.3% of black duck pairs) and the frequency of hybrids, which were 8.4% of harvested black ducks. If our population of 80:20 mallard:black ducks (W. M. Giese, unpubl. data) exhibited random mating then we would expect 32% hybrids and only 4% of an equilibrium population to be pure black ducks. These predicted frequencies are much different from our observed frequencies of 1% hybrids in the total mallard-black duck population in our observational surveys. Johnsgard (1961) reported hybridization rates ranging from 0.2% to 1.7% of the mallard-black duck population, with lower hybridization rates in areas with great disparities in abundance of either species. Heusmann (1974) reported hybrids as 8.1-12.9% of the mallard-black duck population in areas that were predominately black ducks. In contrast, Morgan et al. (1984) report hybrid frequencies above the frequencies expected with random mating in Maryland (49%) and Massachusetts (62%).

My data showed strong assortative mating in black ducks and mallards. However, the abundance of hybrids conflicts with pair composition information. I suggest that the key to understanding the abundance of hybrid individuals will be with studies on the breeding grounds and latter in the year. Forced copulation or repairing during the breeding season may account for most hybridization of mallards and black ducks (Ankney et al. 1987). Although black ducks and mallards in eastern Canada rarely attempted interspecific forced

copulation (Seymour 1990, D'Eon et al. 1994), mixed pairs were more frequent than I observed in Maryland (D'Eon et al. 1994).

Pairing Chronology

In this study black ducks paired somewhat earlier than did wild mallards, as reported for other areas (Johnsgard 1960, Hepp and Hair 1983). Captive-reared mallards paired later than wild mallards, which may reflect a difference in average age (Hepp 1986) or an effect of game farm origin (Cheng et al. 1979, DesForges and Wood-Gush 1976). Game farm mallards on one RSA had abnormal pairing late into the spring (Stanton et al. 1992). This may be due to changes resulting from artificial selection on game farms, where mallards have high levels of plasma testosterone (Pauke and Haase 1978) and elevated promiscuity (Titman and Lowther 1975, DesForges and Wood-Gush 1976).

Pairs were evident earlier in the season on BNWR than on RSAs. This was especially apparent for captive-reared mallards. Intense hunting pressure on RSAs may have disrupted pairs or inhibited pairing. Alternatively, the delayed pairing on RSAs could reflect a population with more young mallards. I believe the age explanation is more likely because wild mallards and black ducks did not show substantial differences in pairing between RSAs and BNWR.

Mallard Mate Selection

Our pair composition data strongly supports assortative mating between wild mallards and captive-reared mallards. Wild female mallards primarily mated with wild male mallards (75%), while captive-reared females largely

mated with captive-reared males (87%). Mate choice of wild and captive-reared mallards is influenced by exposure to individuals of differing strains early in life (Cheng et al. 1978, 1979). Felial imprinting may cause assortative mating between wild and captive-reared mallards.

MANAGEMENT IMPLICATIONS

The release of captive-reared mallards is discouraged by wildlife biologists (Smith and Rohwer 1997). My results suggest that the release of mallards in Maryland is not associated with a high frequency of interspecific pairs between mallards and black ducks. In addition, the incidence of hybrids I recorded in Maryland was lower than reported in other eastern areas. Winter pairing was strongly assortative between mallards and black ducks on my study area. The relative abundance of female mallards due to releases and male-selective harvest on RSAs may decrease the frequency of mixed pairings between mallards and black ducks. Even late in February there are many female mallards on both BNWR and RSAs that remain unpaired, which probably decreases the likelihood that male mallards will court female black ducks. Concerns that captive-reared mallards decrease the fitness of wild mallards should be dampened by our finding of avoidance of pairings between wild and captive-reared mallards.

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CHAPTER 5

MOVEMENTS OF HAND-REARED MALLARDS RELEASED IN MARYLAND: STATE AND PRIVATE RELEASES

INTRODUCTION

Release of captive-reared mallards as a means of boosting local populations has been discouraged because it is ineffective and does not address the underlying causes for declining wild populations (Schladweiler and Tester 1972, Batt and Nelson 1990, Yerkes and Bluhm 1998). The primary intent of mallard releases in Maryland is to provide hunting opportunities for owners of regulated shooting areas (RSAs) and their guests (Hindman et al. 1992). However, waterfowl biologists express much concern that hand-raised mallards (HRM) will detrimentally impact wild populations (Smith and Rohwer 1997), especially through hybridization with American black ducks (*Anas rubripes*) (Heusmann 1974; Ankney et al. 1987, Ankney et al. 1989; Rhymer and Simberloff 1996) or spread of disease (Smith and Rohwer 1997).

Since 1986, there have been no bag limits on released mallards harvested on RSAs in Maryland (Maryland Department of Natural Resources (DNR) Title 08, Subtitle 03, Chapter 09; federal regulation 50 CFR 21.13). Bag limit exemptions were allowed because released HRM are considered domestic animals; thus, the release site might be expected to provide adequate resources to sustain released mallards. However, even if food is available, hunting pressure, predation, or other disturbances might cause birds to move from the release property. Management practices, including means of

providing food, number of mallards released, hunting pressure, and property characteristics vary between RSAs (Smith and Rohwer 1997) and may effect movement of the released mallards.

The range of movement by released mallards affects the potential for effects on wild waterfowl through pairing interactions, spread of disease, and competition for food resources. If captive-reared mallards stay on the source RSA, then their use of resources will be limited to the RSA and their social interactions will be limited to HRM and wild waterfowl using the RSA. In this study, I assess whether hand-reared mallards were primarily using the property where they were released and whether habitat characteristics of the release RSA property affect movements. I used radio-telemetry to investigate movements, habitat use, and factors influencing movement and habitat selection of HRM released onto RSAs.

STUDY AREA

I studied HRMs released on private RSAs in the southern half of Dorchester County, on Maryland's Eastern Shore (Smith and Rohwer 1997). Some RSAs hatch and raise mallards for release, but most RSAs purchase mallards from 1 to 8 weeks old from commercial producers. . In 1991, I also selected 2 RSAs, one adjacent to each state release site, trapped ,and radio-tagged 25 HRM at each site. This marking was done in September and early October. I also radio-tagged 10 HRM at each of 6 randomly selected RSAs in each of 1992 and 1993. In total, 170 HRM were radio-tagged on 14 different RSAs in the 3 years of this study. I then contacted owners of selected RSAs to

seek permission to release and track tagged mallards on the property. If an owner was unwilling to participate (n = 3), then another RSA was randomly selected. Three large blocks of estuarine marshes located in southern Dorchester County include Blackwater National Wildlife Refuge (BNWR), and Fishing Bay and Taylors Island Wildlife Management Areas (WMA).

METHODS

In 1991, I bait-trapped mallards previously released on 2 RSAs. I selected young of the year based on plumage and cloacal characteristics (Hochbaum 1942, Carney 1964). Mallards studied in 1992 and 1993 were donated by Frost Game Farm, Coloma, Wisconsin. This removed variation in source of HRM between RSAs and allowed us to release radio-marked birds in a manner consistent with standard procedures on each RSA.

Six to 8 week old mallards were fitted with 19-21 g transmitters with a modified Dwyer type backpack (Dwyer 1972, Advanced Telemetry Systems, Inc., Isanti, MN). Radios were attached with the front and back loops intertwined once on the chest, which allowed radios to be loosely attached so birds could grow. The transmitters had an expected life of 180 days and a maximum range of about 8-km with truck-mounted, 4-element, null-peak antennas. When a transmitter could not be detected by monitoring from the ground, I searched using antennas attached to fixed-wing aircraft (Gilmer et al. 1981).

I estimated locations of all birds every six hours over a 48-hour period once a week from October through December. This systematic sampling of

animal locations achieved a sample size adequate to estimate home ranges. I used program Locate II to estimate animal locations using Length's Tukeys method (Nams 1990) in the field. A minimum of 3 non-simultaneous bearings were used but additional bearings were taken if the first 3 bearings did not converge and produce an estimated location. Coordinates of receiving stations were determined with United States Geologic Survey 7.5-minute series orthophotomaps.

Core and 95% Harmonic Mean (HM) home range polygons were estimated for each mallard with over 30 estimated locations with the program HOME RANGE (Dixon and Chapman 1980, Ackerman et al. 1990). Core areas were defined as the area in which bird use exceeded a uniform utilization distribution (Ackerman et al. 1990). Home range polygons were superimposed on cadastral information with Modular Geographic Information System Environment (MGE, Intergraph Corporation, Huntsville, AL). MGE was used to determine the areal extent of property types included in the HM 95% and core home range polygons and circles defining availability (defined below).

Habitat selection is hierarchical in nature (Johnson 1980). I compared habitat selection at two levels, with available habitat defined by the next higher level of selection. Area available for each individual to select its 95% home range was determined by a circle with its center at the arithmetic mean of its observations and a radius equal to the maximum distance between any two consecutive observations. The 95% polygon for each individual became the available area for the analysis of selection of core areas.

I categorized RSA types by their habitat and management characteristics as MARSH, FARM, and INTENSE management. MARSH was composed primarily of marsh and had no arable upland. FARM and INTENSE both contained arable upland components, but INTENSE had the ability to flood standing grains in impoundments.

The hypothesis that property types are used in proportion to availability was examined with compositional analysis with MANOVA following Aebischer et al. (1993). Options for selection were SOURCE (the RSA where the individual was released), OTHER-RSA, and OTHER properties (non-RSA private properties, BNWR, and WMA). If one of the property types was not available to an individual, the type was merged with another type for all individuals or the individual was dropped from the analysis. BNWR, WMA, and major waterways were not available to most individuals (Table 5.1), so those property classifications were merged with OTHER. Zero values for use of property types that were available were replaced with a value equal to an order of magnitude less than the lowest nonzero value observed for that property type (Aebischer et al. 1993). The rational for this was that zero observed use represented a use too low to be recorded. Property types were ranked in order of use and pairwise comparisons were made with significance levels from the t-distribution (Aebischer et al. 1993).

I also examined the hypothesis that RSA release type does not affect property type use. The MANOVA model contained the log ratios of use of property types as dependent variables, RSA type where the individual was

Table 5.1. Composition of available and harmonic mean home range polygons by property type for mallards released onto Maryland regulated shooting areas.

Area		Property Type					
		SOURCE	OTHER RSA	OTHER	BNWR	WMA	WATER
Available	mean (%)	25.00	28.37	32.12	3.23	3.11	8.19
	n	56	55	56	13	16	36
	nulls[a]	2	3	2	45	42	22
95% Home Range	mean (%)	49.35	23.63	17.23	2.35	1.37	6.18
	n	53	43	47	7	6	27
	0 observed[b]	3	11	9	6	10	8
	nulls	5	15	11	51	52	31
Core Home Range	mean (%)	59.12	20.47	13.52	1.44	0.30	4.40
	n	53	43	47	7	6	27
	0 observed	3	9	13	3	3	11
	nulls	8	24	24	54	55	42

[a]Nulls indicate the property was not available.

[b] Observed 0's indicate that the property was classified as available for an individual but not used. 0's were included in means.

released as the classification variable, and the log ratios of property types available, and the total available area as covariates. Least square means (SAS Institute 1990) were used to determine the significance of differences in property type use by mallards released on each RSA type. This analysis was done for 95% and core harmonic mean polygons.

Home range sizes and distances moved were log transformed to meet the assumptions of ANOVA. RSATYPE and sex of the individual were the explanatory variables in a MANOVA to examine their effects on home-range size. Size of the source RSA and the number of mallards released on the source RSA were examined as covariates in the analysis of 95% and core home range sizes, and maximum distance moved from the release site.

RESULTS

I radio-tagged and released 170 HRMs on 14 RSAs in the three years of this study. Home ranges were calculated for 58 individuals with 31 to 108 location estimates each for a total of 3,991 observations. RSA type had a significant affect on the size of 95% ($F=7.60$, 2 d.f., $P = 0.001$) and core ($F=5.84$, 2 d.f., $P = 0.005$) home ranges. Mallards on MARSH RSAs had core and 95% home ranges significantly larger than mallards inhabiting INTENSE ($P = 0.020$) and FARM ($P = 0.001$) properties (Table 5.2). Size of the release RSA was positively related to home range sizes ($F=4.72$, 1 d.f., $P=0.034$). RSA type ($F=19.07$, 2 d.f., $P < 0.0001$) and size ($F=4.38$, 1 d.f., $P=0.041$) also affected the maximum distance moved from the release site. Mallards released on MARSH RSAs moved significantly farther from their release location than

Table 5.2. Characterization by regulated shooting area type (RSA) of RSA in Dorchester County, Maryland where radio-collared mallards were released and movements of released mallards by SOURCE RSA type.

		Farm	Intense	Marsh
Properties		4	5	4
Mallards radio collared		29	17	12
Size (acres)	Mean	503.25	494.00	977.50
	Std Dev	419.03	258.61	838.27
	Max	1124	900	1800
	Min	214	220	250
Mallards released	Mean	300.00	1860.00	500.00
	Std Dev	476.10	1569.39	264.58
	Max	1000	4500	800
	Min	0	500	300
Maximum distance (m)	Mean	2083.36	3488.30	5856.90
	Std Dev	422.47	2137.53	2517.99
	Max	2622.00	6041.75	8357.60
	Min	1597.10	1037.00	3681.50
Available polygon (ha)	Mean	896	4235	3910
	Std Dev	1591	9131	4779
	Max	9028	38078	17150
	Min	50	144	269
95% polygon (ha)	Mean	154	330	584
	Std Dev	202	415	449
	Max	1028	1201	1414
	Min	26	35	37
Core polygon (ha)	Mean	48	101	169
	Std Dev	68	131	119
	Max	332	407	384
	Min	6	12	13

mallards released on INTENSE RSAs, which moved farther than those released on FARM RSAs. The number of mallards released on an RSA had no affect on movements of radio-tagged mallards ($P > 0.05$). Available, 95%, and core polygon sizes were not correlated with sample size ($P > 0.3$). My definition of available habitat resulted in 2 cases where no part of the release RSA was classified as available. Both of these individuals moved from the release RSA soon after tracking began and centered their activities on another RSA near their release RSA.

Use of property types differed significantly from random for the 95% polygon ($\Lambda=0.496$, $F=25.384$, $n=52$, $P=0.0001$) and core ($\Lambda=0.741$, $F=5.428$, $n=33$, $P=0.010$) home ranges. Sample sizes were reduced due to individuals with one or more property types unavailable. SOURCE RSA was used significantly more than expected for the 95% and core polygons ($P=0.05$). OTHER RSAs were preferred over OTHER at the scale of the 95% polygon and vice versa at the scale of the core polygons, but differences were not significant (Table 5.3).

The RSA type an individual was released onto affected the property type it used most at both the 95% ($\Lambda=0.496$, $F=9.46$, $n=52$, $P=0.0001$) and core polygon levels ($\Lambda=0.586$, $F=3.985$, $n=33$, $P=0.007$). Although rankings of property type use differed by RSA release type, SOURCE RSA was always most commonly used or not different from the classification that was most commonly used (Table 5.4).

Table 5.3. Matrix of mean ± standard errors of differences between log ratios of property type use and availability for compositional analysis and preference ranking. The number of positive values in each row determine the rank of habitats in order of relative use.

Numerator	Denominator			RANK
	SOURCE	OTHER RSA	OTHER	
95% Home Range				
SOURCE		2.153 ± 0.399 * [a]	2.359 ± 0.343 *	2
OTHER RSA	-2.153 ± 0.399 *		0.206 ± 0.364	1
OTHER	-2.359 ± 0.343 *	-0.206 ± 0.364		0
Core Home Range				
SOURCE		1.620 ± 0.539 *	1.093 ± 0.452 *	2
OTHER RSA	-1.620 ± 0.539 *		-0.526 ± 0.572	0
OTHER	-1.093 ± 0.452 *	0.526 ± 0.572		1

[a] "*" indicates statistically significant difference.

Table 5.4. Ranking of preference of property classifications by mallards released on different Regulated Shooting Area types. Lower rank indicates higher use.

	Ranking of Property Types					
RSA TYPE	1		2		3	
95% Home Range						
Farm	OTHER	A[a]	SOURCE	A	OTHER RSA	B
Intense	SOURCE	A	OTHER RSA	B	OTHER	C
Marsh	SOURCE	A	OTHER	B	OTHER RSA	B
Core Home Range						
Farm	SOURCE	A	OTHER	A	OTHER RSA	B
Intense	SOURCE	A	OTHER RSA	A	OTHER	B
Marsh	OTHER RSA	A	SOURCE	A	OTHER	B

[a]Property types within a row with non-differing use (p=0.05) are followed by the same capital letter.

DISCUSSION

Dorchester County, MD has a high density of RSAs, with 70 of 130 registered in Maryland (Smith and Rohwer 1997). Released mallards readily move from one RSA to another, perhaps in response to disturbances, attraction of other birds, or food availability. If an RSA includes adequate resources, I would expect a HRM released there to maintain its core home range on that property. HRM released on RSAs preferred their release RSA to other RSAs and non-RSA properties. The characteristics of the RSA where a HRM was released also affected its range of movements and home range. Definitive interpretation of the causes of movement are not possible given the data I collected.

If resources were the major motivation for movements of HRM, then I would have expected a ranking of home range size by RSA type such that INTENSE < FARM < MARSH. Instead the result was FARM < INTENSE < MARSH. Hunting pressure may have increased movement on RSAs categorized as INTENSE. I was not able to get a good index of hunting pressure in surveys submitted to RSA operators, but I believe hunting pressure was highest on INTENSE RSAs.

The hierarchical nature of selection means that lack of availability of one property type indicates selection against that property type at a higher order of selection. However, first-order selection (Johnson 1980) in this case was manipulated by the selection of release site for HRMs. Our analysis includes what Johnson (1980) called second- (home range) and third-order (core areas

within the home range) selection. Ideally, all property types of concern would have been available to all individuals in the study. This would have made it unnecessary to pool several non-RSA properties and allowed a more detailed examination of preferences. Forty-five of the 58 mallards never encountered BNWR and so did not have the opportunity to select for or against use of that habitat (Table 5.1). An individual was excluded from analysis if any of the property types remaining were not located in its available polygon. Since an individual can only use what is available, any value assigned to use of a property type is meaningless if that type is not available (Aebischer 1993).

A common problem with radio-telemetry studies is auto-correlation of locational data where observations were recorded too close together in time and space and therefore contain redundant information. In such cases, the subject has not had time to cross a statistically significant part of its home range between observations (Ackerman et al. 1990). Autocorrelation, as measured by Schoener's ratio (Schoener 1981, Swihart and Slade 1985b), was probably unavoidable in our study for several reasons. The underlying cause was a lack of normality, a common situation for the distribution of animal movements (McNay and Bunnell 1994). An individual's range of movements often changed in size or location as the HRM changed from being relatively sedentary to mobile. This may have been due to increase in age, cessation of direct feeding on RSAs, and the onset of hunting. Tests of independence of locational data assume a stable home range (Swihart and Slade 1985b), which was not the case for many of our mallards. In some cases the shift in the areas

used was obvious, however in others it was not possible to separate a shift in the area being used from true autocorrelation. Some of these individuals did not maintain a "stable" home range, while others used certain areas combined with a few long movements that created low values of Schoener's ratio. Outliers, defined as extreme locations, may dramatically affect home range estimates and are not traditionally considered part of a home range (Burt 1943). In some cases, when these movements are removed from the calculation of Schoener's ratio, values of the ratio were closer to those expected under independence.

I used a sampling scheme designed to avoid autocorrelation and 12 or 24-hour periodicity in the data, to include the full diurnal cycle, and to sample evenly over the study period (Swihart and Slade 1985a). A systematic sampling interval reduces the effects of bias due to redundant data (White and Garrott 1990). Systematic sampling could still result in an inflated apparent sample size, thereby causing underestimation of the variance of the home ranges, but this is typically not of concern and rarely calculated (McNay and Bunnell 1994). Variance and covariance of the locational data would be affected by autocorrelation, but the value of the estimates would not be affected. In particular, the harmonic mean method does not depend on the variance or covariance in the data and is therefore robust to autocorrelation in the data.

Maximum movements between observations by individual HRM were lower than mean daily movements observed in other studies. Distances moved

in this study were the change in location 6-120 hours apart. Mean daily mallard and northern pintail (*Anas acuta*) flights between roost and feeding sites ranged from 6.4 – 48.8 km (Jorde et al. 1983, Cox 1996). Movements by HRM of this magnitude were rare and mean movements of HRM were lower than reported mean daily movements of wild ducks in winter (Table 5.2).

I began monitoring movements when HRMs were 12 - 14 weeks old. Survival of HRM released on RSAs was 35 to 55% at the end the monitoring period in January (Chapter 3). Birds were about 6 months old at that point and only about 1 week remained of the hunting season. Movements of these surviving HRMs from that point on are not known. As of 1995, no band recoveries of the 806 HRM I banded had come from outside Dorchester County. Soutiere (1986) found that the majority (83%) of HRM that were eventually harvested were shot on the RSA where they were released. Another 14% of the recoveries were within 79 km of the release site. Although 69% of the 2,819 recoveries of HRM released in Pennsylvania were recovered in state, the rest were recovered from 32 states and provinces in the Atlantic and Mississippi Flyways (Dunn et al. 1995). Most out of state recoveries were indirect recoveries of mallards banded as immatures. This suggests that HRMs that survive the first year will move longer distances. A larger scale study of immature and adult HRM would improve our knowledge of their movement and survival after the first 6 months of independence.

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CHAPTER 6

CONCLUSION

This study provides basic biological information needed to make management and regulatory decisions regarding the effectiveness and impacts of the use of captive-reared mallards to increase hunter opportunities. Survival of captive-reared mallards released at 8 weeks of age was highly dependent on the treatment they received after release. Mallards released into brackish marshes without additional care had 75% mortality within 7 weeks of release (Chapter 3). However, the mallards that survive constitute 5-10% of the harvest on the Wildlife Management Areas where they were released (Chapter 2). Mallards provided with supplemental food after release appeared to have higher survival until care ceased or the hunting season began (Chapter 3). Mortality of mallards released onto private properties was primarily due to hunting (Chapter 3) and released mallards were the great majority of the ducks harvested on RSAs (Chapter 2).

The increase in mallards in the study area has not resulted in frequencies of hybrids or interspecific pairs higher than those reported in the literature. Winter pairing is strongly assortative between captive-reared mallards, black ducks, and wild mallards (Chapter 4). However, half of the mallards and 20% of the black duck hens remained unpaired at the end of our observations each year in February. The availability of unpaired female mallards through February probably decreases the likelihood that male mallards will court female black ducks. However, the frequency of hybrids observed is higher than would

be expected based on the frequency of interspecific pairs during the winter. This suggests that to understand the mechanisms producing mallard-black duck hybrids will require more detailed study of nesting ducks.

Movements of the released mallards are limited during the first six months after release (Chapter 5). Mallards released on private properties most often stayed on and preferred the property where they were released. Characteristics of the release property affect the probability that an individual will stay on that property and the range of its movements.

Unanswered questions regarding the use of HRM to boost hunting opportunities include the possibility of disease being spread from high densities of HRM to wild waterfowl populations. This may present the most dramatic threat HRM pose to wild populations, but research on this subject was beyond the scope of this project. The disparity between the frequencies of hybrids and interspecific pairs also needs to be examined. Recent findings indicate that interspecific aggression in breeding areas is not as great as previously suggested (McAuley et al. 1998) and that mixed pairs were common (D'Eon et al. 1994). Additional research on the breeding grounds may be necessary to answer this question (Ankney et al. 1987). The fate of the large proportion of HRM that remained unpaired in February also needs to be addressed.

Mallard releases in Dorchester County, Maryland, appear to be meeting the goals of private release operations. Regulated shooting areas continue to operate in Maryland as of 1999. I found no obvious negative impacts of such mallard releases on wild populations of waterfowl that winter in the Chesapeake

Bay area. The habitat management necessary to retain released free-ranging mallards on the site where they were released may actually benefit wild waterfowl that also use these managed areas. However, my research did not address the potential for spread o f infectious disease from hand reared mallards to wild waterfowl. This is an area of potential concern that clearly should be examined in future research.

Hand reared mallards released by the state of Maryland showed very high mortality rates prior to the hunting season. A small proportion of these birds survived until the opening day of the hunting season, so the decision to discontinue those releases after the last year of this study in 1993 was probably a wise choice. In the long term, it is likely that habitat programs are more likely to benefit waterfowl and waterfowl hunters than is a state operated release program.

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APPENDIXES

A: PERMISSION TO REPRINT CHAPTER 1.

23 July, 1997

Kelly Wadsworth
Director of Publications
1101 14th Street, N.W.
Suite 801
Washington, D.C. 20005

Dear Ms. Wadsworth:

I am completing my Ph.D. in Wildlife and Fisheries Science at Louisiana State University. I would like to include as part of my dissertation an article that has been accepted for publication in The 1997 Transactions of the 62nd North American Wildlife and Natural Resources Conference. The article is:

Smith, D. B. and F. C. Rohwer (1997). "Perceptions of releases of captive-reared mallards, with emphasis on an intensive program in Maryland." Transactions of the North American Natural Resource Conference(62): 217-225.

I am required by the Graduate School at Louisiana State University to obtain written permission from the publisher to allow me to include the article as part of my dissertation. Thus, I am requesting written permission to use the article.

Thank you,

David B. Smith

School of Forestry, Wildlife and Fisheries
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Wildlife Management Institute

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ROLLIN D. SPARROWE
President

LONNIE L. WILLIAMSON
Vice-President

RICHARD E. McCABE
Secretary

July 30, 1997

To: David B. Smith
From: Kelly Wadsworth Kelly Wadsworth

Per your request of July 23, the Wildlife Management Institute is pleased to grant permission for "Perceptions of Releases of Captive-reared Mallards, With Emphasis on an Intensive Program in Maryland" (Smith and Rohwer 1997) to be included in your dissertation.

B: QUESTIONNAIRE TO PUBLIC HUNTERS

8 March 1993

«Name»
«Address»
«City», «State» «Zip»

Dear «coutesy»,

You may recall talking with me or one of my colleagues at «Location» during the past duck hunting season about our study of Mallard release programs. When you gave us your name and address we said we would be contacting you to get your opinion about duck releases. I hope yu are still willing to provide your opinion and will do so by completing the enclosed survey. Your response will provide important information about what you feel are successes or failures of such release programs and their affect on you as a hunter.

The information you and other hunters provide will be combined with data that we gather about the biology of released ducks. This combination of information will allow management agencies (Maryland Department of Natural Resources and the U.S. Fish and Wildlife Service) and private operations to improve their management of waterfowl. I hope you agree that better management and increased waterfowl populations would improve hunting for all wildfowlers in Maryland.

Please take a few minutes and provide us with your opinion about duck releases. The information you provide will be held in strict confidence. No one other than my graduate student, David Smith, and I will see your survey form. Note that your name is not on the form you return to us; however, there is a letter-number code on the survey form so we know whether or not you respond. We truly want candid opinions about release programs.

Thank you in advance for helping us gain knowledge about release programs and their affect on waterfowl hunting in Maryland.

Sincerely,

Dr. Frank C. Rohwer

Background Information: The money from the sale of Maryland Duck Stamps is divided between two programs. The first is the acquisition and management of Maryland wetlands. The second is the release of captive-reared Mallards onto public marshes and waterways.

Releases of Mallards by private groups or individuals have a long history, but they became quite common in Maryland during the 1960's as the number of Regulated Shooting Areas (hereafter called RSAs) grew rapidly. RSAs in Maryland are 200 acres or more where the owner (or renter) may release and shoot captive-reared Mallards. Those who hunt this land are not bound by Federal bag limits on privately released ducks. They are, however, subject to the normal limits on all wild ducks.

Please place an X or a check in the appropriate box under each question.

1. Personal Information

In which of the following age classes do you fall?

under 16	16 - 23	23 - 30	31 - 40	41- 50	51 - 65	over 65

Sex | male | female |

City or town of Residence: _____

Occupation: _____

2. Hunting Activity

How many days did you duck hunt in Dorchester county this past duck season?

0	1 to 3	4 to 6	7 to 9	9 to 11	12 or more

How many days did you duck hunt on public land in Dorchester County?

0	1 to 3	4 to 6	7 to 9	9 to 11	12 or more

How many days did you duck hunt on private land in Dorchester County?

0	1 to 3	4 to 6	7 to 9	9 to 11	12 or more

How many years ago did you begin hunting in Dorchester County?

0	1 to 5	6 to 10	11 to 20	20 or more

Did you buy a waterfowl stamp for the 1991-92 waterfowl season?

Yes	No

Did you hunt ducks during the 1991-92 waterfowl season?

Yes	No

Did you buy a waterfowl stamp for the 1992-93 waterfowl season?

Yes	No

Did you hunt ducks during the 1992-93 waterfowl season?

Yes	No

If no, go to #4.

Note: A State released Mallard wears a band that says "MD Duck Stamp Duck", whereas an RSA released Mallard band typically has a private name and address on it. A Mallard not wearing a band is considered to be a wild bird.

3. Harvest: Report only those birds that you personally killed. Do not include those killed by your hunting partners.

How many ducks (Mallard and all others) did you shoot and recover this hunting season?

none	1 to 3	4 to 6	7 to 9	10 to 20	21 or more

How many State Mallards did you shoot and recover?

none	one	two	three	four	5 or more

How many RSA Mallards did you shoot and recover?

none	one	two	three	four	5 or more

4. RSA release programs

Do you feel that RSA's have affected the quality of your hunting.

Strong Positive Affect
Slight Positive Affect
No Affect
Slight Negative Affect
Strong Negative Affect

Do you feel that RSAs are meeting the following goals. Mark Y for yes and N for no.

	Take hunting pressure off wild ducks
	Provide habitat for wild ducks and geese
	Boost population of wild Mallards
	Improve hunting on and around RSA properties
	Draw more hunters to Dorchester County

Should individuals hunting on RSA's be subject to limits on the number of released Mallards that they are allowed to shoot?

yes	no	no opinion

Would you be interested in hunting at an RSA?

yes	no	no opinion

Do you center your hunting around the borders of RSA's?

Never	Occasionally	Regularly

5. State Release

How do you feel that State released Mallards have affected your hunting?

Strong Positive Affect
Slight Positive Affect
No Affect
Slight Negative Affect
Strong Negative Affect

Do you feel that the State should continue to release ducks?

yes	no	no opinion

If no, would the money be better spent aquiring new marsh land or improving management of existing lands?

new land	better management	both

If yes, do you feel there is room for improvement in the release program?

yes	no	no opinion

If yes, please explain how in the space provided here or on back of this sheet.

6. Impacts of Release Programs

The following are potential problems associated with the release of captive-reared Mallards (Maryland DNR and RSA). Assuming that the following situations exist, please indicate whether you feel that each is important. Rate your response on a scale of 1 (very important) to 5 (not important).

	released Mallards breeding with Black Ducks
	released Mallards increasing predator populations
	released Mallards competing with wild ducks for food
	low survival of released Mallards
	increase chance of disease being spread from released to wild ducks

7. General comments.

How, if at all, do you feel the Maryland Duck Stamp and RSA release programs have affected you? Feel free to make additional comments. Continue on the back of this page if necessary.

C: QUESTIONAIRE TO RSA OWNERS

November 18, 1993

{{Inside Address}}

Dear «Salutation» «Last_NAME»,

As you may know we are conducting a study of the Regulated Shooting Area (RSA) and Maryland Department of Natural Resources Mallard release programs in Maryland. We are collecting much biological information about Mallard releases. As an important supplement to our data on the biology of releases we want to collect information on land management and peoples opinion about the RSA program. We are contacting you to ask that you take a few minutes to respond to the enclosed questionnaire about your experience with a RSA. We hope this information combined with ours will allow an objective look at RSAs on which to base regulations. We feel both types of information are vital to any assessment of Mallard releases. We hope you will provide this information to us.

We recognize that your time is valuable so we have kept the questionnaire as short as possible. We want to stress, however, that we can only get this information from you and it is very important information. The first half of this form concerns the current operation of your regulated shooting area. The rest pertains to your perception of the successes of the RSA program in Maryland.

It would be very helpful if you could also provide us with a copy of a map and/or aerial photo of your Regulated Shooting Area Showing boundaries.

We are also interested in documenting waterfowl harvest on RSAs. We would like to get information from the 1992-93 (if you were registered as an RSA in 1992) and 1993-94 waterfowl seasons. Forms are enclosed for recording this information. We would like to have the bag for each hunter each day. The hunters name is not necessary but please record each hunter on a separate line each day.

The information you give us will be used in summary form only and nobody other than us will ever see these questionnaires. It is important that we report as valid a picture of the potential benefit of RSAs as possible and we must have your cooperation to do that. Your response is in the best interest of this study and the future of the RSA program.

Feel free to write or call if you have any questions about the questionnaire or harvest survey.

Sincerely,

Dr. Frank C. Rohwer

Assistant Professor

David B. Smith

Graduate Assistant

Name _____

RSA Location _____

Please place an X or check mark in the appropriate box below each question.

In the following questions "Regulated Shooting Area (RSA) land" refers only to acreage registered with the State of Maryland on your RSA permit.

1. a. How many acres do you own and/or lease that are registered as RSA?

Own _____

Lease _____

b. How many of those acres are managed as impoundments? _____

or open water? _____

c. Approximately how many acres were in crops this past season? _____

d. Of those crops, how much was sold or used other than for waterfowl?___

_____

e. Of those same crops, how much was set aside for use by waterfowl through the winter? Acres left standing or quantity harvested and then used as feed.

_____

f. Did you purchase feed for waterfowl? What and how much?

_____

g. Are you practicing any predator control?

yes	no

If yes, what species and by what methods?

If no, do you feel that predator control is not necessary, not effective, not worth the expense or trouble, ...?

h. If you own or lease other land (non-RSA) that is managed specifically for waterfowl, how many acres and how is it managed?

i. How many mallards did you release on your property in 1992?

j. How many mallards did you release on your property in 1993?

2. Please rate the following RSA goals on a scale from 1 (very important) to 5 (not important).

	Take hunting pressure off wild ducks
	Provide habitat for wintering wild waterfowl
	Boost the wild population
	Provide good hunting
	Attract more hunters to Dorchester county

3. Rate the success of RSA's at accomplishing these goals on a scale from 1 (very effective) to 5 (not effective).

	Take hunting pressure off wild ducks
	Provide habitat for wintering wild waterfowl
	Boost the wild population
	Provide good hunting
	Attract more hunters to Dorchester county

4. Please rate the following potential problems posed by the presence of RSAs on a scale from 1 (very important) to 5 (not important).

	Chance of disease outbreaks.
	Competition for food with wild waterfowl
	Hybridization with American Black Ducks
	Enforcement issues such as baiting and live decoys
	Altering genetics of wild Mallards
	Increase in predator populations around RSA's

5. a. Do you believe any limits should be placed on the number of RSA mallards shot on RSAs?

yes	no	no opinion

b. What bag limit (ducks per day) would you consider to be too low to be worth the expense and trouble to continue to operate an RSA?

3	4	5	7	10	20

c. If you were no longer allowed to release ducks, how would your management practices change? Place a check in the appropriate box(es).

	stop planting crops
	plant crops but leave none standing for waterfowl
	crop only what could be sold, leave the rest for waterfowl
	sell or quit leasing the property
	would not change

d. If you no longer had a bag limit incentive, how would your management practices change? Place a check in the appropriate box(es).

	stop releasing mallards
	stop planting crops
	plant crops but leave none standing for waterfowl
	crop only what could be sold, leave the rest for waterfowl
	sell or quit leasing the property
	would not change

6. Please make any additional comments about the RSA program that you feel are important.

D: QUESTIONAIRE TO STATE BIOLOGISTS

Rohwer and Smith Captive-reared Mallard Survey- Please attach another sheet if you need more space for written comments on the issue of mallard releases, fold with this page so that the addresses on the back show, staple and mail. Thank you!

Does your state offer licensing to allow the release of captive-reared mallards by individuals or organizations? (Circle one) YES/NO

If so, what year were such licenses first issued?_____

If you have a licensed release program, does this allow the permittee to harvest these mallards without regard to bag limits? (Circle one) YES/NO

If yes: how many properties are licensed to release waterfowl?_____

how many birds are released state wide:

flighted (Tower shoots)?_____ based on ESTIMATE or RECORDS
stocking of mallards?_____ based on ESTIMATE or RECORDS

how are these harvested: flighted (tower shoots)?_____

stocking of mallards (i.e. liberated some time prior to hunting)?_____

Do large scale releases occur in your state without licensing? (Circle one) YES / NO

If yes, please provide an estimate of the number of birds released with no licensing?__

Is the liberation of captive-reared waterfowl specifically outlawed? (Circle one) YES / NO

If yes, please state in what year this prohibition was begun and why?

The following are potential problems associated with the release of captive-reared mallards. Please indicate whether you feel that each of the following issues is important. Independently rate each of the following on a scale of 1 (very important) to 5 (not important).

	Released mallards breeding with Black Ducks.
	Released mallards breeding with wild stock mallards.
	Released mallards increasing predator populations.
	Released mallards competing with wild ducks for food.
	Released mallards have low survival.
	Increase chance of disease outbreaks in wild ducks.
	Makes sportsmen believe that released ducks can enhance regional populations

Comments:

E: SURVIVAL DATA

YEAR	RELEASE	SITE	FREQ	SEX	TARSUS	MASS	DATE	DAY	FATE
91	md	drcreek	164.143	f	62	915	08-Oct-91	50	c
91	md	drcreek	164.153	m	0	1100	27-Aug-91	8	c
91	md	drcreek	164.252	f	61	970	02-Oct-91	44	c
91	md	drcreek	164.353	m	60	1005	22-Aug-91	3	c
91	md	drcreek	164.363	m	61	1080	02-Sep-91	14	m
91	md	drcreek	164.390	f	62	940	22-Aug-91	3	m
91	md	drcreek	164.801	m	63	1160	20-Aug-91	1	c
91	md	drcreek	164.814	f	61	965	22-Aug-91	3	m
91	md	drcreek	165.002	m	62	1150	20-Sep-91	32	m
91	md	lakes	164.212	m	60	930	27-Aug-91	8	c
91	md	lakes	164.370	m	64	1030	28-Aug-91	9	m
91	md	lakes	164.442	f	62	940	20-Aug-91	1	m
91	md	lakes	164.783	f	59	985	27-Aug-91	8	t
91	md	lakes	164.892	f	60	1000	03-Sep-91	15	t
91	md	lakes	164.902	m	60	970	22-Aug-91	3	c
91	md	lakes	165.091	f	61	935	26-Aug-91	7	m
91	md	lakes	165.172	f	61	985	18-Sep-91	30	c
91	md	ubw	164.008	m	61	958	20-Oct-91	62	c
91	md	ubw	164.050	m	64	1005	20-Aug-91	1	m
91	md	ubw	164.123	m	64	940	22-Aug-91	3	m
91	md	ubw	164.132	f	46	860	20-Aug-91	1	c
91	md	ubw	164.159	f	58	1015	20-Sep-91	32	c
91	md	ubw	164.192	m	64	1030	11-Oct-91	53	t
91	md	ubw	164.232	f	58	890	20-Aug-91	1	c
91	md	ubw	164.262	f	58	925	20-Aug-91	1	m
91	md	ubw	164.322	f	63	932	13-Nov-91	86	c
91	md	ubw	164.383	f	60	1110	30-Aug-91	11	c
91	md	ubw	164.433	m	62	1040	20-Aug-91	1	m
91	md	ubw	164.500	m	63	950	23-Aug-91	4	m
91	md	ubw	164.773	f	60	916	30-Sep-91	42	th
91	md	ubw	164.794	f	60	895	22-Aug-91	3	c
91	md	ubw	164.822	f	60	925	20-Aug-91	1	m
91	md	ubw	164.883	m	63	983	21-Aug-91	2	m
91	md	ubw	164.912	m	65	1120	14-Sep-91	26	th
91	md	ubw	165.032	m	64	1084	21-Aug-91	2	m
91	md	ubw	165.041	m	61	980	20-Aug-91	1	m
91	md	ubw	165.082	m	62	990	20-Aug-91	1	c
91	md	ubw	165.100	f	61	940	25-Aug-91	6	m
91	md	ubw	165.151	m	63	1120	30-Aug-91	11	t
91	md	ubw	165.160	m	61	985	27-Aug-91	8	m
91	rsa	lp	165.000	F	57	865	06-Dec-91	109	c
91	rsa	lp	165.000	F	61	910	20-Oct-91	62	h
91	rsa	lp	165.000	F	64	1080	12-Nov-91	85	t
91	rsa	lp	165.000	F	59	905	30-Nov-91	103	h
91	rsa	lp	165.000	M	58	830	14-Sep-91	26	m
91	rsa	lp	165.000	F	56	945	20-Oct-91	62	h
91	rsa	lp	165.000	M	60	850	24-Jan-92	158	a

YEAR	RELEASE	SITE	FREQ	SEX	TARSUS	MASS	DATE	DAY	FATE
91	rsa	lp	165.000	M	63	1090	28-Sep-91	40	th
91	rsa	lp	165.000	M	60	790	20-Oct-91	62	c
91	rsa	lp	166.000	F	55	780	24-Jan-92	158	a
91	rsa	lp	166.000	F	59	780	15-Dec-91	118	m
91	rsa	lp	166.000	F	62	925	18-Jan-92	152	a
91	rsa	lp	166.000	F	58	890	15-Dec-91	118	m
91	rsa	lp	166.000	F	61	950	15-Dec-91	118	m
91	rsa	lp	166.000	M	61	1090	30-Dec-91	133	c
91	rsa	lp	166.000	M	61	1075	03-Oct-91	45	m
91	rsa	lp	166.000	F	56	790	20-Dec-91	123	c
91	rsa	lp	166.000	M	57	920	15-Dec-91	118	m
91	rsa	lp	166.000	F	60	985	20-Oct-91	62	h
91	rsa	lp	166.000	M	59	720	20-Oct-91	62	h
91	rsa	lp	166.000	M	61	875	12-Oct-91	54	m
91	rsa	lp	166.000	M	62	980	14-Sep-91	26	m
91	rsa	lp	166.000	M	60	850	12-Oct-91	54	m
91	rsa	lp	166.000	M	61	895	20-Oct-91	62	h
91	rsa	lp	166.000	M	61	940	15-Dec-91	118	m
91	rsa	willey	164.016	f	63	900	12-Dec-91	115	c
91	rsa	willey	164.025	f	62	985	21-Dec-91	124	m
91	rsa	willey	164.042		66	985	24-Dec-91	127	m
91	rsa	willey	164.050	m	62	1115	27-Feb-92	192	a
91	rsa	willey	164.067	m	63	1045	05-Jan-92	139	c
91	rsa	willey	164.086	f	59	0	24-Dec-91	127	m
91	rsa	willey	164.123	m	62	980	21-Dec-91	124	m
91	rsa	willey	164.330	m	62	840	01-Oct-91	43	c
91	rsa	willey	164.329	f	58	850	12-Dec-91	115	c
91	rsa	willey	164.400	f	61	1040	05-Jan-92	139	m
91	rsa	willey	164.410	f	61	940	30-Nov-91	103	m
91	rsa	willey	164.432				02-Jan-92	136	m
91	rsa	willey	164.457	f	59	1080	24-Dec-91	127	m
91	rsa	willey	164.464	m	62	930	18-Jan-92	152	a
91	rsa	willey	164.488	m	67	865	03-Dec-91	106	m
91	rsa	willey	164.500	f	63	855	30-Dec-91	133	m
91	rsa	willey	164.663	m	61	1080	21-Dec-91	124	c
91	rsa	willey	164.708	m	61	995	12-Dec-91	115	th
91	rsa	willey	164.782	m	60	860	18-Dec-91	121	c
91	rsa	willey	164.814	m	61	955	10-Nov-91	83	t
91	rsa	willey	164.820	m	62	900	23-Oct-91	65	m
91	rsa	willey	165.041	m	63	1060	07-Nov-91	80	t
91	rsa	willey	165.091	f	57	800	11-Oct-91	53	th
91	rsa	willey	165.160	f	59	785	18-Dec-91	121	c
91	rsa	willey	165.545	m	62	915	10-Dec-91	113	h
92	md	drcreek	164.035	f	58	780	19-Nov-92	92	c
92	md	drcreek	164.121	m	63	1110	25-Aug-92	6	c
92	md	drcreek	164.221	f	58	815	19-Aug-92	0	m
92	md	drcreek	164.355	f	60	950	20-Aug-92	1	m
92	md	drcreek	164.370	f	58	860	21-Aug-92	2	c

YEAR	RELEASE	SITE	FREQ	SEX	TARSUS	MASS	DATE	DAY	FATE
92	md	drcreek	164.457	f	57	780	28-Aug-92	9	m
92	md	drcreek	164.500	f	60	920	21-Aug-92	2	m
92	md	drcreek	164.555	f	59	875	30-Oct-92	72	m
92	md	drcreek	164.570	f	58	885	16-Oct-92	58	h
92	md	drcreek	164.870	m	63	930	21-Aug-92	2	m
92	md	drcreek	165.040	m	59	850	23-Aug-92	4	m
92	md	drcreek	165.190	f	59	785	17-Sep-92	29	m
92	md	drcreek	165.250	f	62	980	25-Aug-92	6	m
92	md	drcreek	165.278	m	60	1015	26-Aug-92	7	m
92	md	drcreek	165.395	f	59	755	20-Aug-92	1	c
92	md	drcreek	165.405	f	61	935	27-Aug-92	8	m
92	md	drcreek	165.485	f	61	825	21-Aug-92	2	m
92	md	drcreek	165.503	m	62	935	29-Aug-92	10	m
92	md	drcreek	165.555	m	65	1000	23-Aug-92	4	m
92	md	drcreek	165.617	m	57	910	03-Sep-92	15	m
92	md	drcreek	165.968	m	64	1110	10-Oct-92	52	c
92	md	lakes	164.025	m	62	1190	26-Aug-92	7	m
92	md	lakes	164.087	f	56	865	06-Sep-92	18	m
92	md	lakes	164.145	f	53	725	08-Sep-92	20	m
92	md	lakes	164.307	f	62	930	08-Sep-92	20	m
92	md	lakes	164.408	f	57	780	29-Aug-92	10	m
92	md	lakes	164.433	f	60	820	17-Sep-92	29	m
92	md	lakes	164.505	m	62	1200	10-Oct-92	52	th
92	md	lakes	164.765	m	62	1100	17-Sep-92	29	c
92	md	lakes	164.783	m	63	870	12-Nov-92	85	m
92	md	lakes	164.820	m	61	925	24-Aug-92	5	m
92	md	lakes	165.008	m	64	1020	02-Sep-92	14	m
92	md	lakes	165.032	f	55	875	31-Aug-92	12	c
92	md	lakes	165.085	f	56	770	11-Sep-92	23	m
92	md	lakes	165.165	f	60	775	23-Aug-92	4	c
92	md	lakes	165.203	f	60	865	19-Nov-92	92	c
92	md	lakes	165.302	f	58	795	29-Aug-92	10	th
92	md	lakes	165.427	m	59	880	20-Aug-92	1	c
92	md	lakes	165.633	m	60	830	06-Nov-92	79	m
92	md	lakes	165.817	m	58	850	17-Oct-92	59	h
92	md	lakes	165.907	m	61	940	06-Sep-92	18	m
92	md	ubw	164.515	f	56	770	31-Aug-92	12	m
92	md	ubw	164.663	f	60	905	03-Sep-92	15	m
92	md	ubw	164.130	m	65	985	24-Sep-92	36	m
92	md	ubw	164.191	f	54	675	25-Oct-92	67	m
92	md	ubw	164.240	m	59	920	21-Aug-92	2	c
92	md	ubw	164.324	f	56	845	20-Aug-92	1	m
92	md	ubw	164.332	m	60	820	02-Sep-92	14	c
92	md	ubw	164.363	m	60	860	01-Sep-92	13	m
92	md	ubw	164.401	f	60	925	30-Aug-92	11	m
92	md	ubw	164.463	m	64	1020	10-Sep-92	22	m
92	md	ubw	164.490	f	60	920	03-Sep-92	15	m
92	md	ubw	164.600	m	64	975	28-Aug-92	9	m
92	md	ubw	164.708	m	64	965	20-Aug-92	1	m

YEAR	RELEASE	SITE	FREQ	SEX	TARSUS	MASS	DATE	DAY	FATE
92	md	ubw	164.825	m	67	1085	24-Aug-92	5	m
92	md	ubw	164.890	f	58	770	18-Sep-92	30	m
92	md	ubw	164.970	m	67	1070	19-Aug-92	0	m
92	md	ubw	165.002	m	62	1020	22-Aug-92	3	c
92	md	ubw	165.050	f	62	825	27-Aug-92	8	m
92	md	ubw	165.090	m	61	930	28-Aug-92	9	m
92	md	ubw	165.225	m	61	770	06-Sep-92	18	m
92	md	ubw	165.236	f	65	800	10-Sep-92	22	m
92	md	ubw	165.270	m	59	940	10-Sep-92	22	m
92	md	ubw	165.322	m	61	1095	19-Aug-92	0	m
92	md	ubw	165.335	f	56	800	02-Sep-92	14	m
92	md	ubw	165.360	f	55	830	11-Sep-92	23	c
92	md	ubw	165.387	f	61	855	30-Nov-92	103	c
92	md	ubw	165.435	m	60	810	22-Aug-92	3	m
92	md	ubw	165.477	m	62	980	28-Sep-92	40	c
92	md	ubw	165.516	m	58	850	14-Sep-92	26	m
92	md	ubw	165.545	m	65	1095	03-Sep-92	15	m
92	md	ubw	165.605	f	59	775	15-Sep-92	27	th
92	md	ubw	165.658	m	58	875	24-Sep-92	36	c
92	md	ubw	165.685	f	59	1085	05-Sep-92	17	m
92	md	ubw	165.754	m	63	995	17-Sep-92	29	m
92	md	ubw	165.830	m	59	865	10-Sep-92	22	m
92	md	ubw	165.870	m	61	930	01-Oct-92	43	t
92	md	ubw	165.930	m	63	930	07-Oct-92	49	c
92	md	ubw	165.939	m	67	915	07-Sep-92	19	t
92	md	ubw	165.957	f	56	860	20-Sep-92	32	m
92	md	ubw	165.982	f	56	995	04-Nov-92	77	c
92	rsa	bugg	164.773	f	59	925	23-Nov-92	96	c
92	rsa	bugg	164.790	m	58	955	14-Feb-93	179	a
92	rsa	bugg	164.800	m	67	885	03-Sep-92	15	m
92	rsa	bugg	164.945	f	57	835	17-Oct-92	59	h
92	rsa	bugg	164.980	m	64	1015	14-Dec-92	117	c
92	rsa	bugg	165.025	m	63	1035	18-Dec-92	121	c
92	rsa	bugg	165.070	m	63	915	19-Aug-92	0	m
92	rsa	bugg	165.103	m	64	1005	18-Dec-92	121	c
92	rsa	bugg	165.140	m	67	1055	26-Nov-92	99	h
92	rsa	bugg	165.160	f	57	850	20-Oct-92	62	th
92	rsa	daly	165.228	m	61	865	16-Oct-92	58	h
92	rsa	daly	165.375	f	58	765	06-Oct-92	48	m
92	rsa	daly	165.468	f	59	855	17-Oct-92	59	h
92	rsa	daly	165.530	f	61	910	03-Feb-93	168	a
92	rsa	daly	165.563	m	61	850	13-Sep-92	25	m
92	rsa	daly	165.695	f	52	780	11-Feb-93	176	a
92	rsa	daly	165.705	m	62	870	28-Nov-92	101	th
92	rsa	daly	165.745	m	57	810	10-Sep-92	22	c
92	rsa	daly	165.775	m	64	990	11-Feb-93	176	a
92	rsa	daly	165.890	m	59	850	28-Oct-92	70	m
92	rsa	eagle	164.833	f	59	830	02-Oct-92	44	th
92	rsa	eagle	164.845	f	66	850	14-Feb-93	179	a

YEAR	RELEASE	SITE	FREQ	SEX	TARSUS	MASS	DATE	DAY	FATE
92	rsa	eagle	164.863	m	59	840	15-Feb-93	180	a
92	rsa	eagle	164.900	f	61	965	07-Sep-92	19	m
92	rsa	eagle	164.923	m	62	905	17-Dec-92	120	m
92	rsa	eagle	164.935	m	59	880	23-Dec-92	126	c
92	rsa	eagle	164.955	m	64	965	01-Dec-92	104	m
92	rsa	eagle	165.033	f	59	920	01-Sep-92	13	m
92	rsa	eagle	165.130	m	60	1010	17-Oct-92	59	h
92	rsa	eagle	165.218	f	61	870	23-Oct-92	65	m
92	rsa	pyramid	164.085	f	61	835	10-Sep-92	22	m
92	rsa	pyramid	164.155	m	63	990	19-Oct-92	61	m
92	rsa	pyramid	164.170	m	60	930	17-Oct-92	59	h
92	rsa	pyramid	164.313	f	61	930	17-Oct-92	59	h
92	rsa	pyramid	164.375	f	59	835	26-Nov-92	99	h
92	rsa	pyramid	164.440	f	57	790	21-Dec-92	124	m
92	rsa	pyramid	164.515	m	66	960	30-Nov-92	103	m
92	rsa	pyramid	164.540	f	63	1055	26-Oct-92	68	m
92	rsa	pyramid	164.635	f	60	800	30-Dec-92	133	m
92	rsa	pyramid	164.663	m	58	845	09-Jan-93	143	h
92	rsa	thunder	165.175	f	58	835	14-Nov-92	87	m
92	rsa	thunder	165.215	m	62	1030	03-Sep-92	15	th
92	rsa	thunder	165.255	f	57	815	08-Nov-92	81	c
92	rsa	thunder	165.575	m	64	1045	23-Sep-92	35	m
92	rsa	thunder	165.585	f	59	945	26-Oct-92	68	c
92	rsa	thunder	165.625	m	64	960	25-Oct-92	67	m
92	rsa	thunder	165.765	f	59	840	20-Oct-92	62	c
92	rsa	thunder	165.783	m	61	1065	16-Sep-92	28	m
92	rsa	thunder	165.850	f	58	895	17-Oct-92	59	h
92	rsa	thunder	165.920	f	56	745	16-Nov-92	89	c
92	rsa	williams	164.105	f	60	965	11-Feb-93	176	a
92	rsa	williams	164.203	m	64	840	14-Feb-93	179	a
92	rsa	williams	164.250	f	57	930	14-Feb-93	179	a
92	rsa	williams	164.385	f	55	630	14-Feb-93	179	a
92	rsa	williams	164.658	f	60	885	04-Nov-92	77	c
92	rsa	williams	164.683	f	60	900	17-Oct-92	59	h
92	rsa	williams	164.728	f	59	820	04-Nov-92	77	c
92	rsa	williams	164.808	m	60	895	14-Feb-93	179	a
92	rsa	williams	165.150	f	55	860	16-Oct-92	58	h
92	rsa	williams	165.493	f	58	810	14-Feb-93	179	a
93	md	lakes	164.050	m	61	780	21-Aug-93	2	c
93	md	lakes	164.087	m	62	610	20-Aug-93	1	m
93	md	lakes	164.105	m	62	710	30-Aug-93	11	m
93	md	lakes	164.130	m	61	760	24-Aug-93	5	m
93	md	lakes	164.170	m	61	930	28-Aug-93	9	m
93	md	lakes	164.191	m	67	900	31-Aug-93	12	m
93	md	lakes	164.221	m	64	875	31-Aug-93	12	m
93	md	lakes	164.238	m	62	950	10-Nov-93	83	c
93	md	lakes	164.307	m	60	850	03-Sep-93	15	c
93	md	lakes	164.324	f	58	790	29-Aug-93	10	m
93	md	lakes	164.344	m	61	740	03-Sep-93	15	m

YEAR	RELEASE	SITE	FREQ	SEX	TARSUS	MASS	DATE	DAY	FATE
93	md	lakes	164.355	f	61	935	29-Aug-93	10	m
93	md	lakes	164.363	m	63	830	08-Nov-93	81	m
93	md	lakes	164.375	f	60	1010	01-Sep-93	13	m
93	md	lakes	164.405	m	60	775	14-Sep-93	26	c
93	md	lakes	164.433	f	57	705	23-Aug-93	4	c
93	md	lakes	164.457	f	57	740	28-Aug-93	9	c
93	md	lakes	164.491	m	61	860	25-Aug-93	6	m
93	md	lakes	164.500	f	59	865	14-Sep-93	26	c
93	md	lakes	164.515	f	50	675	30-Sep-93	42	m
93	md	lakes	164.540	f	59	730	05-Sep-93	17	m
93	md	lakes	164.555	f	56	680	28-Aug-93	9	m
93	md	lakes	164.566	m	62	925	28-Aug-93	9	m
93	md	lakes	164.600	f	56	930	28-Aug-93	9	c
93	md	lakes	164.635	f	57	760	29-Aug-93	10	m
93	md	lakes	164.660	m	61	740	29-Sep-93	41	c
93	md	lakes	164.708	m	59	800	23-Aug-93	4	c
93	md	lakes	164.773	m	64	865	21-Aug-93	2	m
93	md	lakes	164.820	f	58	740	31-Aug-93	12	m
93	md	lakes	164.890	f	56	790	25-Aug-93	6	c
93	md	lakes	164.900	f	58	790	25-Aug-93	6	m
93	md	lakes	164.913	f	57	625	01-Sep-93	13	m
93	md	lakes	164.955	m	66	1288	04-Sep-93	16	c
93	md	lakes	165.038	m	62	910	02-Sep-93	14	m
93	md	lakes	165.050	m	64	830	29-Aug-93	10	m
93	md	lakes	165.100	f	61	1005	01-Sep-93	13	m
93	md	lakes	165.130	f	58	670	29-Aug-93	10	m
93	md	lakes	165.175	m	62	720	29-Aug-93	10	m
93	md	lakes	165.190	m	62	875	26-Aug-93	7	m
93	md	lakes	165.218	m	63	770	29-Sep-93	41	m
93	md	lakes	165.228	f	60	850	30-Oct-93	72	c
93	md	lakes	165.335	f	57	720	03-Sep-93	15	m
93	md	lakes	165.375	f	57	810	06-Sep-93	18	m
93	md	lakes	165.435	f	57	725	20-Oct-93	62	c
93	md	lakes	165.468	f	59	795	10-Nov-93	83	m
93	md	lakes	165.563	m	60	710	26-Aug-93	7	c
93	md	lakes	165.930	m	59	620	19-Aug-93	0	m
93	md-fed	raccoon	164.085	m	60	930	21-Nov-93	94	m
93	md-fed	raccoon	164.313	m	64	830	26-Aug-93	7	c
93	md-fed	raccoon	164.505	m	61	935	17-Sep-93	29	t
93	md-fed	raccoon	164.513	m	61	855	02-Sep-93	14	th
93	md-fed	raccoon	164.562	m	63	735	06-Sep-93	18	c
93	md-fed	raccoon	164.663	f	58	725	03-Nov-93	76	c
93	md-fed	raccoon	164.683	m	63	1085	17-Oct-93	59	c
93	md-fed	raccoon	164.825	f	62	880	31-Aug-93	12	c
93	md-fed	raccoon	164.945	m	62	960	28-Aug-93	9	c
93	md-fed	raccoon	164.970	m	60	710	01-Sep-93	13	c
93	md-fed	raccoon	165.008	m	60	670	17-Oct-93	59	t
93	md-fed	raccoon	165.033	m	61	900	10-Sep-93	22	c
93	md-fed	raccoon	165.070	f	61	795	30-Sep-93	42	t

YEAR	RELEASE	SITE	FREQ	SEX	TARSUS	MASS	DATE	DAY	FATE
93	md-fed	raccoon	165.085	m	59	945	15-Oct-93	57	h
93	md-fed	raccoon	165.140	m	62	970	06-Oct-93	48	t
93	md-fed	raccoon	165.150	f	58	720	24-Nov-93	97	c
93	md-fed	raccoon	165.160	m	61	960	17-Sep-93	29	c
93	md-fed	raccoon	165.215	m	59	750	04-Sep-93	16	c
93	md-fed	raccoon	165.225	f	60	1025	03-Sep-93	15	th
93	md-fed	raccoon	165.236	m	62	815	09-Oct-93	51	c
93	md-fed	raccoon	165.250	m	62	885	04-Dec-93	107	c
93	md-fed	raccoon	165.270	f	57	780	17-Oct-93	59	m
93	md-fed	raccoon	165.278	f	55	710	24-Aug-93	5	m
93	md-fed	raccoon	165.315	f	57	870	23-Oct-93	65	c
93	md-fed	raccoon	165.322	m	64	915	14-Nov-93	87	c
93	md-fed	raccoon	165.455	f	56	655	26-Aug-93	7	c
93	md-fed	raccoon	165.503	f	59	1030	14-Sep-93	26	c
93	md-fed	raccoon	165.530	f	56	705	28-Aug-93	9	c
93	md-fed	raccoon	165.545	f	58	745	13-Oct-93	55	m
93	md-fed	raccoon	165.555	f	57	840	05-Oct-93	47	c
93	md-fed	raccoon	165.575	f	57	675	15-Oct-93	57	h
93	md-fed	raccoon	165.605	f	56	890	21-Nov-93	94	t
93	md-fed	raccoon	165.625	f	56	890	25-Aug-93	6	th
93	md-fed	raccoon	165.633	f	57	810	21-Aug-93	2	c
93	md-fed	raccoon	165.646	m	61	770	23-Oct-93	65	m
93	md-fed	raccoon	165.685	f	59	840	02-Sep-93	14	th
93	md-fed	raccoon	165.705	m	61	770	22-Aug-93	3	c
93	md-fed	raccoon	165.755	m	61	880	21-Aug-93	2	c
93	md-fed	raccoon	165.765	f	59	815	28-Sep-93	40	c
93	md-fed	raccoon	165.775	f	59	830	29-Sep-93	41	t
93	md-fed	raccoon	165.783	f	57	765	22-Aug-93	3	t
93	md-fed	raccoon	165.817	f	56	805	17-Sep-93	29	c
93	md-fed	raccoon	165.830	m	62	890	23-Oct-93	65	m
93	md-fed	raccoon	165.870	f	56	695	18-Oct-93	60	m
93	md-fed	raccoon	165.907	f	59	675	25-Oct-93	67	m
93	md-fed	raccoon	165.940	m	61	805	14-Nov-93	87	c
93	rsa	Garrett	164.858	f	63	990	27-Dec-93	130	c
93	rsa	Garrett	165.000	m	60	890	03-Jan-94	137	c
93	rsa	Garrett	165.015	m	59	910	29-Nov-93	102	h
93	rsa	Garrett	165.025	f	59	900	18-Sep-93	30	c
93	rsa	Garrett	165.110	f	59	830	27-Sep-93	39	c
93	rsa	Garrett	165.305	f	55	885	09-Sep-93	21	c
93	rsa	Garrett	165.347	m	62	920	06-Sep-93	18	th
93	rsa	Garrett	165.357	f	57	830	27-Aug-93	8	c
93	rsa	Garrett	165.365	m	61	910	27-Aug-93	8	c
93	rsa	Garrett	165.395	m	62	980	21-Sep-93	33	c
93	rsa	Golden	164.073	f	60	880	10-Oct-93	52	m
93	rsa	Golden	164.095	f	58	840	13-Jan-94	147	a
93	rsa	Golden	164.157	m	65	950	27-Aug-93	8	m
93	rsa	Golden	164.180	m	61	920	10-Dec-93	113	c
93	rsa	Golden	164.210	m	64	890	21-Aug-93	2	m
93	rsa	Golden	164.250	f	60	840	27-Aug-93	8	m

YEAR	RELEASE	SITE	FREQ	SEX	TARSUS	MASS	DATE	DAY	FATE
93	rsa	Golden	164.282	m	62	860	21-Oct-93	63	c
93	rsa	Golden	164.295	f	61	900	23-Aug-93	4	c
93	rsa	Golden	164.425	f	62	970	18-Sep-93	30	c
93	rsa	Lewis	164.140	f	61	870	03-Jan-94	137	c
93	rsa	Lewis	164.225	m	64	1140	13-Jan-94	147	a
93	rsa	Lewis	164.320	f	58	890	13-Jan-94	147	a
93	rsa	Lewis	164.328	m	63	915	02-Dec-93	105	c
93	rsa	Lewis	164.352	m	59	855	03-Jan-94	137	t
93	rsa	Lewis	164.482	f	62	1020	13-Jan-94	147	a
93	rsa	Lewis	164.535	f	63	900	13-Jan-94	147	a
93	rsa	Lewis	164.655	f	59	850	13-Jan-94	147	c
93	rsa	Lewis	164.838	m	60	910	16-Dec-93	119	m
93	rsa	Lewis	164.920	m	62	910	18-Dec-93	121	c
93	rsa	Savanna	165.415	f	60	850	15-Dec-93	118	c
93	rsa	Savanna	165.595	m	64	930	15-Sep-93	27	c
93	rsa	Savanna	165.655	f	61	870	31-Aug-93	12	c
93	rsa	Savanna	165.695	m	63	1020	06-Dec-93	109	c
93	rsa	Savanna	165.725	f	64	980	13-Jan-94	147	a
93	rsa	Savanna	165.795	m	68	1100	13-Jan-94	147	a
93	rsa	Savanna	165.845	f	59	870	31-Aug-93	12	m
93	rsa	Savanna	165.855	m	59	880	08-Jan-94	142	h
93	rsa	Savanna	165.915	m	62	890	15-Sep-93	27	m
93	rsa	Savanna	165.950	f	58	855	03-Sep-93	15	c
93	rsa	Shoenke	164.440	f	61	855	13-Jan-94	147	a
93	rsa	Shoenke	164.450	m	63	890	27-Sep-93	39	c
93	rsa	Shoenke	164.465	m	63	890	24-Sep-93	36	c
93	rsa	Shoenke	164.525	f	58	850	28-Aug-93	9	c
93	rsa	Shoenke	164.614	m	64	1055	20-Dec-93	123	h
93	rsa	Shoenke	164.673	m	62	885	13-Jan-94	147	c
93	rsa	Shoenke	164.690	f	59	905	09-Sep-93	21	m
93	rsa	Shoenke	164.765	f	60	840	22-Nov-93	95	c
93	rsa	Shoenke	164.785	f	60	875	27-Sep-93	39	th
93	rsa	Shoenke	164.795	m	63	1345	11-Oct-93	53	t
93	rsa	Tieder	164.015	f	60	835	24-Sep-93	36	th
93	rsa	Tieder	164.025	m	61	995	04-Oct-93	46	th
93	rsa	Tieder	164.035	f	57	840	03-Sep-93	15	c
93	rsa	Tieder	164.045	m	60	920	04-Oct-93	46	c
93	rsa	Tieder	165.045	f	57	860	06-Sep-93	18	th
93	rsa	Tieder	165.095	f	56	850	14-Dec-93	117	h
93	rsa	Tieder	165.125	m	61	935	25-Aug-93	6	m
93	rsa	Tieder	165.173	m	62	915	22-Nov-93	95	c
93	rsa	Tieder	165.335	f	58	870	25-Aug-93	6	m
93	rsa	Tieder	165.925	m	62	935	02-Jan-94	136	h

Under fate:
a = alive at end of season
c = censored
f = transmitter failure
h = hunter killed and returned
m = observed mortality
th = hunter returned transmitter failure

F: PAIRING DATA.

DATE	PROP	TYPE	BMBF	BMUF	UMBF	UMUF	BMF	UMF	MBF	MF	BM	BF	UM	UF	M	F	U	RM	RF	RMRF	RU	MMRF
9/12/92	BNWR	refuge	0	0	0	2	1	0	0	0	7	3	4	3	0	0	0	0	0	0	1	0
10/9/92	BNWR	refuge	0	1	1	7	0	0	1	12	6	6	19	7	66	19	0	0	0	0	0	0
11/9/92	BNWR	refuge	0	3	1	9	0	0	1	16	2	2	12	6	33	30	0	6	3	0	8	0
12/3/92	BNWR	refuge	2	0	0	7	0	0	0	11	4	7	8	12	16	17	0	4	1	4	1	0
1/4/93	BNWR	refuge	1	0	0	1	0	1	0	8	2	1	5	6	6	8	0	0	0	0	0	0
1/12/93	BNWR	refuge	0	0	0	2	0	0	0	11	0	0	3	2	4	16	0	1	0	2	0	0
2/6/93	BNWR	refuge	1	0	0	1	0	0	1	27	5	8	0	1	50	10	0	7	7	9	0	0
14/9/93	BNWR	refuge	0	0	0	0	0	0	0	0	0	3	0	2	1	0	0	0	0	0	0	0
15/9/93	BNWR	refuge	0	0	0	0	0	0	0	0	1	3	3	5	1	1	0	0	0	0	0	0
18/10/93	BNWR	refuge	0	0	0	0	0	0	0	3	0	0	1	2	9	1	0	0	0	0	0	0
19/10/93	BNWR	refuge	0	0	1	3	0	0	0	2	0	1	5	5	37	9	0	2	2	1	3	0
30/10/93	BNWR	refuge	0	0	0	0	0	0	0	2	0	0	0	0	10	7	0	3	2	1	4	0
10/11/93	BNWR	refuge	1	0	0	0	0	0	0	0	9	7	4	1	16	11	0	0	0	0	0	0
11/11/93	BNWR	refuge	0	0	0	1	1	0	0	0	1	0	6	4	14	6	0	2	1	2	0	0
12/11/93	BNWR	refuge	0	0	0	1	0	0	0	3	0	0	1	0	13	5	0	0	0	1	14	0

DATE	PROP	TYPE	BMBF	BMUF	UMBF	UMUF	BMF	UMF	MBF	MF	BM	BF	UM	UF	M	F	U	RM	RF	RMRF	RU	MMRF
13/11/93	BNWR	refuge	0	0	0	0	0	0	0	0	0	0	0	0	2	2	0	1	1	7	8	0
2/12/93	BNWR	refuge	0	0	0	0	0	0	1	2	2	1	4	2	13	4	0	0	1	0	0	0
3/12/93	BNWR	refuge	0	0	0	2	0	0	0	0	0	0	7	3	2	4	0	1	0	0	0	0
3/12/93	BNWR	refuge	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	13	0
4/12/93	BNWR	refuge	1	0	0	5	0	0	0	0	1	1	4	4	0	0	0	0	0	0	0	0
8/12/93	BNWR	refuge	3	0	0	0	0	0	0	4	0	0	7	5	0	0	0	0	0	0	0	0
1/7/94	BNWR	refuge	0	1	0	2	0	0	1	1	2	4	5	3	2	0	0	2	0	1	0	1
1/22/94	BNWR	refuge	2	0	1	0	0	0	0	0	6	2	0	0	0	0	0	0	0	0	0	0
1/24/94	BNWR	refuge	8	3	2	6	0	0	0	0	8	3	5	1	0	0	0	0	0	0	0	0
2/7/94	BNWR	refuge	0	0	0	0	0	0	0	6	0	0	0	0	0	0	0	2	0	3	0	0
2/14/94	BNWR	refuge	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
2/14/94	BNWR	refuge	3	2	0	2	0	0	0	0	1	2	0	0	0	0	0	0	0	1	0	0
2/15/94	BNWR	refuge	2	0	0	0	0	0	0	0	3	1	0	0	1	2	0	0	0	13	0	0
9/12/92	BNWR	refuge	0	0	0	2	1	0	0	0	7	3	4	3	0	0	0	0	0	0	1	0
10/9/92	BNWR	refuge	0	1	1	7	0	0	1	12	6	6	19	7	66	19	0	0	0	0	0	0

DATE	PROP	TYPE	BMBF	BMUF	UMBF	UMUF	BMF	UMF	MBF	MF	BM	BF	UM	UF	M	F	U	RM	RF	RMRF	RU	MMRF
11/9/92	BNWR	refuge	0	3	1	9	0	0	1	16	2	2	12	6	33	30	0	6	3	0	8	0
12/3/92	BNWR	refuge	2	0	0	7	0	0	0	11	4	7	8	12	16	17	0	4	1	4	1	0
1/4/93	BNWR	refuge	1	0	0	1	0	1	0	8	2	1	5	6	6	8	0	0	0	0	0	0
1/12/93	BNWR	refuge	0	0	0	2	0	0	0	11	0	0	3	2	4	16	0	1	0	2	0	0
2/6/93	BNWR	refuge	1	0	0	1	0	0	1	27	5	8	0	1	50	10	0	7	7	9	0	0
14/9/93	BNWR	refuge	0	0	0	0	0	0	0	0	0	3	0	2	1	0	0	0	0	0	0	0
15/9/93	BNWR	refuge	0	0	0	0	0	0	0	0	1	3	3	5	1	1	0	0	0	0	0	0
18/10/93	BNWR	refuge	0	0	0	0	0	0	0	3	0	0	1	2	9	1	0	0	0	0	0	0
19/10/93	BNWR	refuge	0	0	1	3	0	0	0	2	0	1	5	5	37	9	0	2	2	1	3	0
30/10/93	BNWR	refuge	0	0	0	0	0	0	0	2	0	0	0	0	10	7	0	3	2	1	4	0
10/11/93	BNWR	refuge	1	0	0	0	0	0	0	0	9	7	4	1	16	11	0	0	0	0	0	0
11/11/93	BNWR	refuge	0	0	0	1	1	0	0	0	1	0	6	4	14	6	0	2	1	2	0	0
12/11/93	BNWR	refuge	0	0	0	1	0	0	0	3	0	0	1	0	13	5	0	0	0	1	14	0
13/11/93	BNWR	refuge	0	0	0	0	0	0	0	0	0	0	0	0	2	2	0	1	1	7	8	0
2/12/93	BNWR	refuge	0	0	0	0	0	0	1	2	2	1	4	2	13	4	0	0	1	0	0	0
3/12/93	BNWR	refuge	0	0	0	2	0	0	0	0	0	0	7	3	2	4	0	1	0	0	0	0

DATE	PROP	TYPE	BMBF	BMUF	UMBF	UMUF	BMF	UMF	MBF	MF	BM	BF	UM	UF	M	F	U	RM	RF	RMRF	RU	MMRF
3/12/93	BNWR	refuge	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	13	0
4/12/93	BNWR	refuge	1	0	0	5	0	0	0	0	1	1	4	4	0	0	0	0	0	0	0	0
8/12/93	BNWR	refuge	3	0	0	0	0	0	0	4	0	0	7	5	0	0	0	0	0	0	0	0
1/7/94	BNWR	refuge	0	1	0	2	0	0	1	1	2	4	5	3	2	0	0	2	0	1	0	1
1/22/94	BNWR	refuge	2	0	1	0	0	0	0	0	6	2	0	0	0	0	0	0	0	0	0	0
1/24/94	BNWR	refuge	8	3	2	6	0	0	0	0	8	3	5	1	0	0	0	0	0	0	0	0
2/7/94	BNWR	refuge	0	0	0	0	0	0	0	6	0	0	0	0	0	0	0	2	0	3	0	0
2/14/94	BNWR	refuge	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
2/14/94	BNWR	refuge	3	2	0	2	0	0	0	0	1	2	0	0	0	0	0	0	0	1	0	0
2/15/94	BNWR	refuge	2	0	0	0	0	0	0	0	3	1	0	0	1	2	0	0	0	13	0	0
23/9/93	boggs	rsa	0	0	0	0	0	0	0	0	23	17	2	0	2	2	0	1	0	0	0	0
22/10/93	boggs	rsa	0	0	0	0	0	0	0	1	26	21	1	0	44	16	0	2	3	1	3	0
15/11/93	boggs	rsa	1	0	0	0	0	0	0	1	18	11	0	1	13	14	0	8	6	1	0	0
9/12/93	boggs	rsa	1	0	0	0	0	0	0	5	19	20	2	0	15	3	0	1	3	1	1	0
2/9/94	boggs	rsa	7	2	1	0	0	0	0	4	8	5	2	0	0	2	0	1	2	4	0	0
23/9/93	boggs	rsa	0	0	0	0	0	0	0	0	23	17	2	0	2	2	0	1	0	0	0	0

DATE	PROP	TYPE	BMBF	BMUF	UMBF	UMUF	BMF	UMF	MBF	MF	BM	BF	UM	UF	M	F	U	RM	RF	RMRF	RU	MMRF
22/10/93	boggs	rsa	0	0	0	0	0	0	0	1	26	21	1	0	44	16	0	2	3	1	3	0
15/11/93	boggs	rsa	1	0	0	0	0	0	0	1	18	11	0	1	13	14	0	8	6	1	0	0
9/12/93	boggs	rsa	1	0	0	0	0	0	0	5	19	20	2	0	15	3	0	1	3	1	1	0
2/9/94	boggs	rsa	7	2	1	0	0	0	0	4	8	5	2	0	0	2	0	1	2	4	0	0
9/13/92	BWHC	rsa	0	0	0	0	0	0	0	1	12	4	1	0	1	3	0	0	0	0	0	0
10/20/92	BWHC	rsa	1	0	0	0	0	0	0	1	8	2	0	0	31	23	0	0	0	0	0	0
11/12/92	BWHC	rsa	0	0	0	0	0	0	0	0	26	29	0	0	11	10	0	2	0	1	0	0
12/13/92	BWHC	rsa	1	0	0	0	0	0	0	1	4	5	0	0	43	36	0	0	0	0	0	0
1/26/93	BWHC	rsa	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
2/11/93	BWHC	rsa	0	0	0	0	0	0	0	9	1	0	0	0	10	18	0	0	0	0	0	0
9/13/92	BWHC	rsa	0	0	0	0	0	0	0	1	12	4	1	0	1	3	0	0	0	0	0	0
10/20/92	BWHC	rsa	1	0	0	0	0	0	0	1	8	2	0	0	31	23	0	0	0	0	0	0
11/12/92	BWHC	rsa	0	0	0	0	0	0	0	0	26	29	0	0	11	10	0	2	0	1	0	0
12/13/92	BWHC	rsa	1	0	0	0	0	0	0	1	4	5	0	0	43	36	0	0	0	0	0	0
1/26/93	BWHC	rsa	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
2/11/93	BWHC	rsa	0	0	0	0	0	0	0	9	1	0	0	0	10	18	0	0	0	0	0	0

DATE	PROP	TYPE	BMBF	BMUF	UMBF	UMUF	BMF	UMF	MBF	MF	BM	BF	UM	UF	M	F	U	RM	RF	RMRF	RU	MMRF
9/11/92	CRABPT	rsa	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	11	8	1	0	0
3/11/93	cunningha	rsa	0	0	0	0	0	0	0	1	5	1	0	0	11	13	0	0	1	0	0	0
19/11/93	cunningha	rsa	3	0	0	0	0	0	1	2	10	14	0	0	7	4	0	3	4	0	0	0
9/12/93	cunningha	rsa	3	0	1	3	0	0	0	2	3	0	3	4	1	0	0	0	0	0	3	0
2/17/94	cunningha	rsa	35	5	4	5	0	0	0	0	40	28	13	4	0	0	0	2	0	9	0	0
3/11/93	cunningha	rsa	0	0	0	0	0	0	0	1	5	1	0	0	11	13	0	0	1	0	0	0
19/11/93	cunningha	rsa	3	0	0	0	0	0	1	2	10	14	0	0	7	4	0	3	4	0	0	0
9/12/93	cunningha	rsa	3	0	1	3	0	0	0	2	3	0	3	4	1	0	0	0	0	0	3	0
2/17/94	cunningha	rsa	35	5	4	5	0	0	0	0	40	28	13	4	0	0	0	2	0	9	0	0
25/10/93	fbwma	state	0	0	0	0	0	0	0	2	0	0	0	0	2	3	0	0	0	4	11	0
28/10/93	fbwma	state	0	0	0	0	0	0	0	0	0	0	0	0	2	2	0	0	0	0	2	0
10/11/93	fbwma	state	0	0	0	0	0	0	0	1	0	0	0	0	1	0	0	0	0	8	6	0
10/12/93	fbwma	state	0	0	0	0	0	0	0	2	0	0	0	0	0	0	0	0	0	3	1	0
25/10/93	fbwma	state	0	0	0	0	0	0	0	2	0	0	0	0	2	3	0	0	0	4	11	0
28/10/93	fbwma	state	0	0	0	0	0	0	0	0	0	0	0	0	2	2	0	0	0	0	2	0
10/11/93	fbwma	state	0	0	0	0	0	0	0	1	0	0	0	0	1	0	0	0	0	8	6	0

DATE	PROP	TYPE	BMBF	BMUF	UMBF	UMUF	BMF	UMF	MBF	MF	BM	BF	UM	UF	M	F	U	RM	RF	RMRF	RU	MMRF
10/12/93	fbwma	state	0	0	0	0	0	0	0	2	0	0	0	0	0	0	0	0	0	3	1	0
11/16/92	FISHBAY	state	0	0	0	0	2	0	0	0	0	0	0	0	0	0	0	0	0	1	3	0
1/18/93	FISHBAY	state	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0
2/8/93	FISHBAY	state	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	2	0	0
11/16/92	FISHBAY	state	0	0	0	0	2	0	0	0	0	0	0	0	0	0	0	0	0	1	3	0
1/18/93	FISHBAY	state	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0
2/8/93	FISHBAY	state	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	2	0	0
10/12/92	GUINEA	state	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
10/12/92	GUINEA	state	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
1/25/94	hughes	rsa	8	2	0	1	0	0	0	0	6	10	1	2	3	0	0	0	3	3	0	0
1/25/94	hughes	rsa	8	2	0	1	0	0	0	0	6	10	1	2	3	0	0	0	3	3	0	0
11/15/92	ISLAND	state	0	0	0	0	0	0	0	2	0	0	0	0	2	0	4	0	0	0	0	0
11/15/92	ISLAND	state	0	0	0	0	0	0	0	2	0	0	0	0	2	0	4	0	0	0	0	0
9/16/92	ISLCREEK	state	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	6	0	0
10/13/92	ISLCREEK	state	0	0	0	0	0	0	0	0	1	3	0	0	0	0	0	0	0	1	1	0
1/19/93	ISLCREEK	state	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0

DATE	PROP	TYPE	BMBF	BMUF	UMBF	UMUF	BMF	UMF	MBF	MF	BM	BF	UM	UF	M	F	U	RM	RF	RMRF	RU	MMRF
22/11/93	ISLCREEK	state	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	4	2	0
9/16/92	ISLCREEK	state	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	6	0	0
10/13/92	ISLCREEK	state	0	0	0	0	0	0	0	0	1	3	0	0	0	0	0	0	0	1	1	0
1/19/93	ISLCREEK	state	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0
22/11/93	islcreek	state	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	4	2	0
28/9/93	johnson	rsa	0	0	0	0	0	0	0	0	14	13	0	0	0	0	0	5	2	0	3	0
29/9/93	johnson	rsa	0	0	0	0	0	0	0	0	14	14	2	1	4	5	0	1	0	0	0	0
21/10/93	johnson	rsa	0	0	0	0	0	0	0	0	19	15	0	0	1	0	0	3	0	0	14	0
18/11/93	johnson	rsa	0	0	0	0	0	0	0	3	5	3	1	1	15	3	0	6	5	2	0	0
2/3/94	johnson	rsa	5	0	1	5	0	0	0	0	11	8	12	5	0	2	0	2	1	3	0	0
28/9/93	johnson	rsa	0	0	0	0	0	0	0	0	14	13	0	0	0	0	0	5	2	0	3	0
29/9/93	johnson	rsa	0	0	0	0	0	0	0	0	14	14	2	1	4	5	0	1	0	0	0	0
21/10/93	johnson	rsa	0	0	0	0	0	0	0	0	19	15	0	0	1	0	0	3	0	0	14	0
18/11/93	johnson	rsa	0	0	0	0	0	0	0	3	5	3	1	1	15	3	0	6	5	2	0	0
2/3/94	johnson	rsa	5	0	1	5	0	0	0	0	11	8	12	5	0	2	0	2	1	3	0	0

DATE	PROP	TYPE	BMBF	BMUF	UMBF	UMUF	BMF	UMF	MBF	MF	BM	BF	UM	UF	M	F	U	RM	RF	RMRF	RU	MMRF
10/13/92	LANGRELL	state	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	3	1	0
11/15/92	LANGRELL	state	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	4	0	0
12/13/92	LANGRELL	state	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	2	0
1/19/93	LANGRELL	state	0	0	0	0	0	0	0	1	0	0	0	0	4	0	0	0	0	13	1	1
2/12/93	LANGRELL	state	0	0	0	0	0	0	0	8	0	0	0	0	0	0	0	0	0	15	4	0
10/13/92	LANGRELL	state	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	3	1	0
11/15/92	LANGRELL	state	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	4	0	0
12/13/92	LANGRELL	state	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	2	0
1/19/93	LANGRELL	state	0	0	0	0	0	0	0	1	0	0	0	0	4	0	0	0	0	13	1	1
2/12/93	LANGRELL	state	0	0	0	0	0	0	0	8	0	0	0	0	0	0	0	0	0	15	4	0
22/11/93	LANGRELL	state	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	3	2	0
22/11/93	LANGRELL	state	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	3	2	0
12/9/92	MCGRAW	refuge	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	7	5	0
1/15/93	MCGRAW	refuge	0	0	0	0	0	0	0	2	0	0	0	0	5	2	0	3	1	14	0	0
2/7/93	MCGRAW	refuge	0	0	0	0	0	0	0	3	0	0	0	0	1	1	0	3	3	4	0	1
12/9/92	MCGRAW	refuge	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	7	5	0

DATE	PROP	TYPE	BMBF	BMUF	UMBF	UMUF	BMF	UMF	MBF	MF	BM	BF	UM	UF	M	F	U	RM	RF	RMRF	RU	MMRF
1/15/93	MCGRAW	refuge	0	0	0	0	0	0	0	2	0	0	0	0	5	2	0	3	1	14	0	0
2/7/93	MCGRAW	refuge	0	0	0	0	0	0	0	3	0	0	0	0	1	1	0	3	3	4	0	1
9/17/92	MCGRAWS	refuge	0	0	0	0	0	0	0	2	1	0	1	0	0	0	0	0	0	0	2	0
10/12/92	MCGRAWS	refuge	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
11/11/92	MCGRAWS	refuge	0	0	0	0	0	0	0	6	0	0	0	0	1	4	0	0	0	6	6	0
9/17/92	MCGRAWS	refuge	0	0	0	0	0	0	0	2	1	0	1	0	0	0	0	0	0	0	2	0
10/12/92	MCGRAWS	refuge	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
11/11/92	MCGRAWS	refuge	0	0	0	0	0	0	0	6	0	0	0	0	1	4	0	0	0	6	6	0
21/9/93	shoenke	rsa	0	0	0	0	0	0	0	2	54	28	1	0	6	2	0	0	0	0	0	0
26/10/93	shoenke	rsa	0	0	0	1	1	0	0	0	48	64	1	0	13	10	0	1	0	0	0	0
17/11/93	shoenke	rsa	1	0	0	0	0	0	0	3	33	33	0	0	27	7	0	0	0	0	0	0
11/12/93	shoenke	rsa	0	0	0	0	0	0	0	0	28	18	0	0	3	5	0	0	0	0	0	0
2/16/94	shoenke	rsa	27	4	5	5	0	0	0	0	38	50	17	15	0	0	0	6	3	12	5	0
21/9/93	shoenke	rsa	0	0	0	0	0	0	0	2	54	28	1	0	6	2	0	0	0	0	0	0
26/10/93	shoenke	rsa	0	0	0	1	1	0	0	0	48	64	1	0	13	10	0	1	0	0	0	0
17/11/93	shoenke	rsa	1	0	0	0	0	0	0	3	33	33	0	0	27	7	0	0	0	0	0	0

DATE	PROP	TYPE	BMBF	BMUF	UMBF	UMUF	BMF	UMF	MBF	MF	BM	BF	UM	UF	M	F	U	RM	RF	RMRF	RU	MMRF
11/12/93	shoenke	rsa	0	0	0	0	0	0	0	0	28	18	0	0	3	5	0	0	0	0	0	0
2/16/94	shoenke	rsa	27	4	5	5	0	0	0	0	38	50	17	15	0	0	0	6	3	12	5	0
9/13/92	TIEDER	rsa	0	0	0	0	0	0	0	0	3	4	0	0	0	0	0	0	0	0	0	0
9/18/92	TIEDER	rsa	0	0	0	0	0	0	0	2	39	31	0	0	16	12	0	2	0	0	0	0
10/16/92	TIEDER	rsa	0	0	0	0	0	0	0	0	71	60	0	0	33	38	0	0	0	0	0	0
11/14/92	TIEDER	rsa	0	0	0	0	0	0	0	1	57	88	6	4	0	0	0	0	0	0	0	0
12/7/92	TIEDER	rsa	2	0	0	0	0	0	0	9	18	20	0	0	55	69	0	0	0	0	1	0
1/22/93	TIEDER	rsa	0	0	1	0	0	0	0	8	0	0	0	0	31	32	0	0	0	0	0	0
2/11/93	TIEDER	rsa	0	0	0	0	0	0	0	11	0	0	0	0	25	28	0	0	0	0	0	0
9/13/92	TIEDER	rsa	0	0	0	0	0	0	0	0	3	4	0	0	0	0	0	0	0	0	0	0
9/18/92	TIEDER	rsa	0	0	0	0	0	0	0	2	39	31	0	0	16	12	0	2	0	0	0	0
10/16/92	TIEDER	rsa	0	0	0	0	0	0	0	0	71	60	0	0	33	38	0	0	0	0	0	0
11/14/92	TIEDER	rsa	0	0	0	0	0	0	0	1	57	88	6	4	0	0	0	0	0	0	0	0
12/7/92	TIEDER	rsa	2	0	0	0	0	0	0	9	18	20	0	0	55	69	0	0	0	0	1	0
1/22/93	TIEDER	rsa	0	0	1	0	0	0	0	8	0	0	0	0	31	32	0	0	0	0	0	0
2/11/93	TIEDER	rsa	0	0	0	0	0	0	0	11	0	0	0	0	25	28	0	0	0	0	0	0

DATE	PROP	TYPE	BMBF	BMUF	UMBF	UMUF	BMF	UMF	MBF	MF	BM	BF	UM	UF	M	F	U	RM	RF	RMRF	RU	MMRF
10/20/92	TIEDER2	rsa	0	0	0	0	0	0	0	0	8	8	0	0	0	0	0	0	0	0	0	0
11/14/92	TIEDER2	rsa	0	0	0	0	0	0	0	0	38	26	0	0	0	0	0	0	0	0	0	0
12/7/92	TIEDER2	rsa	0	0	0	0	0	0	0	1	16	21	0	0	9	10	0	0	0	0	0	0
1/22/93	TIEDER2	rsa	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
2/11/93	TIEDER2	rsa	0	0	0	0	0	0	0	1	0	0	0	0	0	2	0	0	0	0	0	0
10/20/92	TIEDER2	rsa	0	0	0	0	0	0	0	0	8	8	0	0	0	0	0	0	0	0	0	0
11/14/92	TIEDER2	rsa	0	0	0	0	0	0	0	0	38	26	0	0	0	0	0	0	0	0	0	0
12/7/92	TIEDER2	rsa	0	0	0	0	0	0	0	1	16	21	0	0	9	10	0	0	0	0	0	0
1/22/93	TIEDER2	rsa	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
2/11/93	TIEDER2	rsa	0	0	0	0	0	0	0	1	0	0	0	0	0	2	0	0	0	0	0	0
10/14/92	WALL	rsa	3	0	0	0	0	0	0	2	13	13	1	0	11	10	0	0	0	0	0	0
11/12/92	WALL	rsa	0	0	0	0	0	0	0	2	49	43	0	0	7	2	0	1	0	1	0	0
12/9/92	WALL	rsa	0	0	0	0	0	0	0	3	25	26	0	0	24	24	0	1	0	0	0	0
1/23/93	WALL	rsa	0	0	0	0	1	0	0	5	0	1	0	0	5	10	0	0	0	0	0	0
2/11/93	WALL	rsa	0	0	0	0	0	0	0	12	1	0	0	0	5	21	0	0	0	0	0	0
10/14/92	WALL	rsa	3	0	0	0	0	0	0	2	13	13	1	0	11	10	0	0	0	0	0	0

DATE	PROP	TYPE	BMBF	BMUF	UMBF	UMUF	BMF	UMF	MBF	MF	BM	BF	UM	UF	M	F	U	RM	RF	RMRF	RU	MMRF
11/12/92	WALL	rsa	0	0	0	0	0	0	0	2	49	43	0	0	7	2	0	1	0	1	0	0
12/9/92	WALL	rsa	0	0	0	0	0	0	0	3	25	26	0	0	24	24	0	1	0	0	0	0
1/23/93	WALL	rsa	0	0	0	0	1	0	0	5	0	1	0	0	5	10	0	0	0	0	0	0
2/11/93	WALL	rsa	0	0	0	0	0	0	0	12	1	0	0	0	5	21	0	0	0	0	0	0
24/9/93	williams	rsa	0	0	0	0	0	0	0	0	32	21	2	0	7	1	0	2	2	0	0	0
20/10/93	williams	rsa	0	0	0	0	0	0	0	0	46	32	4	3	15	24	0	2	0	0	5	0
16/11/93	williams	rsa	2	0	0	0	0	0	0	0	17	9	4	1	26	6	0	4	3	4	0	0
10/12/93	williams	rsa	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	4	0	0
24/9/93	williams	rsa	0	0	0	0	0	0	0	0	32	21	2	0	7	1	0	2	2	0	0	0
20/10/93	williams	rsa	0	0	0	0	0	0	0	0	46	32	4	3	15	24	0	2	0	0	5	0
16/11/93	williams	rsa	2	0	0	0	0	0	0	0	17	9	4	1	26	6	0	4	3	4	0	0
10/12/93	williams	rsa	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	4	0	0
9/11/92	WINGATE	rsa	0	0	0	0	0	0	0	0	48	0	18	0	0	0	0	0	0	0	0	0
9/26/92	WINGATE	rsa	0	0	0	0	0	0	0	0	17	17	0	0	3	2	0	1	1	0	0	0
10/19/92	WINGATE	rsa	0	0	0	0	0	0	0	0	26	21	0	0	26	21	0	0	0	0	0	0
11/17/92	WINGATE	rsa	0	0	0	0	1	0	0	2	1	1	0	0	18	8	0	0	0	1	0	0

DATE	PROP	TYPE	BMBF	BMUF	UMBF	UMUF	BMF	UMF	MBF	MF	BM	BF	UM	UF	M	F	U	RM	RF	RMRF	RU	MMRF
12/8/92	WINGATE	rsa	0	0	0	0	0	0	0	0	18	13	1	0	35	25	0	0	0	0	3	1
1/23/93	WINGATE	rsa	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
9/11/92	WINGATE	rsa	0	0	0	0	0	0	0	0	48	0	18	0	0	0	0	0	0	0	0	0
9/26/92	WINGATE	rsa	0	0	0	0	0	0	0	0	17	17	0	0	3	2	0	1	1	0	0	0
10/19/92	WINGATE	rsa	0	0	0	0	0	0	0	0	26	21	0	0	26	21	0	0	0	0	0	0
11/17/92	WINGATE	rsa	0	0	0	0	1	0	0	2	1	1	0	0	18	8	0	0	0	1	0	0
12/8/92	WINGATE	rsa	0	0	0	0	0	0	0	0	18	13	1	0	35	25	0	0	0	0	3	1
1/23/93	WINGATE	rsa	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
9/17/92	WOLFPIT	refuge	0	0	0	0	0	0	0	0	0	2	0	0	0	4	0	0	0	0	4	0
9/17/92	WOLFPIT	refuge	0	0	0	0	0	0	0	0	0	2	0	0	0	4	0	0	0	0	4	0
2/17/94	Yacht	city	2	0	0	1	0	0	0	3	0	0	7	4	0	0	0	0	0	2	0	0
2/17/94	yacht	city	2	0	0	1	0	0	0	3	0	0	7	4	0	0	0	0	0	2	0	0
9/12/92	YARMOUTH	rsa	0	0	0	0	0	0	0	0	22	1	0	0	0	1	0	0	0	0	0	0
9/12/92	YARMOUTH	rsa	0	0	0	0	0	0	0	0	22	1	0	0	0	1	0	0	0	0	0	0

BMBF = banded male mallard paired to banded female mallard
BMUF = banded male mallard paired to unbanded female mallard

UMBF = unbanded male mallard paired to banded female mallard
UMUF = unbanded male mallard paired to unbanded female mallard
BMF = banded male mallard paired to female mallard of unknown origin
UMF = unbanded male mallard paired to female mallard of unknown origin
MBF = male mallard of unknown origin paired to banded female mallard
MF = paired male and female mallard both of unknown origin

VITA

David Benjamin Smith, the son of Lenore Oglesby Kirkpatrick and Don McQueen Smith, was born 21 April 1962 in Montgomery, Alabama. He graduated from Prattville High School in Prattville, Alabama in 1980. He married Donna Loretta Huey on 17 December 1983 and they are the parents of two children, Benjamin Howard and Nina Fuller. He earned a Bachelor of Science degree in Biological Sciences (Marine Science) at Auburn University in Auburn, Alabama, in 1985 and a Master of Science in Biology and Living Resources from the University of Miami in 1991. He began work on his Doctor of Philosophy degree at Louisiana State University in 1991. He and his family presently live in Prattville, Alabama where he is self employed, is a deacon at First Presbyterian Church Prattville, is a leader for the Boy Scouts of America, and is member of the board of managers for the Prattville Young Men's Christian Association.

DOCTORAL EXAMINATION AND DISSERTATION REPORT

Candidate: David Benjamin Smith

Major Field: Wildlife and Fisheries Science

Title of Dissertation: Survival, Behavior, and Movements of Captive-Reared Mallards Released in Dorchester County, Maryland

Approved:

Major Professor/Chairman

Dean of the Graduate School

EXAMINING COMMITTEE:

Date of Examination:

13 May 1999