# The Plight of the Loggerhead Shrike: A One-Plan Approach to Saving an Iconic Grassland Bird in North America

*Dr. Amy Chabot[1], Jessica Steiner[2] and Hazel Wheeler[2].*

*[1] African Lion Safari, 1386 Cooper Road, Cambridge, Ontario, Canada*
*[2] Wildlife Preservation Canada, 5420 ON-6, Guelph, Ontario, Canada*

The Loggerhead Shrike (*Lanius ludovicianus*) is one of only two species of shrike that occur in the New World, and the only shrike endemic to North America. The species utilizes a variety of shrub- and grassland habitats that vary from shrub-steppe in the western United States to unimproved pastureland associated with limestone plains in the eastern Canadian province of Ontario, to longleaf pine savanna in the southeast Coastal Plain (Pruitt, 2000). Shrikes breeding in northern portions of their range undertake short-distance migration to more southerly states and Mexico, wintering generally south of 47 degrees latitude (Yosef, 1996; Chabot et al., 2017). The wintering range is almost entirely encompassed within that of non-migrant conspecifics (Yosef, 1996; Chabot et al., 2017).

Many reasons have been cited as potentially contributing to the decline of the Loggerhead Shrike, including loss of habitat on the breeding and wintering grounds, pesticides, mortality associated with roads, adverse weather conditions and inter-specific competition (Yosef, 1996; Pruitt, 2000). It is likely that more than one factor is involved, potentially acting at different times throughout the annual life cycle. For example, adverse climatic trends on the breeding grounds may reduce nesting success, while road mortality may decrease the survival rate during migration, and climatic trends influenced by the North American Oscillation Index may lead to low over-wintering survival.

The breeding range of the Loggerhead Shrike prior to European colonization is unclear. The species likely expanded within northeast North America with the clearing of land for agriculture (Cadman, 1985). The shrike was considered to be common throughout the continent by the mid-1900s (Pruitt, 2000). However, by 1960 a declining trend had been observed in shrike populations throughout North America, but with the greatest contraction among migratory populations (Sauer et al., 2018). The species is now rare in much of its former range (Sauer et al., 2018), even where apparently suitable habitat still exists (Pruitt, 2000). The United States Fish and Wildlife Service considers the Loggerhead Shrike to be a bird of Conservation Concern and it is listed as a focal species in the State Wildlife Action Plans for 34 states (Natureserve, 2017). In northeastern North America, Loggerhead Shrike populations have declined precipitously to the point where the species is confined to a few small isolated populations. Until recently, conservation efforts were focused mainly in this portion of the species range, and in particular eastern Canada. Movement toward a full annual lifecycle focus and thus international collaboration is now seen as a priority.

## Summary of past work

*Taxonomic Reassessment*

Miller (1931) conducted the first comprehensive systematic treatment of *L. ludovicianus* and, based on evaluation of external characteristics from 1,878 museum specimens, recognized 11 subspecies with broad regions of intergradation that he attributed to gradual environmental gradients, lack of sharp geographic barriers, and migration. Conservation efforts in the northeastern portion of the species' range recently gained further importance after the finding that the Loggerhead Shrikes found in Ontario represent a distinct subspecies, provisionally, *L.l. alvarensis*, separate from the *migrans* subspecies, as they had previously been considered (Chabot, 2011). The presence of a distinct genetic subspecies in the northeast implies that the species may have occurred in this region prior

*Captive female on a nest from the Toronto Zoo. Photo by Kevin Kerr.*

to the early 1900s, likely inhabiting areas characterized by alvars and native tallgrass prairies (Vickery and Dunwiddie, 1997). The association of Loggerhead Shrikes with alvars and, more broadly, with the limestone plains of eastern Ontario is broadly recognized (Cadman et al., 1987; Cadman et al., 2007; COSEWIC, 2014). The unique alvar ecosystem (Reschke et al., 1999; Brownell and Riley, 2000) would have historically provided suitable habitat for shrike even prior to European colonization and clearing of land, exerting unique evolutionary pressures culminating in genetic distinction for this population. Though the historic range of this subspecies likely extended throughout much of eastern Canada, at this point the only substantial breeding populations of migratory *L.l. alvarensis* exist in Ontario. A multi-faced recovery program, coordinated by Wildlife Preservation Canada, is underway to prevent these populations from disappearing. This recovery program has several major initiatives, each having achieved substantial accomplishments, as detailed below.

*Wild Population Monitoring and Banding*

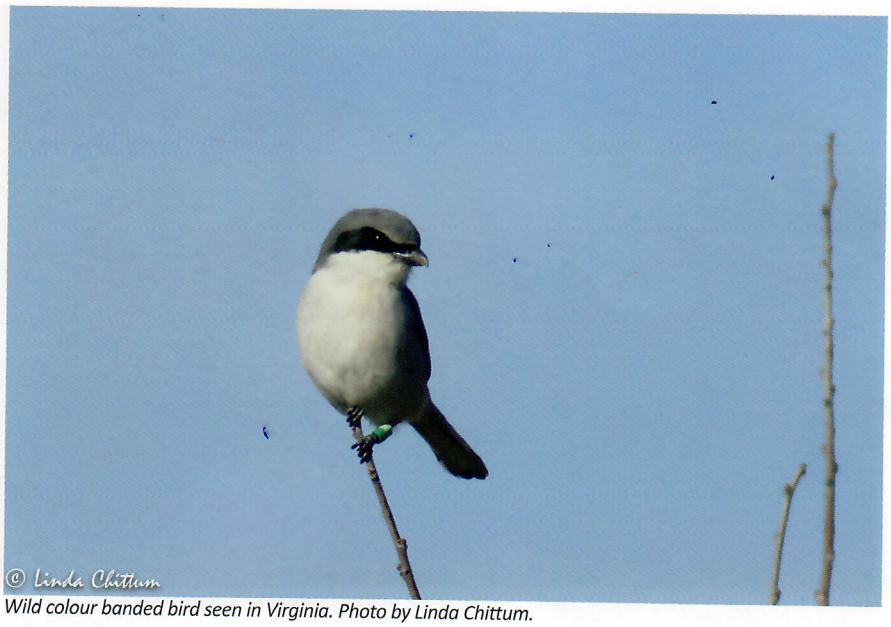
Over the last 20+ years, Ontario recovery partners have accumulated in-depth knowledge of population dynamics and demographics of *L.l. alvarensis*, which is essential for the formulation of an effective conservation plan. This information is shared annually with provincial and federal government agencies, and serves to guide decisions around habitat protection.

There has been a particular focus on banding and resighting individuals with unique color band combinations. Almost 350 wild Loggerhead Shrike have been banded since 2003, with 228 resighting records from subsequent years thanks to well-developed survey and monitoring protocols. Ontario's banding protocol has been adopted as the standard for the species by the North American Banding Council, available online (http://www.nabanding.net/other-publications/).

Threats to Ontario's breeding population are being assessed through applied research. The impact of contaminants has been studied through analysis conducted on eggs collected from failed nests from 2000-2013. Results found only low levels of contaminants (specifically, PCBs and other organochlorids, PBDEs, and mercury) that were not considered to have deleterious effects on reproduction (Hughes et al., 2015). The impact of nest predation is assessed on an annual basis, with data gathered on both mammalian and avian predators using remote nest cameras. While much suitable habitat appears to remain in the province, many historic breeding sites continue to remain unoccupied. A hierarchical habitat analysis has been conducted to assess habitat requirements at multiple scales, including nest tree, territory, habitat patch, and landscape, providing science-based guidelines for identifying, maintaining and/or restoring suitable habitat.

*International Collaboration – towards a full lifecycle approach*

In 2013 a group of state, provincial and federal representatives from both Canada and the United States came together and formed the North American Loggerhead Shrike Working Group (www.loggerheadshrike.org). The collaboration of scientists and managers involved in, or beginning to work toward, conservation of the Loggerhead Shrike in North America is focused on standardizing methods used across the continent and implementing coordinated broad-scale research efforts



*Wild colour banded bird seen in Virginia. Photo by Linda Chittum.*

for the species. To date, work has focused on developing standardized survey and monitoring protocols, completing broad-scale Species Distribution Modeling, and expanding the color-banding program to amass range-wide demographic data and information on dispersal and site fidelity.

The color-banding program has allowed new data to be obtained on the species' population dynamics. We now have evidence of long-distance (~900 km) mid-season movements, when a breeding bird banded in spring 2016 in West Virginia was observed in August of that year in Napanee, Ontario. The increase in Loggerhead Shrike banding activity in the U.S. has also increased the frequency of band resightings, with reports of birds in both spring and fall migration.

Collaboration with academic partners has focused on priority research questions, including Loggerhead Shrike detection probability with different survey methods, wild population health assessment, and continued refinement of subspecies ranges. Finally, the Working Group is piloting a citizen science initiative, the "Shrike Force", to engage private citizens in Loggerhead Shrike recovery across the continent.

The Working Group continues to expand, with each year bringing additional partners in new regions, as shown by growing attendance at each subsequent annual meeting.

*Conservation Breeding*

The conservation breeding program for Loggerhead Shrike is the only program of its kind for a migratory songbird. It has been recognized internationally as a model for breeding and reintroduction programs for songbirds (Kleiman and Lynch, 2008; Soorae, 2013), and has made a significant contribution to the scientific literature on the use of conservation-breeding in species recovery (e.g. Nichols et al., 2010; Lagios et al., 2015; Parmley et al., 2015; Imlay et al., 2017). Since 2001, 1,249 juveniles have been released, with an average return rate of 8.4% since 2012, when breeding was moved largely to partner facilities, rather than *in situ* field breeding (as described in Nichols et al., 2010). Conservation-bred juveniles have shown typical migratory behavior and high post-release survival rates, highlighting their potential to contribute to the wild population (Imlay et al., 2010). Captive-origin birds make a substantial contribution to the wild population in Ontario, with breeding pairs that include at least one captive-origin bird contributing up to 40% of wild fledglings observed in recent years. The captive colony of Loggerhead Shrike, and annual release of conservation-bred juveniles, has had a stabilizing effect on the wild population, and proven key to the persistence of the species in Ontario (Tischendorf, 2009, 2015).

In addition to directly supplementing the wild population, the use of conservation-bred birds in priority research has facilitated our ability to address knowledge gaps without increasing risk to the critically small wild population. Most notable is the use of tracking devices to identify migratory routes and wintering grounds of shrike breeding in Ontario, a key knowledge gap for the species. Tracking devices are deployed on a subset of conservation-bred juveniles released each year. Research to-date suggests there are two migratory routes for shrike in Ontario: one travelling around the eastern end of Lake Ontario, and one heading west towards Windsor. With constantly improving tracking technology, there is great opportunity for exciting developments as shrike are tracked out of the province and along migration routes. More broadly, data from the use of tracking devices on conservation-bred Loggerhead Shrike can aid in refining techniques for other songbirds; shrike data were recently used in a meta-analysis of the effects of geolocators on small birds (Brlík et al., 2019).

Though conservation breeding started in Ontario, several U.S. partner institutions are now housing and breeding shrikes for subsequent release, in an effort to increase program capacity. While the breeding and release program has helped stabilize the Ontario population, efforts must ramp up over the next several years in order to evaluate whether this tool can effectively recover the wild population. To do so, the program is looking for additional partner institutions to help at least double the size and output of the captive population, which now releases over 100 birds a year. Interested institutions should contact Wildlife Preservation Canada for further details on how to get involved. In addition to being involved in the breeding program, there are opportunities to contribute to outreach and education, research, and fundraising.

Increased U.S. engagement in Loggerhead Shrike recovery is underway, in part through partnership with Conservation Centers for Species Survival (C2S2) and its members. Currently, all young produced at U.S. partner intuitions are transferred to

Ontario for release. While the benefits of using the Ontario captive population as a source for conservation breeding and release in the U.S. would be invaluable, further research is needed to determine if the current captive colony is genetically suitable to be used as release stock elsewhere, or whether new or hybridized colonies are warranted, e.g. in areas where introgression occurred historically.

## Recommendations for Future Efforts and Ways to Participate

Despite the dedicated recovery efforts to date, the Loggerhead Shrike population in northeastern North America remains critically low and the species continues to exhibit declines over the majority of its range. However, the program is still relatively young, and the successes that the Loggerhead Shrike Recovery Program has achieved in Ontario over its first 20 years are substantial: a tremendous amount of knowledge has been gained, and momentum created for future recovery efforts. But more work is needed, with a potential for engagement of new partners in both *ex situ* and *in situ* communities.

*In Situ Research*

Loggerhead Shrikes are not well detected through roadside Breeding Bird Surveys, so a species-specific monitoring program is required to maintain the quality of the data collected. These data are important to evaluate recovery activities, protect critical habitat for the species based on site occupancy, and prioritize areas for habitat enhancement and restoration. A Population Habitat Viability Analysis is needed on the subspecies-scale to determine where sufficient habitat exists to support a viable population of Loggerhead Shrike in eastern North America, with results used to guide future recovery efforts and recovery targets. Activities should be undertaken to ensure sufficient demographic and habitat data is collected to inform management decisions, specifically: surveys of areas where probability of the species occurrence is high based on results of Species Distribution Mapping conducted by Working Group members; monitoring of breeding activity to assess lifetime reproductive success and habitat factors influencing nesting success; and identification of returning banded birds to determine if they are wild source, or captive bred.

*Captive-bred juvenile being banded. Photo by Lydia Dotto, ImageInnovation Photography.*

*Conservation breeding*

A healthy and viable captive population must continue to be maintained and managed to meet existing recovery goals and arising demands. The size of the captive population should be increased to allow a doubling of release output, increasing the speed of recovery and positive impact on the wild population. An increase in capacity will also supply more birds to be used in identification of migratory routes and wintering grounds, and allow experimentation with alternative release techniques for re-establishing populations in historic cores, without compromising existing release efforts. The captive population may also become an important source of release stock for conservation efforts in areas of the subspecies' U.S. range, and new partnerships with U.S. facilities interested in conservation breeding will be an integral part of those efforts.

*Habitat stewardship and public outreach/engagement*

Habitat stewardship must continue, with development of stewardship projects guided by results of the Population and Habitat Viability Analyses, to ensure sufficient habitat exists at the landscape level to achieve recovery goals. Projects should also be used to engage and raise awareness among landowners of the species' need for "heritage farming" practices. In many areas, the majority of habitat is privately owned, so landowner engagement is imperative for species' recovery.

*Research to address priority knowledge gaps*

While limiting factors should continue to be evaluated on the breeding grounds (e.g. nest predation, disease, environmental instability), we must also look at what could be contributing to declines outside of the breeding season. Coordination of efforts to share information internationally among jurisdictions is a priority. In particular, research should be supported to address identification of wintering grounds and migratory routes, dispersal of birds among breeding grounds, the interaction between migratory and resident populations, and the origin of immigrants into small isolated populations. Efforts should work toward the ultimate goal of gaining a better understanding of the full annual lifecycle of the species.

## Conclusion

Range-wide recovery of the Loggerhead Shrike will require the collaborative efforts of multiple stakeholders across North America. Many opportunities exist for engagement in shrike

recovery, integrating both *in-situ* and *ex-situ* recovery activities. For more information on becoming involved in the recovery efforts, please contact Amy Chabot (achabot@lionsafari.com) or Hazel Wheeler (hazel@wildlifepreservation.ca).

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