

Longitudinal Study of Tree Swallows

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Introduction

Tree swallows (*Tachycineta bicolor*) are the most widely distributed of the *Tachycineta* species, extending from northern Alaska and Canada to the southern United States. They are semi-colonial, secondary cavity nesters, primarily aerial insectivores, and migratory throughout most of their range. Tree swallows are a widely used model organism for avian ecologists and environmental physiologists because their life history lends itself to long-term study. They can be readily and repeatedly trapped at nests, and losses to nest predators are low. Adults return to previous breeding sites with high fidelity, so individuals marked during or after their first reproductive season can be reliably captured in subsequent years, and return rate to the breeding area can be used as an index of survival. Swallows using nest boxes are extraordinarily resistant to the disturbance of handling, allowing repeated captures to obtain measurements, blood samples, etc., both within and between breeding seasons.

Our research is designed to identify physiological traits associated with aging in tree swallows, the impact of individual variation in those traits on survival and reproduction, and test the hypotheses that oxidative damage, telomere (a DNA sequence near the end of the chromosome) shortening, or both underlie aging processes. We have been tracking tree swallows at the ISU Horticulture Research Station as well as ISU's Hinds Farm and Ames' Ada Hayden

Heritage Park (all in Story County, Iowa) since 2005. Our field sites are part of the western hemisphere-wide Golondrinas de las Americas *Tachycineta* project (<http://golondrinas.cornell.edu/>), in which collaborators collect a series of standard measurements at each site (Figure 1). The compilation of these data will enable improved understanding of nesting biology and migration timing as a function of nesting location, ecology, and climate change.

Materials and Methods

Since 2005 we have been monitoring nesting tree swallows using nest boxes at the Horticulture Research Station. Nest boxes are laid out in two grids (one added in 2006 and one in 2009) and along roads and paths at about 20 meter intervals. All birds that occupy nest boxes are trapped and banded. For each nesting pair, we record the date eggs are laid, clutch size, nestling growth rate, fledging success, and return rate in subsequent years. Blood samples are collected from each bird for measurements of telomere length, immune function, antioxidant levels, and oxidative damage. Birds that were initially banded as chicks and then return in subsequent years are of particular interest because we know their exact age. We can also age most females in their first breeding season by their distinctive brown dorsal plumage. Older females and all males are primarily blue.

Results and Discussion

The number of nest boxes we have monitored at the Horticulture Station has increased from 36 to 132, and occupancy has averaged about 40 percent (Figure 2). We have banded 788 nestling tree swallows at this locale, of which 77 (9.8 percent) have returned to nest in our nest boxes (Table 1). This is slightly higher than the recruitment rate reported at most tree

swallow colonies, probably because we trap all males as well as females attending boxes at our sites, while many researchers do not. Chick recruitment rates have varied between about one and 13 percent, which may reflect year-to-year variation in conditions on the wintering grounds in the southern U.S. Lifespan of these small migratory birds can be surprisingly long—one bird banded as a chick in 2005 was still alive in 2011 at six years of age.

The ease with which survival, reproductive investment, and reproductive success can be monitored in free-living tree swallows, and integrated with measurements of physiological variables associated with aging allows us to determine how telomere length, oxidative damage, and immune function vary with age and reproductive effort. Combining

demographic data from our sites with those from other sites reveals wide scale patterns. For example, comparisons of nest box occupancy rates from tree swallow sites throughout North America indicate populations are declining in the east and increasing in the west, which is consistent with hypotheses of the effects of widespread climate change on swallow wintering, migratory, and breeding grounds.

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Table 1. Returns of nestling tree swallows banded at the Horticulture Research Station.

Year	Chicks banded	Chicks returning to breed the following year (percent)	Chicks alive in 2011
2005	86	6 (7.0)	1
2006	70	1 (1.4)	0
2007	110	12 (10.9)	2
2008	164	22 (13.4)	5
2009	169	19 (11.2)	10
2010	189	17 (9.0)	17

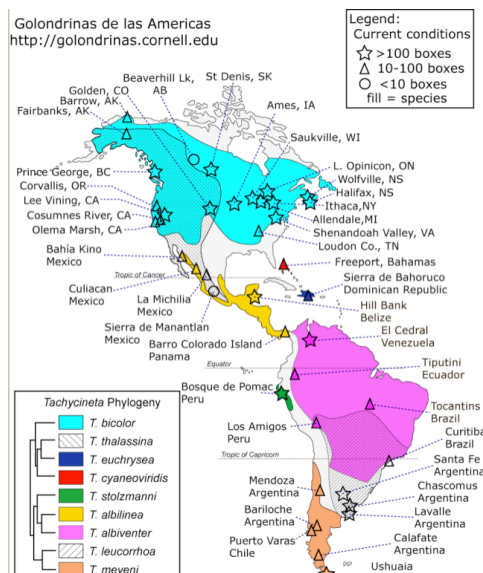


Figure 1. Distribution of Tachycineta swallows and Golondrina study sites.

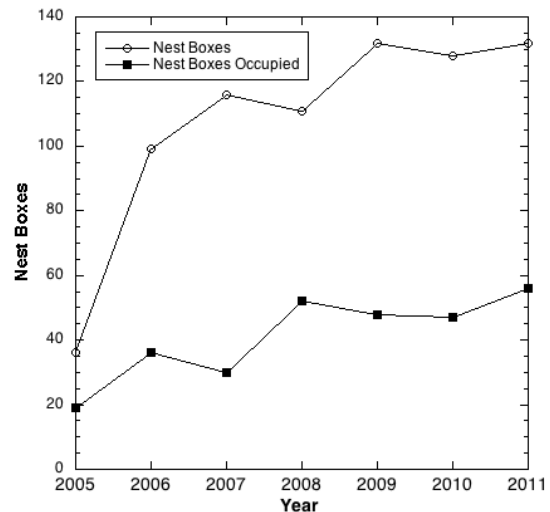


Figure 2. Nest box availability and occupancy at the Horticulture Research Station by year since 2005.