

# The Motus Wildlife Tracking System

Progress and Detections in  
Missouri, Midwest, and Beyond

2022 Update





These partners have generously assisted in the growth of the Motus network in Missouri and beyond. Thank you for your support!



- Neil Reynolds
- Daniel Whithaus
- Rick Holton
- Aaron Jungbluth via Boeing Company
- Katherine Ward
- Susan Hazelwood
- Ruth Grant
- Mary Christine Angelo
- Linda Williams
- Donna Menown
- Edith Starbuck
- Ethan Duke and Dana Ripper
- Wendy Williams



None of the Missouri Motus installs would have been possible without the knowledge, expertise, and kindness of MDC's Joe Davis.

Report prepared by Trevor Lindsay (MDC) and Sarah Kendrick, (USFWS), April 2023

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# Introduction

The Motus Wildlife Tracking System (Motus) is a collaborative research network that uses arrays of automated radio telemetry receivers to study movements of small animals. Motus works using ultra-lightweight radio tags coded to the Motus frequency attached to our smallest species of migratory birds, bats, and even large insects. When a Motus-tagged animal passes within range of any of the over 1,500 Motus receivers in the world, the signal of the tag is detected and stored. The beauty of Motus is that regardless of who places receiver stations across a migratory animal's range, all receivers listen on the same radio frequency and detect Motus tags within range. This means that one researcher doesn't have to place Motus receivers along an animal's entire migratory route – anyone who places a Motus station in the world contributes to the broader network of receivers for Motus tags to be detected. This collaborative array of receivers across the hemisphere allows researchers to learn more about migration timing, stopover sites, and wintering locations more efficiently and at broader scales to target conservation efforts and habitat management for some of our most rapidly declining bird species that need targeted conservation through their full annual cycle.



*A free-standing Motus station powered by solar. Motus.org*



*Golden-winged Warbler with Motus nanotag. Sarah Kendrick*

In 2017, when the Missouri Department of Conservation (MDC) began work to broaden the Motus network, the Midwest was largely a “black hole” for Motus coverage with only about 17 receiver stations in the northern Midwest and near the Great Lakes. The Motus station network has grown exponentially; between 2016 and 2022, the number of receiver stations increased almost 300% from 430 to over 1,500 in 34 countries. The number of projects increased six-fold in that time and 174 peer-reviewed publications and scientific documents have been published (Motus Wildlife Tracking System Strategy to 2030, 2022; Motus.org). This report educates on Motus and its potential to learn more about our migratory birds and bats and outlines progress in Motus station placement in Missouri, the Midwest, and parts of the Neotropics. The report also includes information on Missouri's receiver arrays and a list of Motus-tagged species detected on Missouri Motus stations in 2022. We have also gathered notable detections from our Missouri receivers since our last Motus Report was published in December 2021 and those are reported here.



MDC and the U.S. Fish and Wildlife Service (USFWS) proudly support collaborative Motus projects across the hemisphere by growing and maintaining a strong Motus network.

## Why Motus?

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Motus' collaborative nature appeals to a broad suite of partner agencies and organizations due to its scope, scale, and ability to teach us about our long -distance migrants. As of April 24, 2023, there are 1,557 active Motus receivers worldwide (Motus.org). While the majority of receivers can be found in Canada and the U.S. (Figure 1), the ever-expanding network includes 34 countries, 317 species tagged (37,919 individuals), 1,789 collaborators, and 174 publications based on Motus data. Various researchers and Motus collaborations have added a significant amount of knowledge on migratory species (Taylor et al. 2017), including information on migration timing, stopover sites, and other locations that Neotropical migrants and migratory bat species are using throughout the year.



Figure 1. Locations of active Motus receivers worldwide as of April 2023. Motus.org

New data and publications on both local and long-distance movements discovered using Motus continue to flow in the last few years with the rapid expansion of the network. These findings are contributing to regional, national, and international conservation efforts of Motus-tagged species by identifying and targeting conservation efforts in key stopover habitats during migratory species' full life cycles.

## Full Annual Cycle Bird Conservation

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The Missouri Department of Conservation has supported full annual cycle (FAC) conservation efforts for migratory landbirds since 2009 and has supported full annual cycle of our migratory waterfowl species for decades. FAC conservation involves working to protect migratory bird species that breed in Missouri when they are beyond our state's borders. Roughly 335 species occur in Missouri each year, give or take vagrants



and rarities. Of those, 170 species breed in Missouri, and 84 of those leave Missouri in the non-breeding season. Fifty-eight of these birds, or one-third of Missouri breeding migratory bird species, leave the U.S. in the non-breeding season for up to 8 months of the year. As a conservation community, we cannot ignore the threats that landbirds face when they are beyond our borders and know that we are doing all we can for bird conservation. In light of the 2019 *Science* article quantifying the net loss of three billion birds (or 29%) of North American birds since 1970 (Rosenberg et al. 2019), we must bring further attention and support to FAC conservation as a vital piece of bird conservation programs.

MDC has proudly supported FAC landbird conservation since the creation of the Association of Fish and Wildlife Agencies' Southern Wings program in 2009, which provides a menu of international conservation project partnerships on migratory stop-over sites and the wintering in Mexico, Central America, and South America for our long-distance migrant landbirds. States then choose which projects to support that best benefit birds that breed and migrate through their states to support FAC conservation work. MDC has been a lead state contributing to Southern Wings; in fact, FAC conservation is included in [MDC's Comprehensive Conservation Strategy](#) (Missouri's State Wildlife Action Plan). Motus tracking of birds through migration and beyond identifies timing, stopover sites, overwintering locations, and even overwinter survival, to inform conservation work for migratory birds throughout the annual cycle. Motus can also be used for local tracking efforts to target conservation and management actions that give us the greatest return on effort for the broadest suites of species, including birds.



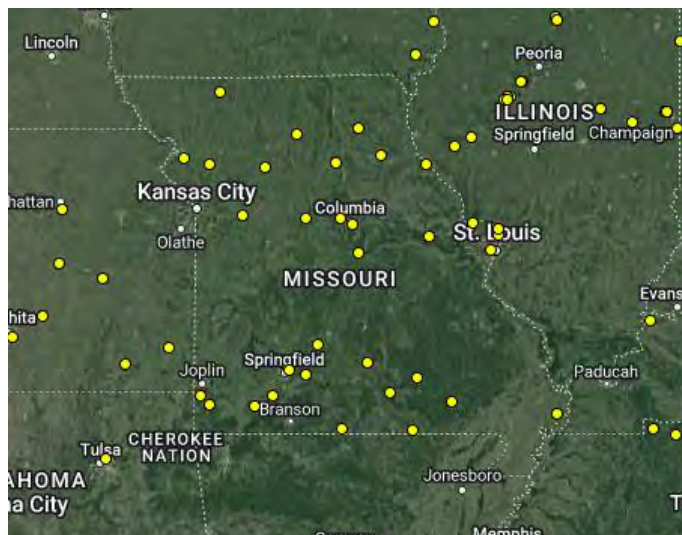
**Figure 2. eBird map of a Wood Thrush showing full life-cycle range and abundance. Addressing threats that Missouri's breeding birds face when they're beyond state borders is central to full annual cycle conservation efforts. eBird.org**





# Motus Station Placement Progress: Missouri

Missouri’s approach to Motus receiver station placement has been to build two east-west latitudinal arrays, or “digital fences” of stations with detection diameters as close as possible to maximize detection of Motus-tagged animals as they migrate north-south through the state. The two Missouri arrays have been placed in separate ecoregions of the state in grassland and hardwood forest systems (Figure 3). The northern array lies across the Eastern Tallgrass Prairie Bird Conservation Region of the state (generally along U.S. Hwy 36) and the southern array through the Central Hardwoods Bird Conservation Region (generally along U.S. Hwy 60). Additional stations are also being placed along the Missouri and Mississippi Rivers in an attempt to capture the movements of a diversity of migratory species’ guilds that use different habitats as they move through the state.



*Figure 3. Missouri’s Motus array generally follows two northern and southern latitudinal arrays and along the Missouri and Mississippi Rivers. Motus.org*



*Figure 4. Active (yellow) and proposed (orange) locations of Motus stations in the Midwestern U.S. Midwest Migration Network*

Missouri’s efforts in placing stations also helped build out the Midwest Migration Network’s Strategic Motus Plan, which outlines east-west latitudinal arrays and stations along major rivers and the Great Lakes across USFWS Region 3 (Figure 4). Missouri’s first Motus station was placed in October 2018 at MDC Headquarters. Supplies for this station were provided by USFWS Ecological Services in Columbia and was intended to test the functionality of Motus technology as a pilot before expanding Missouri’s Motus network more broadly. In 2019, USFWS awarded MDC and partners St. Louis Zoo and Illinois Natural History Survey a grant to place 14 new stations in Missouri, Illinois, and Guatemala. In addition to this grant, MDC funded seven new stations across the northern state array. A few private partners have also placed

Stations on their lands, including the Audubon Center at Riverlands. All but one of Missouri’s Motus stations are dual-listening Cellular Tracking Technologies (CTT) SensorStations, which are receivers equipped with two types of antennas to detect Motus tags on two separate frequencies: 166.38 MHz NanoTag™ tags (Lotek Wireless Inc.) and 434 MHz LifeTag™, PowerTag™, and HybridTag™ tags (Cellular Tracking Technologies). Missouri and the Midwest have adapted to these changes in the Motus technology to make receivers as useful as possible to the widest range of tag types and research approaches.

In 2020, a USFWS Competitive State Wildlife Grant (CSWG) was awarded to MDC and nine other partners (Iowa Department of Natural Resources (DNR); Indiana DNR; Ohio DNR; Minnesota DNR; Kalamazoo Bird Observatory; Illinois Natural History Survey; University of Maine; SELVA: Investigación para la Conservación en el Neotropico; and National Audubon Society) to place 62 Motus stations across eight Midwestern states and Mexico, Costa Rica, and Colombia. Six of these new stations were deployed in Missouri. In addition to station placement, the grant supports three Motus-tracking research projects on American Kestrels (*Falco sparverius*), Golden-winged Warblers (*Vermivora chrysoptera*), and Wood Thrush (*Hylocichla mustelina*). Additional details on the outcomes of this grant award are discussed in the following sections. With the addition of these six CSWG-funded stations, an additional eight were funded by MDC, two by the Missouri Conservation Heritage Foundation, and one by USFWS, bringing the total number of active Motus stations in Missouri to 33 with three more on the way in 2023 (Figure 5).



Nearly all Motus stations in Missouri are located on existing MDC operated communications towers. Trevor Lindsay

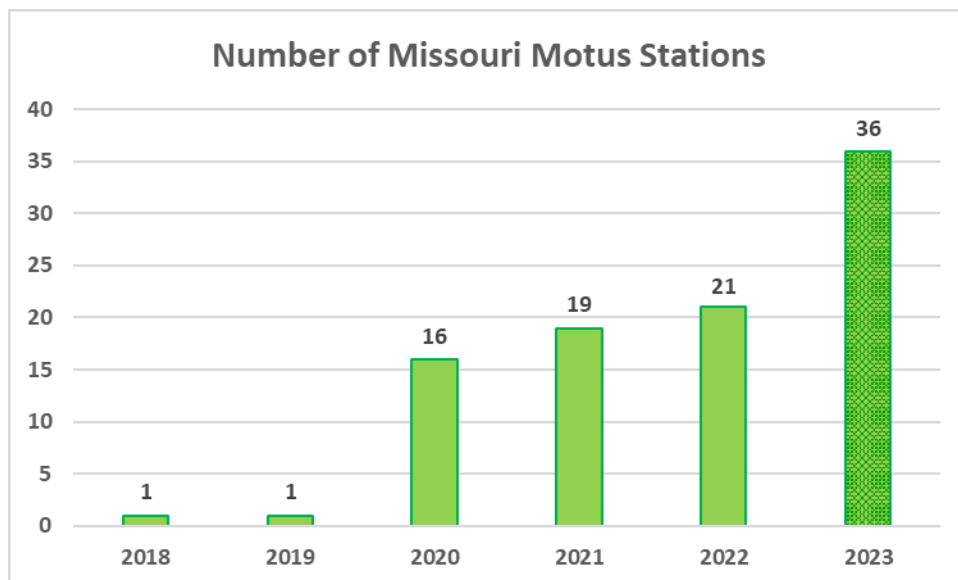


Figure 5. Number of active Motus stations in Missouri since 2018. It is projected that there will be 36 active stations by the end of 2023.





## Motus Station Placement Progress: Midwest

Prior to 2020, there was a large gap in the Motus receiver array across the Midwest (Figure 6). There has been tremendous progress in station placement over the past five years. In January 2018 there were 17 Motus stations across the Midwestern states of Iowa, Indiana, Illinois, Michigan, Missouri, Minnesota, Ohio, and Wisconsin. Currently, there are 186 stations situated across these states with more planned for deployment in the immediate future.



Figure 6: Motus receiver locations in the Midwest in January 2018 and April 2023. Motus.org

## Motus Station Placement Progress: Neotropics

An equally important area for a stronger Motus network is throughout the Neotropics. Motus tagging efforts won't tell us much if we don't have active stations along these species' migratory routes and winter ranges. In January 2018, there were 8 Motus stations between southern Mexico and Colombia. Currently, there are now 58 active stations as of April 2023 (Figure 7). While there has been much progress placing Motus stations in the Neotropics since 2018, there is still a critical need for expansion of the Motus network in this area.

The 2020 CSWG also included funding for the placement of 11 Motus stations in the Neotropics: four stations in Mexico's Yucatan Peninsula, three in Costa Rica, and four in Colombia. Between two USFWS grants and donations by Missouri birding groups and private citizens, conservation partners in the Midwest will have supported the placement of 20 Motus stations in the Neotropics in the last few years. Many stations not outlined in this report have been placed in recent years thanks to dedicated conservation partners in the region.



Figure 7. Neotropic Motus receiver location comparison in 2018 and 2023. Motus.org



# Missouri Motus Station Detections

Since 2018, Missouri Motus stations have logged 317 total detections consisting of 180 individual tags representing 24 species of bird and one species of bat (Table 1). Animals detected by Missouri Motus stations were deployed by 25 different projects across the western hemisphere (Figure 8). In the following sections, each Missouri Motus station is listed by name with a brief summary of detections, and a table listing all detections for the station. Figure 9 illustrates variation in number of detections by station.








Figure 8. Original Motus-tagging locations of species detected on Missouri Motus stations.






- Common Nighthawk (*Chordeiles minor*)
- Eastern Whip-poor-will (*Antrostomus vociferus*)
- Virginia Rail (*Rallus limicola*)
- Sora (*Porzana carolina*)
- Least Sandpiper (*Calidris minutilla*)
- Semipalmated Sandpiper (*Calidris pusilla*)
- Stilt Sandpiper (*Calidris himantopus*)
- Western Sandpiper (*Calidris mauri*)
- Lesser Yellowlegs (*Tringa flavipes*)
- Semipalmated Plover (*Charadrius semipalmatus*)
- Black Tern (*Chlidonia niger*)
- Common Tern (*Sterna hirundo*)
- American Kestrel (*Falco sparverius*)
- Blue Jay (*Cyanocitta cristata*)
- Bank Swallow (*Riparia riparia*)
- Barn Swallow (*Hirundo rustica*)
- Gray Catbird (*Dumetella carolinensis*)
- Swainson’s Thrush (*Catharus ustulatus*)
- American Tree Sparrow (*Spizelloides arborea*)
- White-throated Sparrow (*Zonotrichia albicollis*)
- Rusty Blackbird (*Euphagus carolinus*)
- Golden-winged Warbler (*Vermivora chrysoptera*)
- Mourning Warbler (*Geothlypis philadelphia*)
- Canada Goose (*Branta canadensis*)
- Eastern Red Bat (*Lasiurus borealis*)















**Table 1. Species detected by Missouri Motus stations, number of detections, and number of individuals during from January 2018 to December 2022.**

Species	# Detections	# Individuals	
<p style="text-align: center;"><b>Common Nighthawk</b> <i>(Chordeiles minor)</i></p>	17	12	 <p style="text-align: right; font-size: small;">CC by 2.0 Julio Molero</p>
<p style="text-align: center;"><b>Eastern Whip-poor-will</b> <i>(Antrostomus vociferus)</i></p>	15	9	 <p style="text-align: right; font-size: small;">CC by 2.0 Andy Reago</p>
<p style="text-align: center;"><b>Virginia Rail</b> <i>(Rallus limicola)</i></p>	6	5	 <p style="text-align: right; font-size: small;">CC by 2.0 Andy Reago</p>
<p style="text-align: center;"><b>Sora</b> <i>(Porzana carolina)</i></p>	10	9	 <p style="text-align: right; font-size: small;">CC by 2.0 Susan Young</p>
<p style="text-align: center;"><b>Least Sandpiper</b> <i>(Calidris minutilla)</i></p>	2	2	 <p style="text-align: right; font-size: small;">CC by 2.0 Gregory Smith</p>

Species	# Detections	# Individuals	
Semipalmated Sandpiper <i>(Calidris pusilla)</i>	3	3	 <p>CC by 2.0 Tom Wilberding</p>
Stilt Sandpiper <i>(Calidris himantopus)</i>	5	4	 <p>CC by 2.0 Andrew Reding</p>
Western Sandpiper <i>(Calidris mauri)</i>	1	1	 <p>CC by 2.0 Deborah Freeman</p>
Lesser Yellowlegs <i>(Tringa flavipes)</i>	15	5	 <p>CC by 2.0 Mick Thompson</p>
Semipalmated Plover <i>(Charadrius semipalmatus)</i>	1	1	 <p>CC by 2.0 Fyn Kynd</p>



Species	# Detections	# Individuals	
<p><b>Black Tern</b> <i>(Chlidonias niger)</i></p>	<p>25</p>	<p>14</p>	 <p>CC by 2.0 Virginia Rivers</p>
<p><b>Common Tern</b> <i>(Sterna hirundo)</i></p>	<p>2</p>	<p>2</p>	 <p>CC by 2.0 Sonia Johnson</p>
<p><b>American Kestrel</b> <i>(Falco sparverius)</i></p>	<p>85</p>	<p>25</p>	 <p>CC by 2.0 Kenneth Cole Schneider</p>
<p><b>Blue Jay</b> <i>(Cyanocitta cristata)</i></p>	<p>3</p>	<p>1</p>	 <p>CC by 2.0 Karin Lewis</p>
<p><b>Bank Swallow</b> <i>(Riparia riparia)</i></p>	<p>1</p>	<p>1</p>	 <p>CC by 2.0 Sam May</p>

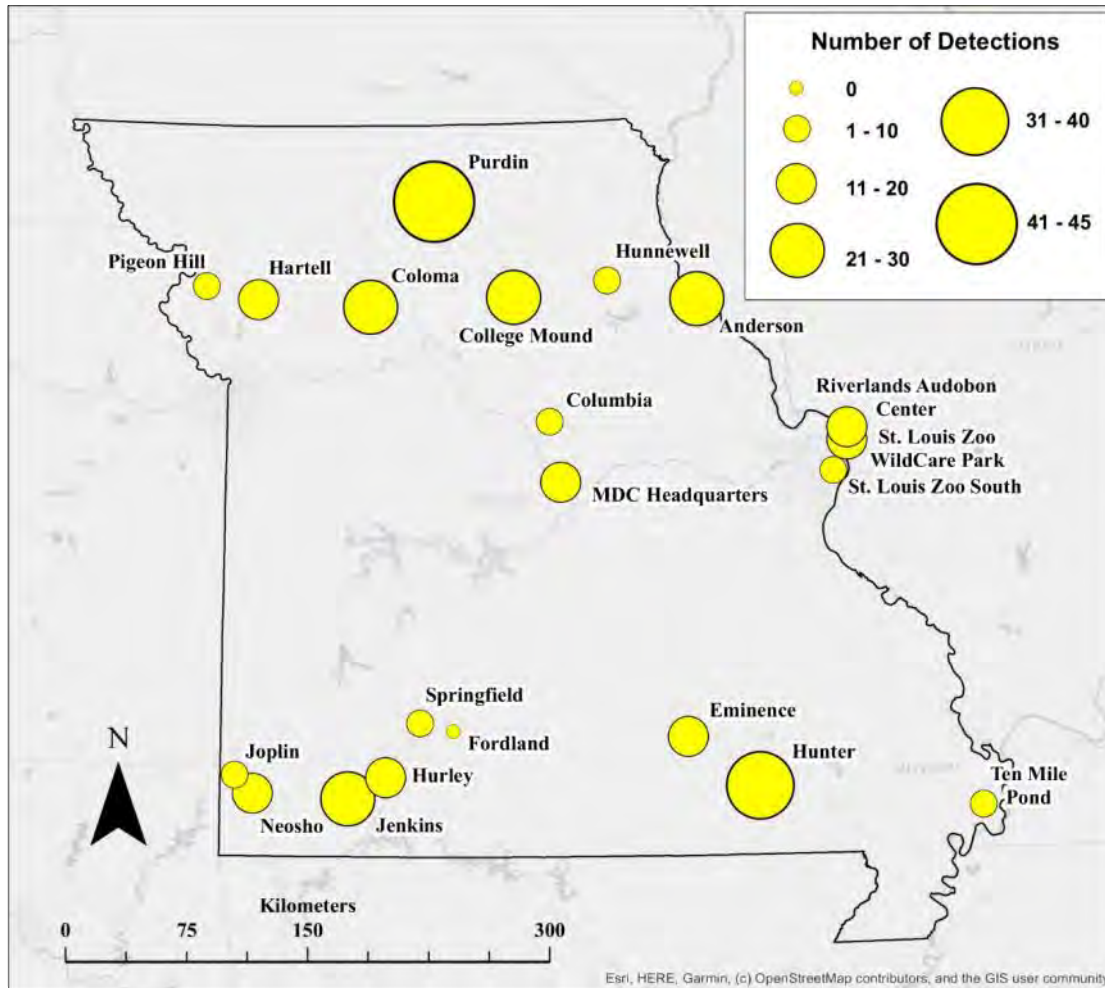
Species	# Detections	# Individuals	
<p>Barn Swallow <i>(Hirundo rustica)</i></p>	<p>4</p>	<p>4</p>	 <p>CC by 2.0 Doug Greenburg</p>
<p>Gray Catbird <i>(Dumetella carolinensis)</i></p>	<p>7</p>	<p>5</p>	 <p>CC by 2.0 Dennis Church</p>
<p>Swainson's Thrush <i>(Catharus ustulatus)</i></p>	<p>80</p>	<p>58</p>	 <p>CC by 2.0 Kelly Colgan Azar</p>
<p>American Tree Sparrow <i>(Spizelloides arborea)</i></p>	<p>1</p>	<p>1</p>	 <p>CC by 2.0 Tom Murray</p>
<p>White-throated Sparrow <i>(Zonotrichia albicollis)</i></p>	<p>6</p>	<p>4</p>	 <p>CC by 2.0 John Benson</p>



Species	# Detections	# Individuals	
<p>Rusty Blackbird <i>(Euphagus carolinus)</i></p>	<p>1</p>	<p>1</p>	 <p>CC by 2.0 Andy Reago</p>
<p>Golden-winged Warbler <i>(Vermivora chrysoptera)</i></p>	<p>5</p>	<p>4</p>	 <p>CC by 2.0 Alan Schmieger</p>
<p>Mourning Warbler <i>(Geothlypis philadelphia)</i></p>	<p>3</p>	<p>1</p>	 <p>CC by 2.0 Tom Benson</p>
<p>Canada Goose <i>(Branta canadensis)</i></p>	<p>2</p>	<p>2</p>	 <p>CC by 2.0 Bernard Spragg</p>
<p>Eastern Red Bat <i>(Lasiurus borealis)</i></p>	<p>1</p>	<p>1</p>	 <p>CC by 2.0 Judy Gallagher</p>

# Missouri Station Details

The following section outlines each Missouri Motus station with some details on its deployment and detections of Motus-tagged birds. All Missouri stations, except one, are dual-listening stations and equipped with Cellular Tracking Technologies' SensorStations to monitor Motus tags on 166 and 434 frequencies.



**Figure 9.** Locations of active Motus stations in Missouri. Marker size represents the number of detections at each station from January 2018 to December 2022.

## MDC Headquarters

The Missouri Department of Conservation (MDC) deployed the first Motus station in Missouri at the Conservation Commission Headquarters in Jefferson City on 12 October 2018. The station has had three detections of one tag during 2022, a White-throated Sparrow. Regrettably, this station spent most of 2022 offline due to a receiver glitch; it was replaced on 14 October 2022 and detected a bird a mere five days later.





Table 2. Detections at MDC Headquarters station during 2022. The Missouri Department of Conservation manages the MDC Headquarters station located at the MDC Conservation Commission Headquarters in Jefferson City, MO.

MDC Headquarters/Jefferson City			
Detection Date	Species	Deployment Date	Deployment Project
2022-10-29	White-throated Sparrow	2022-05-26	White-throated Sparrow Migration
2022-10-31	White-throated Sparrow	2022-05-26	White-throated Sparrow Migration
2022-11-10	White-throated Sparrow	2022-05-26	White-throated Sparrow Migration

## Ten Mile Pond

The Motus station at Ten Mile Pond Conservation Area, located in Mississippi County, was first activated on 9 January 2020. The dual-listening receiver detected one tagged bird during 2022, a Lesser Yellowlegs.



Table 3. Detections at the Ten Mile Pond station during 2022. The Missouri Department of Conservation manages the Ten Mile Pond station, located at Ten Mile Pond Conservation Area near Mississippi County, MO.

Ten Mile Pond			
Detection Date	Species	Deployment Date	Deployment Project
2022-07-25	Lesser Yellowlegs	2022-04-19	SELVA Colombia

## Hunter

The Hunter station, located at Hunter Towersite, was first activated on 9 January 2020. The current dual-listening receiver has detected 12 tags during 2022. Species detected by this station include Gold-winged Warbler, Black Tern, Virginia Rail, Sora, and Swainson's Thrush.



Table 4. Detections at the Hunter station during 2022. The Missouri Department of Conservation manages the Hunter station, located at Hunter Towersite in Hunter, MO.

Hunter			
Detection Date	Species	Deployment Date	Deployment Project
2022-05-19	Golden-winged Warbler	2022-03-18	SELVA - Costa Rica
2022-07-11	Black Tern	2022-06-28	Black Tern Dispersal - Saskatchewan
2022-09-25	Virginia Rail	2022-05-01	Forbes Bio Station Motus Tags
2022-09-25	Swainson's Thrush	2021-09-09	BC Interior Thrushes
2022-09-26	Sora	2022-05-22	Forbes Bio Station Motus Tags
2022-09-26	Swainson's Thrush	2022-08-24	BC Interior Thrushes
2022-09-28	Swainson's Thrush	2021-08-31	BC Interior Thrushes
2022-10-03	Swainson's Thrush	2022-08-24	BC Interior Thrushes
2022-10-04	Swainson's Thrush	2021-08-31	BC Interior Thrushes
2022-10-05	Swainson's Thrush	2022-08-24	BC Interior Thrushes
2022-10-13	Swainson's Thrush	2022-09-06	Intermountain West Collaborative - UM Birds
2022-10-13	Swainson's Thrush	2022-08-24	BC Interior Thrushes
2022-10-14	Swainson's Thrush	2022-09-15	Intermountain West Collaborative - UM Birds



## Eminence

The Eminence station, located in the Angeline Conservation Area, was first activated on 9 January 2020. The station was deactivated on 23 June 2021. The current station has detected seven tags during 2022. Species detected include Swainson’s Thrush, Black Tern, Stilt Sandpiper, American Kestrel, and Sora.



Table 5. Detections at the Eminence station. The Missouri Department of Conservation manages the Eminence station, located at Angeline Conservation Area in Eminence, MO.

Eminence			
Detection Date	Species	Deployment Date	Deployment Project
2022-05-28	Bank Swallow	2022-04-04	Swallow connectivity-Latin America to North America
2022-07-20	Stilt Sandpiper	2022-07-02	Nol - Churchill Shorebirds
2022-09-23	Sora	2022-05-04	Forbes Bio Station Motus Tags
2022-09-23	Sora	2022-09-06	Forbes Bio Station Motus Tags
2022-09-25	Swainson's Thrush	2022-08-24	BC Interior Thrushes
2022-10-03	Swainson's Thrush	2022-09-06	Intermountain West Collaborative - UM Birds

## Springfield/Southwest Regional Office

The Motus station in Springfield, Missouri was first activated on 14 January 2020. The station has detected one tagged bird, a Golden-winged Warbler.



Table 6. Detections at the Missouri Department of Conservation (MDC) Springfield/Southwest Regional Office station during 2022. MDC manages the Springfield/Southwest Regional Office station, located at the MDC Southwest Regional Office in Springfield, MO.

Springfield			
Detection Date	Species	Deployment Date	Deployment Project
2022-05-10	Lesser Yellowlegs	2022-04-19	SELVA Colombia
2022-08-10	American Kestrel	2022-06-14	AMKE Research Minnesota
2022-09-23	American Kestrel	2022-06-10	AMKE Research Minnesota
2022-10-07	American Kestrel	2021-06-02	AMKE Research Minnesota

## Neosho

The Motus station in Neosho, located at the MDC Neosho District Headquarters, was first activated on 14 January 2020. The station has detected five tags during 2022. Species detected by the current receiver include American Kestrel and Lesser Yellowlegs.



Table 7. Detections at the Neosho station during 2022. The Missouri Department of Conservation (MDC) manages the Neosho station, located at the MDC Neosho District Headquarters in Neosho, MO.





Neosho			
Detection Date	Species	Deployment Date	Deployment Project
2022-05-10	Lesser Yellowlegs	2022-04-19	SELVA Colombia
2022-08-10	American Kestrel	2022-06-14	AMKE Research Minnesota
2022-09-23	American Kestrel	2022-06-10	AMKE Research Minnesota
2022-10-07	American Kestrel	2021-06-02	AMKE Research Minnesota

## Joplin

The Joplin station, located at the Joplin Towersite, was first activated on 14 January 2020. The station has detected one tag during 2022. The species detected by the current receiver was an Eastern Whip-poor-will.



Table 8. Detections at the Joplin station during 2022. The Missouri Department of Conservation manages the Joplin station, located at the Joplin Towersite south of Joplin, MO.

Joplin			
Detection Date	Species	Deployment Date	Deployment Project
2022-09-29	Eastern Whip-poor-will	2022-07-09	Eastern Whip-poor-wills

## Jenkins

The Jenkins station located northwest of Jenkins, MO, was first activated on 14 January 2020. The current receiver has detected 12 tags during 2022. Species detected include Lesser Yellowlegs, Common Nighthawk, Black Tern, American Kestrel, Eastern Whip-poor-will, and Swainson's Thrush.



Table 9. Detections at the Jenkins station during 2022. The Missouri Department of Conservation manages the Jenkins station, located northwest of Jenkins, MO.

Jenkins			
Detection Date	Species	Deployment Date	Deployment Project
2022-05-08	Lesser Yellowlegs	2022-04-19	SELVA Colombia
2022-05-11	Lesser Yellowlegs	2022-04-19	SELVA Colombia
2022-05-29	Common Nighthawk	2021-07-14	Intermountain West Collaboration - Birds
2022-07-23	Black Tern	2022-06-26	Black Tern Dispersal - Saskatchewan
2022-08-10	American Kestrel	2022-06-14	AMKE Research Minnesota
2022-09-22	American Kestrel	2022-06-14	AMKE Research Minnesota
2022-09-23	American Kestrel	2022-06-10	AMKE Research Minnesota
2022-09-26	Eastern Whip-poor-will	2022-07-11	Eastern Whip-poor-wills
2022-09-27	American Kestrel	2022-06-14	AMKE Research Minnesota
2022-10-07	Eastern Whip-poor-will	2022-06-17	Eastern Whip-poor-wills
2022-10-07	Swainson's Thrush	2022-08-24	BC Interior Thrushes
2022-10-13	American Kestrel	2022-06-14	AMKE Research Minnesota



## Hurley

The Hurley station located northeast of Highlandville, MO, was first activated on 14 January 2020. The station has detected one bird during 2022, a Golden-winged Warbler. Please note a particularly awesome story about this tagged Golden-winged Warbler on page 23.



Table 10. Detections at the Hurley station during 2022. The Missouri Department of Conservation manages the Hurley station, located northeast of Highlandville, MO.

Hurley			
Detection Date	Species	Deployment Date	Deployment Project
2022-05-02	Golden-winged Warbler	2022-03-05	SELVA - Costa Rica

## Pigeon Hill

The Pigeon Hill station, located on the Pigeon Hill Conservation Area in St Joseph, was activated on 21 October 2020. The station has had eight detections of four tags during 2022. Three belonging to American Kestrels and one Swainson's Thrush.



Table 11. Detections at the Pigeon Hill station during 2022. The Missouri Department of Conservation manages the Pigeon Hill station, located at the Pigeon Hill Conservation Area near St Joseph, MO.

Pigeon Hill			
Detection Date	Species	Deployment Date	Deployment Project
2022-09-07	American Kestrel	2022-07-08	AMKE Research Minnesota
2022-09-08	American Kestrel	2022-07-08	AMKE Research Minnesota
2022-09-09	American Kestrel	2022-07-08	AMKE Research Minnesota
2022-09-13	American Kestrel	2022-07-08	AMKE Research Minnesota
2022-09-21	American Kestrel	2022-07-08	AMKE Research Minnesota
2022-09-22	American Kestrel	2022-06-10	AMKE Research Minnesota
2022-09-25	American Kestrel	2022-07-08	AMKE Research Minnesota
2022-10-06	Swainson's Thrush	2022-09-06	Intermountain West Collaborative - UM Birds

## Hartell

The Hartell station, located on the Ronald and Maude Hartell Conservation Area northeast of Plattsburg, was activated on 21 October 2020. The station has detected 11 tags during 2022. Species detected include Lesser Yellowlegs and American Kestrel.



Table 12. Detections at the Hartell station during 2022. The Missouri Department of Conservation manages the Hartell station, located in the Ronald and Maude Hartell Conservation Area northeast of Plattsburg, MO.

Hartell			
Detection Date	Species	Deployment Date	Deployment Project
2022-03-29	American Kestrel	2021-06-02	AMKE Research Minnesota





Hartell (continued)

Detection Date	Species	Deployment Date	Deployment Project
2022-04-06	American Kestrel	2021-05-28	AMKE Research Minnesota
2022-05-10	Lesser Yellowlegs	2022-04-19	SELVA Colombia
2022-05-11	Lesser Yellowlegs	2022-04-19	SELVA Colombia
2022-09-07	American Kestrel	2022-07-08	AMKE Research Minnesota
2022-09-08	American Kestrel	2022-07-08	AMKE Research Minnesota
2022-09-09	American Kestrel	2022-07-08	AMKE Research Minnesota
2022-09-13	American Kestrel	2022-07-08	AMKE Research Minnesota
2022-09-21	American Kestrel	2022-07-08	AMKE Research Minnesota
2022-09-22	American Kestrel	2022-06-10	AMKE Research Minnesota
2022-09-25	American Kestrel	2022-07-08	AMKE Research Minnesota

## Coloma

The Coloma station, located on the Bunch Hollow Conservation Area in Carroll County, was activated on 21 October 2020. The station has detected 15 tags during 2022. Species detected include Lesser Yellowlegs, Black Tern, Least Sandpiper, Eastern Whip-poor-will, Sora, Virginia Rail, White-throated Sparrow, and American Kestrel, and Swainson’s Thrush.



Table 13. Detections from the Coloma station during 2022. The Missouri Department of Conservation manages the Coloma station, located on the Bunch Hollow Conservation Area in Carroll County, MO.

Coloma			
Detection Date	Species	Deployment Date	Deployment Project
2022-05-08	Lesser Yellowlegs	2022-04-19	SELVA Colombia
2022-05-10	Lesser Yellowlegs	2022-04-19	SELVA Colombia
2022-07-21	Black Tern	2022-06-27	Black Tern Dispersal - Saskatchewan
2022-07-29	Least Sandpiper	2022-06-21	Arctic Shorebirds - CWS Yellowknife
2022-08-19	Black Tern	2022-06-20	Black Tern Dispersal - Saskatchewan
2022-09-07	American Kestrel	2022-07-08	AMKE Research Minnesota
2022-09-08	American Kestrel	2022-07-08	AMKE Research Minnesota
2022-09-09	American Kestrel	2022-07-08	AMKE Research Minnesota
2022-09-13	American Kestrel	2022-07-08	AMKE Research Minnesota
2022-09-19	American Kestrel	2022-06-14	AMKE Research Minnesota
2022-09-22	American Kestrel	2022-06-10	AMKE Research Minnesota
2022-09-22	Eastern Whip-poor-will	2022-07-13	Eastern Whip-poor-wills
2022-09-22	Sora	2022-04-26	Forbes Bio Station Motus Tags
2022-09-25	Swainson's Thrush	2022-08-24	BC Interior Thrushes
2022-09-26	Swainson's Thrush	2022-08-24	BC Interior Thrushes
2022-10-04	Swainson's Thrush	2022-08-24	BC Interior Thrushes
2022-10-07	American Kestrel	2021-06-02	AMKE Research Minnesota
2022-10-07	American Kestrel	2022-06-14	AMKE Research Minnesota
2022-10-17	White-throated Sparrow	2022-05-25	White-throated Sparrow Migration
2022-10-18	Virginia Rail	2022-05-01	Forbes Bio Station Motus Tags

## Purdin

The Purdin station, located near Purdin, was activated on 21 October 2020. The station has detected 29 tags during 2022. Species detected include Common Tern, Black Tern, Common Nighthawk, Least Sandpiper, Lesser Yellowlegs, Eastern Whip-poor-will, Golden-winged Warbler, Swainson’s Thrush, White-throated Sparrow, Virginia Rail and American Kestrel.



Table 14. Detections at the Purdin station during 2022. The Missouri Department of Conservation manages the Purdin station, located near Purdin, MO.

Purdin			
Detection Date	Species	Deployment Date	Deployment Project
2022-02-14	Common Tern	2021-06-15	Poplar Island Restoration Site - Common Terns
2022-05-08	Lesser Yellowlegs	2022-04-19	SELVA Colombia
2022-05-13	Golden-winged Warbler	2022-02-28	SELVA - Costa Rica
2022-07-11	Black Tern	2022-06-28	Black Tern Dispersal - Saskatchewan
2022-07-20	Lesser Yellowlegs	2022-04-09	SELVA Colombia
2022-07-27	Black Tern	2022-06-20	Black Tern Dispersal - Saskatchewan
2022-07-27	Lesser Yellowlegs	2022-04-19	SELVA Colombia
2022-07-28	Least Sandpiper	2022-06-29	Arctic Shorebirds - CWS Yellowknife
2022-08-08	American Kestrel	2022-06-14	AMKE Research Minnesota
2022-08-09	American Kestrel	2022-06-14	AMKE Research Minnesota
2022-08-30	Common Nighthawk	2022-06-16	Intermountain West Collaboration - Birds
2022-08-31	Common Nighthawk	2022-07-11	Intermountain West Collaboration - Birds
2022-09-07	American Kestrel	2022-07-08	AMKE Research Minnesota
2022-09-12	Eastern Whip-poor-will	2022-07-14	Eastern Whip-poor-wills
2022-09-13	American Kestrel	2022-07-08	AMKE Research Minnesota
2022-09-13	American Kestrel	2022-06-14	AMKE Research Minnesota
2022-09-19	American Kestrel	2022-06-14	AMKE Research Minnesota
2022-09-22	American Kestrel	2022-06-10	AMKE Research Minnesota
2022-09-22	Eastern Whip-poor-will	2022-07-13	Eastern Whip-poor-wills
2022-09-25	American Kestrel	2021-06-02	AMKE Research Minnesota
2022-09-25	Eastern Whip-poor-will	2022-07-11	Eastern Whip-poor-wills
2022-09-25	Swainson's Thrush	2021-09-09	BC Interior Thrushes
2022-09-25	Swainson's Thrush	2022-08-24	BC Interior Thrushes
2022-09-27	Eastern Whip-poor-will	2022-07-09	Eastern Whip-poor-wills
2022-09-27	Swainson's Thrush	2022-08-24	BC Interior Thrushes
2022-09-28	Swainson's Thrush	2022-08-24	BC Interior Thrushes
2022-10-06	American Kestrel	2022-06-14	AMKE Research Minnesota
2022-10-06	Swainson's Thrush	2022-08-24	BC Interior Thrushes
2022-10-07	American Kestrel	2021-06-02	AMKE Research Minnesota
2022-10-07	American Kestrel	2022-06-14	AMKE Research Minnesota
2022-10-17	White-throated Sparrow	2022-05-31	White-throated Sparrow Migration
2022-10-18	Virginia Rail	2022-05-01	Forbes Bio Station Motus Tags
2022-10-26	White-throated Sparrow	2022-05-26	White-throated Sparrow Migration

## College Mound

The College Mound station, located near College Mound, was activated on 22 October. The station has detected 18 tags during 2022. Species detected include Lesser Yellowlegs, Common Nighthawk, Sora, Eastern Whip-poor-will, Black Tern, American Kestrel, and Swainson's Thrush.



Table 15. Detections at the College Mound station during 2022. The Missouri Department of Conservation manages the College Mound station, located near College Mound, MO.

College Mound			
Detection Date	Species	Deployment Date	Deployment Project
2022-07-11	Black Tern	2022-06-28	Black Tern Dispersal - Saskatchewan
2022-07-20	Lesser Yellowlegs	2022-04-09	SELVA Colombia
2022-07-27	Black Tern	2022-06-20	Black Tern Dispersal - Saskatchewan
2022-08-09	American Kestrel	2022-06-14	AMKE Research Minnesota
2022-08-30	Common Nighthawk	2022-06-16	Intermountain West Collaboration - Birds
2022-08-31	Common Nighthawk	2022-07-11	Intermountain West Collaboration - Birds



**College Mound (continued)**

Detection Date	Species	Deployment Date	Deployment Project
2022-09-12	Eastern Whip-poor-will	2022-07-14	Eastern Whip-poor-wills
2022-09-19	American Kestrel	2022-06-14	AMKE Research Minnesota
2022-09-22	Sora	2022-05-04	Forbes Bio Station Motus Tags
2022-09-24	Swainson's Thrush	2022-08-24	BC Interior Thrushes
2022-09-25	Swainson's Thrush	2021-09-04	BC Interior Thrushes
2022-09-25	Swainson's Thrush	2021-09-09	BC Interior Thrushes
2022-09-25	Swainson's Thrush	2022-08-24	BC Interior Thrushes
2022-09-26	Swainson's Thrush	2022-08-24	BC Interior Thrushes
2022-09-28	Swainson's Thrush	2022-08-24	BC Interior Thrushes
2022-09-28	Swainson's Thrush	2022-08-24	BC Interior Thrushes
2022-10-07	American Kestrel	2022-06-14	AMKE Research Minnesota
2022-10-07	Eastern Whip-poor-will	2022-06-17	Eastern Whip-poor-wills

## Hunnewell

The Hunnewell station, located on the Hunnewell Lake Conservation Area in Shelby County, was activated on 22 October 2020. While gathering 7 total detections since its deployment, the station has not recorded any detections during 2022.



## Anderson

The Anderson station, located on the Edward Anderson Conservation Area southeast of Saverton, was activated on 27 October 2020. The station has detected 12 tags during 2022. Species detected include American Kestrel, Sora, Virginia Rail, Lesser Yellowlegs, Common Nighthawk, Stilt Sandpiper, and Swainson's Thrush.



*Table 16. Detections from the Anderson station during 2022. The Missouri Department of Conservation manages the Anderson station, located on the Edward Anderson Conservation Area southeast of Saverton, MO.*

<b>Anderson</b>			
Detection Date	Species	Deployment Date	Deployment Project
2022-05-15	Sora	2022-04-27	Forbes Bio Station Motus Tags
2022-05-17	Virginia Rail	2022-04-30	Forbes Bio Station Motus Tags
2022-07-24	Lesser Yellowlegs	2022-04-19	SELVA Colombia
2022-08-16	Stilt Sandpiper	2022-07-05	Nol - Churchill Shorebirds
2022-08-17	Lesser Yellowlegs	2022-04-19	SELVA Colombia
2022-09-02	Common Nighthawk	2021-07-10	Intermountain West Collaboration - Birds
2022-09-03	Common Nighthawk	2021-07-10	Intermountain West Collaboration - Birds
2022-09-21	Swainson's Thrush	2022-08-24	BC Interior Thrushes
2022-09-22	Swainson's Thrush	2022-08-24	BC Interior Thrushes
2022-09-26	American Kestrel	2022-06-14	AMKE Research Minnesota
2022-09-26	Swainson's Thrush	2022-08-24	BC Interior Thrushes
2022-10-07	Swainson's Thrush	2022-08-24	BC Interior Thrushes
2022-10-08	Swainson's Thrush	2022-09-15	Intermountain West Collaborative - UM Birds



## St. Louis Zoo South

The St. Louis Zoo South station, located a few blocks south of the zoo, was activated on 3 August 2021. The station is managed by the Saint Louis Zoo. There has been one tag detected during 2022. The species detected was a Swainson’s Thrush.



Table 17. Detections from the St. Louis Zoo South station during 2022. The St. Louis Zoo manages the St. Louis Zoo South station, located a few blocks south of the St. Louis Zoo.

St. Louis Zoo South			
Detection Date	Species	Deployment Date	Deployment Project
2022-10-07	Swainson’s Thrush	2022-08-24	BC Interior Thrushes

## St. Louis Zoo WildCare Park

The St. Louis Zoo WildCare Park station, located near the confluence of the Mississippi and Missouri rivers, was activated on 18 August 2022. The station is managed by the Saint Louis Zoo. The station has detected 14 tags during 2022. Species detected include Semipalmated Plover, Common Nighthawk, Sora, Canada Goose, and Swainson’s Thrush.



Table 18. Detections from the St. Louis Zoo WildCare Park station during 2022. The St. Louis Zoo manages the St. Louis Zoo WildCare Park station, located near the confluence of the Mississippi and Missouri rivers.

St. Louis Zoo WildCare Park			
Detection Date	Species	Deployment Date	Deployment Project
2022-08-30	Semipalmated Plover	2022-06-13	Arctic Shorebirds - CWS Yellowknife
2022-08-30	Common Nighthawk	2022-07-04	Intermountain West Collaboration - Birds
2022-08-30	Common Nighthawk	2022-08-10	Intermountain West Collaboration - Birds
2022-09-21	Common Nighthawk	2022-06-15	Intermountain West Collaboration - Birds
2022-09-22	Sora	2022-09-20	Forbes Bio Station Motus Tags
2022-09-22	Canada Goose	2022-07-18	North Atlantic Population Canada Goose
2022-09-24	Swainson's Thrush	2022-08-24	BC Interior Thrushes
2022-09-26	Swainson's Thrush	2022-08-24	BC Interior Thrushes
2022-09-28	Swainson's Thrush	2022-08-24	BC Interior Thrushes
2022-10-07	Sora	2022-09-20	Forbes Bio Station Motus Tags
2022-10-07	Sora	2022-09-15	Forbes Bio Station Motus Tags
2022-10-07	Canada Goose	2022-07-18	North Atlantic Population Canada Goose
2022-10-07	Swainson's Thrush	2022-08-24	BC Interior Thrushes
2022-10-17	Sora	2022-04-24	Forbes Bio Station Motus Tags

## Audubon Center at Riverlands

The Audubon Center at Riverlands station, located in West Alton, Missouri on the Mississippi River was activated on 1 December 2021. The station was funded by a St. Louis Audubon Cathleen Creley Memorial Conservation Grant and is managed by staff at the Audubon Center. During 2022, this station has detected 11 tags. Species detected include Lesser Yellowlegs, Semipalmated Plover, Stilt Sandpiper, Common Nighthawk, Sora, and Swainson’s Thrush.



Table 19. Detections from the Audubon Center at Riverlands station during 2022. The Audubon Center staff manages the station, located in West Alton, MO near the Mississippi River.

Audubon Center at Riverlands			
Detection Date	Species	Deployment Date	Deployment Project
2022-07-24	Lesser Yellowlegs	2022-04-19	SELVA Colombia
2022-08-10	Semipalmated Plover	2022-07-02	Arctic Shorebirds - CWS Yellowknife
2022-08-16	Stilt Sandpiper	2022-07-05	Nol - Churchill Shorebirds
2022-08-30	Common Nighthawk	2022-07-04	Intermountain West Collaboration - Birds
2022-09-21	Common Nighthawk	2022-06-15	Intermountain West Collaboration - Birds
2022-09-22	Sora	2022-09-20	Forbes Bio Station Motus Tags
2022-09-24	Swainson's Thrush	2022-08-24	BC Interior Thrushes
2022-09-26	Swainson's Thrush	2022-08-24	BC Interior Thrushes
2022-09-28	Swainson's Thrush	2022-08-24	BC Interior Thrushes
2022-10-07	Sora	2022-09-20	Forbes Bio Station Motus Tags
2022-10-07	Swainson's Thrush	2022-08-24	BC Interior Thrushes

## Columbia

The Columbia station was installed in Columbia at the Waters-Moss Memorial Wildlife Area near the city's center and was activated on 30 December 2021. The station was funded by the Columbia Audubon Society in memory of Brad Jacobs, retired MDC state ornithologist and passionate proponent and educator of full life-cycle conservation of migratory birds. During 2022, the station detected 10 tags. Species detected include Golden-winged Warbler, Sora, Eastern Whip-poor-will, Common Nighthawk, and Swainson's Thrush. Please note a particularly awesome story about this tagged Golden-winged Warbler on page 23.



Table 20. Detections from the Columbia station during 2022. The Missouri Department of Conservation manages the Columbia station, located at the Waters-Moss Memorial Wildlife Area in Columbia, MO.

Columbia			
Detection Date	Species	Deployment Date	Deployment Project
2022-05-09	Golden-winged Warbler	2022-03-05	SELVA - Costa Rica
2022-08-20	Sora	2022-04-27	Forbes Bio Station Motus Tags
2022-09-12	Eastern Whip-poor-will	2022-07-14	Eastern Whip-poor-wills
2022-09-19	Common Nighthawk	2021-07-07	Intermountain West Collaboration - Birds
2022-09-22	Sora	2022-05-04	Forbes Bio Station Motus Tags
2022-09-24	Swainson's Thrush	2022-09-19	Intermountain West Collaborative - UM Birds
2022-09-25	Swainson's Thrush	2022-08-24	BC Interior Thrushes
2022-09-25	Swainson's Thrush	2022-08-24	BC Interior Thrushes
2022-09-26	Swainson's Thrush	2022-08-24	BC Interior Thrushes
2022-09-27	Swainson's Thrush	2021-08-31	BC Interior Thrushes

## Fordland

The Fordland station was installed on private land owned by Andrew Kinslow's family at Homestead Springs LLC in Fordland, Missouri and was activated on 13 November 2022. As of December 2022, there have been no detections yet to be reported.



## 2023 Station Deployments

As of April 23, 2023, there have been 12 additional stations deployed across the state during 2023 bringing the number of Missouri Motus stations to 33. These locations include Blackwater, Houston, Midway, Mountain View, Novelty, Odessa, Phillipsburg, Rose Hill, Seat, Timber Knob, Trail of Tears State Park, and Warrenton with 3 more to be deployed in the upcoming months to meet the goal of 36 total stations.

## Notable Detections

Several notable detections have been recorded by Missouri Motus stations. These noteworthy detections include species of conservation concern, long detection/stopover times, “recaptures” or multiple detections within the state, and unique highlights of the journeys these birds make every year.

### *Detected Species of Continental Concern*

Nine bird species detected by Missouri Motus stations were included on Partners in Flight’s (PIF) Continental Watchlist. Golden-winged Warblers detected are listed under the PIF Red Watch List as a species with extremely high vulnerability due to small population and range, high threats, and range-wide declines. Eastern Whip-poor-will and Semipalmated Sandpipers are both PIF Yellow –D Watch List species with declining populations and were detected by Missouri Motus stations. Six species detected are listed as PIF Common Birds in Steep Decline including Black Tern, Common Tern, Rusty Blackbird, Common Nighthawk, Bank Swallow, and American Tree Sparrow. Monitoring and continuing research of these species provides crucial information for conservation efforts, and the expanding Missouri Motus network provides necessary infrastructure to support such projects.

### *American Kestrels from Minnesota*

An example of the effectiveness of the Motus’ ability to reveal the length of migratory stopover times in the state was observed through the detections of a particular American Kestrel that was tagged as part of a project by Minnesota Department of Natural Resources funded by the CSWG led by MDC. The noted individual was first detected on September 7, 2022, at the Purdin station in northern Missouri and gathered a total of 16 detections between 4 different stations before its final detection on September 21, 2022. Not only was this the most recorded detections of a single individual in the state of any species to date, but it also informs us of a 14-day stopover in northern Missouri before continuing its journey south.

### *Canadian Swainson’s Thrushes*

Another fascinating aspect of Motus is its ability to allow us to better visualize how far and by which paths some of these species’ travel during their spring and fall migrations. Tracks created by Swainson’s Thrush tagged by the BC

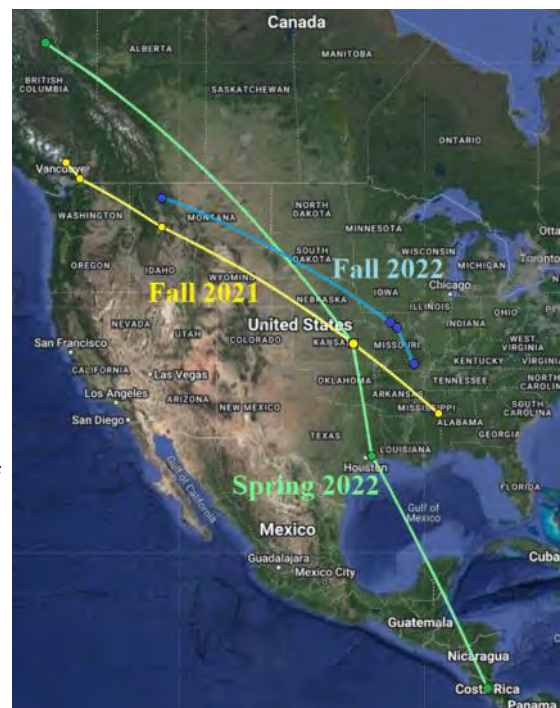


Figure 10. Fall and spring migratory detections of a single Swainson's Thrush tagged in British Columbia, Canada. Motus.org

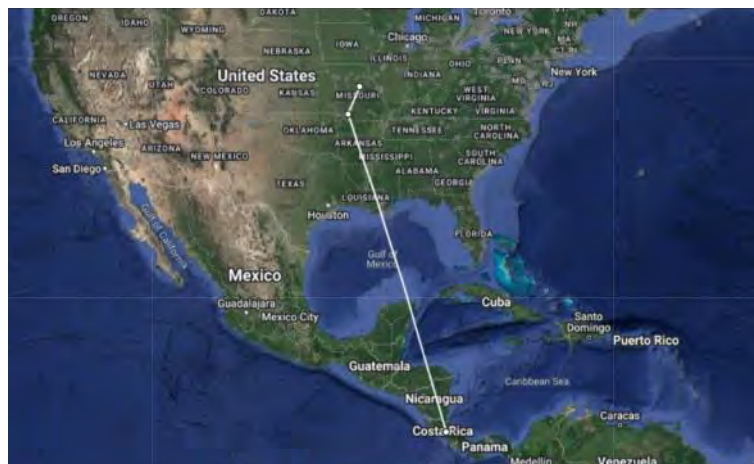


Interior Thrushes Project are a great example of a species detected in Missouri to reinforce our understanding of the amazing feats these birds are capable of (Figure 10). These data allow us to make more informed decisions regarding management and conservation actions by identifying key areas used for breeding, wintering, and migratory stopovers to help declining populations of species across the country and beyond. As the Motus network expands through the addition of receiver stations, these tracks will become more and more precise along with the direction of future conservation efforts.

## CSWG Golden-Winged Warbler and Wood Thrush Tagging

As a result of the aforementioned USFWS CSWG funding, SELVA and MDC deployed 50 Motus tags on 25 Golden-winged Warblers and 25 on Wood Thrush on their wintering grounds pre-spring migration 2022. The strategy for tagging these birds pre-migration was to increase the probability of later detections as the tagged birds move north toward a more robust network of Motus receivers in the U.S. and Canada on spring migration. USFWS Migratory Bird Biologist and previous MDC State Ornithologist, Sarah Kendrick, traveled to Costa Rica in early March to assist SELVA’s Nick Bayly, Ernesto Carman, and Paz Irola in this tag deployment effort. Over the course of that week of Sarah’s visit, five Wood Thrush and four Golden-winged Warblers were tagged. The remaining tags were deployed by Nick, Paz, Ernesto, and other project partners in the following weeks.

On May 2, 2022, one of the male Golden-winged Warbler that was tagged by the group was detected at the Hurley station in the Missouri Ozarks (Figure 11). A week later, on May 9, the same bird was detected at the new Columbia Motus station placed in honor of Brad Jacobs by the Columbia Audubon Society and MDC. Jacobs was the previous ornithologist at MDC and a major advocate for investing in full annual cycle conservation, especially by state agencies via AFWA’s Southern Wings Program; Jacobs passed away in May 2020. This Golden-winged Warbler (Figure 11-12) that Kendrick had helped process and tag months earlier, was the first detection on the Jacobs station



**Figure 11. Pathway of Golden-winged Warbler detection on the Columbia Motus Station. Tagged on Mar. 5 in Costa Rica, detected on May 2 at Hurley station and May 9 at Columbia station. Motus.org**



**Figure 12. This male Golden-winged Warbler was tagged in Costa Rica by SELVA and MDC and later detected on two Missouri Motus stations, including Columbia on May 9. Motus tag seen on the bird at right. Sarah Kendrick**

in the town that Kendrick lives in and where Jacobs lived. It's mind-blowing that the first detection on a station placed in honor of Jacobs, who dedicated decades of his life to supporting migratory birds, was a bird that his MDC ornithologist predecessor tagged in part due to his years of inspiration.

Not only are these detections incredibly coincidental, but they also give us data on a seven-day stopover on spring migration for this bird. The bird stopped in Missouri, likely in Ozark forests, to refuel and regain energy along its journey north. Along with this individual, three other Golden-winged Warblers from this small sample of 25 tagged birds were detected by Missouri Motus stations. Another goal of Missouri's two latitudinal Motus arrays is to capture potential movements of birds through our contiguous blocks of Ozark forest that we suspect are serving as stopover habitat for forest birds. These detections (and others) on our Motus stations are helping us to validate these assumptions with data. These detections also provide further evidence that the more Motus stations you have across the landscape in strategic arrays, the more we can learn about migration ecology and the more tags will be deployed across that network together.

Even though none of the 25 Wood Thrush tagged during this project were not detected in Missouri, the documented detections during their migrations provided us with interesting insight. Wood Thrush are large enough to carry a tag with a battery that lasts a full year across their annual migratory cycle. This means that not only were we able to track their spring migration into the north-eastern U.S and onward, but also their return migration south in the fall. Tracks of eight of these 25 tagged Wood Thrush show strong regional migratory connections to the northeastern states or southeastern Canadian provinces (Figure 13). Incredibly, within the returning tags detected across the eastern U.S. during the fall migration, it was documented that two individuals were detected back at the site where they were tagged the previous year in Costa Rica. This entire effort, especially the site fidelity of some individuals, is a great example of how Motus can be used as a tool as we continue to learn about species' migration and full annual cycle bird conservation.

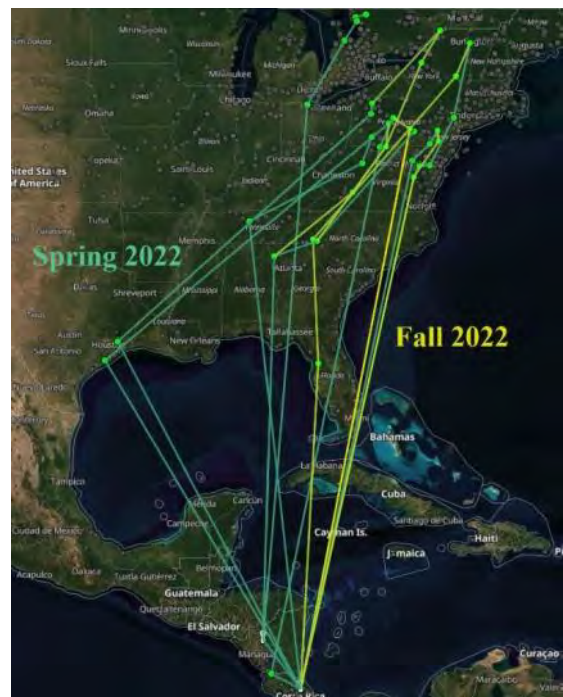


Figure 13. Motus detections of eight Wood Thrush tagged by SELVA and MDC. Motus.org

## Current Work as of March 2023

With the outstanding support of MDC, USFWS, and contributions to an MCHF account from Burroughs Audubon Society, Missouri Birding Society, Columbia Audubon Society, and Greater Ozarks Audubon Society, SELVA is conducting a project this winter 2022-23 to collect the first-ever data on overwinter survival of Cerulean Warblers on shade-grown coffee farms and mature forest using local tracking with Motus tags to fill a key knowledge gap for this declining species. Not only will this initiative provide insight into the wintering movements and habitat selection of Cerulean Warblers, but it will also expand our knowledge of the species full annual cycle migration as the tagged birds are detected northward as they leave their wintering grounds. As of mid-April 2023, the first Cerulean Warblers had begun to migrate north

from these tagging sites on the wintering grounds in Colombia – three individuals have been detected on Costa Rican Motus stations so far.

As an expansion and extension of the 25 Golden-winged Warblers tagged as a part of the 2020 CSWG, SELVA tagged 50 Golden-winged Warblers prior to their spring 2023 migration from wintering sites in Costa Rica with support from MDC and USFWS. This is a species with high vulnerability due to small population and range, high threats, and range-wide declines. In fact, the species is slated for a USFWS Species Status Assessment to assess potential endangered species listing in 2025. The more data we can collect about this species' migratory pathways and survival pre-migration will inform potential listing decisions and future conservation efforts to slow the species' decline. Our fingers are crossed for these birds' detections this spring 2023.

## Future Work

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The insightful Wood Thrush tracks from the 25 birds tagged as part of the CSWG (Figure 13) have led to the current coordination of a large-scale Motus-tagging project on Wood Thrush led by Sarah Kendrick (now U.S. Fish and Wildlife Service) deploying up to 600 tags on this species across both the breeding and wintering ranges with international partner SELVA. This project's findings will inform research questions to tie breeding and wintering populations from across the species' range, learn more about survival rates across all stages of this bird's life cycle, investigate population-specific differences in migratory timing and routes (to then target habitat work and conservation efforts along those routes), among others. Kendrick is actively working with states, Canadian provinces, and regional and international bird-conservation groups to encourage participation in this study across the species' breeding range in over 20 states and six countries. Stay tuned for updates!

Many thanks to the widespread support of Motus in Missouri and beyond. A special thanks goes to MDC for taking a chance on investing in Motus technology over the last five years, giving a huge boost to Midwestern Motus network growth, and continuing their support. The USFWS and MDC are excited to continue this work to learn more about Neotropical migrants collaboratively.

## Motus Resources to Learn More

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### *Motus Wildlife Tracking System*

- [motus.org](https://motus.org)
- Explore Motus projects, tags, and receiver data.
- Learn about active projects and read recent publications.
- Access Motus Guides for deploying receiver stations, tags, and analyzing and visualizing data.

### *Midwest Migration Network*

- [midwestmigrationnetwork.org](https://midwestmigrationnetwork.org)
- Keep up to date with the latest Motus news in the Midwest.
- Connect and collaborate with other professionals working with Motus in the Midwest.





## *Motus: Primer and Progress in Missouri, the Midwest, and Neotropics Recorded Webinar*

- [Search for “YouTube Missouri River Bird Observatory Winter Learning Series 2023 – Motus Bird Tracking” or click the link.](#)
- An hour-long recorded presentation by USFWS Migratory Bird Biologist and Midwest Regional Motus Coordinator Sarah Kendrick in winter 2023 as a Motus update for Missouri, the Midwest, and tagging efforts mentioned above.

## Literature Cited

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