Cost-Share Proposal Form for NorthWestern Energy Project 2188 TAC Funds

Project Title: Linking Tree Swallow Movement and Aquatic Habitat Use to Food-Web and Water-Quality Conditions in the Upper Missouri River

Date: November 3, 2026

Explain how this Project addresses a specific Project 2188 License Article(s):
This project directly addresses License Article 423, particularly Article 423(4), by using Tree Swallows as a riparian-dependent avian indicator to evaluate use of major aquatic-riparian habitat types along the Project 2188 corridor. Building on NorthWestern Energy's investment in establishing and monitoring the Missouri River nest box network, the proposed study will address a critical remaining knowledge gap: identifying the aquatic-riparian habitats that support breeding Tree Swallows and evaluating how environmental conditions influence their use. The project will move beyond documenting nest box occupancy and reproduction to determine where adult swallows forage in relation to nesting sites, how use differs between reservoir (lentic) and river/tailwater (lotic) settings, and whether movement and habitat use correspond with aquatic prey, water quality, algal blooms, and contaminant exposure. The work retains continued demographic monitoring consistent with previous years while producing spatially explicit information that can guide habitat enhancement, nest-box establishment, water-quality coordination, and future avian monitoring under Article 423.

Provide justification for Priority 1, 2 or 3 (above) that you selected:
Priority 1. The focal colonies, receiver arrays, and associated sampling will occur on or immediately adjacent to the mainstem Missouri River between Hauser Reservoir and the river reaches influenced by Holter and the Black Eagle/Rainbow hydro developments. The project provides direct protection, mitigation, and enhancement value for riparian wildlife and habitat within the Project 2188 area by identifying the aquatic and riparian areas that breeding aerial insectivores use most intensively and the environmental conditions associated with that use.

Project Sponsor (submitted by):
University of Montana Bird Ecology Lab (UMBEL), in collaboration with the U.S. Fish and Wildlife Service (USFWS)

Location of Proposed Project:
Existing Missouri River nest-box network from Hauser Reservoir through the Holter/Gates of the Mountains reach and selected downstream colonies

Narrative

Geocode (in decimal degrees ex 46.89743):
Project extends from 46.711209, -111.806356 to 47.538772, -111.215569. Final coordinates for the four focal colonies and all receiver nodes will be provided to NorthWestern Energy before deployment. The Gates of the Mountains Motus station is located at 46.80960, -111.95460.

Total Project Cost: $142,855

TAC Funds (Cost-Share) Requested for Project: $112,355

I. Introduction; brief statement of project to be completed with pertinent background information.

Avian aerial insectivore populations in North America have declined by 32% since 1970 (Rosenberg et al., 2019). One factor implicated in this decline is the loss of aquatic emergent insect prey (Spiller and Dettmers, 2019), which are of higher nutritional value to avian consumers than terrestrial insects (Twining et al., 2016, Twining et al., 2018). Tree

Swallows (*Tachycineta bicolor)* are riparian-dependent aerial insectivores that have a strong dietary preference for aquatic emergent insects (Winkler et al., 2020) and thus are a valuable indicator of riparian ecosystem function, aquatic-to-terrestrial transfer of metals and metalloids, and ecological responses to nutrient enrichment (Custer, 2011). Adults forage over rivers, reservoirs, wetlands, shorelines, and adjacent uplands and deliver aquatic, and, to a lesser extent, terrestrial insects to nestlings (Beck et al., 2013). Tree Swallows readily use nest boxes especially when natural cavities are limited, allowing for the creation of nesting habitat and targeted study of aquatic habitat quality at sites of interest. The habitat preferences and foraging attributes of this avian species create a systematic opportunity to evaluate how dam-influenced lotic and lentic habitats support aerial insectivores and how aquatic prey availability, water quality (e.g., dissolved oxygen, temperature, pH, and turbidity), nutrient enrichment (e.g., nitrogen and phosphorus), algal blooms, and aquatic-derived contaminants may shape habitat use and reproductive outcomes.

The established Missouri River nest box network has supported high Tree Swallow occupancy and repeated collection of reproductive parameters (e.g., clutch size and hatching success), diet, and contaminant-exposure information since 2023. Previous support from NorthWestern Energy has successfully 1) created nesting habitat for Tree Swallows and other cavity-nesting species at 12 colonies, producing an average of 3.3 fledglings per box annually and recruiting an estimated 80 adults to the breeding population the following year (20% juvenile recruitment rate; Butler, 1998), and 2) established a long-term nest box network from which targeted questions around habitat suitability, contaminants, and diet sampling can be implemented. The principal remaining uncertainty is a fine-scale spatial assessment of habitat quality; it is unknown how far nest box inhabitants travel to acquire food resources, whether reservoir- and tailwater-adjacent birds use the landscape differently, if algal blooms or water quality affect foraging distance and reproductive outcomes, or whether contaminant exposure measured at a nest can be attributed to nearby or more distant foraging areas. Consequently, understanding movement and habitat use is essential for interpreting existing biological monitoring data and identifying aquatic-riparian habitats that may warrant targeted management or enhancement.

A 2026 pilot study demonstrated both the promise and limitations of telemetry to address some of these data gaps. It confirmed the scientific value of linking movement, diet, algal blooms, and metal(loid) exposure, but also presented opportunities to refine core study elements including tag performance, harness attachment methods, and receiver density. The proposed research builds upon the pilot study by pairing ultralight 2.4 GHz BluSeries tags (Cellular Tracking Technologies [CTT], Rio Grande, NJ, USA) with a robust, calibrated network of ~45 autonomous receiver nodes. In addition to the autonomous receiver nodes, we will also make use of a newly installed permanent Motus Wildlife Tracking System (Motus) station. Motus is an international collaborative network of automated radio telemetry receiving stations used to track movements of wildlife. This station was installed in 2026 at Gates of the Mountains by Last Chance Audubon Society (LCAS), Montana Fish, Wildlife & Parks (FWP), U.S. Fish and Wildlife Service (USFWS), University of Montana Bird Ecology Lab (UMBEL), and the landowner, and will provide additional corridor-scale infrastructure and demonstrates partner investment in this proposed project.

Solar-powered Node 3.0 receivers can detect tags at approximately 250-300 m and can support localization to 30 m accuracy under favorable conditions. The 0.2-g solar-rechargeable BluBird tag transmits every five seconds and is compatible with CTT Node 3.0 receivers, handheld CTT receiver, 2.4 GHz-enabled Motus stations, and passively listening Bluetooth-enabled smartphones (via Find My Phone technology and cellular data). These specifications allow for systematic and opportunistic, high-frequency movement monitoring with a substantially lighter tag and shorter antenna than the 2026 pilot study, improving data quality and bird welfare.

II. Objectives; explicit statement(s) of what is intended to be accomplished.

1. Quantify fine-scale foraging movements, including distance traveled from nest box sites by adult Tree Swallows (n = 24 tags/year) at focal Missouri River colonies (n = 4 colonies). Compare habitat use and prey quality (% aquatic insects in diet) between paired lentic (reservoir) and lotic (river/tailwater) systems while accounting for site, sex, breeding stage, time of day, time of season, year, and weather.
2. Compare habitat use and prey quality (% aquatic insects in diet) between paired lentic (reservoir) and lotic (river/tailwater) systems while accounting for site, sex, breeding stage, time of day, time of season, year, and weather.

3. Identify frequently used aquatic-riparian foraging areas and evaluate potential associations with aquatic insect prey, algal blooms and other water-quality indicators, and contaminants available from coordinated partner studies.
4. Maintain a limited but comparable record of nest box occupancy, clutch size, hatching success, growth rate and fledging success at all established nest box colonies to characterize reproductive performance and evaluate how it varies with foraging distance, water quality and contaminant exposure data.
5. Evaluate tag performance, attachment success, detection probability, and short-term bird response under a staged, welfare-centered deployment protocol, then translate results into recommendations for future avian monitoring.
6. Opportunistically characterize post-breeding movements and migratory connectivity of tagged Tree Swallows using detections obtained after departure from breeding colonies, including regional and long-distance movements where data are available.
7. Identify adaptive management strategies for targeted habitat enhancement to increase nesting opportunities for aerial insectivores, informed by observed foraging habitat use, aquatic prey availability, and reproductive performance.

III. Methods; description of how Project objectives will be accomplished.

Study design and focal sites

Four existing nest box colonies will be selected before the 2027 field season to provide a balanced habitat comparison: two lentic colonies adjacent to reservoir/open-water habitat and two lotic colonies adjacent to flowing river or tailwater habitat. Site selection will consider occupancy history, algal bloom propensity, safe access, landowner authorization, node security, availability of complementary prey/water-quality data, and proximity to existing receiving infrastructure. The current design allocates approximately ten nodes and six tagged adults per colony per year, with five additional nodes available for gap filling, array expansion, replacement, or targeted coverage of high-use areas. The same receiver infrastructure will be reused in 2028 to replicate or refine the comparison.

Receiver-node deployment and calibration

Forty-five solar-powered CTT Node 3.0 receivers will be deployed in shoreline and riparian arrays extending outward from focal nest boxes and spanning the primary aquatic habitat available to breeding swallows. Initial spacing will generally be 200-300 m, adjusted for terrain, vegetation, access, and line of sight. Each node will record tag identity, timestamp, signal strength, and available sensor data. Arrays will be calibrated with known-location test tags before birds are tagged and checked throughout the field season. Stationary reference tags and controlled moving-tag trials will be used to characterize detection probability, effective receiver coverage, and localization accuracy under representative field conditions. Receiver coverage will be mapped to identify areas where movements can be reliably characterized and to distinguish periods of non-detection from confirmed habitat use. A 2.4 GHz handheld receiver will support calibration, active searches, and troubleshooting. Node data will be stored locally and downloaded manually on a scheduled basis. The Gates of the Mountains Motus station will provide broader movement context and a permanent receiving anchor. Because standard Motus stations do not automatically detect 2.4 GHz BluSeries tags, the installation of an antenna and receiver will be required for compatibility. The proposed budget includes a BluSeries receiver/antenna allowance. Expanded BluBird tags will be registered in the Motus Wildlife Tracking Network and use the Blu+ detection service (access to detection by mobile phones) to supplement, but not replace, the fixed node arrays.

Tagging and animal-welfare safeguards

A target of 24 adult Tree Swallows will be tagged across the four focal colonies (target $n = 6$ per colony) per year. Sex, age, and breeding-stage will be documented and incorporated into analyses. Where feasible, tagging will be conducted during comparable breeding stages, with particular emphasis on the nestling-provisioning period to reduce variation associated with parental behavior. Birds will be captured and handled under approved federal, state, and institutional approvals. The total tag and harness weight will remain below 3% of body mass as stipulated by governing agencies and only adults meeting minimum body condition criteria will be selected for tagging.

The deployment protocol will explicitly incorporate lessons from 2026: (1) field-test tags and receivers under representative shoreline conditions; (2) deploy an initial sentinel cohort of five birds; (3) observe post-release flight and behavior; (4) review tag detections and bird condition before scaling to the full cohort; and (5) pause deployments if predefined adverse-event, attachment-failure, or non-detection thresholds are exceeded. Attachment method, fit, tag function, and all re-encounters will be documented. This staged design protects birds from adverse effects and prevents continued deployment of equipment or methods that are not performing as expected.

Nest-box monitoring and complementary sampling

Monitoring will be concentrated on the four focal nest box sites with tagged birds, with continued baseline monitoring across the entire network (Figure 1). Baseline checks will target key phenological windows needed to determine occupancy, clutch initiation, clutch size, hatching success, growth rate and nest fate, with more intensive observations at the four focal sites for capture, tagging, data collection, and node servicing. This approach will retain continuity with the 2023-2026 dataset while shifting effort toward the central movement question.

Movement data will be integrated with complementary information collected by USFWS, UMBEL, NorthWestern Energy, Montana Department of Environmental Quality (DEQ), U.S. Geological Survey (USGS), U.S. Environmental Protection Agency (EPA), Carroll College, and other collaborators when available. Fecal samples will be taken during the routine nestling banding process and sent to the Canadian Centre for Biodiversity Genomics for DNA metabarcoding analysis which provides information on dietary intake. Core covariates will include aquatic-habitat class, distance to nest box, shoreline/riparian cover, time of day, breeding stage, and weather. Coordinated datasets may include aquatic-insect biomass or community composition; harmful algal bloom presence, extent, chlorophyll-a, cyanotoxins, temperature, dissolved oxygen, or other water-quality metrics; and contaminant concentrations in eggs, blood, feathers, feces, prey, or other matrices. Laboratory analyses funded by other programs will be treated as leveraged support unless specifically included in the final TAC budget.

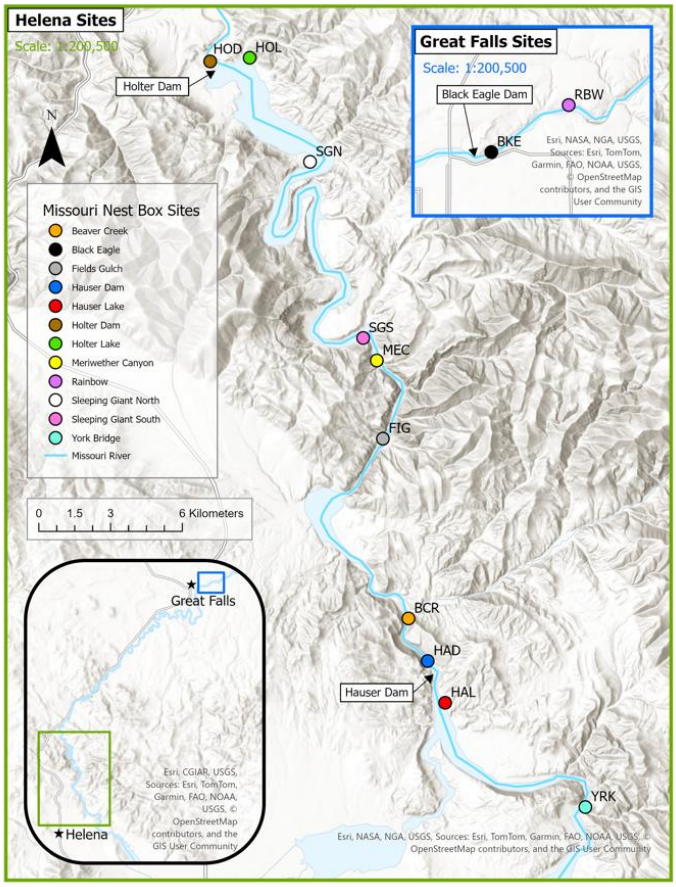


Figure 1. Current study area and nest box colonies (n = 12 colonies, n = 129 nest boxes) with Helena sites in large green box and Great Falls sites in inset blue box.

Data analysis

Raw detections will undergo tag-status, time, receiver-functionality, and spatial QA/QC. Calibrated receiver arrays will be used to characterize individual movement patterns, detection frequency, and relative use of aquatic-riparian habitats. Where sufficient spatial overlap among receivers and calibration data permit, detections will be used to estimate locations and movement trajectories. All habitat-use analyses will account for spatial variation in detection probability, receiver coverage, and associated positional uncertainty. Analyses will quantify detection duration, daily movement extent, maximum and median distance from the nest, time spent within mapped habitat zones, and transitions among aquatic and riparian habitat types. Mixed-effects models will compare movement data across lotic and lentic systems while accounting for repeated observations of individuals and colonies. Where the data support it, resource-selection or time-use models will test associations with prey, bloom, water-quality, diet, contaminant, weather, and reproductive variables. Results will be reported with detection uncertainty and without treating receiver locations as exact GPS fixes.

IV. Schedule; when the Project work will begin and end.

Period	Primary phase	Activities
Jan-Apr 2026	Planning	Confirm focal sites and partners; verify permits; finalize attachment and stop/go criteria; obtain CTT quote; order equipment.
Feb-Apr 2027	Infrastructure	Bench-test tags; assemble and map arrays; secure access; maintain focal nest boxes; deploy and calibrate nodes; Motus station retrofit for BluSeries compatibility
May-Aug 2027	Field season 1	Limited demographic monitoring; sentinel and full tagging cohorts; node servicing; diet sampling; potential coordinated prey, water-quality, algal bloom, and contaminant sampling.
Sep-Dec 2027	QA/QC and interim report	Retrieve and reconcile data; assess tag/receiver performance; map preliminary habitat use; present interim findings and refine 2028 design.
Jan-Aug 2028	Replication	Repair/redeploy node arrays; tag a second cohort or replace failed/lost tags as budget allows; repeat focal monitoring and coordinated sampling.
Sep-Dec 2028	Synthesis	Complete integrated analyses, management recommendations, final technical report, WildTAC presentation, data archive, and manuscript preparation.

V. Personnel who will do the work? Identify Project leader or principal investigator.

Megan Fylling (UMBEL) will serve as Principal Investigator and will manage the project, budget, permits, technical oversight, and reporting. Dr. Brian Balmer (USFWS) will serve as Co-Investigator and Helena-based lead for study design, field logistics, contaminant integration, and partner coordination. Annie Meyer (UMBEL/UM Graduate Student) will be the Lead Field Investigator for monitoring, captures, tagging, node installation/maintenance, data management, data and sample analyses, and reporting.

LCAS will collaborate on Motus infrastructure, station stewardship, volunteer support, and outreach. Montana FWP, including Motus coordination by John Kuntz, will support network integration and technical coordination. The Gates of the Mountains landowner will continue to support station access and operations. NorthWestern Energy, Montana DEQ, USGS, Carroll College, USFWS, UM, EPA, and other ongoing partners will be invited to coordinate relevant water-quality, algal bloom, prey, and contaminant datasets.

VI. Project budget with line items including amounts for the following:

The proposed budget intentionally concentrates equipment purchases in 2027 and reuses the node network in 2028. Equipment prices are planning estimates based on CTT public pricing accessed 27 October 2026 and must be replaced with a formal quote before submission. TAC overhead is calculated at 15% of direct labor and travel only; no overhead is applied to equipment or materials.

Category	2027 TAC	2028 TAC	Two-year TAC
Direct labor	$24,200	$24,200	$48,400
Travel and living	$7,500	$7,500	$15,000
Equipment	$18,000	$0	$18,000
Materials, tags, data service, and mounting	$10,385	$8,560	$18,945

Other Direct expenses (diet analysis)	$1,250	$1,250	$2,500
Direct overhead (15% of labor + travel)	$4,755	$4,755	$9,510
TAC funds requested	**$66,090**	**$46,265**	**$112,355**
Documented USFWS & UMBEL in-kind support	$14,000	$11,500	$25,500
Total project cost	**$80,090**	**$57,765**	**$137,855**

Draft equipment/material assumptions include 45 Node 3.0 receivers with solar power ($375 each), 40 expanded-service BluBird tags with harness attachment (planning price reflects the public 30-unit volume discount), one 2.4 GHz receiver, a BluSeries receiver/antenna allowance for the Gates Motus station, node mounts and field hardware, Blu+ service, and shipping. See the accompanying budget workbook for auditable formulas and source links.

USFWS will provide an estimated three weeks of salary support ($5,500 per year) for study design, field implementation, data integration, and reporting, plus vessel/vehicle/equipment use estimated at $6,000 per year for access to field sites. UMBEL will contribute $2,500 in tag value as in-kind support toward the project. Additional LCAS volunteer time, existing Motus infrastructure, and partner-funded insect, water-quality, bloom, and contaminant analyses will be documented as contributions when commitments and defensible values are confirmed; they are not currently included in the totals above.

VII. Deliverables; describe work product (reports, habitat restoration, etc.) which will result from this Project. How will "success" for this project be monitored or demonstrated?

- 2027: We will provide a brief field report summarizing updates from the field.
- 2028: We will provide a final technical report from the two-year cycle documenting methods, QA/QC, tag and receiver performance, habitat-use and diet results, integrated analyses, limitations, and management recommendations.
- Georeferenced inventory of node locations and calibrated coverage; clean detection and individual metadata files suitable for archive and future analyses.
- Maps of individual and pooled movement, distance from nests, lotic/lentic use, and recurrent foraging hotspots, with uncertainty clearly represented.
- Annual WildTAC presentation and a final partner briefing; data contributions to peer-reviewed manuscript(s) and graduate research products.
- Recommendations for receiver-network design, ethically defensible Tree Swallow tagging, focal water-quality/prey sampling, nest-box siting, and protection or enhancement of high-use aquatic-riparian areas.

Success will be demonstrated by: (1) operational calibrated arrays at four focal colonies; (2) 24 tag deployments attempted annually under protocol, with performance and welfare outcomes fully reported; (3) sufficient detections to quantify habitat use for a defensible subset of individuals in both habitat classes; (4) retention of core demographic data at focal colonies; (5) diet analyses to determine nutritional quality of prey and contaminant exposure pathways for tree swallows (% aquatic vs terrestrial insect types); (6) potential integration of prey, water-quality, algal bloom, and/or contaminant datasets; and (7) management-relevant spatial products delivered to WildTAC. A transparent finding that a tag or receiver configuration is unsuitable will also be treated as a valid result if the stop/go protocol prevents unnecessary additional deployments and yields actionable design guidance.

VIII. Cultural Resources. Cultural Resource Management (CRM) requirements for any activity related to this Project must be completed and documented to NorthWestern as a condition of any TAC grant. TAC funds may not be used for any land-disturbing activity, or the modification, renovation, or removal of any buildings or structures until the CRM consultation process has been completed. Agency applicants must submit a copy of the proposed project to a designated Cultural Resource Specialist for their agency. Private parties or non-governmental organizations are encouraged to submit a copy of their proposed project to a CRM consultant they may have employed. Private parties and non-governmental organizations may also contact the NorthWestern representative for further information or assistance from NorthWestern's staff archeologist. Applications submitted without this section completed, will be held by the TAC, without any action, until the information has been submitted.

The project is designed to avoid ground disturbance. Nodes will be attached to existing posts, temporary driven posts, or other approved non-permanent supports, and nest box work will occur at existing colonies. Before deployment, proposed node and any new support locations will be provided to the appropriate agency or NorthWestern cultural-resource contact. No TAC funds will be used for ground-disturbing activity until any required consultation is complete. If consultation identifies restrictions, nodes will be relocated or mounted on existing infrastructure.

IX. Water Rights. For projects that involve development, restoration or enhancement of streams or wetlands, please describe how the project will comply with the Montana DNRC's "Guidance for Landowners and Practitioners Engaged in Stream and Wetland Restoration Activities", issued by the Water Resources Division on 9 March 2016.

The project involves wildlife monitoring and temporary telemetry infrastructure only. It will not divert, impound, excavate, alter streambanks, modify wetlands, or change water use. Montana DNRC stream and wetland restoration guidance is therefore not applicable. All access and temporary installations will be coordinated with landowners and relevant managing agencies.

Literature Cited

Beck, M.L., Hopkins, W.A., Jackson, B.P., 2013. Spatial and Temporal Variation in the Diet of Tree Swallows: Implications for Trace-Element Exposure After Habitat Remediation. Arch. Environ. Contam. Toxicol. 65, 575–587. https://doi.org/10.1007/s00244-013-9913-5

Butler, R. W. (1988). Population dynamics and migration routes of Tree Swallows, *Tachycineta bicolor*, in North America. Journal of Field Ornithology 59:395-402.

Cellular Tracking Technologies. 2026. CTT BluBird product specifications and pricing. https://celltracktech.com/products/ctt-blubird (accessed 3 October 2026).

Custer, C.M., 2011. Swallows as a Sentinel Species for Contaminant Exposure and Effect Studies, in: Elliott, J.E., Bishop, C.A., Morrissey, C.A. (Eds.), Wildlife Ecotoxicology, Emerging Topics in Ecotoxicology. Springer New York, New York, NY, pp. 45–91. https://doi.org/10.1007/978-0-387-89432-4_3

Rosenberg, K.V., Dokter, A.M., Blancher, P.J., Sauer, J.R., Smith, A.C., Smith, P.A., Stanton, J.C., Panjabi, A., Helft, L., Parr, M., Marra, P.P., 2019. Decline of the North American avifauna. Science, 366(6461), 120–124.

Spiller, K.J., and Dettmers, R., 2019. Evidence for Multiple Drivers of Aerial Insectivore Declines in North America. The Condor: Ornithological Applications 121(2). https://doi.org/10.1093/condor/duz010

Twining, C.W., J.T. Brenna, P. Lawrence, J.R. Shipley, T.N. Tollefson, D.W. Winkler., 2016. Omega-3 Long-chain Polyunsaturated Fatty Acids Support Aerial Insectivore Performance More Than Food Quantity. Proc. Natl. Acad. Sci. U.S.A. 113(39), 10920-10925. https://doi.org/10.1073/pnas.1603998113

Twining, C.W., Shipley, J.R. Winkler, D.W., 2018, Aquatic Insects Rich in Omega-3 Fatty Acids Drive Breeding Success in a Widespread Bird. Ecol Lett, 21, 1812-1820. https://doi.org/10.1111/ele.13156

Winkler, D.W., K.K. Hallinger, D.R. Ardia, R.J. Robertson, B.J. Stutchbury, R.R. Cohen, 2020. Tree Swallow (*Tachycineta bicolor*), version 1.0. In Birds of the World (A. F. Poole, Editor). Cornell Lab of Ornithology, Ithaca, NY, USA. https://doi-org.weblib.lib.umt.edu:2443/10.2173/bow.treswa.01