2021 Eastern Loggerhead Shrike Recovery Program - Summary Report

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1.0 COVID-19 PROGRAM IMPACTS

Though 2021 was closer to a typical season than last year, certain projects and initiatives related to the LOSH Recovery Program continue to be impacted by the ongoing COVID-19 pandemic.

1.1 Conservation breeding and release program

The conservation breeding and release program was able to return to (relatively) normal operations in 2021: cross-border transfers we able to proceed, there were not as many staffing restrictions at facilities, and vaccines were introduced which allowed WPC staff to work together closely to apply radio tags and train seasonal staff. African Lion Safari was still understaffed for the season, which affected the amount of time staff could spend monitoring breeding pairs, performing nest checks, and observing fledgling behaviours. The National Aviary was also prepared to take on a breeding pair for the spring but had to delay bird acquisition due to pandemic-related restrictions. New release enclosures were set to be erected in Napanee with the assistance of Nature Conservancy of Canada volunteers, but the project has been postponed to next season given the government's recommendations for social distancing at the time and the inflated price of lumber (see Section 4.4.4).

1.2 Wild population surveys and monitoring

Field staffing returned to typical levels this year, with teams of two in Carden and Napanee starting at the beginning of May, and all contract work for solar developments progressing on pre-pandemic timelines. Implementation of the volunteer Adopt-A-Site program was the only area that was still heavily affected by the pandemic, as the province implemented an "Emergency Brake" on April 3 that encouraged residents to limit their travel outside of the home. As the majority of volunteers typically surveys habitat patches that are outside of their local area, we decided to again suspend the Adopt-A-Site program for 2021. The few volunteers that did have sites in their vicinity did conduct some early season surveys, but effort was greatly diminished from a typical year.

1.3 Public education and outreach

No in-person events occurred this year, but program staff did deliver several online presentations about the program. See Section 5.0 for details.

2.0 HIGHLIGHTS FROM THE 2021 FIELD SEASON

Wild population

24 wild pairs (14 in Napanee, 9 in Carden, 1 in Smiths Falls)
76 wild young fledged (50 in Napanee, 26 in Carden)
1 unmated single bird
At least 13% of all birds detected in the wild this year were captive-bred

Captive population

26 initial pairs, and 7 repairing attempts
12 pairs fledged young
59 fledglings survived to release or retention (7 died during the field season)
19 fledglings retained
40 fledglings released; 12 with radio tags

Status of the captive population (as of October 25, 2021)

70 birds in captivity
66 breeding adults
1 unreleasable non-breeding bird
3 hand-reared education birds (2013HY bird at Carolina Raptor Centre, 2014HY bird at Toronto Zoo, 2020HY bird at Smithsonian Conservation Biology Institute)

3.0 WILD POPULATION

3.1 Monitoring

Twenty-four pairs of Loggerhead Shrike (LOSH) were confirmed in Eastern Canada this season: 14 in Napanee, 9 in Carden, and 1 in Smiths Falls (Fig. 1). The Napanee pair count increased over 25% compared to 2020, and Carden more than doubled. Staff effort was admittedly limited in 2020, especially in the Carden region, so while comparisons to last year's population counts might be viewed with a level of skepticism we also see the same increases when comparing 2021 results to 2019 (where 11 pairs were seen in Napanee, and 5 in Carden). This is also the third consecutive year that a pair was observed in the Smiths Falls core, and in fact this pair was found on the same habitat patch that was occupied in 2020.

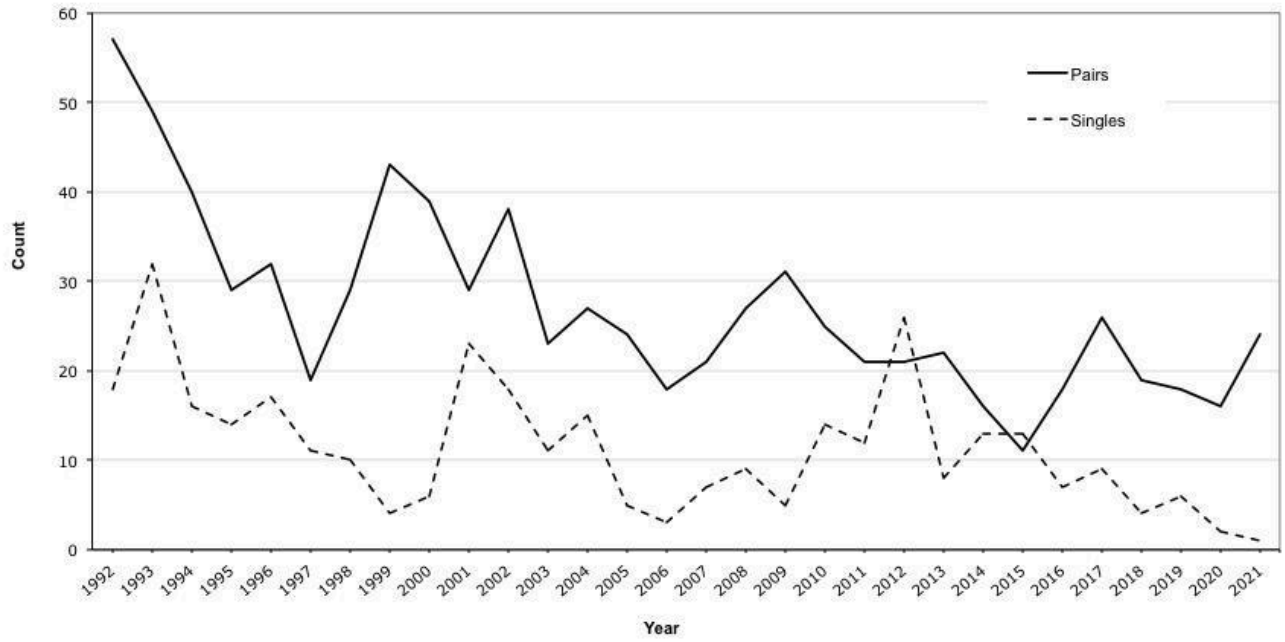

Figure 1. Number of Loggerhead Shrike pairs and single birds in eastern Canada

All pairs observed in Napanee this year fledged young, as did all but one pair in Carden, with a total of 76 fledglings observed (50 in Napanee, 26 in Carden); this is almost doubles the recent low count of 34 fledglings observed in 2019. This count may be attributed to a high nesting success rate in Napanee (89% vs. 70% in Carden) along with a relatively high proportion of successful double-broods in that core. Double-brooding has been a somewhat uncommon occurrence in past decade, only seen in 2019, 2016, and 2012; however, 21% of females observed in Napanee this year successfully double-brooded, and those females (three individuals) accounted for 20 of the fledglings seen in the

region. One additional female may have successfully double-brooded, but the outcome of the second nest was unclear from monitoring observations.

The average number of fledglings produced per successful nests was also higher this year (3.17) than in 2020 and 2019 (2.93 and 2.43, respectively). As with most years, the observed fledgling count may be an underestimate, as some pairs nested on sites that were inaccessible to field staff, making detailed observations difficult. Further, some family groups were located after the young had already fledged, and fledgling counts tend to decrease with time after leaving the nest as the young get more mobile, thus more difficult to detect.

The breeding status and outcome of the isolated pair in Smiths Falls was again unknown this season, despite WPC staff presence in the region. The pair was observed twice in late April by local community members, with only a single bird seen sporadically thereafter. The habitat patch where the birds were seen was surveyed extensively by WPC staff, but a shrike was only observed once on July 8. The persistence of the bird in the region, along with the sporadic nature of the sightings throughout the season, suggests that nesting may have occurred on a nearby site, with the target patch used as foraging habitat. This is the second consecutive year that a pair of birds has been seen on this site.

In addition to breeding pairs, transient single birds were seen on six occasions from May 16 through to July 31, when birds would typically be breeding (Table 1). Notably, only one of these transient singles was seen in an established core (Napanee), with the rest in areas where shrikes are typically only seen during migration.

One bird, seen on May 16 in Tommy Thompson Park in Toronto, can be deemed a transient migrant with reasonable certainty given the location, as a shrike that remained in this heavily-trafficked urban park would have been reported on future dates. The remaining sightings, excluding the one in the Napanee core, were in locations where little suitable habitat exists, and the ultimate fate of these birds is unknown as they were only seen for 1-2 days.

All of these occurrences were either of unbanded birds (5 sightings) or band status was unreported (1 sighting), making it impossible to determine the exact number of individuals. The birds seen at Tommy Thompson Park (May 16) and in Napanee (June 2) could reasonably have been the same bird, and may have bred in Napanee as there was one late nest in the core where it appears an unbanded male replaced a banded bird as a member of an established pair in late June. The bird seen near Goderich (May 31) could be counted as an independent single, but the remaining sightings through the season are spatially and temporally spaced such that none of them can be called independent with confidence. Therefore, despite the various sightings, only one single bird is being counted in 2021.

Using conservative counts of confirmed pairs and single birds, and counting two of the Napanee pairs as having the same female but different males, the observed LOSH population in Ontario was 48 adults this year.

Table 1. Single birds observed in 2021

Location	Nearest city/town	First reported	Days present	Band status	Confirmed LOSH
Tommy Thompson Park	Toronto	May 16	1	UNB	Y
Huron County	Goderich	May 31	1	UNB	Y
Nap177L	Napanee	June 2	1	UNB	Y
Dufferin County	East Garafraxa	June 29	2	UNB	Y
Huron County	Seaforth	July 27	1	Unk	N
Lambton County	Sarnia	July 31	1	UNB	Y

3.1.1 Returning captive-bred birds

Six captive-released birds were confirmed returning to Ontario breeding grounds this year (Table 2). These captive-origin birds made up 13% of the population of adult shrike in eastern Canada. Five of these birds had confirmed breeding with wild mates, producing at least 15 fledglings (20% of all wild juveniles seen in Ontario); however, one of these pairs was on a site where observations were complicated due to limited site access, so this number may be an undercount. The remaining bird, which was observed on the same territory in the Smiths Falls core for the second consecutive year, was only seen with another individual twice in late-April, and both of those observations were by local volunteers. All other sightings, which were sporadic, were of just one bird, so breeding was never confirmed.

Four of the returning birds were confirmed as 2019-releases, two of which were not seen in 2020 so brings the cumulative return rate for that cohort to 10.9% (up from 7.8% in 2020). One bird was a radio-tagged 2018-release that had also not been observed in Ontario in the intervening years; that cohort's cumulative return rate is now 7.7% (up from 6.9% in 2019). This radio-tagged bird was only detected locally in Carden just after release in 2018, so we have no further data on where this bird may have been between release and it's discovery in Ontario this year, but it is notable that it was relocated in Napanee rather than in it's release core.

The final captive-origin bird had only a metal band, so individual identification was not possible. However, this was likely a bird released with a radio-tag, as some tagged birds released from 2014 to 2019 were given only a metal band due to weight restrictions. The other possibility is that this bird removed all of its colour bands, but loss of all bands has become a rare occurrence. Unfortunately this bird could not be trapped as it was on a property to which staff did not have access.

Table 2. Captive-bred birds observed in 2021

Core	Band combination	Hatch year	Hatch site	Release site	Sex	Paired?	Breeding outcome
Carden	SI/LG:OR/GY	2019	MRC	Carden	F	Y	4 fledglings
	SI (L)	U	U	U	M	Y	5 fledglings
Napanee	DB/SI (L)	2018	TZ	Carden	M	Y	4 fledglings
	SI/LG:DB/DG	2019	MRC	Napanee	M	Y	3 fledglings
	SI/LG:WH/OR	2019	TZ	Napanee	F	Y	1 fledgling[a]
Smiths Falls	LG/SI:OR/DG	2019	NZG	Carden	U	Y	Unknown[b]

[a] Aggressive bull on property limited site access, so this may be an undercount

[b] Pair observed by volunteers, but only a single seen by WPC staff; nest location and breeding outcome never determined

3.1.2 Nest checks

Eight nest checks were performed this year (five in Napanee, three in Carden). All of the Carden checks were spurred by nest failures; details of those can be found in Section 3.1.3.

The five nest checks in Napanee occurred at three nest sites. The first (Nap177N) was a nest that was suspected failed on June 25 due to inactivity at the nest tree. A check performed by Amy Chabot on June 30 found an empty nest, so it was thought predated at the nestling stage; however, two fledged young were observed on this site on July 2, so this nest was in fact successful, just on a different timeline than estimated by field staff.

Two nest checks occurred at Nap221A, the first of which was to inform trapping attempts, and revealed two eggs on July 2. This nest was relatively inactive afterwards, and a second check on July 23 revealed an empty nest (see Section 3.1.3). Unfortunately there was no follow-up monitoring conducted by field staff the day after the check on July 2 (as per field protocols) and monitoring was generally infrequent at this site, so it is unknown exactly when this nest failed, and whether that July 2 nest check contributed.

The final two checks occurred at Nap130F-2, the first of which (July 15) was conducted by the Napanee field biologist because of a suspected nest failure, but this check found two 2-5 day-old nestlings. A second check on July 23 by Amy Chabot found three 10-14 day-old nestlings, and a nest with plastic twice incorporated in to the outer structure. Napanee has a history of nestling entanglements, so this twine was removed before Chabot departed the nest (but see Section 3.1.4 for details of plastics found in other nests). Two fledglings were later confirmed at this site.

3.1.3 Nest failures

Four nest failures were observed this season—three in Carden and one in Napanee—of which three were likely due to depredation. All predation events were inferred through the state of the nest, as no predator cameras were deployed this year.

The failure in Napanee occurred at a nest where two eggs were confirmed by a nest check on July 1, though it is unknown whether this was the full clutch or the check was done midway through laying. The position of this nest made it difficult for field staff to see if and when the female was incubating, but by mid-July there was a marked lack of activity and on July 23 the nest was confirmed intact but empty, suggesting avian predation had occurred in the intervening weeks.

Three failures occurred in Carden, affecting two nesting pairs. One pair had nestling on June 6, indicated by the female being off the nest and both adults making frequent prey deliveries, but no activity was observed at the next monitoring session on June 9. A nest check conducted that day revealed an intact but empty nest, suggesting an avian predator. This pair attempted to renest in the same location in late June, but the site was again unoccupied and inactive in early July. Three cold eggs were collected from this nest, which was likely abandoned following a heavy rain event where approximately 80 mm fell in the region over a four day period. No further nesting attempts were observed by the pair.

The final nest failure in Carden was at a site where the pair had built their nest relatively low in a hawthorn and with little foliage for cover. Nestlings had been easily visible by field staff during monitoring on June 29, so it was evident that the young were missing on the next visit on July 2. This nest was found in pieces on the ground with no nestling remains present, and some lower branches in

the nest tree were also broken; mammalian predation was thus inferred from the evidence at this nest tree.

3.1.4 Plastics found in nests

Plastics were incorporated in to seven of nine nests that were inspected in Napanee at the end of the field season. Materials found included plastic bailing twine (7 nests), synthetic stuffing (4 nests), and shredded plastic that appeared to be from a tarp (1 nest; Fig. 2). All nests with stuffing also had twine, and the nest with shredded plastic also contained both stuffing and twine. No juvenile entanglements were observed this year, though three young either died or had to removed from nests due to entanglement with plastics in past (Hudecki et al. 2021). Bailing twine, which was the most common plastic found in nests this year, presents the greatest risk of entanglement due to the length and strength of the fibres, so promotion of proper disposal of this waste material could have a positive impact on future nests.

The prevalence of synthetic materials in Napanee nests was high this year (78% of inspected nests, compared to 28% in 2013 and 13% in 2019), but this may be due to intentional searching for anthropogenic materials in nests, whereas in past the observations were more opportunistic. Nests will continue to be inspected at the end of each field season to look for plastics.

Figure 2. Nests in Napanee that incorporated plastic materials: bailing twine (top left), synthetic stuffing (top right), and shredded plastic (bottom)

3.2 Banding

Eight wild LOSH were trapped and banded this year, seven in Napanee by Amy Chabot, and one in Carden by Hazel Wheeler. Seven of these birds were adults in breeding pairs, and one was an independent fledgling. Additionally, one captive-origin bird was trapped in Napanee by Amy Chabot. This bird had only a partial band combination (DB/SI on left) as it had been released in 2018 with a radio-tag, so it was given a full colour band compliment upon capture this year.

All newly-caught birds were banded with SI/LB on right, to indicate wild birds caught in 2021. Regular behaviour was observed at all territories the day after trapping activities.

Following all trapping, 42% of the observed adult LOSH population was banded, but banded birds were heavily weighted towards Napanee (57% of adults banded), whereas Carden was overwhelmingly unbanded individuals (72% of observed adults). More intensive banding effort will occur in Carden next year to address this abundance of unbanded individuals.

Band status was confirmed for all but five birds. Two of these were a pair in Carden that was found on a property to which staff did not have access. This family group was found after young had fledged and they were fairly distant from the road, so adult band status could never be confirmed. In Napanee, two unknown birds were simply seen infrequently, and one was the mate of the unbanded adult that was found with fledglings on a property in Belleville in August. Though the nest was not located for this family group, the mate was assumed by virtue of the fledglings.

3.3 Development and critical habitat

3.3.1 Post-construction monitoring agreement with BluEarth Renewables

This year marked the third year of a five-year agreement with BluEarth whereby WPC would conduct surveys of two Loyalist Solar Project Generation Sites (SGS), and four Habitat Enhancement Sites (HES) to assess if and how LOSH use these HES, and the areas in and around the generation site infrastructure. This contract has generated approximately $22K per year in revenue for the past three years, which has help support field activities in the Napanee core. HES surveys will continue for two more years, with a contract fee of $20,500 for both years combined, but this was the last year of surveys on the SGS sites. A detailed final report on all results of SGS surveys will be completed by year's end.

This year of surveys again saw a high level of LOSH activity on Loyalist Solar properties, with three pairs nesting within 100 m of SGS perimeter fencing. All of these nests successfully fledged young, and family groups were observed using site infrastructure (panels and barbed wire fencing) and surrounding habitat for foraging. One pair that held a territory just west of Generation Site D (WPC patch: Nap221A) successfully double-brooded, producing eight fledglings between the two nests. Two additional pairs nested on HES, fledgling seven young between them.

One of the birds, a third-year male (RD/OR:OR/SI) from one of the HES pairs, also bred on the same site last year, albeit with a different female. There was another bird (SI/LG on right) that may have been a 2020 breeder returning to the same area, but as it had lost the bands on it's left leg that could not be determined without trapping the individual.

Full details of all activities related the Loyalist Solar Project can be found in the *Loyalist Solar Project – Post-construction Monitoring, Year 2021 Report*, available upon request.

3.3.2 Surveys and research with Kingston Solar

The Kingston Solar Project, undertaken by Samsung and completed in 2016, impacted two shrike habitat patches that met both provincial and federal criteria for Critical Habitat. As part of the Overall Benefit Permit associated with this project, WPC was contracted to release 40 captive-bred LOSH in Ontario (completed in 2016), and to survey two habitat enhancement sites (HES), established by Kingston Solar in consultation with the MNRF.

The original scope of work for this project included annual surveys of both HES for five consecutive years, beginning in 2016, as defined in the conditions of permit PT-C-009-13, issued under the *Endangered Species Act*, 2007. Though surveys were completed in 2016, there was an interruption in work from 2017 through 2019 (inclusive) due to a halt in communication from Kingston Solar, and surveys resumed in 2020. This interruption, as well as one of the HES becoming unsuitable habitat in the intervening years, meant that Kingston Solar LP was no longer in compliance with their permit requirements. Actions to bring the project back in to compliance were discussed in a meeting with Monique Charette and Kristina Hubert (MECP) in May 2021, and included:

1) Habitat restoration work to be completed on the low quality HES (HES-2) before April 2022, to create suitable habitat on the property for LOSH;
2) Five years of consecutive surveys on HES-1, to be completed in 2023 (including work already completed in 2020 and 2021);
3) Five years of consecutive surveys on HES-2, to begin in 2022 (following restoration) and ending in 2026.

WPC will continue with the HES survey work on these updated timelines, and habitat restoration work on HES-2 will be led by Kurt Hennige, an independent contractor in the Napanee region with extensive knowledge of LOSH and their habitat needs, and a frequent collaborator with, and past employee of, WPC.

Kingston Solar's permit also required them to fund research that would "contribute towards filling a knowledge gap for Loggerhead Shrike that is relevant for the protection and recovery of the species in Ontario". WPC proposed a research project that would ground-truth the results of the species distribution model (SDM), developed by Dr. Amy Chabot (African Lion Safari) and Dr. Stephen Spear (The Wilds, OH) that predicted the occurrence of LOSH based on habitat characteristics. The SDM was developed using mapping layers, but lacks any input from finer-scale microhabitat characteristics that require quantification on the ground.

The initial research proposal had fieldwork starting this fall and continuing next spring/summer, but the proposal did not receive MECP approval until August, at which point the window of opportunity had closed. The Lead Biologist therefore submitted an amended proposal that instead included fieldwork to be completed in spring and summer 2022, and the project reporting following in 2023. This change in timeline was discussed and accepted at a meeting with MECP and Kingston Solar reps on October 27. The current plan will use the winter LOSH contractor (see Section 7) to help develop the field methods for the project, with the intent of extending this position through next year to coordinate fieldwork and help with analysis and reporting. Full details of this research can be found in the proposal, *Identification of priority stewardship areas and required actions for Loggerhead Shrike Recovery in Ontario*, available upon request.

4.0 CAPTIVE POPULATION

4.1 Status of the captive population

As of October 25 there were 70 birds in the captive population at partner facilities in both Canada and the U.S. Sixty-six of these birds are considered breeding stock, three are education/exhibit birds, and one is a non-releasable non-breeding adult, retained from the 2019 breeding season. The current breeding stock includes: 50 birds that are 5 years or younger (HY 2016-2021), 14 birds that are 6-10 years old (HY 2011-2015), and two over 10 years old. The two that are over 10 years old did not have any breeding success this past season so will most likely be retired in 2022. Nineteen juveniles were retained this year following a decrease in breeding stock from off-season mortalities at African Lion Safari, three of which have been found dead this fall, all likely due to capillaria-related issues (histology results are pending; see Section 4.3.2 for details).

4.2 Activities at partner facilities

4.2.1 Captive breeding summary

Twenty-six pairs (7 re-pairs) were introduced and given the opportunity to rear young across partner facilities. Twelve of these pairs produced 59 young that survived to release or retention (Fig. 2). Forty of these young were released into the wild at our field sites (23 in Carden, 17 in Napanee). Nineteen young were retained from high-priority pairings to rebalance losses sustained in the off-season (see Section 4.3.1). An additional four fledglings were retained in the captive population but died before the end of the season from various injuries and illnesses, and one fledgling was found dead in a field closure in Carden prior to release (see Section 4.3.2).

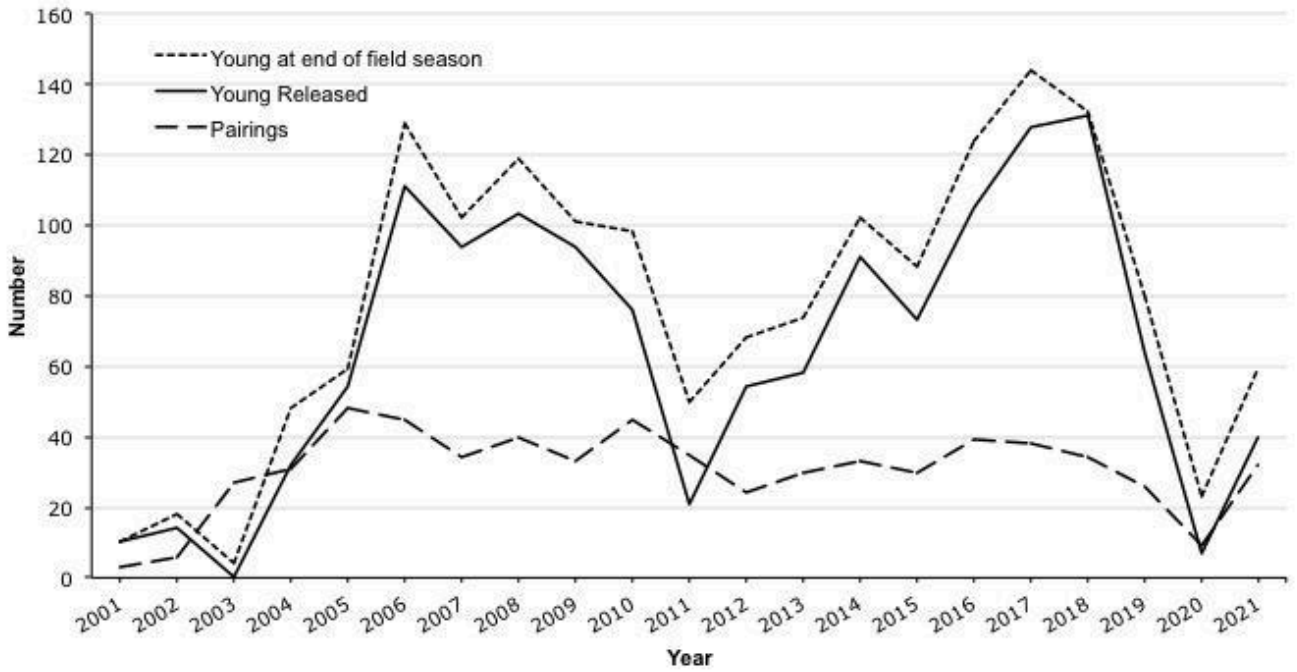

Figure 3. Captive LOSH pairings, young surviving to end of season, and young released

4.2.2 Breeding facility results and wintering status

Ontario Facilities:

***African Lion Safari (ALS)*:** 2 of 7 original pairings fledged 9 young this year (5 from a 2nd clutch after the 1st clutch failed, and 4 from a 1st clutch), two of which were retained, six released, and one died in the field before being released (see Section 4.3.2). Of the five original pairings that failed:

- Three consisted of 1-2 year-old birds with no previous breeding experience. Of these three pairs, two showed no interest in breeding and were therefore re-paired, and one pair built a nest but showed no further breeding activity.
- One pair consisted of a 4 year old female and a year-old male with no previous breeding experience. This pair was persistent and laid three clutches over the course of the season, all of which failed: clutch 1 eggs disappeared, clutch 2 eggs were found broken, and clutch 3 eggs disappeared along with the nest. The nest for clutch 3 was poorly built with little reinforcement and insulation at the base, and may have contributed to that failure (Fig. 4), but staff were reluctant to reinforce the nest since the pair appeared high-stress and each previous clutch seemed to fail soon after nest checks were performed. There were plans to attempt to reinforce the nest after a few days after the nest check if it wasn't abandoned, but the clutch along with the nest disappeared before such intervention. Staff will ensure their nest is reinforced at the beginning of next season if this male and female are paired together again in 2022.
- One pair consisted of a 15 year old male who has not sired offspring since 2018 as his mate died in 2019 before the breeding season. He and his new mate built a nest and exhibited some nesting activity but did not lay any eggs. This bird will likely be retired in 2022

Three re-pairings were made over the course of the season, all due to a lack of interest in breeding from naïve pairs (no aggression seen). Two of these re-pairing attempts were unsuccessful due to mate mortalities (see Section 4.3.1), and the third placed an original pair back together after their new mates died. Staff were hopeful the time apart might spark some interest in breeding, but no nesting activity was observed. ALS currently houses 24 breeding birds.

Figure 4. A poorly constructed nest of a pair at African Lion Safari

***Toronto Zoo (TZ)*:** 5 of 8 original pairings fledged 28 young (23 from 1st clutches, 5 from 2nd clutches); 10 were released in Carden, 5 were released in Napanee, and 9 were retained in the captive population. Two fledglings died before the end of the season (see Section 4.3.2). Three re-pairings were made over the course of the season, two of which were due to aggressive behaviour and one because of lack of interest. Two of the females involved in these re-pairings were old (one turning 10 and one turning 11), which is likely why they were not interested in their mates. The 11 year-old did lay eggs in 2020, so was paired this season as a last breeding opportunity, but will be retired in 2022. The 10 year-old was euthanized later in the season after developing a severe respiratory infection (see Section 4.3.1). Toronto Zoo is currently housing 16 breeding birds and one education bird on display.

U.S. Facilities:

***Smithsonian Conservation Biology Institute (SCBI)*:** 5 of 9 pairs fledged 29 young (14 from 1st clutches, 15 from 2nd clutches); 7 were released in Carden, 10 were released in Napanee, and 8 were retained in the captive population. Four fledglings died before the end of the season (see Section 4.3.2), three of which were set to be released but were held back due to various health concerns. Of the three pairings that failed:

- One laid a clutch of 7 eggs, 5 of which hatched. The entire nest was predated before chicks branched, and the pair did not re-nest before the breeding cutoff.
- One pairing consisted of a year-old male and 2 year-old female with no previous breeding experience. The pair laid a clutch of three eggs but abandoned their nest soon afterwards. The pair then built two other nests but did not lay any other eggs. The female was observed sitting on the second nest briefly but no other breeding activity was seen.
- The last was a proven pair who had been very successful in previous years, but the female injured her wing early in the season and had to be separated from her mate to recover. She was placed back with her mate and the pair was able to lay a clutch but the eggs were found to be non-viable. It is suspected that the pair was not able to copulate effectively due to the female's injury; her perching and flight capabilities will be re-assessed next season.

SCBI is currently housing 20 breeding birds and one hand-reared education bird.

***Nashville Zoo at Grassmere (NZG)*:** 0 of 2 original pairings (and 1 re-pairing) fledged young this year. One pair laid a clutch of 4 eggs but abandoned the nest after a severe weather event. The female of this pair then died in care (see Section 4.3.1). The male of the other original pairing died in care, so the remaining male and female were paired mid-season. Some nuptial gifts were offered but no other breeding activity was observed. Nashville Zoo is currently housing 6 breeding birds.

4.2.3 Non-breeding facility status

Carolina Raptor Centre (CRC): 'Pierce' (the hand-reared education bird raised at Mountsberg Raptor Centre) remains at CRC as a permanent education ambassador.

4.3 Mortality

4.3.1 Adults

We had 10 adult deaths in the captive population this year (as of October 25) and two deaths in the captive population in 2020 after the Recovery Team report was distributed in November. Nine of these deaths occurred at Ontario facilities and three occurred at a U.S. facility.

African Lion Safari: Three males and three females died at African Lion Safari in December 2020 through October 2021. One female was found dead in her enclosure in December 2020 after getting her leg caught between two pieces of wood in an outdoor enclosure overnight. No necropsy was performed as it was clear the bird died from stress and/or injury to her leg while attempting to free herself. Another male bird was found weak on the ground during morning rounds on May 26; when staff returned with a vet to assess the bird it was found dead. Necropsy results did not reveal any clear cause of death.

The remaining four deaths (two males and two females) were attributed to head trauma. A male was found dead with a dirty vent in its enclosure in December 2020; necropsy results revealed head trauma to be the primary cause of death (1 cm focal hemorrhage on skull), with many nematode eggs and adults (likely Capillaria spp.) seen in the esophagus. Days after this a second male was found dead after extensive treatment for poor flight, inappetence and a prolapsed vent. Treatment for this bird began on November 16th after staff noted the bird's abnormal behaviour (poor flight and non-responsive). Necropsy results revealed emaciation and a 1 cm hemorrhage over the skull, and suggested that either could have been the primary cause of death, though it is likely there was another underlying chronic disease or condition to explain the overall poor state of this bird. An additional two birds (both females) were found dead on the ground at morning rounds—one at the beginning of February and one at the end of May—and necropsies revealed head trauma in both cases.

Two of the birds listed above died in the Pod enclosures, one died in winter housing, and one died in a field enclosure: there is no clear pattern for where mortalities took place. Cameras were installed for close surveillance during the winter months in case wildlife was causing some disturbance and causing the captive birds to fly in to the walls of the enclosures, but no predators were captured on this footage. A screech owl was seen in March near the winter enclosures; efforts were made to attract and trap the owl to no avail.

Though it is still suspected that the head trauma fatalities above might be attributed to a local predator antagonizing the birds from outside their enclosures as there is no evidence of entry, nothing has been detected using camera footage and the fatalities have occurred across a fairly large area (field enclosures and winter housing/pods are about a kilometer apart). West Nile virus (WNV) cases can involve intracranial hemmorhaging (Harroud et al. 2020); this possibility was explored for the bird that died in late May in its field enclosure. WNV tests results were negative.

One individual was found to have severe plaque build-up in its nares when staff were administering routine spring vaccinations (Fig. 4). The bird was observed with some weakness in flight and was found to have bilateral swelling above each eye, and similar symptoms have been seen in cases of hypovitaminosis A according to ALS staff. Plaque build-up was removed and the bird received a course of vitamin A supplemental treatments, and it is still alive in the captive population. The swelling and bruising seen in this individual could appear similar to what pathologists might consider to be intracranial hemorrhaging, so it is suspected that head trauma cases might be more closely related to a vitamin deficiency.

A fledgling at SCBI was found with head trauma-like symptoms this summer, and a necropsy revealed severe capillaria loads that resulted in a secondary bacterial infection that possibly lead to the observed neurological behaviours. One of the adult trauma cases listed above was shown to have high burdens of nematodes in its esophagus upon necropsy, so it might be that high capillaria loads are causing abnormal neurological behaviours that could lead to birds injuring themselves in their enclosures. All possibilities will be discussed further at the LOSH Recovery Team Captive Subcommittee meeting this fall.

Figure 5. Plaque build-up in nares and mouth of an ALS shrike (left); bilateral swelling and hemorrhaging in the same bird (right)

***Toronto Zoo*:** Three females died at Toronto Zoo this year. One was found on the ground during morning rounds mid-April; necropsy revealed a serious case of bacterial ventriculitis. A 2011 HY female was euthanized in the summer after sustaining a severe respiratory infection, and the third female was found dead in early fall; necropsy results are pending.

Nashville Zoo at Grassmere: One male and two females died at Nashville Zoo this year. The male adult died after spring vaccinations; it was found upon necropsy that the bird hemorrhaged at the vaccination site. A female died later in the summer from aspergillosis one day after being introduced to her mate. A 15-year-old retired female was euthanized earlier this fall after a steady decline in health.

4.3.2 Fledglings

There were 10 fledgling deaths this year, 7 of which occurred during the breeding season and 3 in the post-season at overwintering facilities. The seven deaths during the breeding season amounted to a 10% mortality rate for juveniles up to release or retention, which is approximately on par with the average within-season mortality to date (11%; Fig. 5), Of the within-season deaths, one of these deaths was a bird hatched at ALS, two were hatched at TZ, and four at SCBI, as detailed below. Post-retention fledgling deaths occurred at ALS (1) and TZ (2).

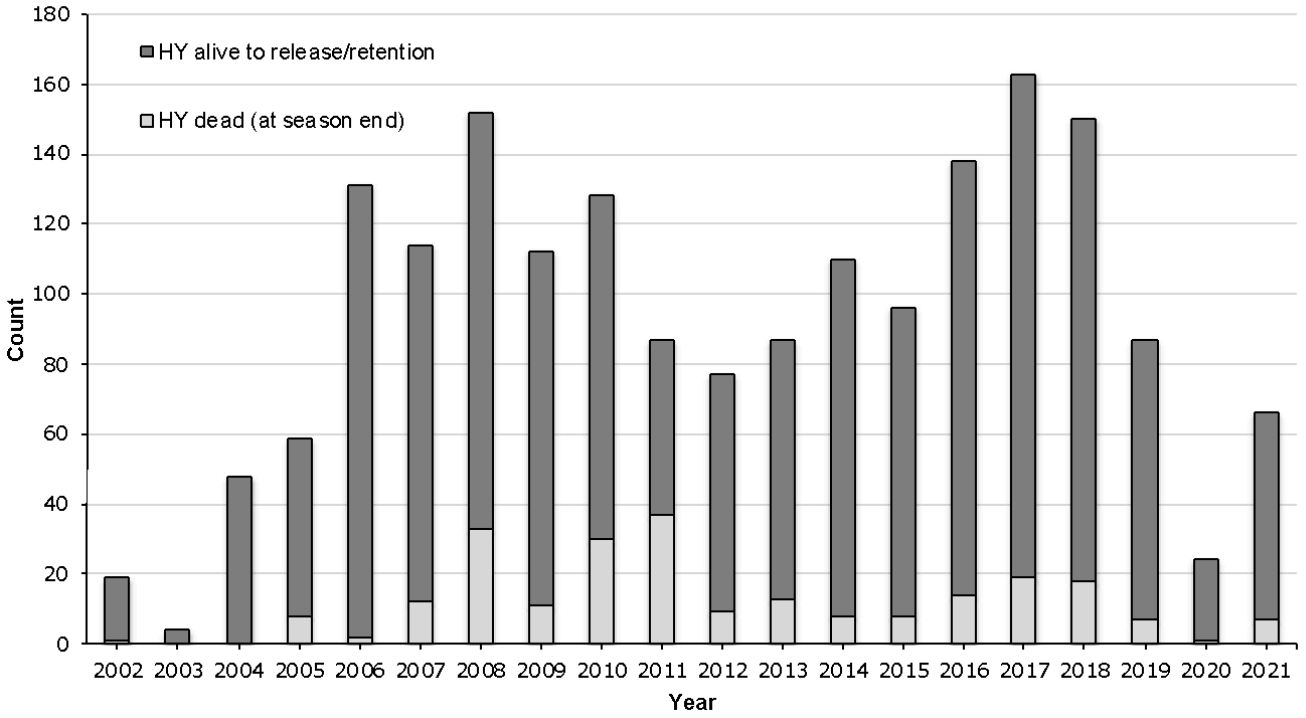

Figure 6. Annual number of fledglings produced that died or survived to release or retention

African Lion Safari: One fledgling from African Lion Safari died after transfer to the Carden release site, where it was found dead during morning rounds on August 13; preliminary necropsy resulted diagnosed unilateral conjunctivitis, but final necropsy results are pending. This individual was from a clutch that fledged a few poor-doers, two of which were deemed unfit for release and consequently retained, and one of those retainees was found dead at morning rounds on September 23. This fledgling exhibited poor flight and capture avoidance since branching and had a dirty vent and squeaky vocals at first catch-up. This individual was treated for capillaria and showed some improvement but progress was slow. A necropsy report is pending.

Toronto Zoo: Two fledglings from the same clutch died at Toronto Zoo during the breeding season. The first had sustained a leg injury from what appeared to be a feather wrapped around its tarsus (Fig. 6). The bird was newly fledged when the injury was discovered and still completely reliant on parents for food. Vet staff treated the foot but left the bird with its parents in the hopes that the leg would heal on its own. The fledgling died in care August 17; cause of death is suspected to be related to the injured tarsus but results are pending. The second fledgling disappeared from its enclosure; staff could not find a body or any evidence of a predatory event.

It should be noted that a nestling at the Zoo sustained a similar leg injury to the fledgling that died (Fig. 7). The bird became entangled in nesting material and sustained a severe stricture to its left leg and

died during recovery (though was not counted in fledgling deaths as it had not yet fledged). The material wrapped around its leg was a thin thread of plastic—originated from frayed black mesh lining on the bottom of its enclosure—which the parents had incorporated into their nest. Staff will take extra care next season to ensure that the plastic mesh lining is not accessible to breeding pairs.

The two retained fledgling deaths were discovered on September 27 during morning rounds. Prior to their deaths both birds had dirty vents and one was in poor body condition. Since both were scheduled for a fall deworming treatment but hadn't received their first doses yet it is suspected that the deaths might be related to high capillaria loads but histology results are pending.

Figure 7. Toronto Zoo fledgling with an apparent feather wrapped around its tarsus

Figure 8. Toronto Zoo nestling with plastic wrapped around its tibiotarsus causing injury (left); plastic filament that appeared to be from exposed mesh lining at the base of the enclosure (right)

Smithsonian Conservation Biology Institute: Four fledglings from SCBI died before the end of the season. One was found dead during morning rounds on July 12 with no remarkable injuries and its body was too deteriorated for a necropsy. Three others died from severe capillaria infections, two of which presented with poor flight and squeaky vocals. The third capillaria death was in a bird that was found on the ground of its enclosure with a head tilt, so was treated for possible head trauma. After death, necropsy revealed that the bird suffered a severe capillaria infection that resulted in a secondary bacterial infection that possibly lead to the observed neurological behaviours. Discussions on a modified HY deworming protocol will take place at the captive subcommittee meeting later this fall.

4.4 Captive-bred releases

4.4.1 Banding

Fifty-five captive juvenile shrikes received stainless steel bands this season (40 released young, 14 retained young, 1 young that died before release). Released birds that received colour-bands were given a combination that included either LB/SI (27 birds) or SI/LB (7 birds) on the left leg to identify them as a 2021 release bird. One bird was given a SI band only on its left leg and a full colour combination on its right leg owing to a scab that had formed on its left tarsus. Birds released with radio tags (12 individuals; see Section 4.4.2) were banded with the year combination on their left leg only (three released with SI/LB, four with LB/SI) if they received a size 1D SI band; radio-tagged birds that received a size 2 SI band (five individuals) did not receive any colour bands.

Young at the Smithsonian Conservation Biology Institute received colour-band identifiers only for transfer across the border since SCBI staff were not permitted to apply stainless steel bands. WPC personnel applied SI bands to the SCBI young once they were transferred to field sites for release. Colour-band identifiers were left on for the few SCBI young that were transferred to African Lion Safari

to be retained in the captive population; these birds will gradually and opportunistically receive SI bands by permitted staff as they are being handled.

We continue to encounter a “shrinking tarsus” phenomenon with juveniles, so several fledglings that were initially banded with size 2 stainless steel bands this year had to have them removed due to hallux abrasions. Although these bands were all applied well after fledging, tarsus widths decreased between the time of initial banding (when measurements warranted that size) and later band inspection. Size 2 bands will therefore be applied as late as possible (i.e. in the field instead of at a facility for a fledgling up for release) to prevent band removals, and any bird that measures size 2 will have banding delayed until the final inspection to be sure of appropriate sizing.

4.4.2 Radio tags

Twelve birds were released with radio tags on the Motus network this season (five in Napanee, seven in Carden) using the same nylon-coated elastic cord harness attachment technique used since 2015. No tags had to be removed. All tags applied were from a 2019 purchase by SCBI; these tags have a 10-month battery life, which creates the potential for detections on both fall and the subsequent spring migration.

4.4.3 Juvenile Transport

Several transport crates used this year were constructed with smaller gauge mesh than past crates, which resulted in severe bill injuries in fledglings transferred to released sites (Fig. 8). Three juveniles sustained broken maxilla tips and dented maxillas, and upon arrival at the Carden field site one of the transport boxes with this smaller mesh had a significant amount of blood smeared at the tops of the inside walls of each partition. It is suspected that the birds got their beaks caught in the mesh, and with the smaller gauge they were unable to get free without some breakage. These crates will be retrofitted with a larger mesh size to prevent future injuries.

Figure 8. New crates outfitted with a small gauge mesh (top left) resulted in broken maxillae in three juveniles (top right), as shown by blood in crate upon arrival at field site (bottom).

4.4.4 Napanee release cage construction

Plans were developed in 2019 to increase the number of release enclosures at the Napanee field site from two to four, using funding supplied by the Nashville Zoo at Grassmere (USD$5000) and African Lion Safari (USD$8891). The intention was to erect the enclosures in Napanee this spring with the assistance of Nature Conservancy of Canada volunteers, but due to inflated lumber costs and the government's recommendations for social distancing at the time panel construction has been delayed until the fall and/or spring of 2022. With the majority of the public now vaccinated and lumber costs decreasing, panel construction can hopefully begin this winter and the enclosure can potentially be erected in the spring.

4.5 Population management

Andrea Morgan (African Lion Safari) continued in her role of acting studbook keeper in 2021, and Colleen Lynch (Consulting Population Biologist with the Population Management Centre) was once again contracted by WPC to produce a Breeding and Transfer Plan for the season, including release prioritization and repairing recommendations throughout the breeding season. Jane Spero has access to the studbook and was able to assist Andrea with HY acquisitions from the breeding season earlier this fall.

4.5.1 Program capacity

Excluding holdings for education/outreach birds, holding capacity across all project partners heading in to 2022 will be 76 birds. The National Aviary was eager to house one pair for the spring of 2021 in a temporary breeding enclosure, but COVID-19-related restrictions once again prevented their involvement as a breeding facility this year, and also prevented them from taking birds this fall. Further details on new partners can be found in Section 4.5.2.

4.5.2 New partner facilities

Three potential new breeding partners that may be joining the LOSH program in the near future: The National Aviary (Pittsburgh, PA), Granby Zoo (Granby, QC), and Parc Omega (Montebello, QC). National Aviary and Granby Zoo both connected with WPC just before the pandemic, so momentum has stalled with them the past year, though both plan to participate in this LOSH Recovery Team meeting this fall, so hopefully new onboarding plans can be developed in 2022.

Parc Omega is a CAZA-accredited drive-through safari park in Quebec, similar in concept to African Lion Safari, but with a focus on North American wildlife. Parc Omega staff are currently reviewing information on the program and hope to schedule site visits to African Lion Safari and the Toronto Zoo in the near future to gain a better understanding of the program's requirements. This interest from Parc Omega creates the possibility of a Quebec breeding hub if both this facility and Granby Zoo are onboarded as breeding facilities. Both zoos are within a 4-hour drive of the Napanee release site, and given the consistency with which LOSH are showing up in eastern Ontario/Quebec in recent years, these two zoos could certainly help to increase visibility of the LOSH Recovery Program in the region.

4.5.3 Developments at existing partner facilities

African Lion Safari is considering installing a Motus tower on site, which would be a great contribution to the Motus network as African Lion Safari is currently in a 'dead zone' for tower coverage. Erecting a tower on-site could also offer opportunities for educating park visitors on the recovery program. Discussions on tower location and components are currently underway.

Toronto Zoo secured $30K in funding for upgrades related to the shrike conservation breeding and release program in the fall of this year. While discussions are still preliminary, the Zoo plans on using the funding to repair existing field breeding enclosures or to build a shrike pod using schematics from African Lion Safari. If funding is used to build a pod, Toronto Zoo will be able to increase their overwintering capacity by a third (if overwintering spaces in their shrike barn are still used).

The Toronto Zoo is still waiting to fill their vacant head vet position, at which point there should be more clarity on Toronto Zoo veterinary involvement in the LOSH program.

5.0 PUBLIC EDUCATION AND OUTREACH

5.1 Public presentations

The LOSH program was the subject of six public presentations this year, all on virtual platforms (Table 3). All presentations were well received with excellent feedback from collaborators and those in attendance.

Table 3. Public presentations delivered in 2021

Date	Host	Staff	Attendees	Description
Mar 25	Wild Ontario	Jane	40	Half-hour presentation on the LOSH Recovery Program for Wild Ontario volunteers
Mar 29	Fleming College	Hazel	25	Two hour guest lecture and Q&A for a Conservation Biology class about the LOSH Recovery Program; Instructor: Cori Carveth
Apr 27	Holy Trinity Catholic School	Jane	45	15 minute presentation and Q&A to grade 2 classes; topic: Growth and changes in Loggerhead Shrikes
Apr 28	Holy Trinity Catholic School	Jane	200	15 minute presentation and Q&A to lower school classes on WPC and the LOSH Recovery Program
May 20	Toronto Region Conservation Authority	Jane	75	One hour presentation and Q&A on the LOSH Recovery Program
Oct 24	Lakehead University	Hazel	25	1.5 hour guest lecture and Q&A on the LOSH Recovery Program to third year Environmental Studies students; instructor: Chase Moser

5.2 Media and Events

The LOSH Recovery Program was mentioned in the following media pieces:

- “Ontario government announces funding for shrike and turtle habitats in Lennox and Addington” (The Napanee Beaver, January 6, 2021)– press release on species at risk funding for Napanee region; both WPC and the LOSH Recovery Program are mentioned.

http://www.napaneebeaver.ca/2021/01/06/ontario-government-announces-funding-for-shrike-and-turtle-habitats-in-lennox-and-addington/. [Accessed October 21 2021]

- "Butcher of the Alvar" (Luke Fuendling, Ontario Nature, Spring 2021) – in-depth article on the LOSH Recovery Program by independent journalist Luke Fuendling, who attended a captive juvenile release in Carden in 2020. Hazel Wheeler is quoted and all captive program partners are mentioned. https://view.publitas.com/on-nature/spring-2021/page/30-31. [Accessed October 21 2021]
- "How do you raise a Loggerhead Shrike?" (Leighann Cline, Smithsonian's National Zoo & Conservation Biology Institute News, November 5, 2021) – online news article written by SCBI's shrike keeper about the captive-breeding process; WPC mentioned. https://nationalzoo.si.edu/center-for-species-survival/news/how-do-you-raise-loggerhead-shrike [Accessed November 5 2021]
- "Look, it's daybreak, dear, time to sing", a multimedia art installation by Richard Ibghy and Marilou Lemmens that features video of the Carden release site (filmed in 2018), is on exhibit at the Ulrich Museum of Art (Wichita KS), and is part of a group exhibition ("Eco-urgency: now or never") at the Wave Hill gallery in Bronx NY; both exhibits run from August to December.

6.0 HABITAT STEWARDSHIP

No habitat stewardship work was completed in 2020, so this year a few larger projects are underway or in the planning stages, Planning for stewardship projects is underway, with a focus this year on Napanee as several landowners with key areas of LOSH habitat have reached out about work that is needed on their properties. The following projects are underway or in development:

1) Vegetation management is being completed on a northeastern portion of Carden Alvar Provincial Park that is slowly being lost to succession (WPC patch: Car90D). This project was brought to WPC by a rancher in the area, Susan Winter, who runs her cattle on the property and has been monitoring the loss of grazing area on this site. Ontario Parks was amenable to the project, and mapped out an 89 ha area in which clearing could occur. The Lead Biologist met with Susan Winter, along with Ontario Parks staff (Jennifer Hoare, Scott Thomas and Phil Careless) and the contractor who is doing the clearing (James Munro) on September 24 for a site walkthrough and to decide on a smaller parcel within the 89 ha that would be the focus for this year. Thinning and brush piling began in early October and is ongoing, and Ontario Parks will burn the piles in late winter. Though this site hasn't had consistent shrike occupancy (there was a successful nest in 2008, a single birds seen nearby in 2009, 2010, 2014, and 2018), this clearing is occurring within 1 km of consistently occupied territories, so will expand the amount of high quality habitat in an important area.

2) A project was developed with Napanee landowner Scott Boese for winter 2019/20 that would have seen fencing installed around his 50 ha property to recommence grazing and control vegetation. All plans had been developed and were set to be implemented in late winter, but were halted due to the COVID-19 pandemic. This project has been picked up again this year though, with plans for completion this winter. The Boese property is not a mapped habitat patch, but had a successful breeding pair this year, another pair nesting just across the road in 2017, and is within 500m of other nesting territories. This will likely be the first of several projects that will be completed with this landowner, who owns several parcels in the area and is

very interested in wildlife. This year, he even attended a trapping session on his property that was led by Amy Chabot, and started a video call with his kids while the bird was in-hand.

3) The Nature Conservancy of Canada (NCC) has continuing maintenance needs on the Napanee Plain Alvar Nature Reserve that hosts the Napanee LOSH release site, and the adjacent Irene Ockenden Nature Reserve, which is a regular LOSH nesting site. They had planned to clear some woody encroachment on the Nature Reserve last fall/winter using funds from the Grassland Stewardship Initiative (administered by Forests ON), but that project was halted because of the pandemic, so will be implemented this year. There are also some fencing needs on both properties, including repair of the easternmost boundary fence, and installation of fencing around a small parcel of land at the north-east corner of the Irene Ockenden Nature Reserve. Discussions are ongoing as to which part of this work will be completed this year with WPC.

7.0 PROGRAM PERSONNEL

Field staffing returned to pre-pandemic levels this year, with teams of two in the Carden and Napanee cores. We also secured funding to have a short-term contractor conducting surveys in the Smiths Falls and Pembroke-Renfrew cores, in response to the small number of birds showing up in eastern Ontario/western Quebec with some consistency in recent years.

Field contracts were 5-months at maximum this year, whereas we typically have at least one biologist for 6 months. The one month decrease in contract length had a substantial impact on post-season work, as neither field biologist had time to complete their data entry, and several reports for the Napanee core were left unfinished. Fortunately funding was secured this fall to hire a contractor to assist with program activities to be completed over the winter, so these tasks will fall to the new hire, anticipated to start at the end of November. In addition to season wrap-up tasks (data entry, reporting), this position will also assist with organization of the Species Conservation Planning process for LOSH, and with the development of the field protocols for a research project to be completed next spring using funds from Kingston Solar LP (see Section 3.3.2). The intention is to secure further funding in the new year and ultimately extend this contract through to the end of next year, and have this person responsible for coordinating the Kingston Solar research, which will involve field work in Grey-Bruce/Manitoulin and Smiths Falls/Pembroke, and directing the Carden and Napanee teams in field work in their respective cores.

8.0 RESEARCH

8.1 New projects

8.1.1 Retrospective analysis of mortalities and necropsies in captive population

A small retrospective study on mortalities in the captive population is underway this year by Dr. Jordan Foxx (veterinary intern at Ontario Veterinary College) and supervised by Dr. Christopher Dutton (OVC). This analysis is of particular interest given recent head trauma cases; results will hopefully shed some light on these and similar mortalities seen in earlier years.

8.2 Ongoing projects

8.2.1 Migratory urge study

The impact of environmental versus genetic factors on the expression of migratory urge in Loggerhead Shrike became the basis of research by PhD student Alisa Samuelson at Queen's University last year. Work in the past year has focused on finalizing the methodology for video capture and analysis of captive shrike during the fall migration period at African Lion Safari. Based on results to date, collaboration may expand to all interested breeding facilities in Spring 2022. In Fall 2021, a pilot study was conducted at African Lion Safari in collaboration with researchers from Lund, Sweden and Dr. Guglielmo, Western University in which a small number of shrike for which video imagery was being taken also had an accelerometer and/or Motus tag attached. Data analysis from Motus tags is underway and looks promising as a methodology to monitor activity of shrike in enclosures. Accelerometers will be removed in the late fall/winter and returned to collaborators in Sweden who will download the data. Video imagery will be analyzed over the coming months, and data will be compared across platforms to determine efficacy, advantages and disadvantages of each method in detecting movements indicative of migratory urge. Movement data will be compared with environmental and genetic analyses to determine the influence of each of these factors on migratory behaviour in captive shrike. Collaboration with Dr. Kristen Ruegg was initiated in 2021 for DNA extraction and library preparation of feathers collected over a broad range of subspecies and populations (migratory and non-migratory). Low coverage (2-3x) whole genomic assays of feather samples will be completed in by end of 2021, and high (10-20x) coverage will be undertaken on a subset of samples from facultatively migrant populations where individual movements have been monitored by LOSH Working Group partners.

8.2.2 Diet analysis and food preference study

LOSH diets are being analyzed following discussions from the 2019 captive subcommittee meeting; progress was slow in 2020 due to communication challenges resulting from the pandemic. Discussions began again in early 2021 with Toronto Zoo nutritionists who reached out expressing interest in becoming involved: Toronto Zoo will take over from Mike Maslanka (Senior and Head Nutritionist for the Department of Nutrition Science at Smithsonian Conservation Biology Institute) to profile the caloric and nutritional content of facility diets and compare them to target ranges for the species. This analysis is of particular interest given several cases of vitamin A deficiency that have been seen in some breeding facilities. Discussions stopped over the breeding season this year but will get picked up again during the off-season. Methods for a food preference study were explored further at African Lion Safari this year: data collection will commence once video capture equipment becomes available (after its use in the migratory urge study)

8.2.3 Identification of wintering grounds and migratory routes

No juveniles were released with radio tags in 2020 due to low release numbers and efforts to maintain distance between staff because of COVID-19 (tag attachment requires two staff people to work in close proximity). As such, no new telemetry data were gathered for the 2020 cohort. There were also no additional detections for the 2019-release cohort after last year's reporting. However, a wild-origin LOSH banded in Napanee in 2020 (YE/WH:OR/SI) was resighted on February 21 in Tabor City, North Carolina. This bird was found trapped in the attic of an old farmhouse, and the person who found and caught it took a picture of the bands before releasing. This is the southernmost band resighting we've ever recorded for an Ontario bird, and might have elicited scepticism if not for the submitted picture.

No other banded birds were seen in the pre-season, but two recently released juveniles were spotted in Ontario during fall migration: a bird released in Napanee on August 1 was seen in Prince Edward County on August 27 (reported on eBird; exact location unknown), and another bird released in Carden on August 18 was seen in St. Catharines on September 3. The latter was a radio-tagged bird, confirmed through pictures, and it remains to be seen if it was detected on any telemetry towers to that point.

Twelve tags were attached to juveniles released this year. These are all tags that were purchased in 2019 and had a 10-month battery life, but after an extra year in storage they are unlikely to reach that lifespan. So far, one bird released in Napanee on August 14 was picked up on a tower in Brighton ON two weeks later, and it is expected that more detections will be uploaded through the winter.

Three tags remained undeployed at the conclusion of the 2021 field season, and these were given to a PhD student, Alisa Samuelson, who put them on captive LOSH at African Lion Safari as part of a pilot project to look at migratory urge (see Section 8.2.1). One other tag from the 2019 lot had malfunctioned in fall 2019 and as it still remained under warranty, Lotek will supply a replacement when necessary. This tag will be requested for the 2022 season, but more radio tags will also need to be purchased or acquired to continue this tracking project.

8.2.4 Genomic tools for species conservation and management

Several genomic tools are available for use in the management of the conservation-breeding colony of Loggerhead Shrike, including a suite of nuclear genetic microsatellite (MSAT) markers, Single Nucleotide Polymorphic (SNP) markers, Major Histocompatibility Complex (MHC) markers and a high quality genome, fully annotated to chromosome level. Research is currently underway as part of two BSc Honour's thesis projects, and a third informal multi-student project, all in collaboration with students in Dr. Vicki Friesen's lab at Queen's University. Topics of research are as follows:

- MHC data from founders, all breeders (2000-2016), and two cohorts of full family groups (2011 and 2016) to assess the relationship between MHC diversity and lifetime reproductive success. Allelic, genetic and functional genetic metrics will be correlated with fitness data (i.e. age at death, total number of eggs and total number of fledged young).
- SNP data is being filtered and assessed in relation to fitness metrics (lifetime reproductive success, age at death). Filtered SNP data is then being aligned to the genome and a small set of SNPs is being selected for further development into SNP chips. Chips will designed with specific analytical goals e.g. ancestry assignment, overall genetic diversity, etc.

8.2.5 Quantitative genetic techniques for species conservation and management

In addition to genomic tools being used for management, existing data is being analyzed using quantitative genetic techniques that allow measurement of plastic and evolutionary change in shrike phenotypes. Preliminary quantitative genetic results suggest that wild and captive populations differ in their morphology, evolutionary change is occurring in the captive population, and recruitment from the wild population reverses some of the evolutionary changes observed in captivity. An undergraduate student (Dominique Charland) at Queen's is currently leading the analysis to determine if selection in captivity might be driving some of the changes in morphology. A critical gap in knowledge is how captive individuals might be influencing wild phenotypes. Further sampling of genomic markers and phenotypes in wild and captive populations will expand these quantitative genetic analyses and

provide an understanding of how gene flow between them might influence phenotypes and fitness of wild and captive individuals.

8.3 Completed research

8.3.1 Presence and effects of parasites on captive breeding success in Loggerhead Shrikes

Isabelle Zimmermann (co-supervised by Albrecht Schulte-Holstedde and Gabriela Mastromonaco) successfully defended her MSc thesis through Laurentian University on the presence and effects of parasites on breeding success in Loggerhead Shrikes. Both Hazel Wheeler and Jane Spero attended (virtually). Results showed some correlation between age and capillaria loads but should be compared against wild individuals for the data to hold greater significance.

8.3.2 Endocrine correlates of fitness in captive-reared Eastern Loggerhead Shrikes

Josh Robertson completed his PhD this through Trent University. His original thesis was on determining endocrine correlates of fitness in captive-reared Eastern Loggerhead Shrikes using thermal imaging to quantify acute and chronic stress responses, but focus shifted to using Black-capped Chickadees and domestic pigeons as it was not feasible to film shrikes during a simulated stress exposure (e.g. capture) in a consistent manner without them becoming trap-shy. If this complication can be solved, Robertson's findings and techniques using thermal imaging could prove useful for future projects. Publications resulting from Robertson's work include:

- Roberston, J.K., Mastromonaco, G., and G. Burness. 2020. Evidence that stress-induced changes in surface temperature serve a thermoregulatory function. Journal of Experimental Biology. 223 doi:10.1242/jeb.213421
- Roberston, J.K., Mastromonaco, G., and G. Burness. 2020. Social hierarchy reveals thermoregulatory trade-offs in response to repeated stressors. Journal of Experimental Biology 223 doi:10.1242/jeb.229047

8.4 Manuscripts

The following manuscript was published this year:

- Hudecki, J., Wheeler, H., and A. Chabot. 2021. Evidence and Impact of Plastic Use by the Loggerhead Shrike (Lanius ludovicianus). Wilson Journal of Ornithology 132:729-733.

The following manuscript was submitted for publication in October and is under review:

- Sauve, D., J. Hudecki, J. Steiner, H. Wheeler, and A. Chabot. Improving species conservation plans under IUCN's One Plan Approach using quantitative genetic methods.

Other manuscripts currently in development include:

- Analysis of environmental contaminants in LOSH eggs
- Stainless steel band removal protocol
- Use of geolocators to study LOSH movements

9.0 PARTNERSHIPS AND COLLABORATION

9.1 Loggerhead Shrike Working Group

The 7th annual LOSH Working Group (WG) meeting was held virtually for a second year due to the ongoing COVID-19 pandemic. The topics were condensed and prioritized so that the meeting was just two 3-hour sessions (on April 27 and May 25), rather than the five sessions that were planned in 2020 and proved logistically challenging. Topics covered: Sampling protocols and updates to the banding manual, updates to the banding scheme, full-annual cycle modelling for the species, best management practices and associated outreach materials, updates on the citizen science ShrikeForce program, and funding needs and opportunities. Amy Chabot, Jessica Steiner, Jane Spero and Hazel Wheeler attended all sessions to represent Ontario interests.

Full details of all topics discussed are available in the WG meeting minutes (available upon request). No discussions have yet been initiated about the 2022 meeting, so it is yet to be determined if an in-person meeting will be attempted. Monthly Working Group calls were largely suspended this year as most members are part of Loggerhead Shrike Working Group the Species Conservation Planning process for LOSH (see Section 9.3), so meetings for that purpose took precedence

9.2 Building Regional Capacity

9.2.1 Regional networking

Regional working groups were again inactive this year owing to the ongoing COVID-19 pandemic. WPC staff continue to hold the position of co-chair of the Napanee Plain Joint Initiative (NPJI) along with Amanda Tracey of the Nature Conservancy of Canada (NCC), and WPC also remains engaged in the Carden community through a strong partnership with the Couchiching Conservancy, and participation in the Carden Forum. Though no winter meeting occurred this year, various project updates, including LOSH, were circulated to Forum participants over email. . It is hoped that these regional working groups will be able to resume in 2022.

Though no meetings occurred this year, regional networks were tapped in the development of the stakeholder invite list for the LOSH Species Conservation Planning process (see Section 9.3). Invitations to participate did not go out to all partners in these networks, but the final report of the process will be circulated widely throughout.

9.2.2 Community Science programs

The LOSH program's usual community science "Adopt-A-Site" program was again cancelled this year due to the COVID-19 pandemic. Planning was underway for more of a typical program this year, but the decision was made to suspend volunteer when the provincial Emergency Brake was implemented on April 3. As last year, the Lead Biologist prioritized work with field staff, so no volunteer program was implemented.

9.3 Species Conservation Planning for Loggerhead Shrike

The Species Conservation Planning (SCP) process for Loggerhead Shrike (formerly the Population and Habitat Viability Assessment) began this year, with the first two workshops held in July and August. The SCP is a workshop process facilitated by the Conservation Planning Specialist Group (CPSG)— part of the International Union for Conservation of Nature (IUCN)—that includes numerous stakeholders, and will incorporate existing demographic and spatial data in its modeling. The results

will help: a) identify how and when the species is being limited; b) identify high priority habitat for stewardship and protection; c) determine if and how habitat needs vary outside of the breeding season; and d) adapt the conservation breeding and release program to ensure it best supports recovery of the wild population.

The first workshop in the series took place virtually July 14-16 and included 37 participants from Canada (Ontario) and the US (Indiana, Tennessee, Virginia, Colorado, Arkansas, Ohio, Kentucky, Texas, North and South Carolina), representing academia, zoological institutions, government, non-government organizations, land trusts, aggregate extraction industry, cattle ranching, and members of the Loggerhead Shrike Working Group. Over 3 days, participants defined success by formalizing a shared conservation vision for Loggerhead Shrike, established the geographic scope of the planning process, and identified and quantified the severity of regional threats to better understand the system. This workshop laid the foundation for the next stage of the process: conducting a Population Viability Analysis (PVA) to assess the long-term persistence of the shrike population and evaluate potential management approaches.

The second workshop (August 16-18) consisted of four sessions focusing on the initial stages of developing a population viability analysis (PVA) through presentations and group discussions. Input was provided by 20 participants representing Ontario, Indiana, Kentucky, North Carolina, Ohio, Virginia, and West Virginia. During four virtual sessions, workshop participants reviewed the conservation vision and the proposed geographic scope developed in the first workshop and discussed the structure and input of the PVA model and next steps in the PVA development process.

The planning scope for the SCP includes all individuals at the species level throughout the life cycle across the defined geographic scope (Fig. 3). This broad scope was deemed necessary to ensure the long-term viability of the *migrans* subspecies, whose populations overlap that of other subspecies in their wintering range, and with which they interbreed. Based on this decision, the group discussed a series of key topics on PVA model structure, including how to model metapopulation structure and annual cycle demographics across the geographic scope and how to integrate threats and management decision making into the PVA process.

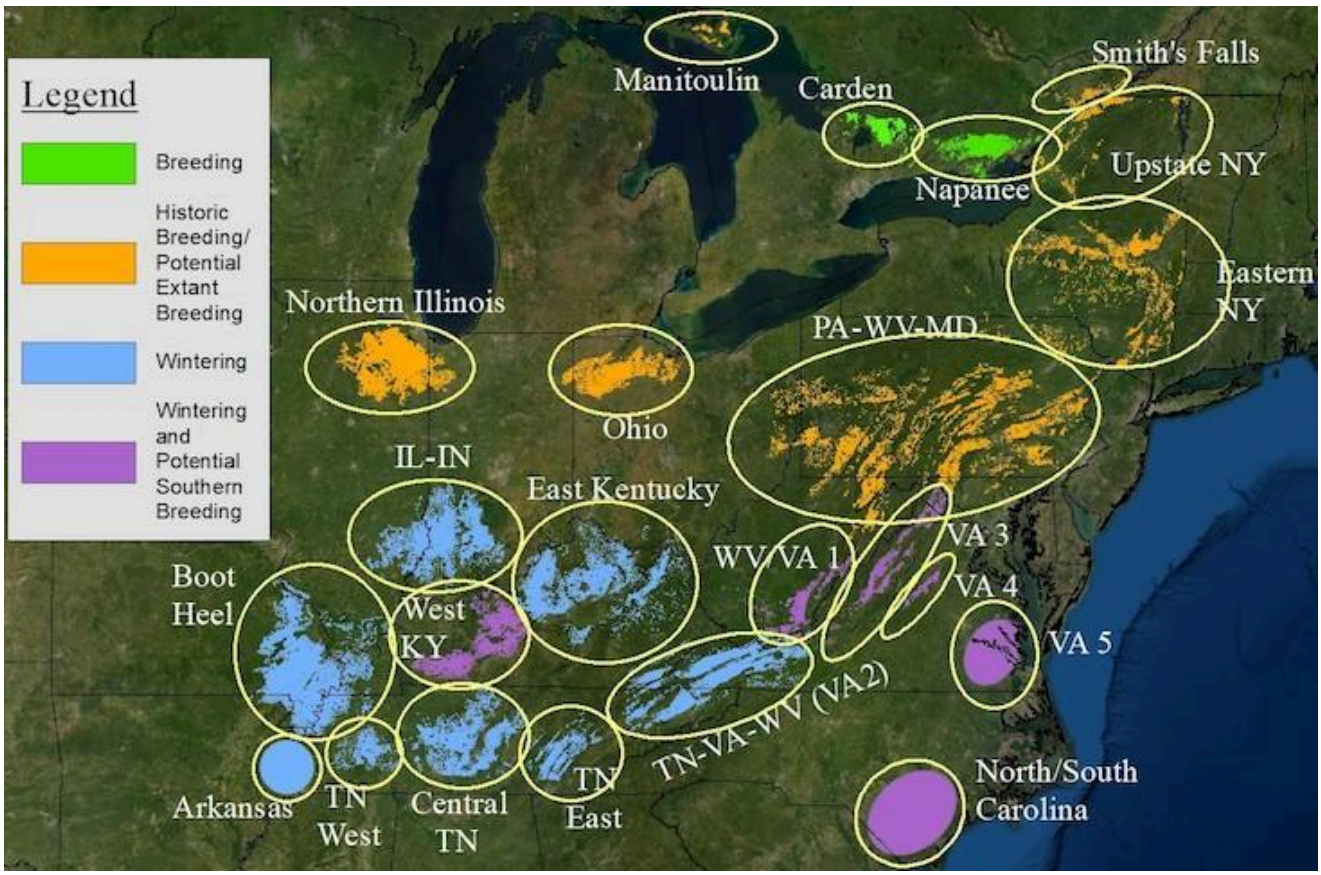

Figure 9. Maps of the proposed geographic scope for the *L. l. migrans* Species Conservation Planning process delineating likely habitat type (by colour) and subpopulations (ellipses)

While this second workshop was originally intended to include detailed discussions on PVA input parameters and scenarios (e.g., future management options), several key species experts and data holders were unable to attend the workshop, and participants decided that the discussions should be completed through smaller, regional meetings to be held prior to Workshop 3, at which point the PVA model will be reviewed, and management scenarios discussed that will be used to guide additional modeling.

The lack of experts present at workshop 2 is indicative of the biggest challenge we've encountered through the process thus far: participant attendance. These workshops are typically multi-day in-person events, but the pandemic has necessarily pushed us to the virtual environment where each workshop has become a series of up to five online sessions. Attendance has tended to fluctuate between sessions, which has made it difficult to maintain momentum, and some participants haven't necessarily committed to all sessions as they would tend to if we were meeting in-person. The planning committee has discussed this issue, but as yet has no solution; it may simply be a limitation of organizing the SCP in a virtual environment. The process has been a bit slower than anticipated because of this challenge though, so while the initial timelines planned for workshops 3 and 4 in October 2021 and March 2022, respectively, updated timelines are as follows:

Workshop 3 – series of smaller meetings January through April 2022
Workshop 4 – July/August 2022
Final report drafted – November/December 2022

10.0 PROGRAM FUNDING

WPC implemented the recovery program this year with funding from the following sources:

- Species at Risk Stewardship Program ($93.6K; Year 2 of a 3-year agreement)
- BluEarth Renewables ($22.8K; Year 3 of a 5 year post-construction monitoring agreement)
- Employment and Social Development Canada – Canada Summer Jobs ($16.9K to subsidize four field positions)
- Kingston Solar LP ($10K; Year 3 of a 5 year agreement, but see Section 3.3.2 for updated agreement timelines)
- Private foundations ($10K)
- Private donors ($10K)

11.0 REFERENCES

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