

When this is the case, it is important to gather comparative control information in order to evaluate the extent of the behavioral perturbation. Given the results of the present study, and those of others, it is probably wisest to minimize package size, attempt to streamline the package as much as possible, minimize protuberances such as antennae, and to limit the duration of package deployment on individuals.

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## ORPHANED MALLARD BROOD TRAVELS ALONE FROM NEST TO WATER<sup>1</sup>

GARY L. KRAPU, CHRISTOPHER P. DWYER<sup>2</sup> AND CARMEN R. LUNA<sup>3</sup>  
*U.S. Fish and Wildlife Service, Northern Prairie Wildlife Research Center,  
Box 2096, Jamestown, ND 58402*

*Key words:* Mallard; *Anas platyrhynchos*; brood; drought; travel; mortality.

Waterfowl young often travel long distances from the nest site to water when accompanied by a parent; the timing of the trip can range from a few hours to days after hatching (Sowls 1955, Bjärvall 1968; Dzubin and Gollop 1972; Ball 1973; Duncan 1983; Afton and Pau-

lus, in press). Little is known, however, of what happens to waterfowl broods or individual young stranded far from water by the death of a parent or after becoming separated or abandoned.

We documented the response of a Mallard (*Anas platyrhynchos*) brood orphaned at a nest in south-central North Dakota in July 1988 while studying daily survival rates and causes of mortality among Mallard ducklings in prairie pothole habitat. On 16 April 1988, an adult hen Mallard was captured in a decoy hen trap (Sharp and Lokemoen 1987), banded, and fitted with a radio transmitter. The transmitter weighed approximately 23 g and was attached with a back harness as described by Dwyer (1972). She later nested in tall, dense cattail (*Typha* spp.) vegetation in a 44-ha dry semipermanent wetland basin (Fig. 1). The last egg of her seven-egg clutch was laid on 5 June; pipping began

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<sup>2</sup> Present address: College of Environmental Science and Forestry, State University of New York, Syracuse, NY 13210.

<sup>3</sup> Present address: Arrowwood National Wildlife Refuge, Rural Route 1, Pingree, ND 58476.

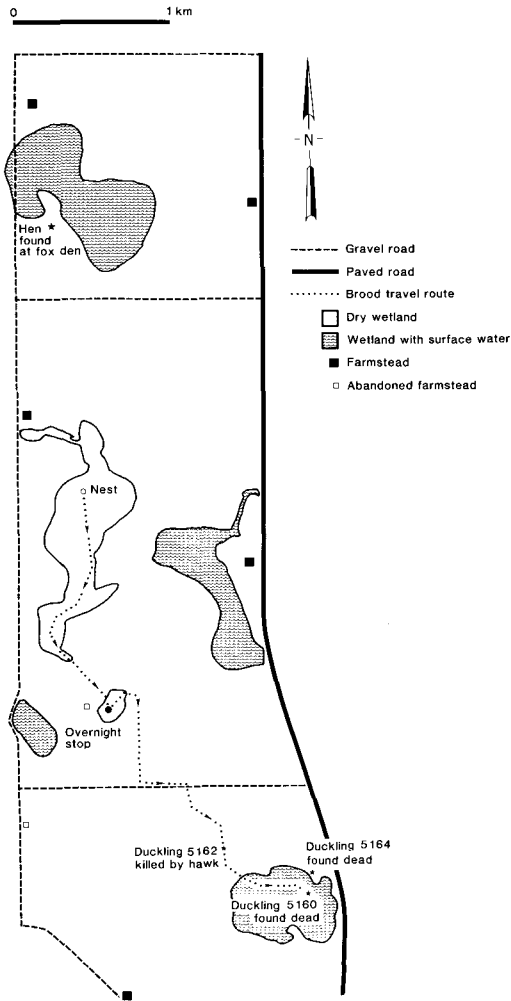


FIGURE 1. Location of Mallard nest, hen remains, and route traveled by brood from the nest to water.

on 1 July and all eggs had hatched by the evening of 2 July. Microtransmitters weighing approximately 2.5 g each were glued and sutured to the backs of two of the ducklings of the brood. Each duckling in the brood received a uniquely numbered web-tag. We monitored the radio transmitters from the time the ducklings were tagged until they reached water.

A predator killed the hen during the night of 2 July while the ducklings remained in the nest bowl; the brood left the nest in the late afternoon (16:00) of 3 July on a 17.5-hr, 4.1-km trip to water (Fig. 1). Although the brood was not seen during the trip, several sources of information suggest the ducklings were not accompanied by an adult during and after their departure from the nest. First, we know the mother was not with them. Throughout the ducklings' travel period, the hen's radio signal remained in the vicinity of

an active red fox (*Vulpes vulpes*) den where her remains were found later (Fig. 1). Second, in the course of monitoring the ducklings' movements from nest to water, we observed no adult Mallards or other waterfowl in the vicinity of the brood. Hens are secretive when moving their broods, so lack of an observation does not rule out an adult's presence; however, sparse cover on the pastures the ducklings crossed increased the likelihood of seeing an adult. Third, we saw no adult with the brood after they reached water even though four of the ducklings were sighted. Fourth, with severe drought conditions and limited nesting underway, these ducklings had little chance of linking up with another brood at or near the nest.

The ducklings apparently traveled together during the trip to water. The two radio-tagged ducklings (Nos. 5160 and 5162) had similar signal locations until 5162 was killed by a Swainson's Hawk (*Buteo swainsonii*) at 10:50 of the second day of travel (Fig. 1). The three non-transmittered ducklings were seen with the remaining radio-tagged duckling on the same afternoon at 16:00 after they reached water. Mallard ducklings will imprint on brood mates during the first three days after hatching (Lickliter and Gottlieb 1986) and brood members show a strong tendency to keep together whether or not a parent is present (Collias and Collias 1956). This may explain why the brood mates did not become separated during the prolonged journey from the nest to water.

Although the ducklings demonstrated the capacity to travel a long distance to reach water in the absence of a parent, there are indications that the ducklings may have been hampered by the lack of maternal care. The brood's late afternoon departure from the nest was atypical but not unprecedented. Among 10 other Mallard broods for which nest departure times were known, eight left the nest in the morning and two later in the day (Gary L. Krapu, unpubl. data). The proportion of Mallard broods that departed during the morning approximates the pattern observed by Bjärvall (1968) in Sweden.

The brood while traveling from the nest to water maintained a rather direct course (Fig. 1), but the entire trip took 10 times longer than the 1.8-hr median of five previously monitored Mallard broods (Gary L. Krapu, unpubl. data). The overnight stay by the brood in a wetland without surface water accounted for much of this difference. The ducklings probably had no visual or auditory cues of the direction to water when leaving the nest, and they did not go to the nearest wetland with water (Fig. 1). However, there may have been cues available later in the journey when closer to their wetland destination. The route taken did not follow a natural drainage and required traversing a steep hill on the morning of 4 July.

Lack of maternal care also may have contributed to low duckling survival. In addition to hawk predation of 5162, duckling 5160 was found dead in the water on the morning of 6 July; most of the carcass had been eaten apparently by a mink (*Mustela vison*). Another brood mate, duckling 5164, was found dead near the edge of the wetland on the same morning (Fig. 1). The remaining ducklings in the brood were not seen again.

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## THE LOSS OF AVIAN CAVITIES BY INJURY COMPARTMENTALIZATION<sup>1</sup>

JAMES A. SEDGWICK AND FRITZ L. KNOPF

*U.S. Fish and Wildlife Service, National Ecology Research Center, 4512 McMurry,  
Fort Collins, CO 80525-3400*

*Key words:* Compartmentalization of injury; cavity-nesting birds; cavity dynamics; cottonwood bottomlands; Colorado.

Cavity-nesting birds are dependent upon the availability of suitable substrates for nesting, foraging, and roosting. For nesting and roosting, substrates must be large enough in diameter to contain a cavity and soft enough for excavation to occur. Cavities are believed to be available to cavity-nesting birds and other species of wildlife until the cavity deteriorates, or until the tree or limb containing the cavity falls. Cavity deterioration may occur over a period of years, with the cavity entrance becoming too large, or the back, sides, or bottom of the cavity compartment decomposing to the point where the cavity becomes unsuitable. Cavities in fallen limbs or boles are typically no longer available to cavity-nesting birds; however, we have observed Black-capped Chickadees (*Parus atricapillus*) using cavities in fallen, leaning limbs and House Wrens (*Troglodytes aedon*) using those in fallen boles along the South Platte River in northeastern Colorado (Sedgwick and Knopf,

unpubl. data). Other species (e.g., Turkey Vultures [*Cathartes aura*]) may also use cavities in fallen limbs and boles (J. Tate, pers. comm.).

Here, we provide evidence of another way in which cavities become unusable. Incidental to a larger study of habitat relationships of cavity-nesting birds along the South Platte River in northeastern Colorado (see Sedgwick and Knopf 1990 for a complete description of the study area), we monitored a pair of Black-capped Chickadees nesting in a live plains cottonwood (*Populus sargentii*) in the summer of 1985. The cavity was a "knothole" cavity (i.e., at the site of a previous limb break) and was in living substrate. Cavity height was 1.6 m and cavity entrance diameter was 3.0 cm, barely large enough for an adult to squeeze through. Adult chickadees were actively carrying food to the cavity and feeding young in June 1985. Upon revisiting the site two years later, we discovered that the cavity entrance had sealed shut (Fig. 1). New sapwood and bark had gradually grown over the cavity opening and sealed the cavity closed as the tree compartmentalized the wound. In 1990 we reexamined all cavities ( $n = 181$ : 157 in plains cottonwood, 10 in peachleaf willow [*Salix amygdaloides*], 14 in unknown species of [dead] trees) previously located in 1985-1986 and found an additional nine cavities that had become completely or partially resealed. A total of one House Wren, one Red-

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