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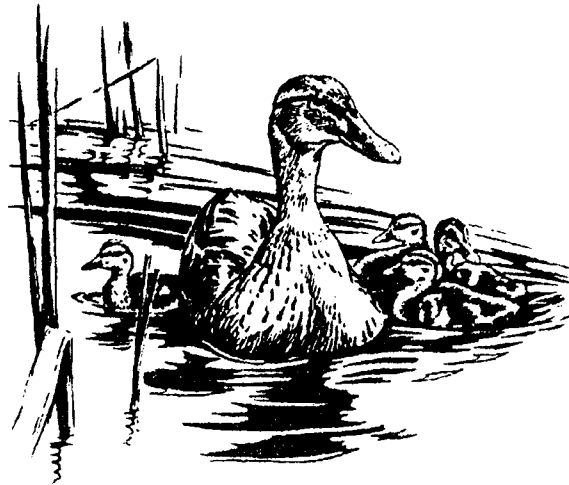
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ILLINOIS NATURAL HISTORY SURVEY

CENTER FOR WILDLIFE ECOLOGY



Mallard Investigations

W-130-R-2

Annual Federal Aid Performance Report

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EXECUTIVE SUMMARY

The nesting biology of mallards (Anas platyrhynchos) was studied at the Metropolitan Water Reclamation District of Greater Chicago (MSD) in westcentral Illinois from 17 March to 6 August 1999. The objectives were to develop a data set of mallard nesting information in Illinois and evaluate recruitment. To achieve these objectives, 43 female mallards were livetrapped (Sharp and Lokemoen 1987, Ringelman 1990) during spring and fitted with radio transmitters (Pietz et al. 1995). Radio-marked females were located daily throughout the nesting season and their broods were also located daily for 20 days posthatch (Orthmeyer and Ball 1990).

Thirty-three radio-marked females initiated 45 nests (1.63 nests/adult hen, and 1.12 nests/yearling hen). The mean nest initiation date for first nest attempts was 5 May. Clutch sizes for first nest attempts ranged from 7 to 11 eggs ($\bar{x}=9.25$ eggs/clutch). Hatched nests were incubated from 24 to 31 days ($\bar{x}=27.0$ days).

Coyotes (Canis latrans) were the most common cause of nest failure and hen mortality. The Kaplan-Meier procedure (Kaplan and Meier 1958, Pollock et al. 1989, White and Garrott 1990) was used to estimate nest success and brood, duckling, and hen survival. The nest success rate for 1999 was $\hat{s}=0.159$ and was similar for adult and yearling hens. Brood and duckling survival were $\hat{s}=0.857$ and $\hat{s}=0.388$, respectively. Hen survival ($\hat{s}=0.554$) did not differ between the age classes.

SEGMENT PERFORMANCE REPORT
Mallard Investigations
Federal Aid in Wildlife Restoration W-130-R-2
1 July 1998 through 30 June 1999

STUDY I: THE NESTING BIOLOGY OF MALLARDS IN ILLINOIS

To consolidate work effort, the study site at the Banner Marsh State Fish and Wildlife Area (Hine et al. 1998) (Banner) was eliminated during the 1999 field season. Difficulties encountered at Banner with water-level fluctuations and outdoor recreationists during spring 1998 convinced us to concentrate our efforts at the Metropolitan Water Reclamation District of Greater Chicago (MSD) allowing for more efficient monitoring of mallard hens. In addition, battery life of radio transmitters was increased from the 70 days used in 1998 to 120 days to better monitor late season hens with broods. The enhanced battery life increased the mass of transmitters from ~0.3 oz. to ~0.4 oz. Transmitters were otherwise comparable to those used in 1998.

JOB NO. I.1. Nesting History and Reproductive Success of Mallards in Illinois.

STUDY AREA

MSD is located in Fulton County near Cuba, Illinois, and is owned by the City of Chicago. The property consists of 15,249 acres of reclaimed surface-mined lands (Lawrence 1987, Prairie Plan 1998). MSD is currently managed as a disposal site for biosolids (sludge) received from Chicago. Sludge is transported in dry form and spread over agricultural fields and incorporated into the soil. Major land uses at MSD include approximately 4,000 acres of agricultural row crops, 1,700 acres of hay and pasture, and 300 acres of biosolid application. The remainder is a variety of wetland and deepwater habitats ranging from strip-mine final-cut lakes to small ponds and marshes (Prairie Plan 1998).

METHODS

With the exceptions of increasing the battery life of radio transmitters and eliminating the Banner study site, field procedures followed protocol described by Hine et al. (1998).

Data Analysis

The Kaplan-Meier product-limit estimator modified for the staggered entry (Kaplan and Meier 1958, Pollock et al. 1989, White and Garrott 1990) was used to calculate mallard nest success and brood, duckling, and hen survival. Hen survival rates encompassed the prenesting, nesting, and brooding periods that ranged from 18 March to 6 August. Monitored broods, ducklings, and nests either survived, died, or were censored. For determining survival, hens were censored the day following the last radio contact, the day following loss of a transmitter, the day of brood loss, or the 20th day posthatch (Paquette et al. 1997). Mallard brood and duckling survival were estimated to 20 days posthatch (Orthmeyer and Ball 1990). A brood was considered to have survived if ≥ 1 duckling lived for 20 days. Ducklings were censored when their brood hen's transmitter failed. Duckling survival may not have been independent among brood mates, which is an assumption for using the Kaplan-Meier survival estimate. However, Pollock et al. (1989) stated that violation of this assumption does not bias the survival estimate but decreases the variance and hence the 95% confidence interval.

Mallard hen survival and nest success were compared between the age classes (adult and yearling, Krapu et al. 1979) using log-rank tests. The most conservative of the three χ^2 tests was used to detect differences in hen survival and nest success between the age classes (White and Garrott 1990:241). Brood and duckling survival rates were not compared between the age classes because of the limited number of broods monitored.

Two sample t -tests (PROC TTEST; SAS Institute 1988) were used to detect differences in the number of nest attempts per female, nest initiation dates, and clutch sizes between the age classes. Nest initiation dates were determined by subtracting the number of eggs in a nest when found from the date the nest was found (Paquette et al. 1997). We assumed an egg laying interval of 1 egg/day and that incubation started when the last egg was laid. Incubation periods were calculated as $((\text{HATCH DATE} - \text{NEST INITIATION DATE}) - \text{CLUTCH SIZE}) + 1$. A weighted mean was used to summarize egg dimensions (Zar 1996). Significance levels were set at $P \leq 0.05$, and we report all means as \pm standard error.

RESULTS

Trapping

Mallards were live trapped from 17 March to 11 April 1999 for a total of 23 days and 191 trapdays. Seventy-eight mallards were captured including 2 females and 1 male banded at the MSD study site in 1998. The number of captured hens totaled 44 of which 43 were fitted with radio transmitters. Thirty-four drakes were banded and measured before release. The 2 recaptured hens no longer carried radio transmitters from the preceding spring and showed no physical evidence of transmitter attachment. One male paired to a nesting female and banded at MSD in 1998 was harvested near Minneapolis, Minnesota, during the 1998 duck hunting season.

Of the 43 mallard hens fitted with radio transmitters during spring 1999, 32 nested and were tracked successfully. Three hens were migrants and subsequently left the study area before attempting to nest. Two hens were located periodically and presumed to be local breeders, but their nesting effort was unknown. Two hens died 23 and 35 days postrelease but before nest initiation. One hen was killed 4 days postrelease and excluded from all data analyses because she did not survive the capture adjustment period. One hen's transmitter fell off just prior to hatching

her first nest attempt, and another hen's radio failed during her second nest attempt. Data obtained from the latter 2 hens was used where appropriate. The remaining hen was not known to nest during the 1999 nesting season. In total, 37 mallard hens were tracked during the 1999 nesting season. Age structure was 0.85:1, or 17 adults and 20 yearlings (Krapu et al. 1979).

Nesting

The 1999 nesting season (first egg laid to last nest hatched or destroyed) spanned from 6 April to 17 July (103 days). Nesting effort (nest attempts/hen) was determined for hens that nested and whose nesting histories were complete. The 33 hens initiated 45 nest attempts, and the resulting number of nest attempts was 1.63 ± 0.18 nests/hen for adults ($n=16$) and 1.12 ± 0.08 nests/hen for yearlings ($n=17$). Adults initiated more nests/hen than yearlings ($t=2.58$, 20.8 df, $P=0.018$). Mean nest initiation dates of first nest attempts were 3 May (adults, $n=16$) and 7 May (yearlings, $n=17$); these dates did not differ ($t=0.88$, 22.4 df, $P=0.388$). The nest initiation date of first nests by all hens was 5 May.

The mean clutch size for first nest attempts was 9.60 ± 0.68 eggs/clutch for adults ($n=5$) and 9.00 ± 0.38 eggs/clutch for yearlings ($n=7$); these values did not differ ($t=0.83$, 10 df, $P=0.43$). Therefore, clutch sizes were combined and resulted in 9.25 ± 0.35 eggs/first nest. Egg dimensions were measured from 91 eggs found in nests of 10 different hens. Egg width and length were 41.1 ± 0.3 mm and 57.7 ± 0.5 mm, respectively. Incubation ranged from 24 to 31 days ($n=6$ nests) with a mean of 27.0 ± 0.93 days.

Survival

Forty-seven nests were initiated during spring 1999. Ten nests were destroyed by coyotes (21.3%), 12 nests were accounted for by unknown mammalian predators (25.5%), 3 nests were

depredated by raccoons (*Procyon lotor*, 6.4%), 3 nests were mowed (6.4%) for hay and pasture maintenance, 3 nests were destroyed by snakes (6.4%), 1 nest (2.1%) was unsuccessful because the hen was killed by a turtle while feeding away from the nest site, and 7 nests (14.9%) were destroyed by unknown predators. Seven nests hatched (14.9%), and 1 nest (2.1%) was abandoned due to researcher influence. The abandoned nest was not used in nest success calculations. Therefore, 7 of 46 mallard nests hatched during spring 1999 for a simple nest success estimate of 15.2 percent. Seven of 33 hens were successful at nesting during 1999 yielding a hen success rate of 21.2 percent. Forty-four nests were used to calculate the Kaplan–Meier survival estimate. The survival estimate for adult nests was $\hat{s}=0.120$ (SE=0.065) and for yearling nests was $\hat{s}=0.211$ (SE=0.094). No differences were detected between the age classes ($\chi^2=1.50$, 1 df, $P=0.221$); therefore, the pooled nest success rate was $\hat{s}=0.159$ (SE=0.055), or 15.9 percent (Fig. 1).

Brood survival was calculated for 6 of the 7 hatched nests because 1 hen's radio fell off just prior to hatch. Five of the 6 broods survived to 20 days posthatch, and 1 brood was lost the first night. The Kaplan–Meier brood survival estimate was $\hat{s}=0.857$ (SE=0.132). Fifty-eight ducklings hatched from 7 nests, but 10 were censored due to radio failure. The Kaplan–Meier survival estimate for mallard ducklings was $\hat{s}=0.388$ (SE=0.071) (Fig. 2).

Survival of mallard hens was determined from the date of capture until they either emigrated from the study area, raised a brood to 20 days posthatch, entered a molting flock, or died. Twelve of 42 hens died. Five hens emigrated from the study area, 1 radio fell off, and 1 radio failed. The remaining 23 hens survived the nesting season. Survival was $\hat{s}=0.568$ (SE=0.241) for adults (n=18) and $\hat{s}=0.571$ (SE=0.110) for yearlings (n=24). Hen survival did not

Kaplan-Meier Survival Estimate for Mallard Nests 1999

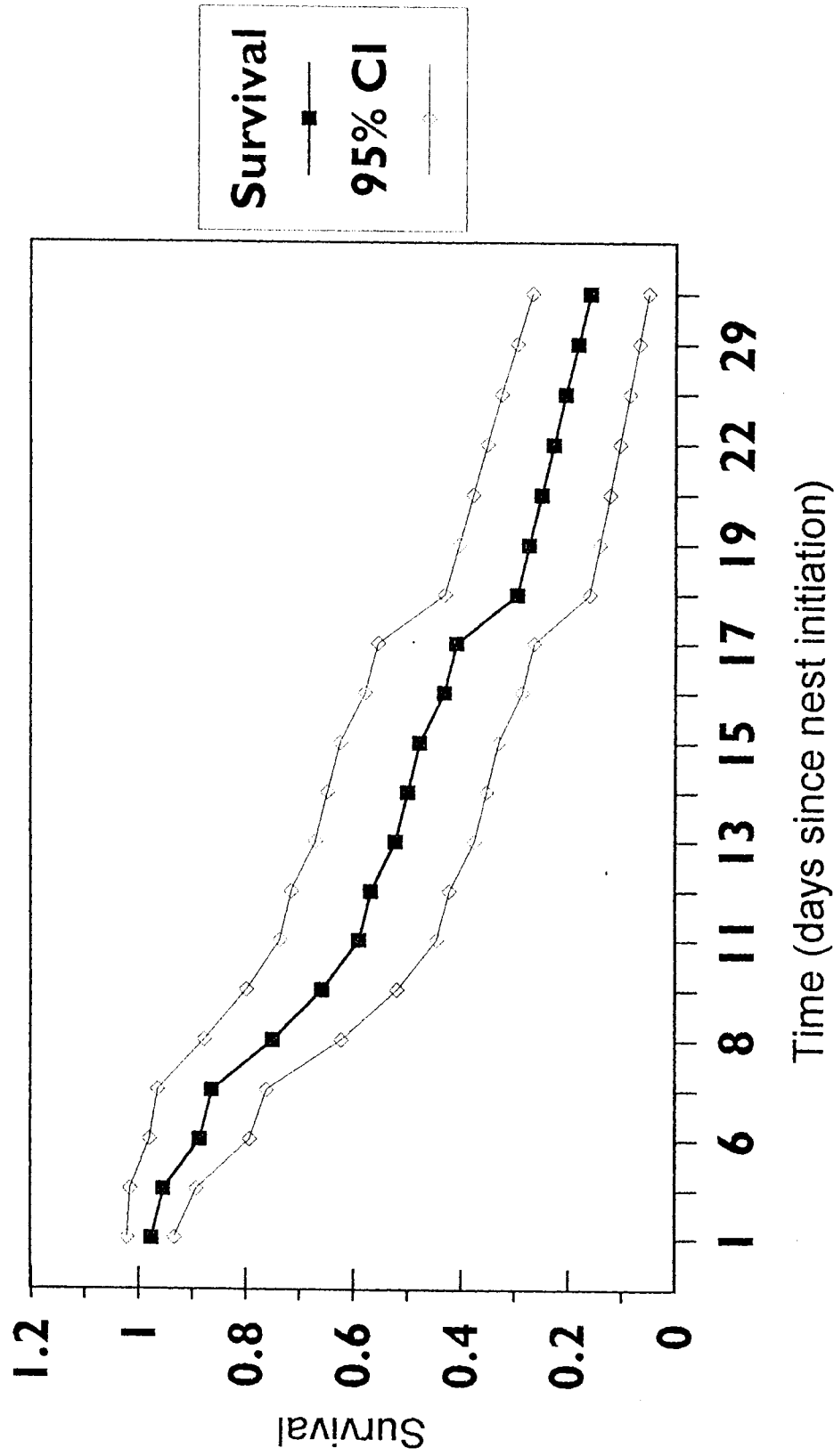


Figure 1. Kaplan-Meier survival estimate of mallard nests at the Metropolitan Water Reclamation District of Greater Chicago in westcentral Illinois during the 1999 nesting season.

Kaplan-Meier Survival Estimate for Mallard Ducklings 1999

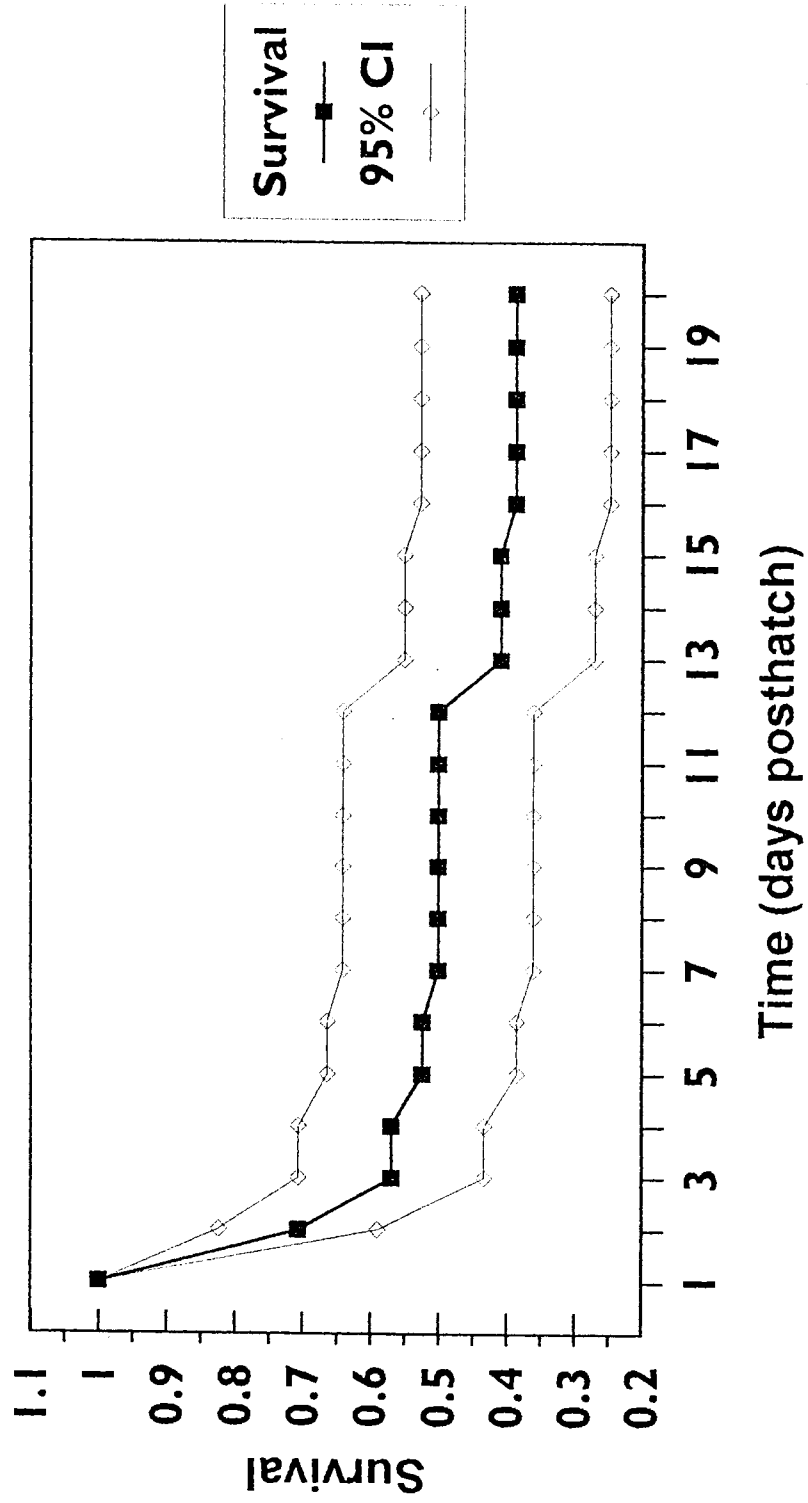


Figure 2. Kaplan-Meier survival estimate of mallard ducklings at the Metropolitan Water Reclamation District of Greater Chicago in westcentral Illinois in 1999.

differ between the age classes ($\chi^2=3.11$, 1 df, $P=0.078$), and the pooled hen survival rate was $\hat{s}=0.554$ ($SE=0.139$) for the nesting and brood rearing season (Fig. 3).

JOB NO. I.2. Assessment of Mallard Recruitment.

Mallard nest success in the prairie pothole region of the United States has been estimated at 5-19 percent (Klett et al. 1988) and was similar to the 15.9 percent we found in westcentral Illinois during 1999. Cowardin et al. (1985) reported that mallard nest success of 15 percent and subsequent hen success of 31 percent were needed to maintain a stable population of mallards in the agricultural environment of North Dakota. Although nest success appeared adequate (15.9%) in 1999, mallard hen success at MSD was only 21.2 percent, which was below the level required to maintain a stable population as suggested by Cowardin et al. (1985).

Thirty-six mallard hens were tracked daily during the 1999 breeding season at MSD. Twelve of the 36 monitored hens were killed or died during prenesting, nesting, and brood rearing; therefore, at least 12 hens needed to be produced and added to the fall population to compensate for hen mortality. Fifty-eight ducklings were produced from the 36 hens. Duckling survival was calculated at $\hat{s}=0.388$; therefore, an estimated 23 of the 58 ducklings survived to 20 days posthatch. Orthmeyer and Ball (1990) found that most mallard duckling mortality occurred prior to 20 days posthatch, and that a duckling surviving to 20 days most likely fledges. Likewise, Anderson (1975) suggested that approximately 75 percent of the mortality of mallards occurred before young birds are flighted. He also estimated that the annual survival rate of young mallard hens banded before the hunting season was 46 percent. Similarly, Havera (1999) reported that the survival rate of immature mallards was estimated at 50 percent. Consequently, the 23 ducklings estimated to have survived to 20 days posthatch at MSD would, therefore, suffer another 50 percent mortality by the following breeding season. Assuming a 50:50 sex ratio of the

Kaplan-Meier Survival Estimate for Mallard Hens 1999

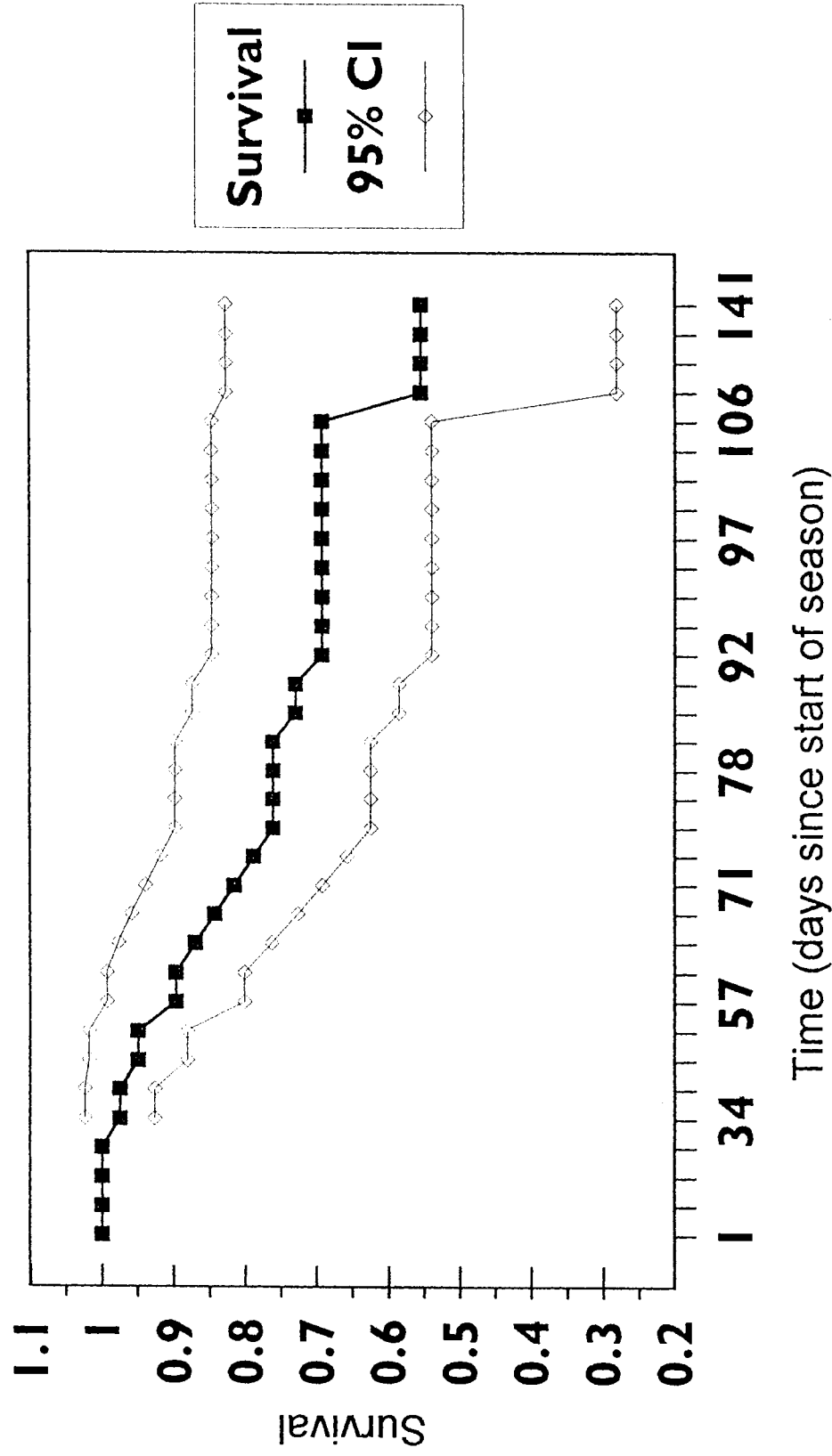


Figure 3. Kaplan-Meier survival estimate of mallard hens at the Metropolitan Water Reclamation District of Greater Chicago in westcentral Illinois during the 1999 breeding season.

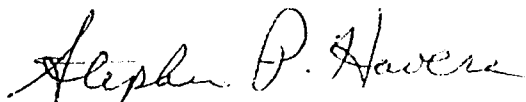
ducklings, only 6 mallard hens would be recruited into the year 2000 breeding population at MSD from the 36 hens monitored in 1999. As a result, mallard reproduction may not have been sufficient to replace hen mortality during the 1999 nesting season at MSD. Future analysis of the spring 2000 nesting data combined with that from 1998 and 1999 will determine the status of the westcentral Illinois mallard population.

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A handwritten signature in cursive script that reads "Stephen P. Havera".

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DATE: 27 August 1999

