DESMAN 2026 PROJECT PROPOSAL

Where did they come from, where did they go? The mystery of shrike migration.

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Introduction

The eastern loggerhead shrike (ELOSH; *Lanius ludovicianus migrans*) is a migratory subspecies of loggerhead shrike, a predatory songbird endemic to North America (Steiner *et al.* 2024; COSEWIC 2014). Historically, ELOSH were found in open grassland habitat from Manitoba to the Maritimes, but have been extirpated from much of their range (Steiner *et al.* 2024; COSEWIC 2014). ELOSH are listed as endangered in Canada, with fewer than 20 breeding pairs remaining in two populations in Ontario (Hess 2026; COSEWIC 2014; Environment Canada 2015). Since 2003, Wildlife Preservation Canada (WPC) has coordinated a recovery program for ELOSH. Recovery actions have included captive breeding and release, population monitoring, and habitat stewardship. However, these efforts have been primarily within the species' breeding range in Ontario due to a fundamental knowledge gap: the migration route and overwintering sites of ELOSH that breed in Ontario is currently unknown. For conservation efforts to be effective, it is crucial to understand migratory movements so that ELOSH can be protected during all phases of their annual cycle (Hallworth and Marra 2015; Hill and Renfrew 2019; Ng *et al.* 2018). This study proposes using a novel radio-transmitter to identify ELOSH migration routes and overwintering sites to better inform ELOSH conservation action.

Background

North American bird species are in crisis. An analysis of 529 species in Canada and the United States found a net loss of 2.9 billion birds since 1970 (Rosenberg *et al.* 2019). Grassland birds had the highest total population loss of over 700 million birds, and 74% of species are declining (Rosenberg *et al.* 2019). This mirrors the results of the State of Canada's Birds report (Birds Canada and Environment and Climate Change Canada 2024), which found grassland bird populations have declined by 67% since 1970, more than any other group. Migratory birds are also facing declines, with a net loss of 2.5 billion birds across 419 species (Rosenberg *et al.* 2019).

Migratory birds present a unique challenge to their conservation. To conserve migratory species effectively, it is crucial to know where they spend their time outside of the breeding season (Hallworth and Marra 2015; Iverson *et al.* 2023; Hill and Renfrew 2019; Ng *et al.* 2018; Macey *et al.* 2026; McIntyre *et al.* 2026). Population dynamics are influenced by factors at all phases of the annual cycle (Figure 1), and understanding migration ecology can help identify drivers of decline outside the breeding range (Hill and Renfrew 2019; Ng *et al.* 2018; Chabot *et al.* 2018; Macey *et al.* 2026). However, migration ecology is poorly understood for many species of migratory songbird, and research is critically needed to further inform conservation efforts (Hallworth and Marra 2015; Macey *et al.* 2026; McIntyre *et al.* 2026).

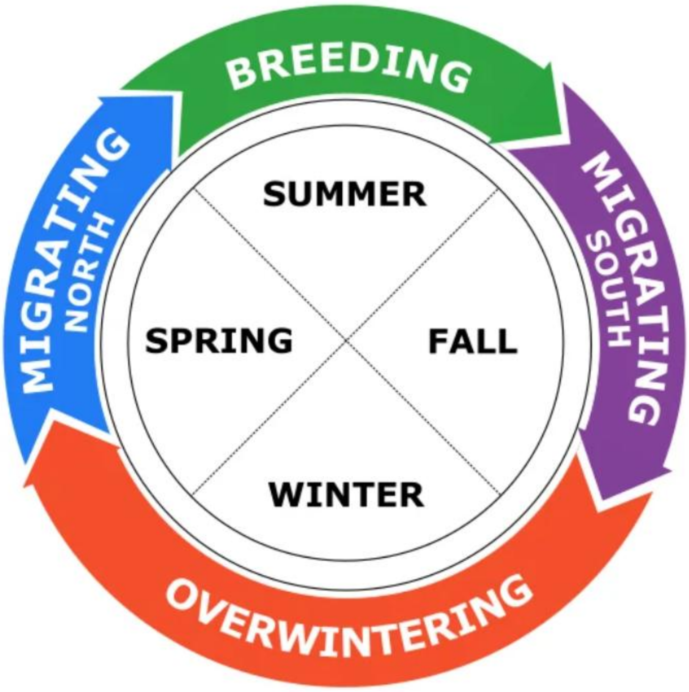

Figure 1: The full annual cycle of a migratory bird. The annual cycle is divided into 4 phases: breeding season, fall migration, overwintering, and spring migration. Birds may use different habitats, behave differently, and face different threats or challenges during each phase of their annual cycle. The experiences an individual has in one phase may carry over to the next, possibly impacting reproduction and survival. To effectively conserve migratory species it is crucial to understand their migration ecology so they can be protected during all phases of their annual cycle (Hill and Renfrew 2019; Ng et al. 2018) [Figure credit: Smithsonian's National Zoo & Conservation Biology Institute].

Historically, methods to study bird migration have included banding, radio-telemetry, light-level geolocators, GPS, and satellite transmitters, each with their own advantages and limitations (Table 1; Hallworth and Marra 2015; Iverson *et al.* 2023; Taylor *et al.* 2017; Macey *et al.* 2026). However, new technology has improved the capabilities of radio-telemetry trackers (Taylor *et al.* 2017). The Motus Wildlife Tracking System (Motus) is a network of automated receiving towers managed collaboratively by Motus members (Taylor *et al.* 2017; Birds Canada 2024). Motus receiving towers detect signals from radio transmitters on tagged animals that pass within range of the tower. What is unique about Motus is that the tags transmit on a single frequency, so they can be detected by any receiver in the network (Taylor *et al.* 2017). This is useful for bird species that are too small for GPS tags but require spatially and temporally accurate location data over long distances, such as ELOSH (Taylor *et al.* 2017).

Table 1: A comparison of the advantages and limitations of different methods used to track migratory bird species.

Method	Advantages	Limitations
Banding	• Cost effective • Small size	• Relies on band resights which are typically low • Can provide information on individuals at different locations, but does not provide details on route
Traditional radio-telemetry	• Small size • Temporal and spatial accuracy • Don't need to retrieve tags to download data	• Restricted to local and regional movements • Requires intense field effort • Limited number of individuals and time that can be spent tracking • Human presence can alter animal behaviour
Motus radio-telemetry	• Small size • Temporal and spatial accuracy • Don't need to retrieve tags to download data • Detections throughout the Motus network	• Can only detect animals that pass within range of a tower with the correct frequency • May be gaps in the receiver network
Light-level geolocators	• Small size	• Need to retrieve the device to get data • Poor location accuracy
GPS	• High location accuracy • Some devices can transmit data so recapture is not necessary	• Size prohibitive • Expensive • Archival devices need to be retrieved to get data
Satellite	• High location accuracy	• Size prohibitive • Expensive

Conservation efforts for ELOSH have focused primarily on the breeding range in Ontario, but limiting factors during migration and overwintering could be driving population declines, as the availability of breeding habitat and fledgling success in Ontario suggest ELOSH may be facing more significant threats outside this area (Steiner *et al.* 2024; Nichols *et al.* 2010). However, little is known about ELOSH migration ecology. WPC has been using radio transmitters on captive bred shrikes since 2014 to try to identify migration routes and wintering sites, but minimal detections have been received outside of Ontario, possibly due to a lack of receiving towers or unusual migration paths (Steiner *et al.* 2024; Hess 2026; Imlay *et al.* 2010). Additionally, wintering ranges of migratory shrike populations overlap with resident populations, making it difficult to distinguish migrants from residents in southern ranges (Figure 2; Chabot et al. 2018). Preliminary results from banding, tracking, and genetic studies have suggested ELOSH may overwinter along the Atlantic coastal states and within the Mississippi Alluvial Valley (Steiner *et al.* 2024).

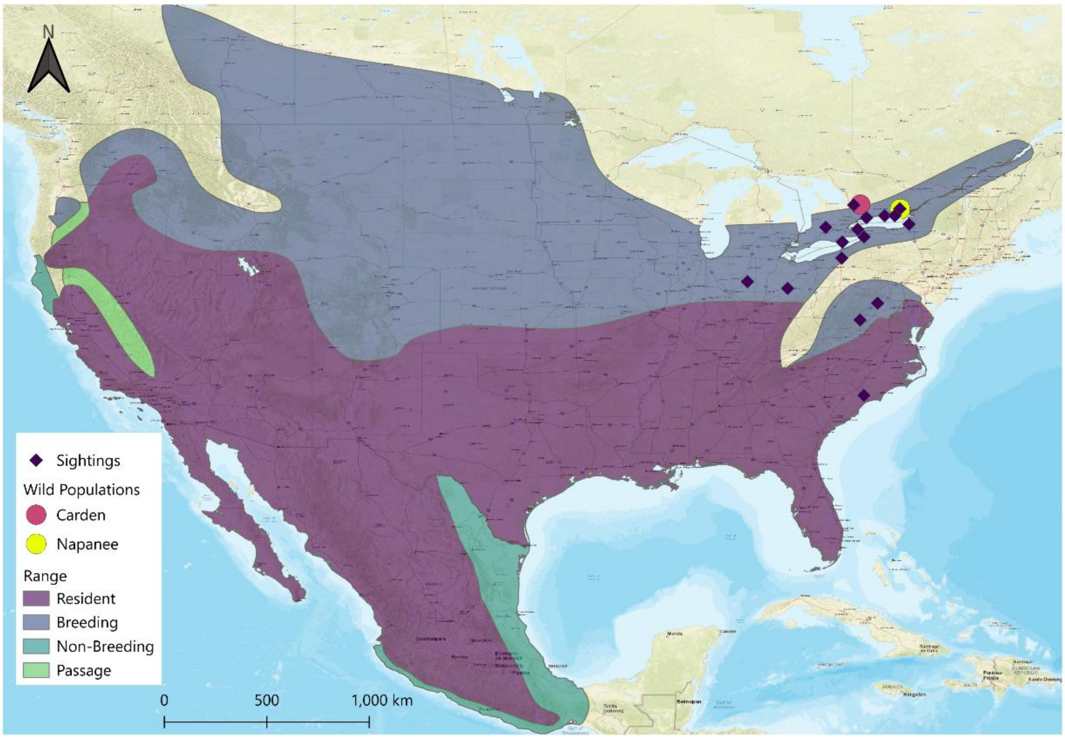

Figure 2: Loggerhead shrike (L. ludovicianus) *range extends from southern Canada throughout the United States to Mexico (Yosef and Pandolfino 2026). Of the 11 subspecies of loggerhead shrike, only two are found in Canada; ELOSH and the prairie subspecies (*L.l. excubitorides) (*COSEWIC 2014; Yosef and Pandolfino 2026). All Canadian populations of shrikes are migratory and overwinter within the range of resident shrikes (Chabot et al. 2018). Loggerhead shrike subspecies are indistinguishable in the field, making it difficult to determine if individuals are migrants or residents in the southern range during the winter (Steiner et al. 2024; Chabot et al. 2018). The two remaining Canadian populations of ELOSH are found in Carden and Napanee in Ontario (Steiner et al. 2024). Very few ELOSH from these populations have been detected outside of Ontario; colour band resightings since 2016 are depicted on the map. [Range map data ©BirdLife. Sightings and wild population data from WPC. Base map ©ESRI].*

This study proposes the use of a new radio-transmitter by Cellular Tracking Technologies (CTT), CTT BlūBird, in an effort to identify ELOSH migration routes and overwintering sites. CTT BlūBird uses the Motus network but has incorporated Bluetooth technology and can use iOS devices as passive receivers, greatly increasing the detection network. This is the first year these tags are available for birds, and with additional Bluetooth capability they have the potential to increase tag detections exponentially. To date, radio transmitters have only been deployed on captive-bred ELOSH; this study also aims to deploy transmitters on wild-hatched ELOSH in tandem with captive-bred individuals to evaluate the influence of captive breeding on migratory behaviour.

Overall Goal

Improve the understanding of ELOSH migration ecology and identify what factors are driving population declines to better inform conservation efforts throughout ELOSH's annual cycle.

Specific Objectives

- Deploy CTT BlūBird tags on both captive-bred and wild-hatched juvenile ELOSH to identify possible migration routes and overwintering sites.
- Determine how far ELOSH migrate and how long it takes them.
- Identify how much time they spend in each phase of their annual cycle and where they are spending that time.
- Compare results between captive-bred and wild-hatched juveniles to see if captive breeding influences migration pattern.

Methodology

Breeding Season

ELOSH captive breeding will take place at captive breeding partner facilities using existing protocols. WPC staff will monitor wild populations in Napanee and Carden for breeding and fledgling success using existing WPC protocols.

Release Preparation

Once captive-bred ELOSH are moved to soft release aviaries they will have a period of acclimation before release. During this time CTT BlūBird radio-transmitters will be attached to a maximum of 50% of birds for release. Additionally, a maximum of 50% of wild-hatched birds will also receive radio-transmitters as they meet tagging requirements. Soft release conditioning, tagging, release, and monitoring of ELOSH will follow existing WPC protocols.

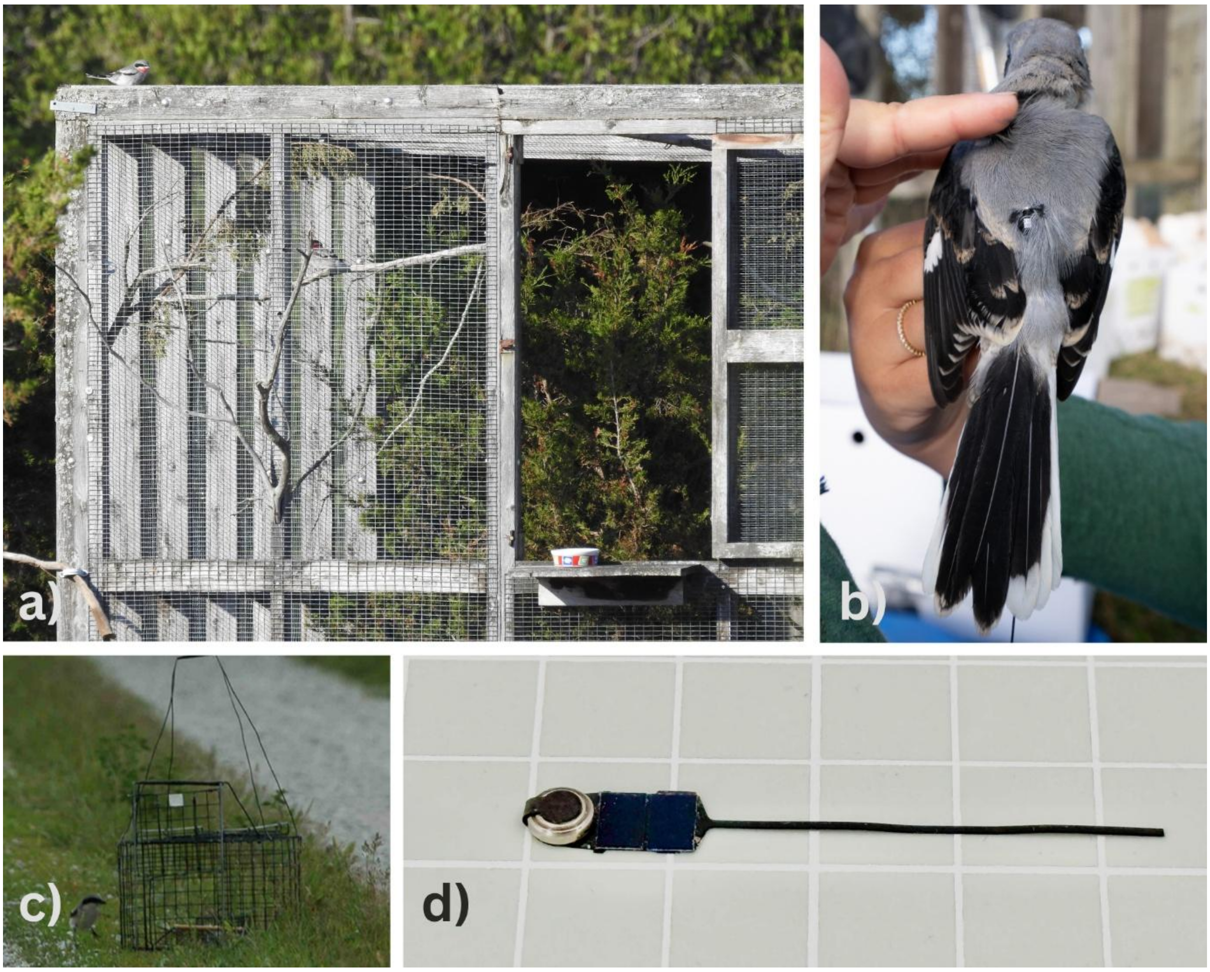

Figure 3: Captive-bred ELOSH are moved to soft release aviaries (a) in Carden or Napanee once they are independent from their parents. They spend 1-2 weeks in the aviaries to acclimate to the environment before they are released. While in the soft release aviaries, the birds will be banded and tagged (b), and given additional time in the aviaries before release to ensure the tags are not causing any injury or discomfort. Wild-hatched ELOSH will be trapped using double-door walk in traps (c) and banded and tagged. Post-tag monitoring of wild birds will occur to ensure the birds have resumed normal behaviour. CTT BlūBird radio-transmitters (d) will be attached using the Rappole & Tipton figure-8 leg-loop harness technique WPC has used since 2015. Per banding permit restrictions, the total equipment weight (bands, tag, and harness) must not exceed 3% of the bird's body weight. Working with a minimum body weight of 50g, equipment weight must be a maximum of 1.5g. All trapping, banding, tagging, and monitoring activities will follow existing WPC and North American Banding Council protocols. [Figure credits: a) WPC, b) WPC, c) NABC, d) CTT].

Data Collection

After tagged ELOSH have been released, their location will be tracked by tag detections via Motus Stations and iOS-based devices. Detections from Motus Stations are processed and accessed via the Motus Database, while detections from iOS-network devices are accessed through the CTT Blū+ Data Portal.

Data Analysis

Migration data will be downloaded from the Motus Database and CTT Blū+ Data Portal. Data received will be loaded into GIS software to visualize the locations of detections and map migration routes and overwintering sites. Once ELOSH have returned to the breeding grounds the following spring, a full analysis of fall migration route, overwintering range, and spring migration route can be completed.

Following methods based on Ng et al. (2018) and Hill and Renfrew (2019), fall migration will be defined as the first detection >50km in a southern direction from the release site to the last detection before they stopped moving southwards. Spring migration will be defined as the first detection >50km in a northern direction following the overwintering period. Overwintering range will be defined as areas of clustered detections between the end of fall migration and the start of spring migration. Stop over sites will be defined as repeated detections in a small area over a short period of time presenting as an outlier to an otherwise southerly (fall migration) or northerly (spring migration) journey. The exact parameters of these migratory movements will likely have to be identified after data has been collected and will depend on the detection rate.

Migration routes will be mapped in GIS software by connecting the points of consecutive detections. These routes will identify which areas ELOSH pass through during migration. Distance travelled will be estimated by calculating the distance of consecutive detections between the start and end of fall migration and start and end of spring migration for each tagged individual. Migration speed will be calculated as distance travelled divided by total number of days. Overwintering range will be analyzed using kernel density estimates to identify high use areas.

Finally, the data will be analyzed to determine if there is a difference in migratory patterns between captive-bred and wild-hatched ELOSH. The analysis will evaluate the differences in migration speed, departure dates, and arrival dates using a t-test. Migration route and wintering site differences will be evaluated using a proximity analysis in GIS software.

Project Schedule

Table 2: Project timeline showing the predicted schedule for each stage. Note there is overlap between the breeding season and release preparation stages as captive-bred fledglings will be moved to soft release aviaries as they reach the appropriate age and subsequently released throughout the breeding and release stages. Additionally, wild fledglings will be monitored, trapped, and tagged as they reach a large enough size to be tagged (~50g) but before they disperse from the nesting grounds. Though not included, the project may be repeated in Year 3 and onwards as the ELOSH program continues and more migration data is needed. Any additional radio tags required should be ordered in March of the deployment year to allow appropriate time for production and shipping.

TASK	Year 1												Year 2												Year 3							
	Jan	Feb	Mar	Apr	May	June	Jul	Aug	Sept	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	June	Jul	Aug	Sept	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	June	Jul	Aug
Breeding Season																																
Captive breeding				■	■	■										■	■	■														
Wild nest monitoring					■	■	■	■									■	■	■	■												
Release Preparation																																
Captive bred birds moved to soft release aviaries					■	■	■	■									■	■	■	■												
Order radio tags (2-3 month lead time)			■												■																	
CB juveniles banded and given radio tags							■	■	■										■	■	■											
Wild juveniles banded and given radio tags							■	■	■										■	■	■											
Release doors opened						■	■	■										■	■	■												
Data Collection																																
Fall Migration									■	■	■										■	■	■									
Overwintering											■	■	■										■	■	■							
Spring Migration													■	■	■										■	■	■					
Data Analysis																																
Receiving data during migration									■	■	■	■	■	■	■						■	■	■	■	■	■	■					
Post migration analysis																■	■	■	■	■								■	■	■	■	■

Expected Outputs

- Better understanding of fall and spring migration routes, stopover sites, and overwintering sites for for ELOSH
- Estimation of time spent in each phase of the annual cycle
- Identification of any differences of migratory behaviour between captive-bred and wild-hatched ELOSH

Expected Outcomes

- The results of this study can provide the foundation for future studies on ELOSH migration such as migration connectivity, stopover and overwintering habitat use and type, and flight behaviour
- The ability to assess potential threats to ELOSH throughout their migration routes and overwintering ranges
- The ability to better inform US collaborators on where to focus habitat management and protection for ELOSH during migration and overwintering

Resources Required

Table 3: Description of equipment and staffing required and expected budget for a 2.5-year project term. Note wage is subject to increase each year for staff but not accounted for in this budget. Including staff wages, the total estimated cost for this project is $188,527 CAD.

Item	Explanation	# Units	Price Per Unit (CAD)	Cost (CAD)
Staffing				
Reasearch Biologist	One year contract for a research biologist to oversee the project for two and a half years (#units = 1*2.5) at $28/hr.	2.5	$58,240.00	$145,600.00
Equipment				
CTT BlūBird Expanded Radio Tag	Radio-transmitters for migration study. "Expanded" tags come with Bluetooth connectivity and prepaid Motus registration ($20/tag). Number of tags assumes 25 captive bred birds will be tagged each year for 2 years, 6 wild-hatched fledgings tagged each year, plus a few extras (sold in USD).	65	$418.20	$27,183.00
Monthly data plan per tag	Expanded tags require a data subscription. # units = # tags * # months (25*24) (sold in USD)	600	$2.79	$1,674.00
CTT SensorStation	CTT tags require a CTT receiving station to be detected. Will need one tower for each field site (sold in USD)	2	$1,369.00	$2,738.00
LTE Connectivity	Add ons for CTT SensorStation (sold in USD)	2	$69.00	$138.00
1 year prepaid LTE data		2	$332.00	$664.00
Weatherproof case		2	$152.00	$304.00
12V30W AC/DC power adaptor		2	$35.00	$70.00
Cable Gland for BluSeries Receiver		2	$14.00	$28.00
BluSeries Receiver + 4 Antenna Kit and Mounting Bracket	Plug-in upgrade to allow CTT SensorStation to detect the new BlūSeries tags. Will need one for each field site.	2	$575.00	$1,150.00
Deep cycle battery	Power source required to power each SensorStations, for example: https://www.canadiantire.ca/en/pdp/motomaster-nautilus-group-size-24-starting-battery-1000-mca-0102495p.0102495.html	2	$210.00	$420.00
Other Resources				
Contingency Fund	5% additional funding for any unforseen expenses.			$8,977.45
			Staffing Subtotal	$145,600.00
			Equipment Subtotal	$33,949.00
			TOTAL	$188,526.45

Risks and Assumptions

Table 4: A summary of the potential risks and assumptions of this study, with a risk/assumption level rating (low, medium, high) and possible mitigation options.

Risk/Assumption	**Level**	**Mitigation**
Risk: Radio tags may impact survival, growth, and /or behaviour	Medium-High. There is conflicting evidence on whether tracking devices negatively impact birds or not. While several studies have reported no/negligible impacts of tagging on factors including survival, reproductive success, and overall health, other studies have found negative impacts that have reduced breeding success, caused entanglement and injury, reduced flight capacity, and increased energy costs (Geldart *et al.* 2022).	Radio tags are deployed following appropriate protocols and birds with tags are monitored in soft release aviaries for a week before release to ensure the harnesses fit properly and are not causing injury or discomfort. Wild birds should be monitored following tag attachment to ensure normal behaviour. Because the CTT BlūBird tags are new, it may be recommended to do a pilot study with captive-bred shrikes before tags are used on wild-hatched shrikes to assess their impact.
Assumption: Radio tags will transmit data accurately and not fail	Low-Medium: The CTT BlūBird tags are new (available for birds as of 2026) so few (if any) studies using them have been published, so their reliability is unknown. There are always risks of tech failures, however as these tags are new technology the expectation is they will work better than previous models of radio-transmitters.	Conduct a pilot study using the CTT BlūBird tags on a small cohort of released captive-bred shrikes to assess the tag's reliability.
Assumption: There are enough receiving stations (Motus and iOS devices) to detect tagged ELOSH	Low-Medium: Similar as above. Because these devices are new there may be fewer Motus towers on the appropriate frequency to detect them, or shrikes may not pass within close enough range to Apple devices.	Conduct a pilot study using the CTT BlūBird tags on a small cohort of released captive-bred shrikes to assess how frequently the tags are detected.
Assumption: WPC will receive appropriate permits to deploy radio-transmitters on wild-hatched ELOSH	Medium. WPC has previously received permits to band wild nestlings and continues to band wild adult shrikes, but as tagging is higher risk than banding and there is such a small population of wild shrikes, permits for tagging wild birds may be denied.	The study will continue with just captive-bred shrikes receiving tags, which can be used as a pilot study to test out method and tag efficiency. Wild-hatched shrikes can be included in future studies. Alternatively, known wild-hatched adult shrikes could be tagged instead of wild hatch year shrikes to potentially mitigate tagging risks.

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