Pre-breeding migration strategies of mallards wintering in the Mississippi Alluvial Valley

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BACKGROUND

- Pre-breeding (spring) migration is a crucial time for waterfowl, yet stopover ecology and migration strategies are the least studied aspect in the otherwise well-studied Anatidae
- Variation among "time-minimizing" versus "energy-maximizing" migration strategies likely exist on a continuum within and among duck populations
- Migration strategies, including metrics such as stopover frequency and duration, heavily-used staging areas, and migratory timing, directly influence habitat conservation planning; however these metrics remain uncertain

OBJECTIVES

1. Describe spring migration chronology of wintering mallard populations across three states in the Mississippi Alluvial Valley
2. Examine behavioral and spatial migratory patterns among wintering mallard populations in the context of time-minimization and energy-maximization migration strategies

PROPOSED METHODS

- Ornitrack GPS/GSM telemetry of female mallards wintering in Arkansas (*n* = 18) and Louisiana (*n* = 42), and 83 male and female mallards deployed in Tennessee (*n* = 25 females and *n* = 58 males; *n* = 143 mallards total in winter 2019–2020)
- Net squared displacement to characterize migration chronology
- Movement metrics to examine migration strategy gradients (Table 1)

Table 1. General hypotheses of migratory behaviors when migrants adopt a time-minimizing or energy-maximizing migration strategy

	Units	Time-minimization	Energy-maximization
Migration speed	km d^{-1}	faster	slower
Migration distance	km	longer	shorter
Stopovers	freq	less	more
Stopover duration	d $freq^{-1}$	shorter	longer
Maximum step length	km	longer	shorter

- Dynamic Brownian Bridge Movement Models (dBBMMs) with 70%, 90%, and 99% contours depicting space-use at stopovers and along migratory corridors

PRELIMINARY RESULTS

- Mallards wintering in Tennessee and Arkansas initiated migration later than those from Louisiana. Tennessee mallards arrived to breeding grounds later and with greater overall variation in migration chronology in general
- Migratory duration was longer for birds from Tennessee than for other wintering states, despite being closer to minimum breeding latitude 43º

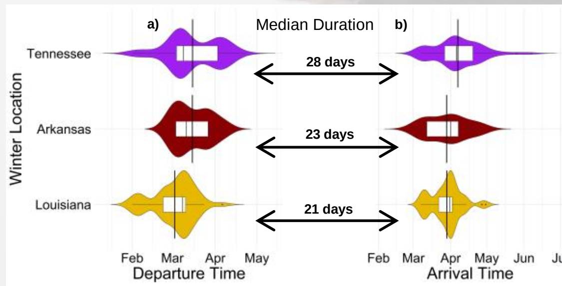
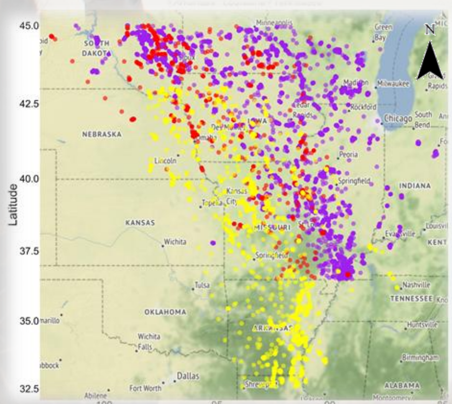


Figure 1. Violin, box-plot, and mean (crossbar) departure (a) and arrival (b) times for spring-migrating mallards wintering in Tennessee, Arkansas, and Louisiana (top to bottom)

Table 2. Mean and standard error (SE) migration speed, total distance, number of stopovers, stopover durations, and maximum step length (i.e., distance from one location to the next) for birds wintering in Arkansas, Louisiana, and Tennessee

	Arkansas *n* = 18	Louisiana *n* = 42	Tennessee *n* = 81
Migration speed (km d^{-1})	58 (SE = 10)	49 (SE = 5)	29 (SE = 3)
Migration distance (km)	2,129 (SE = 190)	2,675 (SE = 142)	1,398 (SE = 94)
Stopovers (freq)	1.3 (SE = 0.2)	1.4 (SE = 0.1)	2.0 (SE = 0.1)
Stopover duration (d $freq^{-1}$)	11.9 (SE = 1.7)	16.7 (SE = 1.9)	17.3 (SE = 1.0)
Maximum step length (km)	228 (SE = 190)	307 (SE = 142)	247 (SE = 94)

- Several individuals migrating from Tennessee appear to occupy separate eastern migratory corridors and distinct stop-and-go, north-then-west migratory pattern compared to birds wintering in Arkansas and Louisiana.



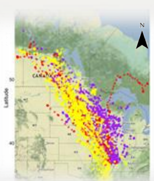


Figure 2. Migration locations of mallards captured in Arkansas, Louisiana, and Tennessee. Mallards captured in Tennessee disproportionately used staging areas in central and northeastern areas of the Upper Mississippi/Great Lakes Migratory Bird Joint Venture Region (i.e., Illinois, Wisconsin, and Minnesota)

EARLY CONCLUSIONS

- Early arrival to the breeding grounds could be a stronger selective pressure for mallards west of the Mississippi River, especially for those wintering farther from breeding areas (e.g., Louisiana)
- Energy-maximizing and partial migrations (if natal philopatry is not assumed) may be a profitable strategy for some individuals wintering in Tennessee
- Comparison of migration chronology and spatial patterns may be confounded by inclusion of males in the Tennessee cohort, if males were unpaired or pair bonds were broken when captured
- Important stopover regions and spring migration corridors differ among wintering subpopulations of Midcontinent mallards

MANAGEMENT IMPLICATIONS

- Stopover frequency and duration, heavily-used staging areas, and migration timing directly affect waterfowl habitat conservation objectives
- Migration corridors and timing among wintering populations may reveal mismatches in restoration or opportunities to enhance spring habitat management
- Matching migration chronology with stopover use and duration will allow for fine-tuned estimates of needed wetland habitat in spring-migrating Migratory Bird Conservation Regions

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