Nest Cavity Type and its Effect on Nesting Success of Purple Martins (*Progne subis*) in East-central Minnesota

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Introduction

Background Information

The purple martin (*Progne subis*) has had a long and intimate relationship with humans as it is the only species of bird that is almost completely dependent upon human-supplied housing for nesting (Brown, 1997). This relationship was first established by Native Americans who placed hollowed-out bottle gourds near their dwellings to attract this most desirable swallow (Hill, 1997). It is widely accepted that this species naturally nested in abandoned woodpecker holes and crevices in rocky outcrops before nesting in human-supplied housing (Hill, 1997). The conversion from nesting in natural cavities to nesting entirely in man-supplied housing was almost complete before 1900 (Brown, 1997). The close relationship Native American's developed with these birds continues to this day among many purple martin "landlords" who provide housing for these birds across much of the eastern half of the United States.

The purple martin is the largest swallow in North America. It is sexually dimorphic, with the male consisting completely of iridescent blue-black plumage, while the female has a lighter colored and mottled breast. The first year male looks very similar to the female.

The genus *Progne* is widely distributed across the Americas and at least eight different species have been described. In the United States, there are several subspecies of purple martins that nest in natural cavities west of the Rocky Mountains. *Progne subis arboricola* breeds at high elevtaions, nesting mostly in vacated tree cavities. *Progne subis hesparia* breeds in the deserts of the southwest, nesting mostly in saguaro cactuses. East of the Rocky Mountains, the much more widespread and common subspecies, *Progne subis subis,* nests only in man supplied housing.

As an obligate insectivore, the purple martin rarely nests at extreme latitudes where insect populations are less stable. In addition, they are highly vulnerable to long periods of cool and rainy weather, which greatly reduces or eliminates their food supply. As a neo-tropical migrant, the purple martin migrates to South America. Those that nest in Minnesota return in early April and head south in late August and early September.

The purple martin is considered a colonial nester, however, the recent conversion of purple martins to artificial nest sites has probably affected the social behavior of these birds (Brown, 1997). This species is considered colonial because multiple pairs nest in the same or adjacent birdhouses. At the beginning of the nesting season, the male chooses and defends a specific cavity from other males. The female chooses a specific cavity and thereby the male that has claimed that cavity. The female then builds the majority of the nest where she lays 4-6 eggs. Incubation is conducted by the female alone and lasts 15-16 days. The male and female both assist in feeding the young, which fledge after 28 days in the nest.

As a secondary-cavity nester, the purple martin has suffered greatly from the invasive European Starling (*sturnus vulgaris*) and English House Sparrow (*Passer domesticus*) which compete with purple martins for nesting sites. European Starlings and English House Sparrows can cause

local extinction of martins by overtaking the martin housing, making it unsuitable for nesting purple martins. Human intervention and management of colony sites and the subsequent removal of European Starlings and English House Sparrows can greatly increase the nesting success of purple martins.

Despite its close connection with humans and its declining population, the purple martin has largely been neglected as a key species of study. One area of study that requires further research is the effect of nest cavity type on the nesting success of purple martins.

East-Central Minnesota Purple Martin Recovery

In Minnesota, the purple martin at one time had a healthy and stable population. Unfortunately, since 1976, its population in Minnesota has decreased by 78% (Audubon MN, 2007). In addition, the population is continuing to decline by 3.8% each year (Breeding Bird Survey, 2006). As a result, the purple martin is listed as a "Common Vulnerable Bird" in Minnesota by the Audubon Society.

In response to this information regarding the drastic population decline of purple martins in Minnesota, the *East-Central Minnesota Purple Martin Recovery* (ECM-PMR) project was initiated. Six colony sites have been placed across east-central Minnesota in prime habitat locations. Individual sites are financially supported by various corporations, businesses, governmental agencies, and individuals. ECM-PMR colonies are extensively managed on a volunteer basis and serve to expose the general public to purple martins as well as help foster a healthy increase in the local purple martin population.

Each colony site consists of a wooden T-14 Purple Martin House which has 14 compartments that are each 6"x12" in size. Each T-14 Purple Martin House also has four plastic Excluder Gourds hanging below the house The Excluder gourds are 11" in diameter. Each site also consists of a gourd rack that is fitted with 24 plastic Excluder Gourds. Each of the six sites contain a total of 52 nesting cavities. The entrances on each of the cavities are "modified excluder" starling-resistant entrances. The housing units are fitted on the mounting pole with a winch, cable, and pulley, allowing it to raise and lower vertically, permitting the researcher to have easy access to each compartment without causing harm to the nests' contents.

All of the colonies are extensively managed to help foster a healthy number of fledglings. Each nest is individually inspected on a weekly basis. At each weekly nest check, the number of nests, eggs, and nestlings are recorded. The final fledgling rate is also calculated. In addition, European Starlings and English House Sparrows are controlled.

During the 2007 nesting season, three colony sites were active, fledgling nearly 100 nestlings.

Objectives

The objective of this study is to determine the effect nest cavity type has on the nesting success of purple martins. The nesting success of purple martins in two different nest cavity types will be studied, wooden housing and artificial plastic gourds.

It is expected that the nest cavity type will have an effect on the nesting success of purple martins (i.e. one of the housing types will statistically fledge more young than the other).

Study/Implementation Plan

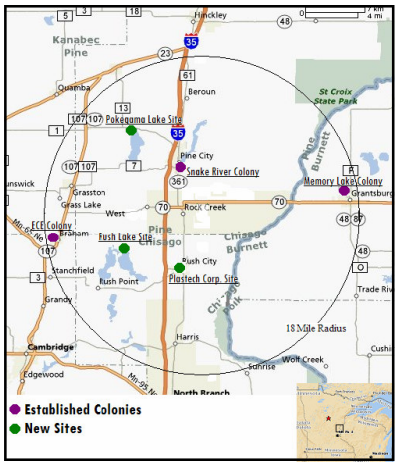

Figure 1. Locations of study colonies.

Study Area

East-Central Minnesota Purple Martin Recovery colonies will be used as the study colonies from which the nesting success will be determined. ECM-PMR colonies are located in Pine,

Kanabec and Chisago counties in Minnesota and Burnett County in Wisconsin (Figure 1). All colonies are within an 18 mile radius of Rock Creek, MN.

Methods

From the 2003 to 2006 nesting seasons, a small colony of purple martins called the Memory Lake Purple Martin Colony (MLPMC) in Grantsburg, WI was studied. This colony consisted of a small wooded house with eight compartments along with four artificial plastic gourds. Every five days during the nesting season, data was recorded about the nest cavity type and number of eggs, nestlings, and fledglings from each nest.

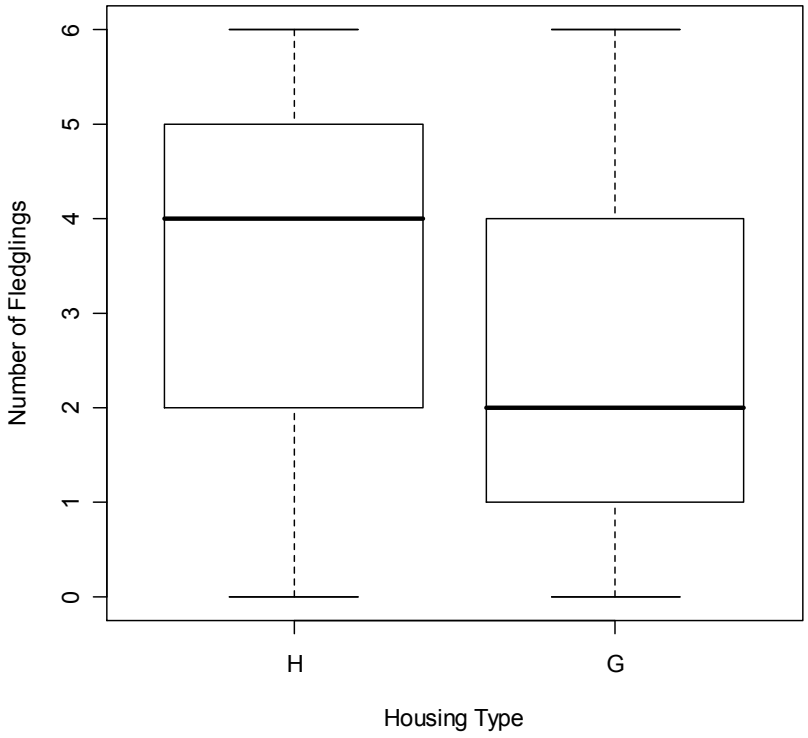

Figure 2. Box-plot showing data on the number of fledglings for wooden houses (H) and artificial plastic gourds (G).

During the 2007 nesting season, in addition to the MLPMC, two additional colonies, the ECE Purple Martin Colony (ECEPMC) and the Snake River Purple Martin Colony (SRPMC) were also studied. Data was recorded about the nest cavity type and number of eggs, nestlings, and fledglings from each nest from all three of these sites.

This study compared two different nest cavity types: wooden housing and artificial plastic gourds. The average number of successful fledglings will be used as the measure of nesting success.

Data Analysis

Data about the nest cavity type and number of fledglings from each nest observed from 2003 to 2006 from the MLPMC as well as from the MLPMC, ECEPMC, and SRPMC during the 2007 nesting season will be used to determine if nest cavity type has an effect on the nesting success of purple martins.

A 2-sample t-test will be used to determine of there is a statistical difference in the nesting success of purple martins. The null hypothesis states that H_O: $\mu_G = \mu_H$ and the alternative hypothesis states that H_A: $\mu_G \neq \mu_H$, where "μ" represents the mean number of fledglings, "G" represents artificial plastic gourds and "H" represents wooden housing. This data will be tested at the 5% level (see appendix).

Results

By analyzing a box-plot of the fledgling data, it is clear to see that the center, as measured by the median, is different for the two groups, with the wooden houses having a higher median number of fledglings per nest than the artificial plastic gourds (Figure 2). The dispersion of each of the groups, as measured by the IQR, is roughly the same (Figure 2).

The mean number of fledglings per nest is also different between the wooden houses and artificial plastic gourds. The mean number of fledglings per nest in wooden housing was 3.208 and a mean of 2.222 fledglings per nest were produced in artificial plastic gourds (Table 1).

By Utilizing the results from the t-sample t-test, it appears that the average nesting success of all purple martins in East-central Minnesota is statistically different between wooden houses and artificial plastic gourd nest cavity types (Table 2).

Table 1. Summary of data on average number of fledglings per nest in wooden housing and artificial plastic gourds.

```
Wooden Housing (H)
   Min. 1st Qu.  Median    Mean 3rd Qu.    Max.
  0.000   2.000   4.000   3.208   5.000   6.000

Artificial Plastic gourd (G)
   Min. 1st Qu.  Median    Mean 3rd Qu.    Max.
  0.000   1.000   2.000   2.222   3.750   6.000
```

One is 95% confident that the difference in fledging success (mean number of fledglings) from wooden housing and artificial plastic gourds is between 0.0139 to 1.9567 (Table 2). Thus, the fledging success per nest in wooden housing is between 0.0139 to 1.9567 fledglings greater, on average, than artificial plastic gourds.

Table 2. T-test results comparing the average number of fledglings per nest in wooden housing and artificial plastic gourds.

```
Two Sample t-test
data:  # of Fledglings by Housing Type
t = 2.0235, df = 69, p-value = 0.04689
alternative hypothesis: true difference in means is not
equal to 0
95 percent confidence interval: 0.01391386 1.95673603
sample estimates:
     mean in group H mean in group G
     3.207547        2.222222
```

Discussion

The purple martin is not a species that has been extensively studied. This study will add to the lacking information-base on this species by providing dispersal information in East-central Minnesota. This information can be used to supplement and further support studies regarding the general colonial breeding habits of the purple martin. This study should help many further studies of this species, especially those specific to Minnesota.

To supplement this study, further research should be conducted with increased numbers different housing types (ie. natural gourd, metal housing, plastic housing). In addition, increasing the number of colony study sites and the area of study would also be beneficial.

Similar studies should also be conducted in other areas of Minnesota so differences in the nesting success of purple martins in relation to cavity type across the state can be compared. After the affect of cavity type on fledging success, these values can be compared with the nesting success in various cavity types, of purple martins across the country.

A greater understanding of the nest cavity effects on purple martin nesting success should be analyzed along with other published and current research to help determine the cause of the drastic decline of this species. The ultimate knowledge of this decline can be used to provide management techniques (i.e. suggest most successfully housing types) to foster an increase and stabilization of the purple martin population.

Literature Cited

Audubon Minnesota. 2007. Common Birds in Decline. *State of the Birds* June.

Breeding Bird Survey. 2006. Purple Martin. Patuxent Wildlife Research Center.

Brown, C. R. 1997. Purple Martin. *The Birds of North America* No. 287.

Hill, J. R., III. 1997. Thanks to Native Americans, Purple Martins underwent a complete tradition shift. *Purple Martin Update* 8(1): 8-9

Appendix

11 Steps for Hypothesis Test

1) Determine which hypothesis to use
   2-sample t-test
      i) quantitative data
      ii) two populations
      iii) independent groups

2) State the null and alternative hypotheses
   H_O: $\mu_G = \mu_H$
   H_A: $\mu_G \neq \mu_H$,
      "μ" represents the mean fledglings
      "G" represents artificial plastic gourds
      "H" represents wooden housing

3) State the rejection criterion
   $\alpha = 0.05$

4) Collect the data
   i) observational with some control
   ii) not random

5) Check all necessary assumptions
   i) independent groups
   ii) $n_G + n_H = 18 + 53 = 71 > 40$
   iii) $\sigma_G^2 = \sigma_H^2$, p-value > α

```
Levene's Test for Homogeneity of Variance
      Df F value Pr(>F)
group  1   9e-04 0.9755
      69
```

6) Calculate the appropriate statistic
   mean in group H (3.2075) - mean in group G (2.2222) = 0.9853

7) Calculate the appropriate test statistic
   t = 2.0235
   df = 69

8) Calculate the p-value
   p-value = 0.04689

9) State rejection decision
   p-value < α, reject H_O

Commands in R

```
library(NCStats)

Martins <- read.table("C:/
Documents and Settings/
lindstromd01/My Documents/
Stats/FledglingData.txt",
header=T)

str(Martins)

Martins$Housing.Type <- factor
(Martins$Housing.Type, levels
= c("H", "G"))

Levenes(Martins$Fledglings ~
Martins$Housing.Type)

t.test(Martins$Fledglings ~
Martins$Housing.Type, alt =
"two.sided", var.equal = T)

boxplot (Martins$Fledglings ~
Martins$Housing.Type, ylab =
"Number of Fledglings", xlab =
"Housing Type")

tapply(Martins$Fledglings,
Martins$Housing.Type, FUN =
summary)
```