Lesser Slave Lake Bird Observatory

Fifteen Year Migration Monitoring Technical Report
1994 to 2008

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Executive Summary

The Lesser Slave Lake Bird Observatory (LSLBO) has been conducting migration monitoring activities since 1994. The migration site is located within the boundaries of the Lesser Slave Lake Provincial Park, Alberta, and has a large species diversity and abundance of birds that migrate through the area during spring and fall migration.

From 1994 to 2008, the LSLBO has monitored both spring and fall migration using four daily monitoring techniques: banding, census, visual migration counts, and incidental observations. These techniques combine to determine a daily total of all observations. The daily totals are used for population trend analysis by Bird Studies Canada. Based on frequency of detections, abundance, and coverage through other population monitoring schemes, 36 species have been listed as priority at the LSLBO.

Over the 15 years, a total of 929, 072 birds have been detected during standard spring and fall migration monitoring. Abundances vary between years, seasons. The four monitoring techniques detect different abundances of birds, but each one has strengths that out way the other methods. From the total number of birds detected, 226 species have been identified. Species diversity varies between years and seasons, but observations range from abundant to rare species detections.

Banding is the highest profile of the monitoring methods conducted at the LSLBO. A total of45,337 birds from 95 species have been banded over both spring and fall migration over the 15 years of operation. Both banding totals and captures rates are highly variable between years, but both have appeared to be slightly declining in recent years.

Indepth analysis of the migration and banding trends of 15 of the priority species was conducted. This analysis shows how the monitoring techniques combine to obtain a stronger sample of the migratory populations of these species. The migration window for many of these species is very short, averaging two to three weeks in the spring, but more protracted in the fall. Capture rates and banding totals are quite variable for all species, and very few show declining trends.

Long-term migration monitoring is very important to identifying migratory population trends. The LSLBO has strived to maintain quality and consistent data collection. There are many challenges to migration monitoring, and opportunities to overcome these challenges to improve both data collection methods and improve the ability to detect trends.

Introduction

Every spring, billions of birds migrate across North America to reach their northern breeding ranges. Many of these migrants are dependant on suitable breeding habitat within the Canadian boreal forest. In the fall, the adults and young travel south to their wintering grounds which include diverse habitats in Central and South America. Not only is suitable habitat required on the wintering grounds, but stop-over habitat is needed along migration routes for birds to feed and rest. Bird populations change in response to habitat alterations and food availability throughout their range (Crewe et al., 2008).

Many bird populations across North America have experienced declines over the past few decades, while others are experiencing reductions in their ranges (Rich et al., 2004). The exact reasons for these declines are not entirely known, but can include habitat loss and changes in food availability. Determining the threats to populations which are experiencing declines is necessary to enact conservation plans to reverse the decline. However, identifying population changes is challenging. A variety of large scale and long-term monitoring and census programs have been designed to monitor population trends and help identify populations exhibiting significant declines. Some examples of these programs include: Breeding Bird Survey, Christmas Bird Count, Project Feeder Watch, Hawk Watch, the May Species Count, and migration monitoring. These projects are capable of producing long-term population trend data; however, each project has unique strengths and weakness related to its ability to detect population trends and species coverage.

The Breeding Bird Survey (BBS) was initiated in 1966 and is one of the primary bird population monitoring programs in North America (Downes et al., 2000). The BBS uses roadside counts during the breeding season. Much of northern Canada, including large tracks of the boreal forest, has limited road access resulting in reduced population monitoring coverage through the BBS program for over 80 species. These species include: Swainson's Thrush, Alder Flycatcher, Cape May Warbler, and Bay-breasted Warbler (Crewe et al., 2008). The Christmas Bird Count (CBC) surveys birds in wintering habitats, but is less standardized than the BBS and has limited coverage for neo-tropical migrants wintering in Central and South America.

Migration monitoring is a method of population monitoring that surveys birds migrating through fixed points during spring and fall migration. Long-term migration data from Long Point Bird Observatory, a migration monitoring program founded in 1960, showed comparable trends with the BBS for several species suggesting that population trends derived from migration monitoring could be vital for species currently not monitored by existing programs (Hussell et al., 1992). In 1998, the Canadian Migration Monitoring Network (CMMN) was formed by Bird Studies Canada, the Canadian Wildlife Service, and independent migration monitoring stations. The purpose of the CMMN was to standardize data collection methods, aid with data management, develop data analysis programs for population trends, coordinate broad scale projects, and share information. Over 25 monitoring stations across Canada are currently involved in the network. The goal of the CMMN is:

> To be an essential component of bird monitoring, migration research and conservation planning in the Western Hemisphere and to contribute to conservation, knowledge, and public understanding of Canadian migrant birds and migration through a collaborative network of independent migration monitoring and research stations. (Crewe et al., 2008).

Migration monitoring consists of a combination of survey methods. Most stations incorporate visual observations (such as visual migration counts, census, and incidental observations) and bird banding. Each station operates under a standardized data collection protocol which allows for the consistent long-term data collection necessary to determine population trends. Protocols address the size of the survey area, the habitats being surveyed, migration monitoring methods, target species, potential habitat change, and methods to identify resident and migrant birds. To ensure the ability to effectively monitor species and analyze population trends, stations are required to operate during a consecutive period of at least one month during the spring and fall and within 75% of the target species migratory window. Target species must have an average of at least 10 birds recorded on an average of at least 5 dates per season, and the majority of the individuals detected must be migrants and not breeding residents (Crewe et al., 2008).

The Lesser Slave Lake Bird Observatory History

Monitoring activities began at the Lesser Slave Lake Bird Observatory (LSLBO) site in 1993 as a project spearheaded by the Beaverhill Bird Observatory. Banding occurred over several weeks throughout the 1993 spring and fall migration periods to sample the diversity and abundance of songbirds migrating through the area. The goal of this initiative was to determine if the volume of birds migrating through the area would make it an ideal location for a migration monitoring station. Results were favorable, so full spring and fall migration monitoring activities began in 1994. The monitoring projects were accompanied by interpretive programs that focused on the boreal forest and songbirds. The Lesser Slave Lake Bird Observatory Society was formed in 1997 and the LSLBO became a member of the CMMN in 1999 (Langford, 2008). In 2008, the LSLBO completed its fifteenth consecutive year of spring and fall migration monitoring.

Goals and Objectives

The primary objective of the LSLBO is to contribute migration data to the CMMN. This is achieved through consistent daily migration monitoring throughout both the spring and fall migration periods each year.

Over the 15 years, the LSLBO has expanded its monitoring and research objectives by initiating several projects and participating in cooperative projects. These projects include: contributing data collected from local breeding birds to the Monitoring Avian Productivity and Survivorship Program (MAPS), Northern Saw-whet Owl fall migration monitoring, studies on the breeding ecology of Canada Warblers, feather collection for

several stable isotope studies, and biodiversity monitoring projects of locally operating forest industry companies.

Education is an important component of the LSLBO. Banding demonstrations and interpretation programs held at the monitoring station are aimed at increasing public awareness of the research projects, bird migration, avian biology, and conservation issues. The Lesser Slave Lake Provincial Park interpreters have incorporated aspects of the research and monitoring projects of the LSLBO into campground programs which highlight the natural history of the boreal forest and songbirds. Collaboration between various organizations, such as the Lesser Slave Forest Education Society, has lead to numerous educational outreach programs. Local support from surrounding communities (i.e., Slave Lake's community newspaper, The Lakeside Leader) has increased community awareness and interest. Collaborative efforts between Alberta Parks and the LSLBO lead to the development of the Boreal Centre for Bird Conservation (BCBC), which officially opened in 2006. The BCBC is located two kilometers from the monitoring station and is a year round research and education facility which houses educational programs, events, and visiting researchers.

As an organization, the LSLBO is continually growing and evolving. The partnership role in the BCBC has expanded the exposure of the LSLBO and has resulted in new co-operative research initiatives and increased public awareness. These opportunities have strengthened the LSLBO's Vision and Mission Statements:

- Dedicated to bird conservation through research and education.
- To gain knowledge, understanding and appreciation of boreal birds by monitoring their populations and participating in research; to produce scientifically defensible data, to deliver education programs that foster appreciation of birds and their habitat needs; and to generate awareness/support of the LSLBO within the Lesser Slave Lake region and throughout Canada.

Migration Monitoring Site

The LSLBO migration monitoring station is located along the north-east shore of Lesser Slave Lake, Alberta (55° 20'N, 114° 40'W). It is approximately 15 kilometers north of the town of Slave Lake, within the Lesser Slave Lake Provincial Park (Figure 1**Error! Reference source not found.**).

The study area is approximately 800 meters long and 200 meters wide along an abandoned highway allowance. The habitat within the study area is made up of poplar-spruce mixed woods, willow shrubbery, limited grasslands, cobble lake shores with limited sand, and open lake water as far from shore as the viewer can see. The banding

lab is located near the center of the study area, in which all the birds are processed and demonstrations and interpretation events are presented. Twelve migration net-lanes are located at the south-east end of the study area. The census route runs the entire length of

the study area. Visual migration counts are conducted in the parking lot at the south-east end, which provides the ability to detect actively migrating birds flying north-west and south-east down the old highway right of way, south-west over the lake, or across the main road access to the north-east (Lesser Slave Lake

Shoreline

Driftwood

Grass and Low Shrubs

Willow, Alder, Poplar Shrubs

Mature Mixedwood Forest

Roads and Trails

Netlane

Banding Station

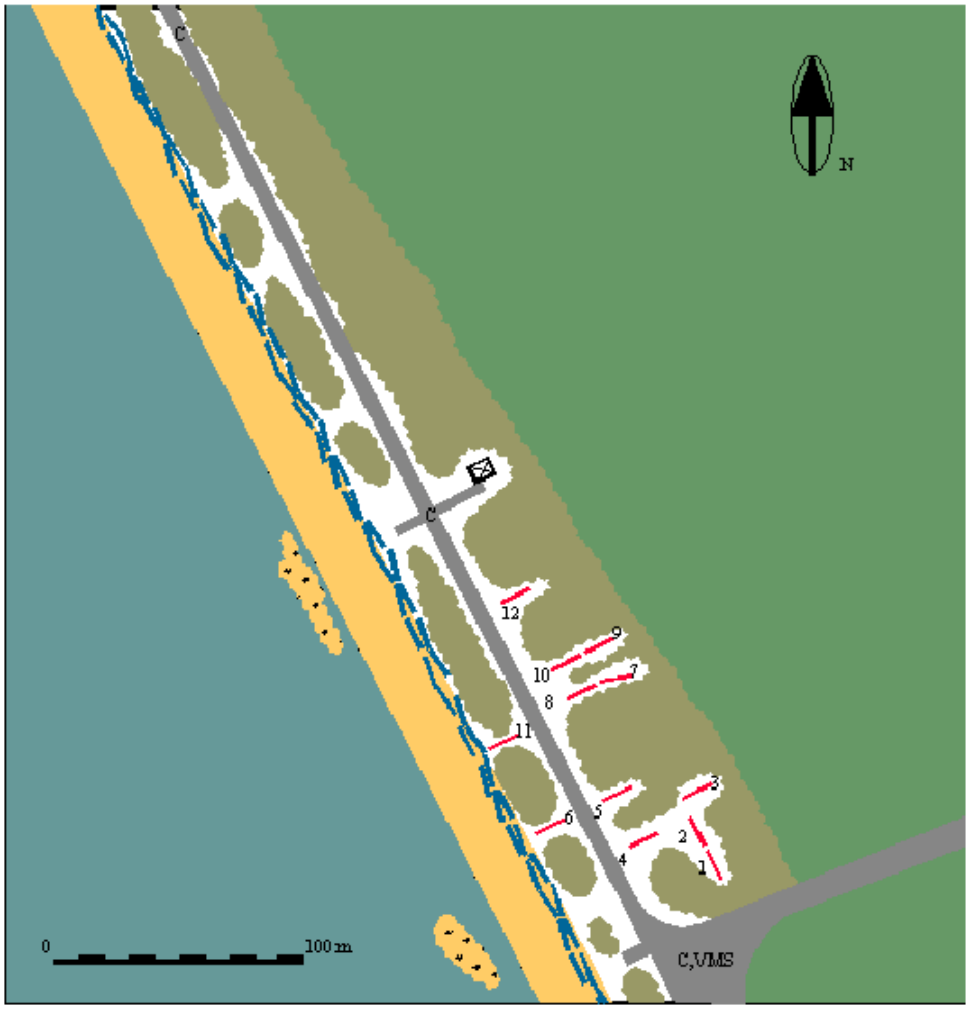
C Census

VMS Visual Migration Survey

Figure 2).

Figure 1. Map of Lesser Slave Lake Provincial Park.

Legend



Lesser Slave Lake
Shoreline
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Grass and Low Shrubs
Willow, Alder, Poplar Shrubs
Mature Mixedwood Forest
Roads and Trails
Netlane
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Figure 2. Map of the LSLBO migration monitoring station.

Migration Monitoring Period

The LSLBO is located in a temperate climate with short, hot summers and long, cold winters. Migration begins as the snow starts to melt and waterbodies become ice-free. The first migrants are generally waterfowl in March and April with landbird migration beginning in mid-April. Spring migration monitoring begins late April and coverage lasts a period of approximately six weeks. This allows the station to be operating during the entire migratory window for most species encountered at the site, particularly for landbirds. However, the full migratory window of early migrant species (Tundra Swan, Dark-eyed Junco, and American Tree Sparrow) may be missed during on years with a delayed start date. The variation of starting dates is due to staff availability and temperature (Table 1). Maximum day-time temperatures can remain below freezing late in April and the banding station is typically opened once day-time highs are sustained above freezing to allow for banding. Monitoring coverage should ideally occur daily during the migration season, but factors do not always allow for this. Reduced coverage occurred in 1994, 1996, and 1997 because of staff availability. A "day of coverage" indicates that Daily Totals (DT) were tabulated including when conditions did not permit all monitoring activities to be conducted.

Table 1. Spring migration monitoring period from 1994 to 2008.

Year	Start Date	End Date	Days of Coverage
1994	May 15	June 9	19
1995	April 28	June 9	39
1996	May 4	June 7	28
1997	April 30	June 17	37
1998	May 4	June 9	36
1999	April 26	June 12	46
2000	April 18	June 13	57
2001	April 16	June 11	57
2002	April 19	June 11	54
2003	April 21	June 10	50
2004	April 19	June 10	50
2005	April 25	June 10	43
2006	April 24	June 10	47
2007	April 24	June 10	48
2008	April 26	June 10	45

Fall migration monitoring period is twelve weeks in duration beginning mid-July until the end of September and encompasses the migration window of most landbird species. The majority of observations in mid-July are likely local birds, but there is also evidence of migration occurring at this time. By the end of September, migration is limited to only a few individuals of late migratory species (e.g. Tundra Swans and Sandhill Cranes) and the majority of observations consist of winter resident species (e.g. Black-capped Chickadees and woodpeckers). Monitoring completion date is also dictated by weather conditions and staff availability. Like the spring, 1994, 1996, and 1997 received reduced daily coverage, whereas 1998 to 2008 received relatively consistent coverage during the monitoring period (Table 2).

Table 2. Fall migration monitoring period from 1994 to 2008.

Year	Start Date	End Date	Days of Coverage
1994	July 27	September 11	31
1995	July 17	September 24	51
1996	July 27	September 29	41
1997	August 5	September 26	35
1998	July 14	September 24	66
1999	July 21	September 23	78
2000	July 7	October 6	91
2001	July 14	September 22	69
2002	July 13	October 4	84
2003	July 12	September 30	77
2004	July 12	September 30	78
2005	July 12	September 29	75
2006	July 12	September 29	77
2007	July 12	September 30	73
2008	July 12	October 2	76

Methods

The original migration monitoring protocol implemented at the LSLBO (Beaverhill Bird Observatory, 1995) was based on the operations manual for Long Point Bird Observatory (McCracken et al., 1993). The protocol was adjusted in 2000, with emphasis on improving the consistency of visual observation methods and a Revised Lesser Slave Lake Bird Observatory Station Manual was developed. (Lesser Slave Lake Bird Observatory, 2003).

Each day during migration a Daily Total (DT) of all birds encountered is derived. The DT represents a sample of the number of each species present in the count area during the monitoring period and is used to generate an index for population size. Four

complimentary monitoring methods are used by the LSLBO to derive the DT: mist-netting, census, visual migration counts, and incidental observations. All birds detected within the standard count time (maximum of 8 hours beginning one-half hour before sunrise) are recorded in their corresponding monitoring activity. The DT is calculated by totaling all encountered individuals of each species from each monitoring activity, ensuring adjustments are made to reflect duplicate observations of the same individual encountered on different activities. This data is then used by the CMMN to create migration indices for population trend analysis (Lesser Slave Lake Bird Observatory, 2003).

Standard mist-netting at the LSLBO consists of operating 12 mist-nets beginning one-half hour before sunrise for seven hours. The net-lanes are in permanent locations and consist of 30mm mesh top and bottom-tethered mist-nets measuring 2.75m high and 12m wide set on 3m high poles. Mist-netting is conducted daily as weather permits. Nets are not set if the temperature is below 2°C, during precipitation, or in heavy wind. In event of a high volume of birds, nets are temporarily closed until banders are able to safely process the captured birds. If netting time was lost during the standard period and conditions permit, nets can remain open until the end of the standard count period. Nets are checked every 30 minutes and any captured birds are removed from the nets and taken to the banding lab for processing. Captured birds are fitted with a numbered aluminum band issued by the Canadian Wildlife Service. The minimum data collected is band number, species, date, time, net number, age, sex, and bander. If time permits, the wing chord, wing wear, fat score, muscle score, weight, cloacal protuberance development, brood patch development, and moult score are recorded. Recaptured birds are processed like newly banded birds with all measurements taken, except if birds are recaptured during the same day. In these cases, the net number and capture time is noted and the bird is released.

The daily census is a sample of the birds present in the area. Unlike other monitoring methods which are conducted from fixed points, the census surveys the entire study area. Census begins within two hours of sunrise and it is conducted daily regardless of weather conditions. The entire route is approximately 700m from the LSLBO parking lot along the Trans Canada Trail (Figure 2). The census takes between 30 to 40 minutes to complete. In the spring, the census route is walked from the northwest to the southeast and in the fall it is walked from the southeast to the northwest. All birds seen or heard along the census route are recorded.

Visible migration watches (vis-mig) are migration counts conducted during each hour block of the count period in the main parking lot. From 1995-1999, the duration of each vis-mig was ten minutes. Often visual migration counts were skipped throughout the morning because they were too long and banding took priority. The time was reduced to five minutes in 2000 to facilitate more consistent coverage. Only birds deemed to be visibly migrating (flying through the area without stopping or pausing briefly and not significantly changing course) are recorded as vis-mig. Vis-migs are conducted regardless of weather. A minimum of six vis-migs are conducted each day, but the time spend on site by researchers allows for eight.

Incidental observations are the recording of birds seen in the count area when observers are not banding or conducting another standardized count during the count period. These observations supplement the standard counting methods and are included in the DT. Incidental observations are important as rare species are often recorded as incidental. Incidental observations allow observers to document migratory activity during slow banding periods or between the other counts.

Protocol Changes

The preliminary study was initiated in 1993 and formal operations commenced in 1994. However, once consistent migration monitoring started in 2005; three important changes were made to the LSLBO monitoring protocol (Jungkind, 2001):

1. Two of the original core net-lanes used in 1994 had their locations altered and two new net-lanes were added.
2. The census route was changed from a loop through the adjacent forest to a straight path along the highway allowance. The new census route was 30 minutes in duration with 5 minute stops at the beginning, middle and end of the census route.
3. Observations were limited to 2:00 p.m., where the original protocol recommended continuing observations until the "late afternoon".

In 2000, a second protocol revision changed several factors of the operations of the LSLBO (Table 3):

1. The standard banding period was increased from six to seven hours during the standard count period.
2. Inconsistent visual migration coverage was experienced in the spring and fall from 1995 to 1999-see Table 4 (Jungkind, 2001). To facilitate more consistent visual migration counts, it was decided to hold shorter, but more frequent visual migration counts and the time for the counts was reduced from 10 minutes to 5 minutes (Wojnowski, 2000).
3. Observers began recording Probable Know Stopover (PKS) for observed birds that were confirmed non-migrants in an attempt to separate locally breeding birds and non-migrants from the migrating birds on the Daily Totals.

Table 3. LSLBO monitoring protocol changes between operating years, 1995-1999 and 2000-2008.

Activity	1994	1995-1999	2000-2008
Number of Nets	8	12	12
Census Route	Loop	Linear Line	Linear Line
Daily Net Hours	Six	Six	Seven
Visual Migration Duration	10 Minutes	10 minutes	5 minutes
Probable Know Stopover (PKS)	Not Enacted	Not Enacted	Figured
Migration Monitoring Emphasis	Banding	Banding	Census and Vis-mig

Monitoring Effort

Monitoring effort is the amount of time that observers conduct migration monitoring utilizing the four monitoring methods. Ideally each day should have maximum coverage of all the survey methods, however this is not always possible due to staff availability, weather conditions, and during busy banding periods. From 1994 to 1999, the frequency of visual migration counts and census was sporadic (Table 4). These two monitoring methods showed increased consistency from 2000 to 2008 with the change of LSLBO protocols (duration of the visual counts reduced from 10 minutes to 5 minutes in 2000). Banding effort (average daily net-hours) shows a degree of variability due to weather condition limitations.

Table 4. Seasonal banding, visual migration, and census coverage from 1994 to 2008.

	Banding Average Daily Net Hours		Vis-Migs Average per Day		Census Number of Days	
Year	Spring	Fall	Spring	Fall	Spring	Fall
1994	37.2	35.7	N/A	N/A	13	18
1995	65.5	50.5	2.8	2.7	35	43
1996	62.1	40.1	3.7	3.3	27	39
1997	58.6	60.9	4.5	1.7	34	8
1998	74.5	48.5	3.8	2.8	32	10
1999	69.1	56.7	N/A	3.9	34	15
2000	62	74	8.2	7.7	55	90
2001	72.9	74.6	7.8	7.9	57	69
2002	63	62.9	8.4	7.7	54	84
2003	48.9	73.8	8	7.6	50	77
2004	60.5	69.8	8.2	7.6	49	78
2005	71.2	76	8	7.7	43	75
2006	70.3	73.9	7.7	7.7	47	77
2007	73.6	71.9	7.9	7.7	48	73
2008	75.8	75.7	7.8	7.5	45	75
Average ±SD	64.3 ± 10.5	63.0 ± 13.7	6.7 ± 2.1	5.9 ± 2.4	41.5 ± 12.1	55.4 ± 29.9

Migration Monitoring Priority Species

Monitoring priorities have been set for species with limited coverage from the Breeding Bird Survey and Christmas Bird Count programs (Badzinski and Francis, 2000), and species that meet analysis requirements for population trend analysis (Crewe et al., 2008). The CMMN trend analyses are based on landbirds that are observed over a 5 day period with a minimum average of 10 birds observed each day, and excludes resident species (e.g. Common Raven) and species with irruptive populations (e.g. Evening Grosbeak). Further monitoring priorities are based on listings and recommendations from Partners in Flight (Rich et al., 2004).

Priority species for migration monitoring have been categorized from A to D, with species in category A the highest priority. The LSLBO monitors 38 species within those categories (Table 5). More details on the monitoring for selected species within the priority categories can be found in Section II: Species Accounts.

Table 5. Species list according to monitoring priority for the LSLBO.

Priority A Species with <50% of North American (Canada & U.S. only) breeding range covered by BBS, and <60% of their winter range in U.S. and Canada.		
Yellow-bellied Sapsucker	Orange-crowned Warbler	Northern Waterthrush
Alder Flycatcher	Tennessee Warbler	Wilson's Warbler
American Pipit	Magnolia Warbler	Lincoln's Sparrow
Swainson's Thrush	Blackpoll Warbler	

Priority B Species with <50% of North American breeding range covered by BBS, but >60% of their winter range in U.S. and Canada.		
Ruby-crowned Kinglet	Swamp Sparrow	White-crowned Sparrow
Myrtle Warbler	White-throated Sparrow	Dark-eyed Junco

Priority C Species with <60% of their Canadian & Alaskan breeding range (but >50% of North American range) covered by BBS, and <60% of their winter range in U.S. and Canada.		
Least Flycatcher	Black-and-white Warbler	Canada Warbler
Philadelphia Vireo	American Redstart	Chipping Sparrow
Red-eyed Vireo	Ovenbird	Clay-colored Sparrow
Tree Swallow	Mourning Warbler	Western Tanager
Yellow Warbler	Common Yellowthroat	

Priority D Species with <60% of their Canadian & Alaskan breeding range (but >50% of North American range) covered by BBS, but >60% of their winter range in U.S. and Canada.		
American Robin	Winter Wren	Song Sparrow
Black-capped Chickadee	Cedar Waxwing	Red-winged Blackbird
American Crow		

Report Objectives and Methods

The objective of the 15 year technical report is to provide a descriptive analysis of the LSLBO's migration monitoring results from 1994 to 2008. Details of the report include:

1. An overview of the diversity and abundance of species observed over the 15 years of spring and fall migration monitoring.
2. A comparison of the effectiveness of each monitoring method used at the LSLBO to detect species diversity and abundance.
3. An analysis of the banding trends observed during the spring and fall migration periods.
4. Detailed accounts of the migratory data collected from selected priority species.

Daily total (DT) data compiled from daily observations using the four monitoring techniques from 1994 to 2008 was analyzed for diversity and abundance of species. Only birds observed during the standard migration count period were used in the analysis. Averages and cumulative totals were used from the calculated DT or observations from individual monitoring methods. Species phenology charts were created using the average cumulative DT over the fifteen years averaged over three day periods in both the spring and the fall. This was further broken down to reflect the proportion that each monitoring method contributed to the detections within each three day period.

Analysis of the banding data explores the observed trends in the banding totals, capture rates, diversity, and abundances. All data includes newly banded birds captured in standardized net-lanes within the count period. Banding effort is dependant on weather, with temperatures and precipitation affecting the amount of time that mistnetting occurs. Capture rate is a method of analyzing mist-netting capture data because it accounts for the number of captures while controlling for sampling effort (net hours). It provides visual banding trends and highlights some of the interesting occurrences at the LSLBO. For this report, the capture rate is presented as the number of birds banded per 100 net hours. Netlane analysis used the cumulative average capture rate for each net lane to highlight the productivity of each netlane. Four species were selected (Black-and-white Warbler, Yellow Warbler, Swainson's Thrush, and Ovenbird) to compare species capture trends observed in the net-lanes during spring and fall migration.

Migration Monitoring Results

The LSLBO's primary focus is the population monitoring of migratory landbirds. Daily totals are tabulated for all species encountered during monitoring activities. This has resulted in 15 years of diversity and abundance data of migratory and resident species in the Lesser Slave Lake Provincial Park. The daily total for each species detected is a result of the combined observations of the four monitoring techniques; banding, visual migration counts, census, and incidental observations. The diversity and abundance of species detections varies among survey techniques.

Diversity

During the 15 years of operation, a total of 226 species have been observed at the LSLBO during migration monitoring activities (Appendix 1). Eighty-five species (38% of the total species detections) have been encountered every year that the LSLBO has been operating (Figure 3). Of these, fifty-one species have been observed during both spring and fall migration activities on all 15 years. Examples of regularly observed species include Common Loon, Spotted Sandpiper, Northern Flicker, Least Flycatcher, Ruby-crowned Kinglet, American Redstart, Chipping Sparrow, and Pine Siskin. Twenty-seven species (12% of the total species detections) have only been encountered during a single year of migration monitoring activities. These species include Brant, Eurasian Wigeon, Gyrfalcon, Rudy Turnstone, Rock Wren, Lazuli Bunting, and Lark Sparrow.

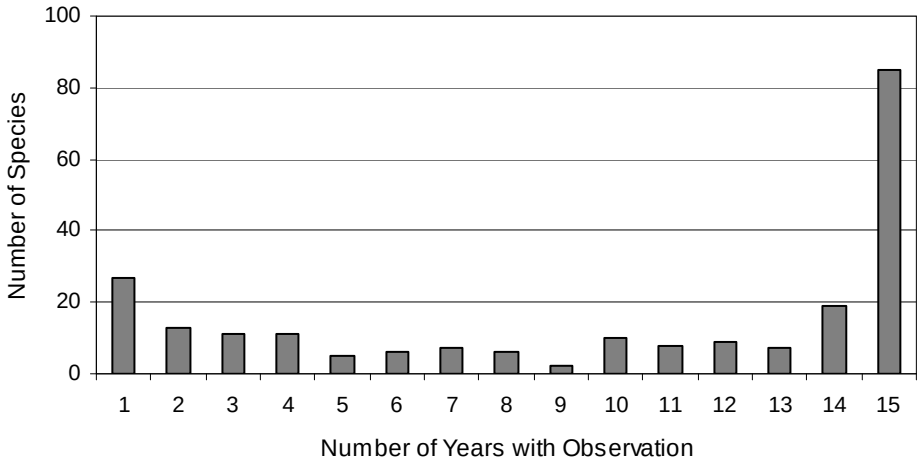

Figure 3. Species observed by the number of years observed, 1994-2008.

From 1995 to 2002, at least five new species were detected every year during monitoring activities. Detections of new species became less frequent from 2003 to 2008 with only nine new additions during those six years (Figure 4). The frequency that new species are detected is expected to continue to decline in future years.

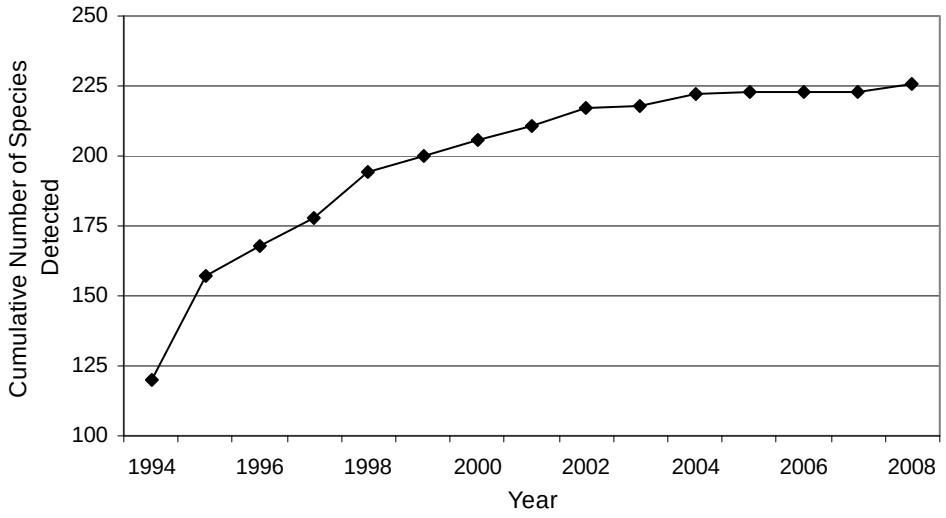

Figure 4. Cumulative number of species detected, 1994-2008.

The number of species detected is higher in the spring (mean 132 ± 18) than the fall (mean 122 ± 16) (Figure 5). Several songbird species are more frequently detected in the spring by their vocalizations; including Winter Wren, Western-wood Pewee, and Vesper Sparrow. Observations of these species are limited to the occasional banding record during the fall. A second factor for the higher spring diversity is the thawing conditions of Lesser Slave Lake. As the ice on the lake slowly thaws along the shoreline, a high diversity of waterfowl species group in the small pockets of open water to rest and feed. Observations of waterfowl species is reduced in the fall. Species such as white-winged scoters, surf scoters, and long-tailed ducks are observed on most springs, but have limited fall records.

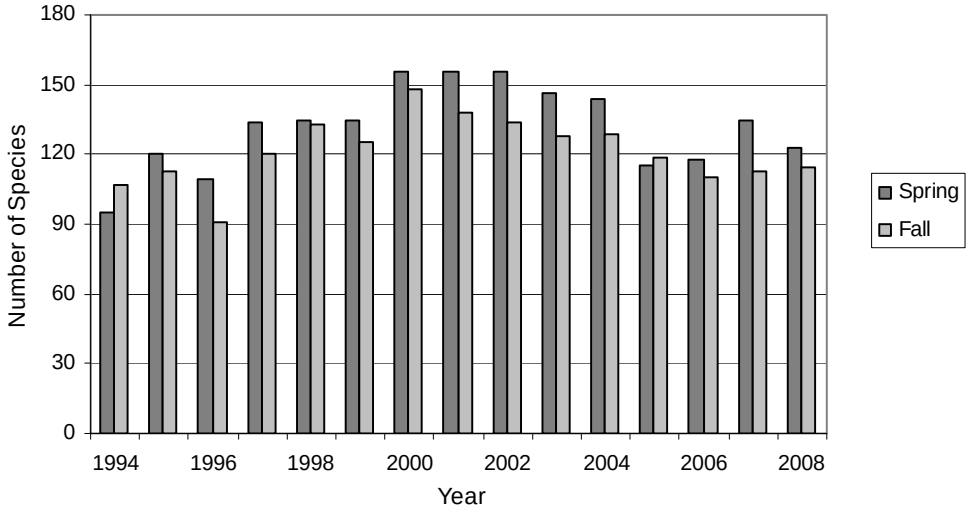

Figure 5. Total number of species observed each spring and fall, 1994-2008.

A total of 214 species have been recorded during spring migration. Sixty-four of these species have been recorded every spring. Twenty-seven species have been rare encounters, recorded on a single year during the spring. The overall fall diversity is slightly lower than the spring, with a total of 190 species records. Sixty-four of these species have been observed every year and 21 species have been encountered on single year during fall monitoring. Both monitoring seasons have similar distribution between common and uncommonly encountered species (ie, the number of species and number of years species have been detected) (Figure 6).

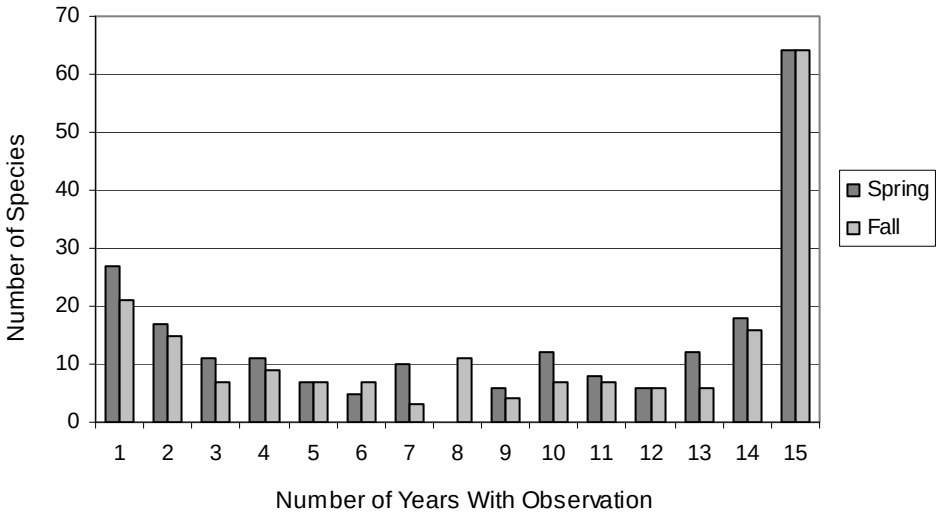

Figure 6. Number of species observed in relation to season and number of years they have been observed, 1994-2008.

Species Diversity and Monitoring Methods

Each of the four monitoring techniques used at the LSLBO accounts for a different amount of the total species detected each season. On average, banding has the lowest species diversity detections, followed by visual migration counts, census, and incidental observations (Table 6). On average, species detections are higher in the spring than fall for all methods except banding.

Table 6. Average number of species detected in four monitoring methods from 1994 to 2008.

	Total Number of Species Detected	Average Spring Detections (±SD)	Average Fall Detections (±SD)
Banding	96	47 ± 7	56 ± 6
Visual Migration	161	48 ± 26	47 ± 17
Census	179	95 ± 17	77 ± 22
Incidental	213	122 ± 20	106 ± 22

Banding has recorded the lowest species diversity, accounting for 42% of the total species observed. The mesh size of the mistnests used is designed to trap small landbird species, ie. thrush size and smaller. Larger sized birds, such as Northern Flickers and Sharp-shinned Hawks, are occasionally entangled in the nets and not able to free themselves. The placement of the mistnets within vegetation stands excludes capturing species that tend to avoid flying through trees, such as Tree Swallows and American Pipits. However, of the priority species (Table 5), only Tree Swallows and American Pipits are not accounted for through banding. Several species have only been observed through banding, such as Northern Pygmy Owl, Northern Mockingbird, Veery, Nashville Warbler, Blackburnian Warbler, MacGillivary's Warbler, and Lazuli Bunting. The total number of species detected each year has remained relatively constant in both the spring and fall over the 15 years (Figures 7 and 8).

Visual migration counts focus on birds actively migrating. This monitoring method has recorded 71% of the total species detected at the LSLBO. This method has detected a slightly lower species diversity than the census and incidental observation methods because it focuses strictly on actively migrating birds. Some species, which are detected in large numbers during peak migration, are well recorded on visual migration counts. For example, American Robin, Yellow-rumped Warbler, and Chipping Sparrow have between 15% and 20% of their total detections through visual migration counts. Species which have been detected by other methods, yet never recorded on visual migration counts include: Gray-cheeked Thrush, Bay-breasted Warbler, Connecticut Warbler, LeConte's Sparrow, and Vesper Sparrow. Species that are most commonly observed through vocalizations, such as Winter Wrens, have not been detected on visual migration counts. Rare and uncommon species are not typically detected on visual migration counts, although the only Whimbrel, Long-billed Dowitcher, Smith's Longspur, and the

only spring sighting of a Northern Shrike have been detected through this method. All priority species (Table 5) have been detected on visual migration counts. Visual migration counts have a high rate of variability in the species detections in both the spring and the fall (Figures 7 and 8). Infrequent sampling effort before 2000 (Table 4) may have resulted in the fluctuations observed from 1994 to 1999.

Both census and incidental observations record every species bird encountered, which includes birds actively migrating, seen foraging in vegetation, heard singing in the forest, or observed dabbling in the lake. As a result, both survey methods account for a large percentage of the total number of species detected (79% for census and 94% for incidental observations). The difference in total detections is a result of effort. Census operates for 30 minutes each day within the first two hours of the standard daily monitoring period. Incidental observations are recorded over the entire six (1994 to 1999) or seven (2000 to 2008) hour period, except when observers are conducting another survey. Incidental observations have accounted for many of the rare bird sightings, such as Red-throated Loon, Wood Duck, Parasitic Jaeger, Three-toed Woodpecker, Rock Wren, Townsend's Solitaire, and Lark Sparrow. Only two species have exclusively been detected during census; Pine Grosbeak and House Sparrow. All priority species (Table 5) have been accounted for on census and incidental observations. Yearly species detections between census and incidental observations follow similar patterns in both the spring and fall (Figures 7 and 8).

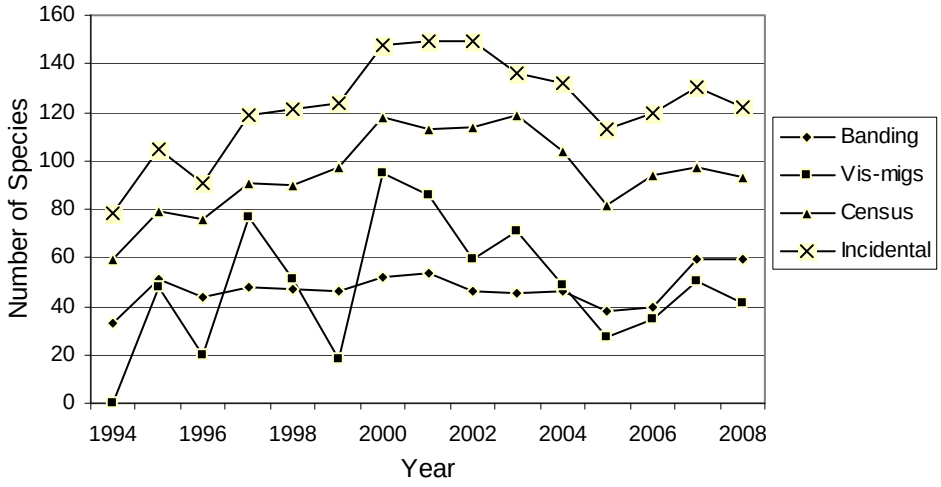

Figure 7. Cumulative number of species observed for each monitoring method in spring, 1994 to 2008.

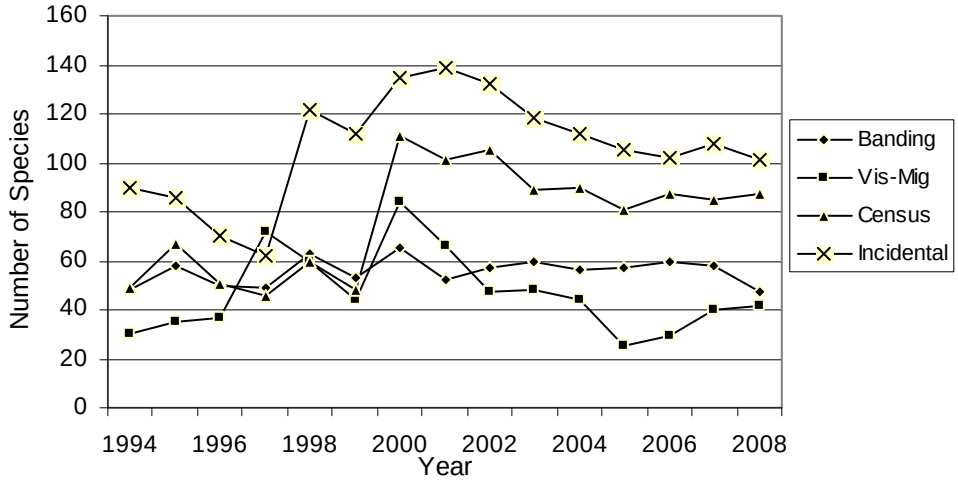

Figure 8. Cumulative number of species observed for each monitoring method in fall, 1994 to 2008.

Abundance

From 1994 to 2008, the LSLBO has recorded 929,072 birds during migration monitoring activities. A total of 382,003 observations have been recorded during spring migration (mean 25,467 ± 17,830) and 547,069 have been recorded in the fall (mean 36,471 ± 22,438). Annual total detections have shown high variability in both the spring and fall (Figure 9). All birds that are observed during monitoring activities are recorded. When positive species identification is not possible, then birds are recorded as unknown.

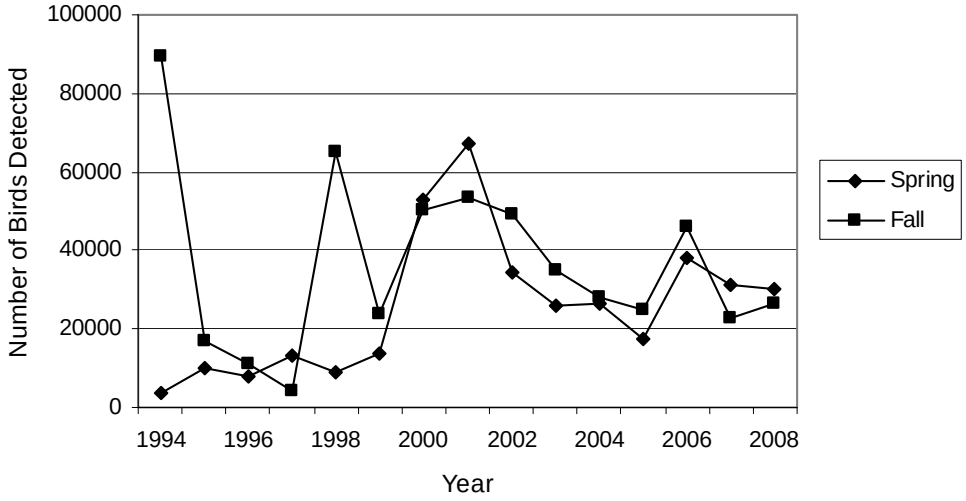

Figure 9. Total number of detections during spring and fall migration.

The four monitoring methods have detected different abundances of birds (Table 7). Banding accounted for only 5% of the total number of birds detected, and the fall averages almost twice as many detections as the spring. Visual migration counts for 14% of the total number of birds detected. On average, an equal number of birds are detected in the spring and fall. The number of birds detected on census is slightly higher than visual migration counts (20%) and fall migration averages more detections than the spring. Incidental observations accounted for 64% of the total number of birds observed. On average, more birds are observed during the fall. All four monitoring methods show annual variability in the total number of birds detected in both seasons (Table 7).

Table 7. Cumulative number of bird detections through monitoring methods (1994 to 2008).

	Total Number of Detections	Average Spring Detections (±SD)	Average Fall Detections (±SD)
Banding	50,144	1,109 ± 690	2,234 ± 825
Visual Migration	132,501	4,604 ± 2,733	4,536 ± 2,108
Census	186,396	5,641 ± 3,582	6,786 ± 5,055
Incidental	594,696	15,375 ± 12,896	24,271 ± 22,005

In many years, visual migration counts, census, and banding show similar patterns in total abundances detected in both spring in fall (Figures 10 and 11). Lower abundances observed from 1994 to 1999 may have been a factor of infrequent visual migration counts and reduced number of daily census counts. The average effort was similar from 2000 to 2008 in respect to the daily census and visual migration counts. Annual abundance detections through incidental observations are also variable and follow similar abundance patterns with the other monitoring methods. However, since incidental observations are recorded when the observers are not busy with another task, it is difficult to determine if the variability is a result of actual abundance or if observers were too busy. Effort was not well documented for the incidental observations.

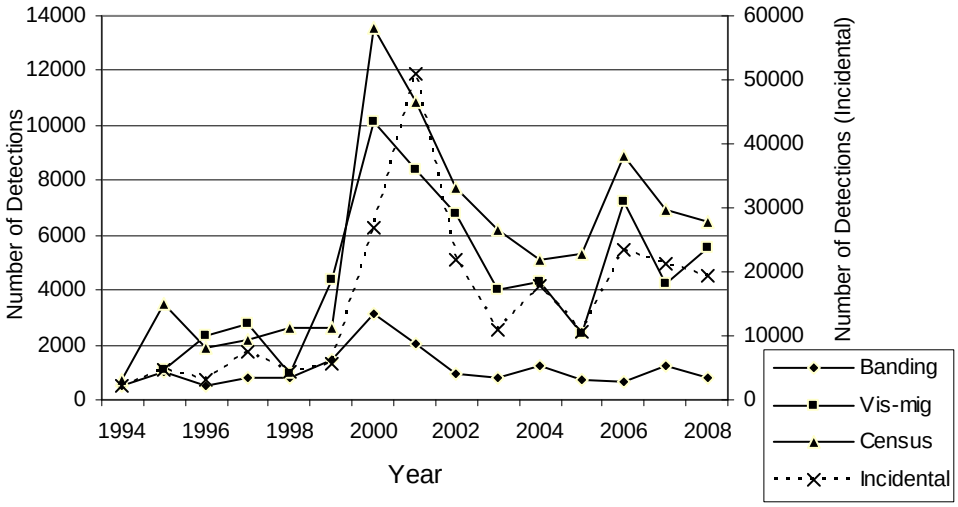

Figure 10. Annual cumulative spring detections through monitoring methods.

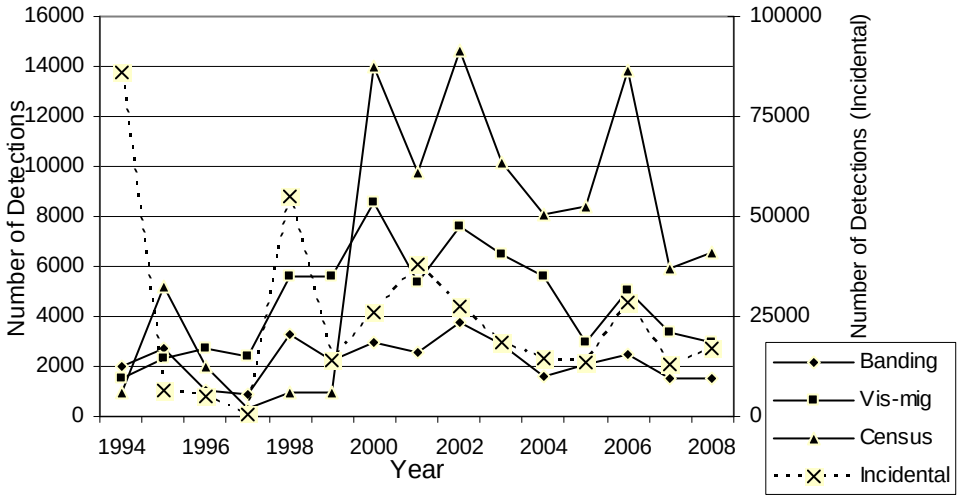

Figure 11. Annual cumulative fall detections through monitoring methods.

Probable Know Stopovers

Newly arrived migrants are the target for migration monitoring and are needed for trend analysis. However, resident birds and stopover individuals are encountered during migration monitoring activities. Probable Know Stopovers (PKS) was enacted in 2000 to identify stopover, resident, and breeding individuals during daily monitoring activities. An equal proportion of birds have been identified as PKS in the spring (average 3350 ± 696) and the fall (average 3047 ± 992) from 2000 to 2008. Removing PKS birds from the observations from 2000 to 2008 reduces the cumulative total of birds detected, but the graphs retain the same shapes in both the spring (Figure 12) and the fall (Figure 13) as the corresponding graphs that include all sightings (Figures 10 and 11).

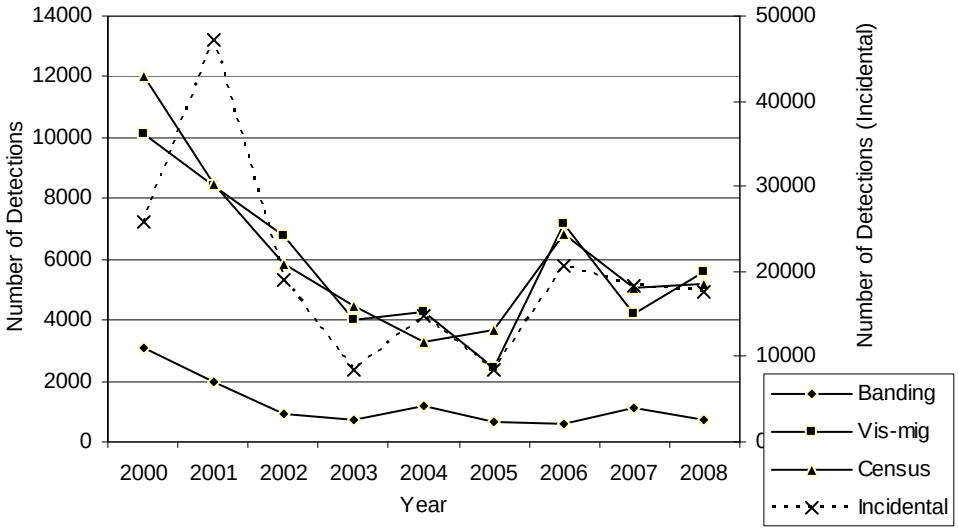

Figure 12. Annual cumulative spring detections without PKS observations.

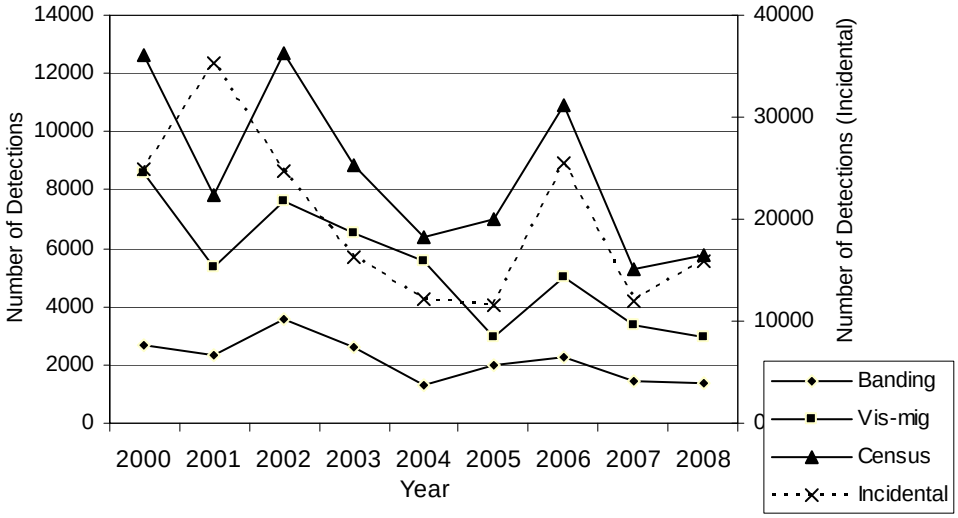

Figure 13. Annual cumulative fall detections without PKS observations.

Monitoring Diversity and Abundance Summary

Based on the combined cumulative spring and fall DTs from 1994 to 2008, 16 species (7%) comprise of the most abundant species observed at the LSLBO with over 10,000 records (Figure 14). These species include the top banded species (such as Myrtle Warbler, American Redstart, and Chipping Sparrow) and species that are regularly observed in large flocks during migration (such as Greater White-fronted Goose, American Robin). Sixty-two species (27%) have between 1000 and 10,000 records over

the 15 years. These species represent some of the commonly encountered species during spring and fall migration and include Ovenbird, Canada Warbler, and White-throated Sparrow. Fifty-five species (24%) have been detected between 101 and 1000 individuals. These include species that are commonly observed, but are recorded in low numbers; including Hermit Thrush, Blackpoll Warbler, Northern Waterthrush, and Western Tanager. A large proportion of the species encountered during migration monitoring are detected in low abundances. A total of 93 species (41%) have had fewer than 100 individuals detected over the 15 years of monitoring. These species are uncommon or rare during migration and include Gray-cheeked Thrush, Chestnut-sided Warbler, and Harris's Sparrow. Fourteen species are represented by one individual at the lab, and include Lazuli Bunting, Lark Sparrow, and Blackburnian Warbler.

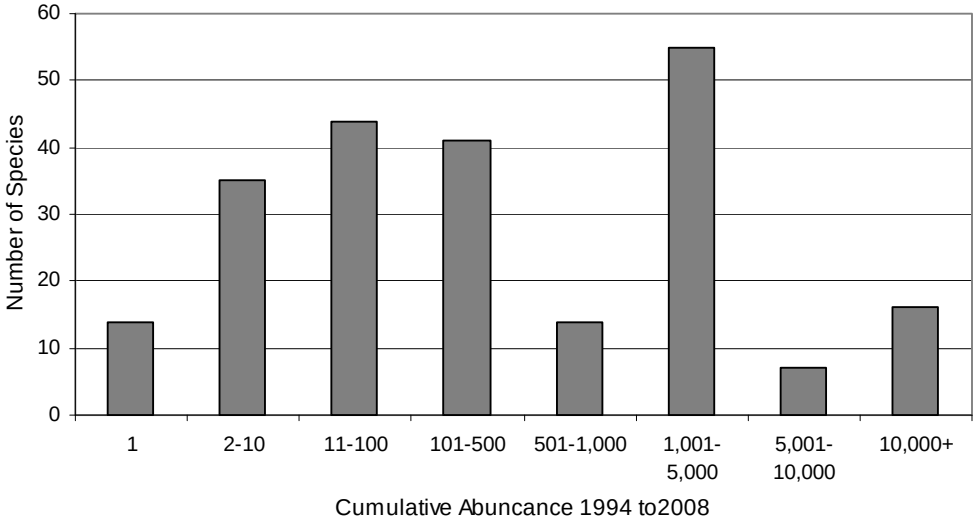

Figure 14. Cumulative abundance for species observed between 1994 and 2008.

The abundance proportions of the species detected by each monitoring method are highlighted in Figure 15. A greater number of the species detected through banding and visual migration counts are observed in lower abundances. However, over 60% of the species detected by all methods have been observed in abundances fewer than 500 individuals. The highest abundance has been recorded on incidental observations, however, the cumulative detections of 3% of the species detected through incidental observations.

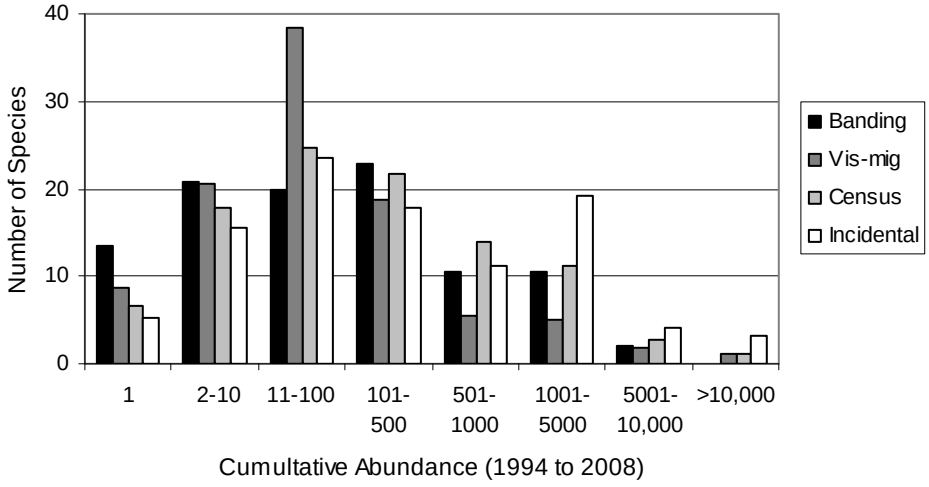

Figure 15. Proportion of species abundances detected through monitoring methods.

Incidental observations account for the highest species diversity and abundances of the four monitoring methods used at the LSLBO. It is an effective way of detecting both priority and non-priority species because it accounts for birds that may not be observed through the other observation methods such as: birds that are migrating outside a standard visual migration count, birds foraging in the forest and not actively migrating, or birds that may miss capture in the mist-nets. It has also detected many of the rare or uncommon species at the LSLBO. The drawback to incidental observations is that it is not a constant effort monitoring method. When banding becomes busy, attention turns to processing the birds in the mistnets and any migrating birds are missed. Rough estimates on the amount of time observers are recording incidental observations throughout the day were documented. This makes it difficult to correlate effort with the observations. Incidental observations also record every bird seen or heard, which includes both migrants and resident breeding or stopover individuals. Efforts to separate the two were enacted with the PKS system in 2000. Prior to 2000, the data for incidental observations gave no separation between migrant and non-migrant detections. This separation is critical because many of the priority species (see individual species accounts) have breeding populations within the vicinity of the banding lab.

Census has detected a lower species diversity and abundance than incidental observations. The lower overall detections are due to its short 30 minute duration. Census is conducted within the first two hours of each day, so it provides a sample of the bird activity within the monitoring at approximately the same time each day. It is a constant effort survey of the monitoring site and allows the opportunity to compare census trends between years. Like incidental observations, census records every bird seen or heard, but it is a constant effort survey of the monitoring site. Like incidental observations, migrants

and non-migrant species are recorded and the PKS system used from 2000 to 2008 separates the two.

Visual migration counts account for actively migrating birds. This is important for migration monitoring because this method focuses on migratory populations only and does not record stop-over birds and local residents. However, certain species are more easily detected in migratory flight than others. For this reason, not all species are well covered on visual migration counts. The detected proportions of the majority of the priority species are low and are detailed in the individual species accounts. The duration of visual migration count each hour is also short (10 minutes from 1994 to 1999, and 5 minutes from 2000 to 2008). This means that it is likely that migrants are passing through in the times between counts. But even with the short durations of this method, observations can be linked to effort to help determine trends each year.

Overall, banding accounts for the lowest diversity and abundances of the four monitoring methods. However, several species are almost exclusively detected by this method. For example, banding has accounted for 80% of the spring and 82% of the fall Cape May Warbler detections, 87% of the spring and 97% of the fall Yellow-bellied Flycatcher detections, and 97% of the spring and 100% of the fall Gray-cheeked Thrush detections. In some species, a large percentage of the total detections in the fall are through banding. For example, banding accounts for 55% of the spring and 77% of the fall Swainson's Thrush fall detections, 28% of the spring and 84% of the fall Hermit Thrush detections, and 27% of spring and 89% of the Ovenbird detections. While banding is an effective method of detecting certain species over certain migratory seasons; in some cases it only supplements the total detections. For example, Yellow-rumped Warblers are a common species observed migrating through the area, yet only 5% of the total number of spring and fall detections are through banding. Still, the potential information that banding provides is extremely valuable, such as age ratios of migrants, differential timing, stop-over length, return rates, and survivorship estimates.

Banding

From 1994 to 2008, a total of 45,337 birds from 95 species have been banded during standardized migration monitoring mistnetting at the LSLBO (Appendix 2). During spring migration, a total of 14,664 birds from 77 species have been banded. Spring banding averaged 978 birds represented by an average of 44 species. Season banding totals ranged from 447 birds in 1996 to 2,546 in 2000. Banding is busier in the fall with and a total of 30,673 birds banded from 88 species. On average, 2,045 birds are banded in the fall from and average of 55 species. Annual fall banding totals have ranged from 891 birds in 1997 to 3,496 in 2002.

Annual banding effort has varied through both migration seasons over the 15 years due to varying starting dates, protocol changes, and weather conditions (Table 8 and Table 9). Weather is a limiting factor affecting netting effort because nets are only set in conditions which do not compromise bird safety. The number of net hours lost due to cold morning temperatures in the early spring and late fall and the number of days lost to rain varies annually. Occasionally other environmental factors limit the number of net hours. In 2003, for example, several net-lanes were flooded for long periods of the spring and were inoperable. Capture rates (the number of birds banded per 100 net hours) is a simple way of comparing the banding productivity through accounting for the annual variation in mistnetting effort. The spring capture rate has been variable over the 15 years. The fall capture rate has experience variation as well, but banding totals from 2004 to 2008 were lower despite excellent mistnetting coverage, resulting in lower capture rates.

Table 8. Banding effort and results for spring migration at the LSLBO between 1994 and 2008.

Year	Banding Days	Net Hours	Birds Banded	Captures /100 net hours
1994	15	558	497	89.1
1995	35	2387	903	37.8
1996	25	1561	477	28.6
1997	34	2001	676	33.8
1998	36	2712	672	24.8
1999	42	3050	1354	44.4
2000	52	3219	2546	79.1
2001	54	3939	1903	48.3
2002	45	2835	866	30.5
2003	39	2450	692	28.3
2004	45	2723	1133	41.6
2005	43	3084	625	20.3
2006	44	3303	534	16.2
2007	47	3534	1085	30.7
2008	43	3411	731	21.4

Table 9. Banding effort and results for fall migration at the LSLBO, 1994-2008.

Year	Banding Days	Net Hours	Total Banded	Captures /100 net hours
1994	30	1071	1840	171.8
1995	50	2594	2387	92.0
1996	35	1388	976	70.3
1997	33	1981	891	45.0
1998	62	2939	3068	104.4
1999	76	4341	2051	47.2
2000	89	6710	2683	40.0
2001	69	5151	2353	45.7
2002	78	4903	3496	71.3
2003	69	5093	2616	51.4
2004	73	5094	1391	27.3
2005	71	5398	1907	35.3
2006	73	5696	2241	39.4
2007	68	5253	1412	26.9
2008	74	5751	1361	23.7

The annual total number of birds banded varies between seasons. In the spring, several peaks occurred over the 15 years (Figure 16). The peak occurring in 2000 was due to high numbers of Tennessee Warblers (167), Yellow Warblers (145), Myrtle Warblers (559), and Chipping Sparrows (592) banded that season. A smaller peak in 2004 was due to a large number of Swainson's Thrush banded (280). Another small peak occurred in 2007 which included higher than normal banding totals of White-throated Sparrows (136) and Black-capped Chickadees (55). The corresponding capture rate for the spring closely follows the banding totals (Figure 16). The exception occurred in 1994, which experienced a high volume of birds banded in relatively low amount of mistnet effort.

The highest banding total during fall migration occurred in 2002 (Figure 17). This was largely due to a high number of Myrtle Warblers banded (1270), which accounted for 36% of the total banded birds that season. The peak occurring in 2006 was due to a high number of Swainson's Thrush (218) and Ovenbirds (222) banded that year. While the fall banding totals have been variable over the 15 years, the capture rate shows a declining trend, which has leveled from 2004 to 2008. A high large number of mistnetting hours with fewer birds banded resulted in the lower capture rates. As with the spring, the capture rate in 1994 was high because of a large volume of birds that were banded over a small amount of overall mistnetting hours.

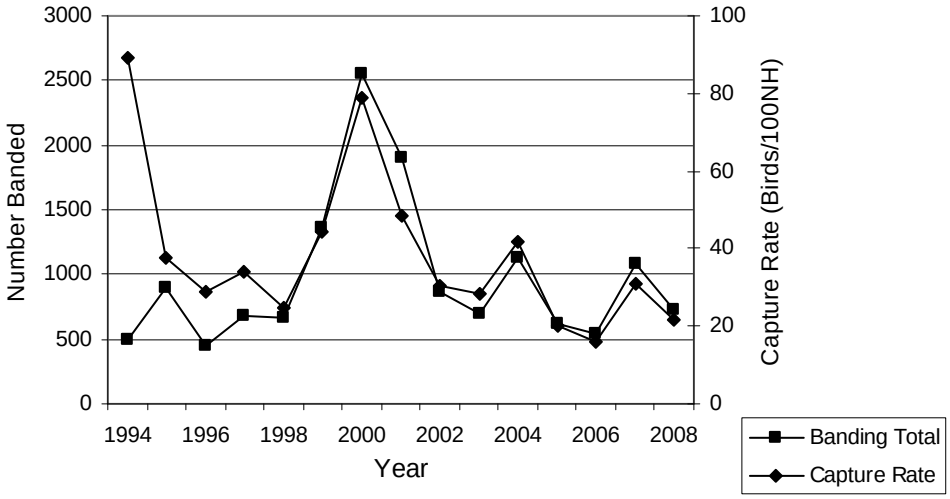

Figure 16. Annual spring banding totals and capture rates.

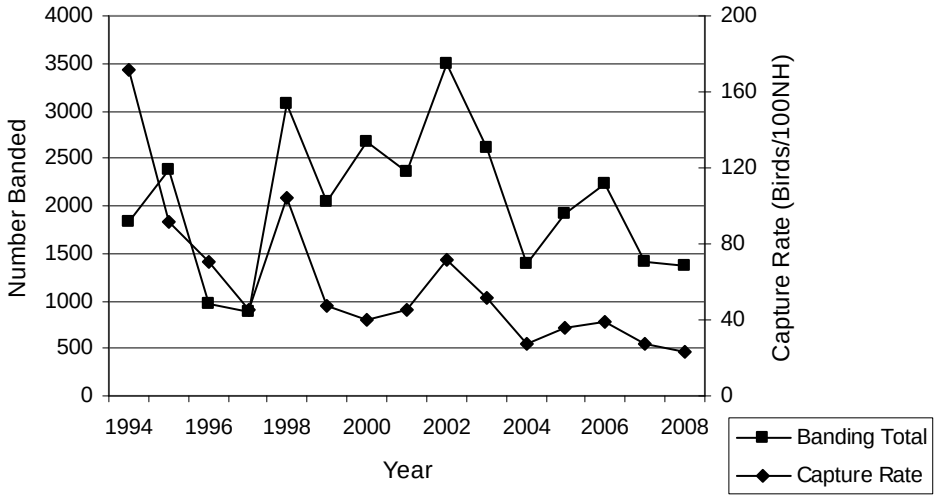

Figure 17. Annual fall banding totals and capture rates.

Banding Diversity

The distribution of the number of species that are common and uncommonly banded is similar in both migration seasons (Figure 18). In the spring, 29 species (38% of the seasons total) were banded on at least 14 years and 38 species (43% of the seasons total) were banded on at least 14 falls. A higher number of uncommon species have been banded in the fall. Eight species (10%) have been recorded on only a single year of fall banding, compared to 16 species (18%) in the spring. Many of these species only have one banding record at the station.

The higher species diversity experienced in the fall is due to a large number of species that have only been banded in that season. Seventeen species have been banded exclusively in the fall and include: Cooper's Hawk, Northern Goshawk, Northern Pygmy Owl, Pileated Woodpecker, Olive-sided Flycatcher, Northern Shrike, American Magpie, White-breasted Nuthatch, Varied Thrush, American Pipit, Nashville Warbler, Blackburnian Warbler, MacGillivray's Warbler, Lapland Longspur, Common Grackle, White-winged Crossbill, and American Goldfinch. This compares to the seven species that have only been banded in the spring: American Kestrel, Gray Jay, Gray Catbird, Northern Mockingbird, Veery, Lazuli Bunting, and Evening Grosbeak. There are also species, such as Boreal Chickadee, Golden-crowned Kinglet, Cape May Warbler, Black-throated Green Warbler, and Bay-breasted Warbler that are banded nearly every fall, but are rarely in the spring.

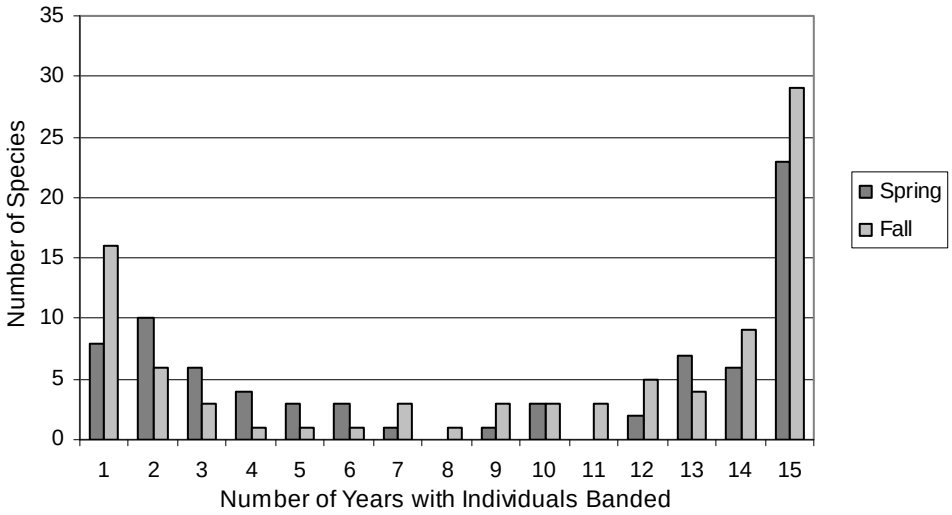

Figure 18. Number of species banded in relation to season and number of years they have been observed, 1994-2008.

Banding Abundance

It is not surprising that the most common species encountered during migration are also banded in the highest numbers. However, the most commonly banded species comprise only a small proportion of the total number of species banded in both the spring and fall (Figure 19). Only five species in the spring (7%) and seven in the fall (8%) have cumulative banding totals over 1,000 individuals and include: Swainson's Thrush, American Redstart, and Myrtle Warbler. A larger number of species, 21 (27%) in the spring and 27 (31%) in the fall, have cumulative banding totals between 101 and 1000. These species are typically banded in most years, but in lower abundances and include; Red-eyed Vireo, Common Yellowthroat, and American Tree Sparrow. The majority of species are banded in low numbers with 52 species (66%) banded in the spring and 54 species (61%) in the fall that have fewer than 100 banding records. These include species that are banded in very low numbers each year (Palm Warbler, annual mean of 13 banded), species banded irregularly (House Wren, a total of 10 banded), and uncommon species (Lazuli Bunting and Varied Thrush, one banding record each). In most cases, species that are commonly banded in the spring are also common in the fall, with some exceptions. For example, Bay-breasted Warblers have a cumulative spring banding total of 2 and fall banding total of 82.

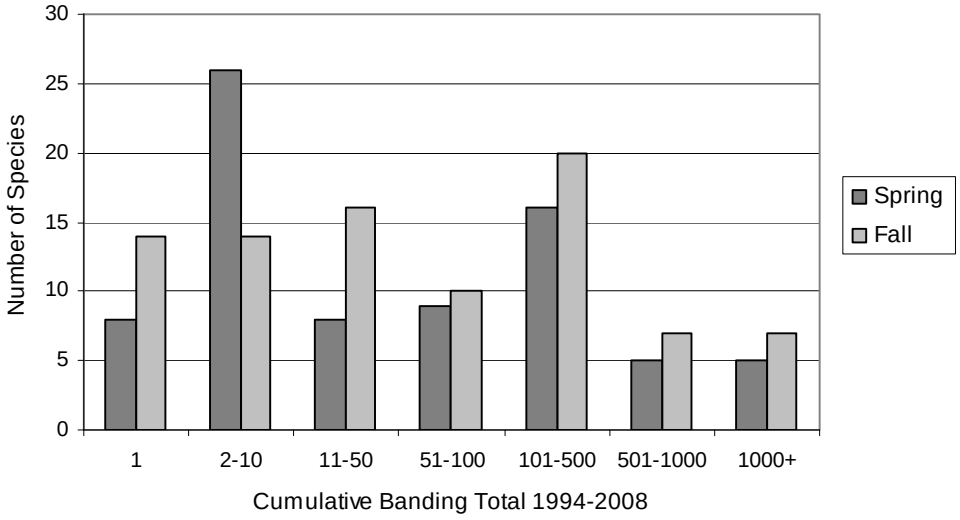

Figure 19. Cumulative banding totals and number of species and corresponding season.

Only a small proportion of the species banded at the LSLBO account for the majority of total number of birds banded. In spring, the top ten most commonly banded birds represent 13% of the banded species, but account for 68% of the total number of banded birds (Table 10). Likewise in the fall, the top ten species in the fall represent 11% of the total number of species, but account for 72% of total birds banded (Table 11). This trend has been documented at several banding stations, with small number of abundant species accounting for a large proportion of all birds banded (Menu, 2007; Priestley, 2007).

The majority of species banded account for only a small proportion of the total number of birds banded. In spring migration, 42 species (55%) have 50 or fewer banding records during the 15 years of monitoring and only account for a total of 377 birds banded (3%, of the total spring banding). In the fall, 44 species (50%) have a cumulative banding total of 491 birds (2% of total fall bandings).

Table 10. Top ten species banded during spring migration.

Species	Cumulative Banding Total (1994-2008)	% of Total Banded
Myrtle Warbler	1779	12%
Chipping Sparrow	1411	10%
American Redstart	1255	9%
Swainson's Thrush	1184	8%
White-throated Sparrow	1018	7%
Least Flycatcher	907	6%
Alder Flycatcher	622	4%
Clay-coloured Sparrow	590	4%
Yellow Warbler	574	4%
Tennessee Warbler	558	4%
Total	**9,918**	**68%**

Table 11. Top ten species banded during fall migration.

Species	Cumulative Banding Total (1994-2008)	% of Total Banded
Myrtle Warbler	5366	18%
American Redstart	4230	14%
Tennessee Warbler	3342	11%
Yellow Warbler	2201	8%
Swainson's Thrush	1885	6%
Ovenbird	1372	5%
Canada Warbler	1271	4%
Alder Flycatcher	892	3%
Black-and-white Warbler	865	3%
Least Flycatcher	735	2%
Total	**22,159**	**72%**

Weekly Capture Rates

The average weekly capture rate from 1994 to 2008 displays the peak banding periods at the LSLBO. In the spring, the average busy banding period begins mid-May and continues into the end of May (Figure 20). The busy season in the fall occurs early in August (Figure 21). By mid-August the capture rate levels off and declines throughout September. This information is useful for planning operations, coordinating volunteer assistance and informing visitors about the busiest periods for birds at the Lesser Slave Lake Provincial Park. Timings for the peak banding periods for the selected priority species are provided in the species accounts section of the report.

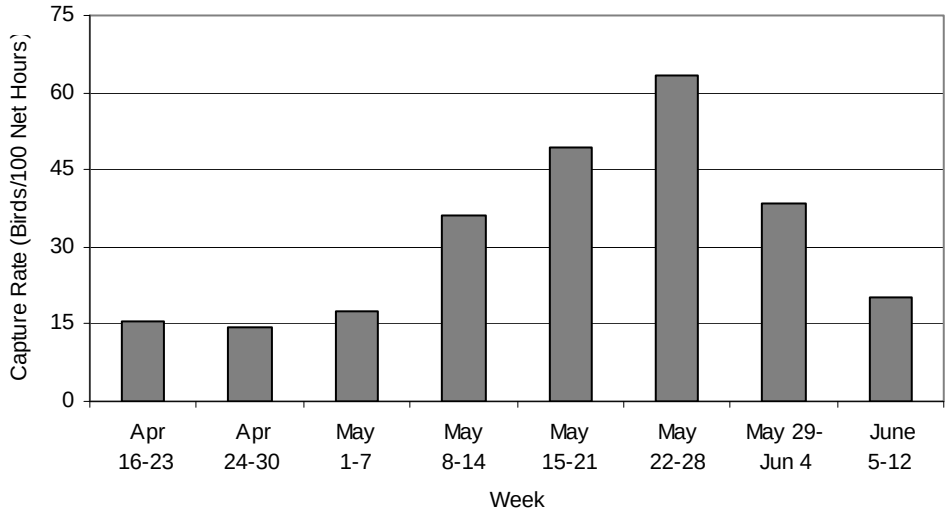

Figure 20. Average weekly capture rates during spring migration 1995-2008.

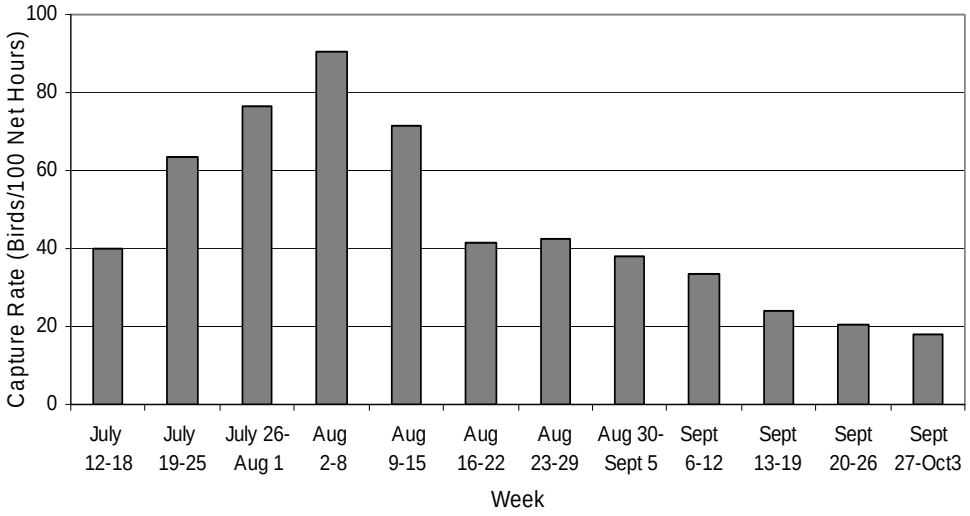

Figure 21. Average weekly capture rates during fall migration 1995-2008.

Net-lane Analysis

The 12 core net-lanes are located in different tree cover and habitat types (Figure 2). The shoreline nets (6 and 11) are located in willow shrubs, three nets (1, 5, and 12) are located in mixed willow and alder, and the remaining nets (2, 3, 4, 7, 8, 9, and 10) are located in older aged aspen forest with some spruce understory. Net-lane 6 is the most productive net for the LSLBO in both the spring and fall, followed by net 11, 12, and 5 (Figure 22). Net 1 is highly productive in the fall.

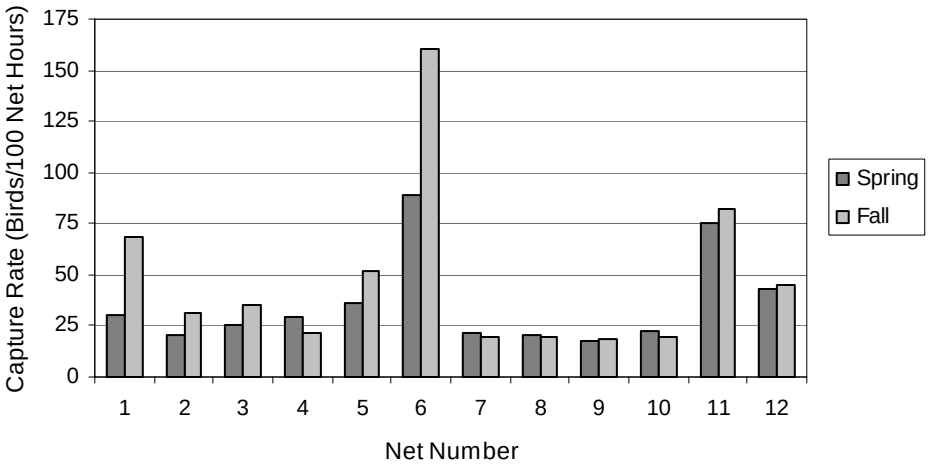

Figure 22. Average capture rate by net-lane (1995-2008).

Several species mirror the distinct capture patterns shown in the overall net-lane capture rates. For example, Yellow Warbler and Black-and-white Warbler are captured in the highest abundance in net-lanes 6, 11, 1, and 5 in both the spring and the fall (Figure 23 and Figure 24). This is a common pattern for species that are regularly observed on diurnal passage. Other species seem to have more of an even capture pattern through the entire study site. For example, Ovenbird and Swainson's Thrush are captured almost evenly throughout the entire site in both the spring and fall (Figure 25 and Figure 26).

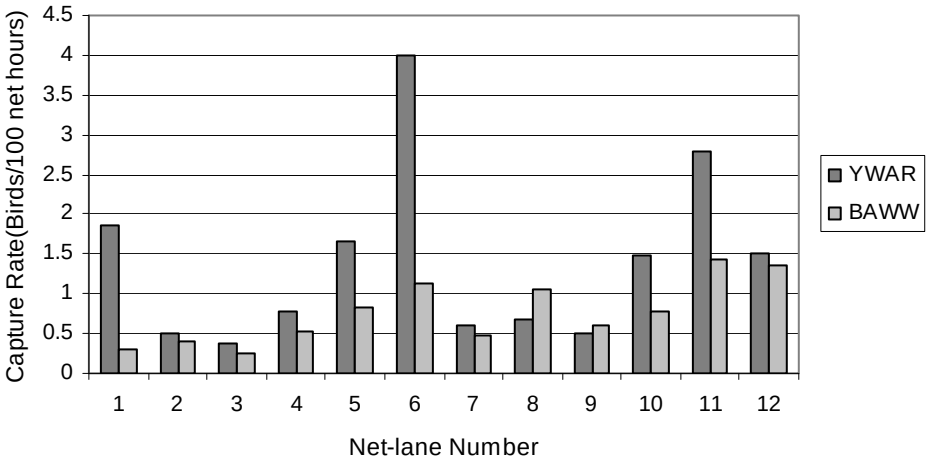

Figure 23. Average spring capture rate by net-lane for Yellow Warbler (YWAR) and Black-and-white Warbler (BAWW) (1995-2008).

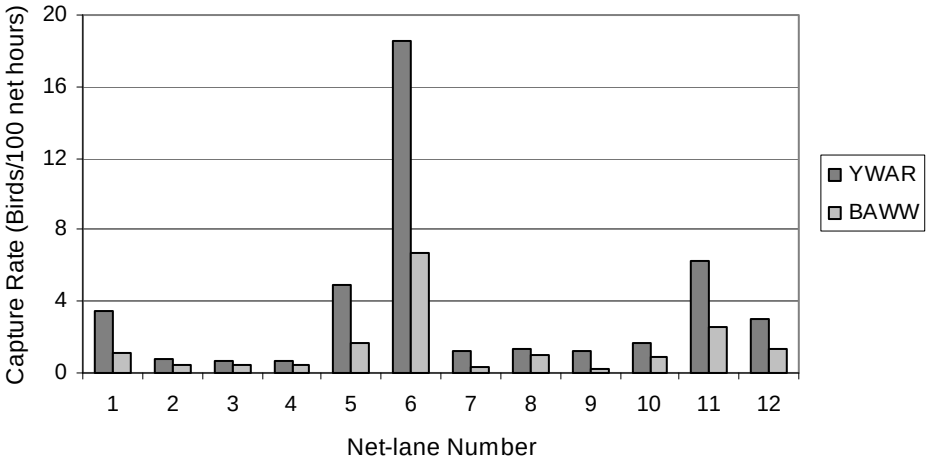

Figure 24. Average fall capture rate by net-lane for Yellow Warbler (YWAR) and Black-and-white Warbler (BAWW) (1995-2008).

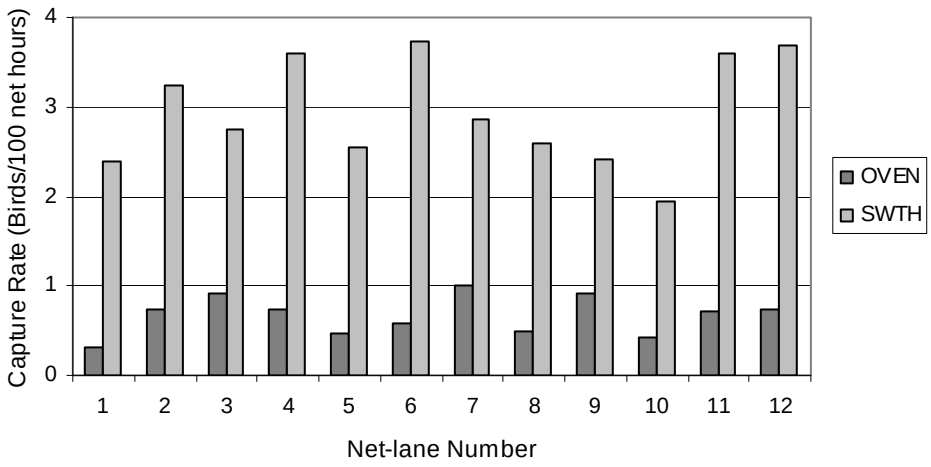

Figure 25. Average spring migration capture rate by net-lane for Ovenbird (OVEN) and Swainson's Thrush (SWTH) (1995-2008).

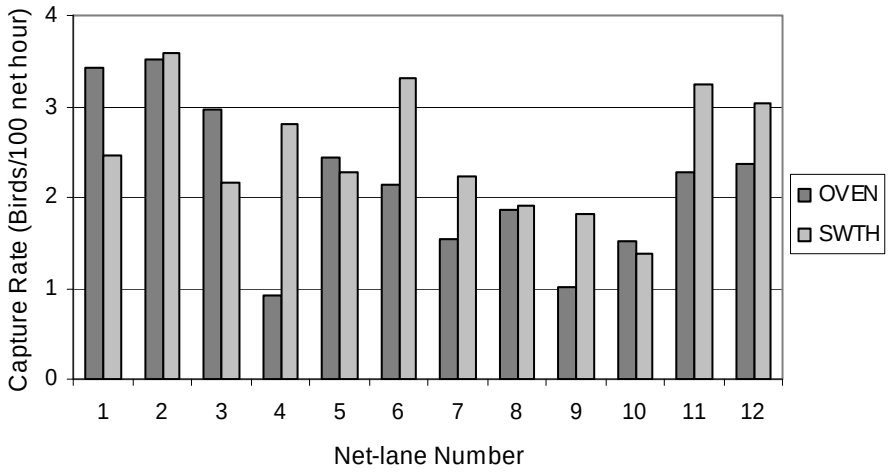

Figure 26. Average fall capture rate by net-lane for Ovenbird (OVEN) and Swainson's Thrush (SWTH) (1995-2008).

Recaptures

A recapture is a bird that has been captured that has been previously banded. Recaptures fall into one of three categories:
1) “repeat” – a bird that was banded and recaptured in the same location within 90 days between captures.
2) “return”- a bird that was banded and recaptured in the same location but in a different season (over 90 days between captures).
3) “foreign recovery”- a bird that was banded and recaptured in two different locations.

Repeats

Repeats occur in individuals that are moving through migration and are using the area as a stopover site and captured on a subsequent day. More common repeat encounters are from individuals from the local breeding population. Although the migration station focuses on migrating birds, a number of birds will set up breeding territories in the vicinity of the migration netlanes and are captured multiple times over the season. Information from repeat birds is useful to help determine stopover rates for migrants and the extent of local breeding populations. The challenge with the LSLBO being located in the boreal forest is being able to identify stopover individuals from the local breeding individuals of boreal forest nesting species.

There have been 803 individual birds, from 34 species, with at least one repeat record over the 15 years of spring monitoring. The highest incidence of repeat birds occurred in 2007 with 75 individual records from 19 species (Table 12). Repeat occurrences were higher in the fall with a total of 1,638 individual records from 49 species. The greatest number of repeats occurred in 2000 with 234 individuals from 33 species (Table 13).

Returns

There are fewer records of returns than repeat captured birds at the LSLBO and are most common in individuals returning to breeding territories that are near the migration monitoring site. Return data can be used for survivorship estimates and longevity records, but this information is more relevant to the monitoring projects that occur on the breeding grounds (MAPS). Returning individuals can occur that pass through on migration, but the occurrence is likely low and it would be difficult separating migrants from locally breeding individuals.

During spring migration there has been return records for a total of 420 individuals from 25 species. The highest number of returning individuals recorded occurred in 2001 with 42 records from 14 species (Table 12). Fewer returns have been recorded in the fall, with a total of 153 records from 21 species. The largest number of returning individuals recorded in the fall occurred in 2004 with 21 returns from 9 species (Table 13).

Table 12. Number of spring recaptures by year and origin.

Year	Number of Repeats	Number of Repeat Species	Number of Returns	Number of Return Species
1994	34	13	9	8
1995	43	16	29	12
1996	23	13	15	6
1997	38	16	26	11
1998	35	14	22	10
1999	35	16	28	10
2000	69	19	30	12
2001	73	15	42	14
2002	68	18	26	11
2003	67	20	37	15
2004	60	23	30	15
2005	56	18	32	15
2006	61	17	29	12
2007	75	19	35	13
2008	66	19	30	13

Table 13. Number of fall recaptures by year and origin.

Year	Number of Repeats	Number of Repeat Species	Number of Returns	Number of Return Species
1994	42	17	2	2
1995	119	21	12	5
1996	37	13	3	2
1997	21	10	0	0
1998	79	21	10	6
1999	97	19	12	5
2000	234	33	16	8
2001	105	18	13	7
2002	138	24	10	5
2003	160	25	15	5
2004	124	22	21	9
2005	128	23	11	8
2006	156	23	13	8
2007	96	16	8	6
2008	102	16	7	6

The number of banded birds that are recaptured in a subsequent year is illustrated in Figure 27. More birds banded in the spring are recaptured in another year than birds banded in the fall, with the most returns occurring from birds originally banded in spring 1998 and spring 2002. The number of returns from birds banded in later years (ie. 2007) is lower because the more time that passes, the more chance there is to recapture a bird. 2008 is not on the list because there has not been an opportunity to recapture those birds.

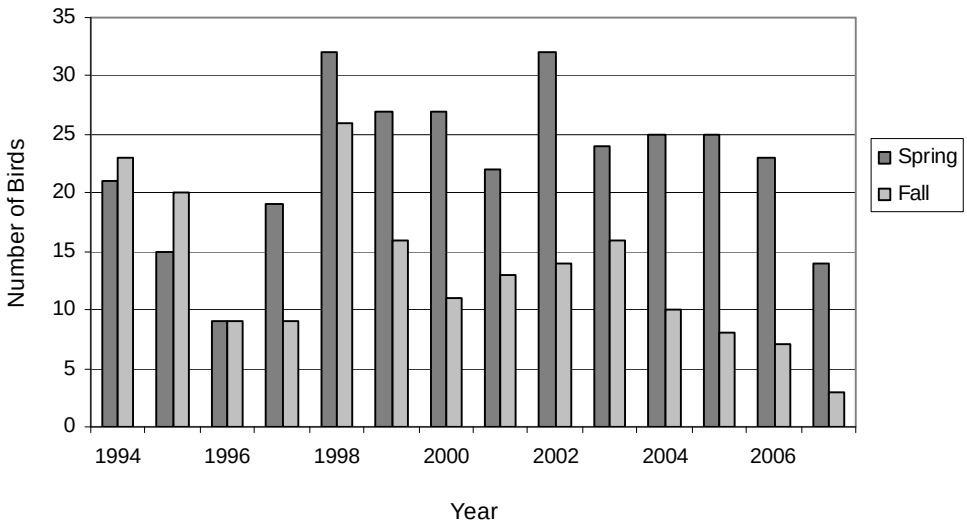

Figure 27. Number of birds banded by year and season recaptured in a subsequent year.

There are several instances each year where birds have returned over 4 years after the original banding. Further details into these birds are provided in the LSLBO annual reports. Two birds stand out as the oldest individuals recorded so far at the LSLBO:

1) Black-capped Chickadee: banded on May 16, 2000 as ASY, recaptured on July 26, 2006; at least 8 years old.
2) Alder Flycatcher: Banded on July 27, 1996 as AHY, recaptured on July 21, 2005; least 10 years old.

Foreign Recoveries

Foreign recaptures include birds that were banded and encountered at another location. Even though these recoveries can provide information on migration movement, encounters of this nature are rare.

There have only been two instances where a bird has been banded at another location and recovered at the LSLBO:

1) Least Flycatcher banded on May 25, 1998 at Omaha, Nebraska and recaptured at the LSLBO on June 5, 1998. This bird traveled approximately 2100 kilometers in 11 days (Jungkind, 2001).

2) Sharp-shinned Hawk banded near Beaverhill Lake, Alberta on July 31 2001 and recaptured at the LSLBO on May 30, 2002.

Instances of birds banded at the LSLBO and recovered at another location are just as uncommon. There have only been three reported birds banded at the LSLBO encountered at another location:

1) Canada Warbler banded on June 24, 2003 at the LSLBO was recovered on May 18, 2004 near Little Falls, Minnesota.

2) Swainson's Thrush banded on September 2, 2003 was recovered on May 5, 2008 near Louisville Kentucky.

3) Blue Jay Banded on September 7, 2006 was recovered near Barrhead, Alberta on April 25, 2007.

Population Trends

Currently, the population trend analysis of the LSLBO migration data is conducted by the CMMN. Current updates are reported on http://www.naturecounts.ca (Bird Studies Canada, 2008) and reports have been published on migration trends through the CMMN (Badzinski and Francis, 2000b; Crewe et al., 2008).

The following is a summary of the LSLBO population trends from *The Canadian Migration Monitoring Network-Rèseau canadien de surveillance des migrations: Ten-year Report on Monitoring Landbird Population Change* (Crewe et al., 2008). The summary of species is based on 10 year trends from 1997-2006. Of the species analyzed during spring migration: 17 species show positive trends, 4 with statistically significant changes, and 21 showing negative population trends, 3 with statistically significant declines (Table 14). In the fall, 17 species showing positive population trends, 1 species is statistically significant, and 23 species have negative population trends, with 5 species showing statistically significant declines (Table 15).

Table 14. Species experiencing positive and negative population trends from LSLBO spring migration data analyzed by the CMMN (Crewe and al. 2008).

Positive Trends (* statistically significant)	Negative Trends (* statistically significant).
Northern Flicker	Yellow-bellied Sapsucker
Eastern Phoebe	Least Flycatcher
Blue Jay	Red-breasted Nuthatch
Tree Swallow	American Pipit
Ruby-crowned Kinglet*	Orange-crowned Warbler
Swainson's Thrush	Magnolia Warbler
Hermit Thrush*	Palm Warbler
Tennessee Warbler*	American Redstart
Yellow Warbler	Northern Waterthrush
Yellow-rumped Warbler	Mourning Warbler
Black-and-white Warbler	Common Yellowthroat*
Canada Warbler	Wilson's Warbler*
Clay-coloured Sparrow	Western Tanager*
Lincoln's Sparrow	American Tree Sparrow
Rose-breasted Grosbeak*	Savannah Sparrow
Brown-headed Cowbird	White-crowned Sparrow
Pine Siskin	Dark-eyed Junco
	Red-winged Blackbird
	Common Grackle
	Purple Finch
	Evening Grosbeak

Table 15. Species experiencing positive and negative population trends from LSLBO fall migration data analyzed by the CMMN (Crewe and al. 2008).

Positive Trends (* statistically significant)	Negative Trends (* statistically significant)
Yellow-bellied Sapsucker	Least Flycatcher*
Eastern Phoebe	Eastern Kingbird
Blue Jay	Philadelphia Vireo
Ruby-crowned Kinglet*	Red-breasted Nuthatch*
Swainson's Thrush	Golden-crowned Kinglet
American Pipit	Hermit Thrush
Tennessee Warbler	American Robin
Orange-crowned Warbler	Cedar Waxwing
Yellow Warbler	Magnolia Warbler*
Yellow-rumped Warbler	Palm Warbler*
Western Tanager	Blackpoll Warbler
Chipping Sparrow	Northern Waterthrush
Lincoln's Sparrow	Mourning Warbler*
Dark-eyed Junco	Common Yellowthroat
Lapland Longspur	Wilson's Warbler
Rose-breasted Grosbeak	Canada Warbler
Purple Finch	American Tree Sparrow
	Savannah Sparrow
	White-crowned Sparrow
	Red-winged Blackbird
	Common Grackle
	Pine Siskin
	Evening Grosbeak

Discussion

Long term monitoring programs are essential to understanding population trends of migratory birds. Over the past 15 years the Lesser Slave Lake Bird Observatory has strived to be a strong organization with the primary goal of long-term migration monitoring. Due to the nature of migration patterns, detected species abundances can show annual variation; one year a species can be abundant while being virtually absent the following year. Long-term abundance patterns can account for these annual variations and provide more precise population trends. The 15 years of migration data collected by the LSLBO has provided strong baseline data of migratory populations and it is highly important to maintain migration monitoring into the future. How bird populations will respond to future changes in habitat or climate is unknown, but the ability to identify populations as decreasing is a crucial step in determining threats to bird populations. Only once a population is identified as decreasing, can the threat/s be identified and targeted conservation plans be implemented. Furthermore, there are still many mysteries to bird migration and monitoring stations like the LSLBO can contribute to furthering the knowledge of bird migration and biology.

The aim of this report is to summarize the results of the 15 years of spring and fall migration monitoring. It highlights the results of the migration monitoring program and focuses on the separate monitoring methods. Although each method has strengths and weaknesses, combined they provide a strong sampling method that covers a diverse range of bird species. The cumulative diversity and abundances that are presented do not display distinct trends. Further analysis and abundances indices can be conducted that focus on specific families or individual species of interest.

Standardized data collection effort is essential for creating and comparing data trends. One of the difficulties in preparing and interpreting migration results for this report was inconsistent efforts prior to year 2000 which led to challenges on how to present the results. The migration data collected in those years, however, was still very strong and useful in providing some trend analysis, but much care was taken when linking observations with effort. Banding effort has been well documented over the 15 years, and for that reason it was covered more in-depth in this report. However, banding effort is, by nature, not consistent due to environmental factors, making it not as ideal as constant effort visual observations. It is vital that full coverage that is consistent with the standards set in 2000 continues in the future years to provide stronger analysis for trends.

The abundance and diversity results showed that of the four standardized monitoring methods incidental observations detect the highest abundances and diversity of bird species. However, because it is not a constant effort survey method, it is difficult to compare yearly trends because time is not factored in. Manpower at the LSLBO is limited and the current operating protocol is a compromise that allows a small number of observers to conduct all monitoring methods each day (Lesser Slave Lake Bird Observatory, 2003). This compromise should remain, as banding holds just as much value in detecting birds that are not otherwise detected on any of the visual counts. An

interesting test would be to compare abundance and diversity detected using only constant effort visual migration counts to the numbers detected using the four combined monitoring methods currently used. This, of course, would only be possible if the staffing was available to not take away from the existing monitoring protocol.

The LSLBO has been fortunate to have had several long-term staff members acting as bander-in-charge. The bander-in-charge is an individual who is highly skilled at bird identification and banding and is responsible for daily monitoring activities. The importance of long-term staff is in the consistency of the date collected. High staff turnover can potentially result in variation of data collection.

Habitat change is currently a concern at the LSLBO. The vegetation within the study site has not been managed since the monitoring program began and the forest stands and surrounding vegetation have matured. The impact of habitat change may have altered migration patterns, abundances, species composition, and the ability to detect birds during migration. For example, the canopy height of the vegetation surrounding all the net-lanes was historically level with the tops of the nets, it is now well above the maximum reach of the nets allowing birds to fly through the canopy and over the nets. This may have influence on the banding totals, capture rates, and species captured. The extent of the changes are unknown and may require further study. Rigorous habitat monitoring has never been occurred at the LSLBO, so it is difficult to quantify the rate of vegetation growth and its link to changes in species abundances. The mandate of the Lesser Slave Lake Provincial Park is to maintain a natural setting, which does not allow for habitat management at the LSLBO. This problem has been identified and solutions are planned for future implementation. One possible solution is to conduct a net-lane by net-lane comparison of capture rates and species diversity over time. Another possible solution is to do sample mist-netting in the canopy layer and in areas with vegetation in early succession growth and compare the information gathered to migration netting in an attempt to identify possible shifts in species composition and abundance caused by habitat change. At minimum, habitat monitoring will be conducted at regular intervals.

Identifying locally breeding birds and the ability to separate migrants from local birds is necessary for precise population trend analysis. Resident breeding birds affect the Dts because they are detected every day and add to the daily counts, which ultimately increases the number of birds sighted during migration. The majority of the priority species monitored (28 of the 38) at the LSLBO have resident breeding populations (Badzinski and Francis, 2000). Identifying Probable Known Stopover birds was incorporated to help separate migrating and non-migrating individuals in the daily totals. Removing PKS birds from observation trends in the migration data from 2000 to 2008 caused little deviation on the migratory trends, just lower abundances. Birds considered to be PKS can be highly subjective between observers to it is important to ensure all observers are considering the same birds as PKS. The next step is to analyze PKS data on a species by species basis. The majority of species with migration timing analysis showed distinct timing of migratory passage, indicating that the impact caused by detecting breeding and stop-over individuals is small (Section II: Species Accounts).

The Canadian Migration Monitoring Network is essential to migration monitoring as they provide the technical support of conducting the population trend analysis on data collected from individual stations. This not only aids stations without the capabilities of conducting trend analysis, but allows for broad geographic comparisons of the migrating bird populations across Canada. Information sharing between stations and distribution of the results to the pubic is easier with a centralized organization. The CMMN also collaborates with other national and international organizations (such as Partners in Flight) to improve methods of monitoring and analysis. They are also crucial in identifying bird species that have monitoring gaps and require more study. The CMMN also promotes cooperative projects that increase the knowledge of avian migration. One such project is an isotope study of feathers gathered from CMMN stations across Canada which will lead to determining bird catchment areas for each station, resulting in a better understanding of migration patterns observed at and between stations (Crewe et al., 2008).

Species Accounts

The following are selected species accounts of priority monitored species observed during migration monitoring at the LSLBO. General migration patterns and abundances are detailed for each species. Spring and fall migration timing is presented by averaging the DTs from 1994 to 2008 in three day periods. Banding trends are provided with annual banding totals and capture rate trends (capture rates are presented in birds captured/100 net hours and exclude 1994). Observed differential migration patterns by age and sex classes through banding records are highlighted for spring migrations.

Alder Flycatcher (*Empidonax alnorum*)

Alder Flycatchers are regular migrants through the LSLBO and are observed in low abundances during both spring and fall migration (cumulative mean DT of 89 in the spring and 121 in the fall). Detections during both seasons consist of small numbers of individuals; daily totals consist of fewer than 20 individuals during peak migration periods. Banding plays an important role in monitoring of Alder Flycatchers. Banded individuals accounted for 50% of spring and 53% of fall DT. No individuals have been recorded on spring visual migration counts, and less than 1% on fall visual migration.

Alder Flycatchers are late spring migrants, arriving the third week of May; the earliest spring record was on May 12. Spring migration is concentrated between late May and early June with the average peak migration occurring within the first week of June (Figure 28). The detections at the end of the spring monitoring period consist of a combination of late migrants and likely local breeding individuals singing in the surrounding forest. The local breeding population is small, but these individuals are frequently detected during monitoring activities. Fall migration timing is less concentrated than the spring, with the bulk of migration occurring from mid-July to mid-August (Figure 29). On average, fall migration abundances peak within the first week of August. Detections begin to decrease mid-August and sightings become uncommon throughout September. The latest fall record occurred on September 27.

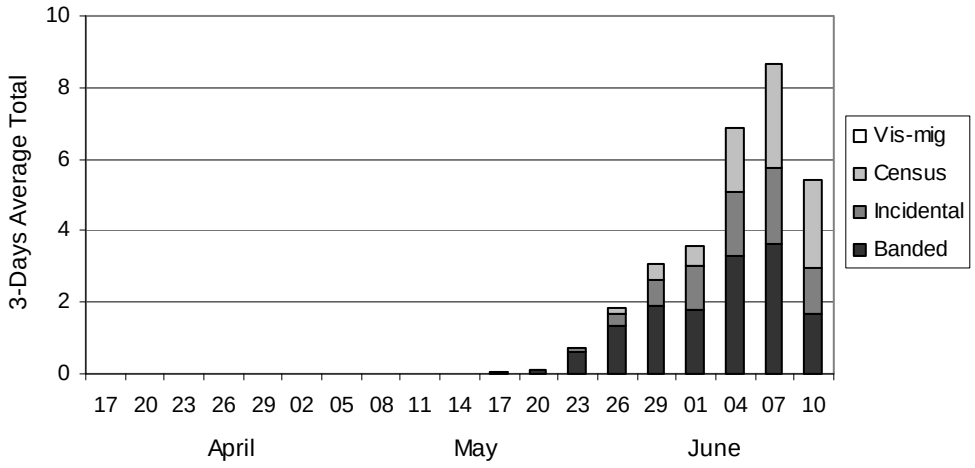

Figure 28. Alder Flycatcher spring migration 3-day average Daily Total (1994 to 2008).

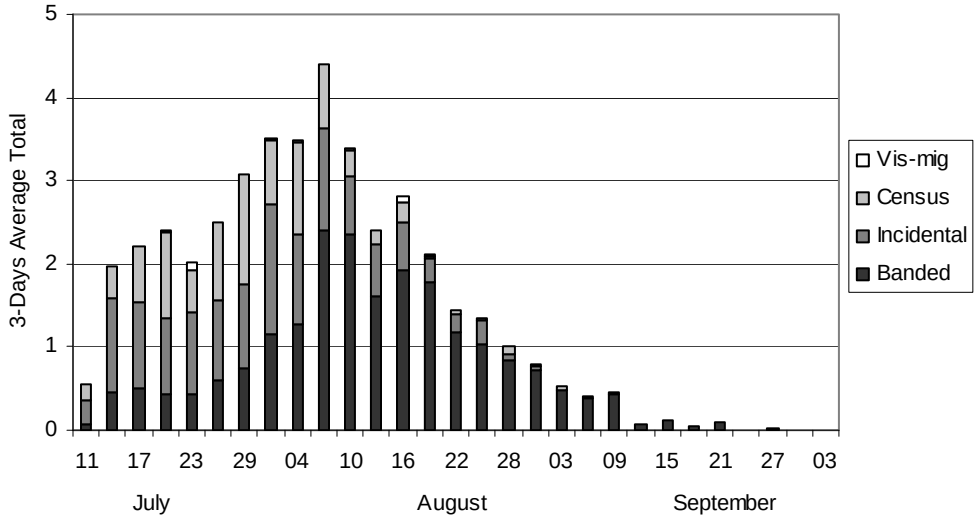

Figure 29. Alder Flycatcher fall migration 3-day average Daily Total (1994 to 2008).

Alder Flycatchers are one of the top ten species banded at the LSLBO in both the spring and fall (Tables 10 and 11). Banding totals have slight variation between years and seasons, but have been consistently low from 2003 to 2008 in the spring and from 2005 to2008 in the fall (Figure 30). A total of 622 birds have been banded in the spring (mean 42, range 4 to 80). Alder Flycatchers are aged with caution in the spring and the sex of most individuals is not reliably determined, resulting in limited information on the migration timing differences between age and sex classes. Fall banding totals are slightly higher than the spring, with a total of 892 banded (mean 60, range 25 to 165). Hatch-year birds account for 70% of birds banded in the fall, which is a lower proportion compared

to many other species at the LSLBO. Capture rates for both the spring and fall show a decline over the course of the LSLBO monitoring history (Figure 31).

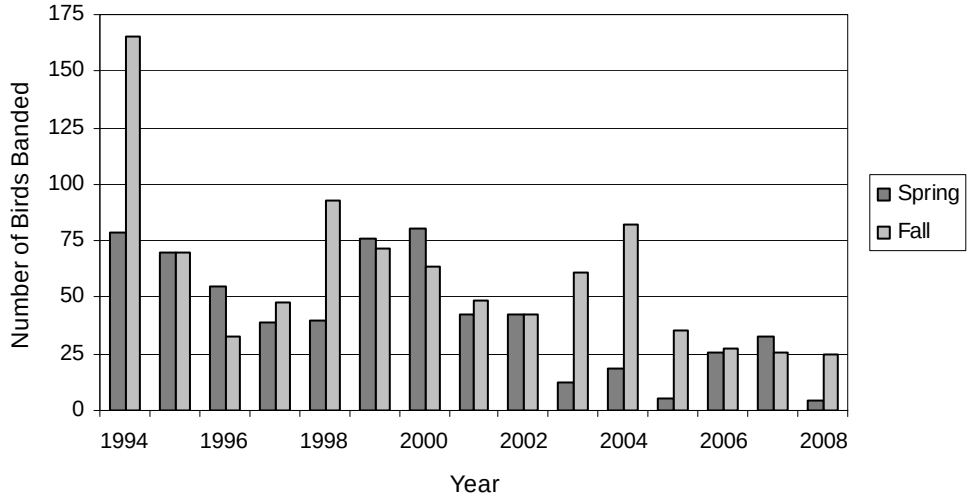

Figure 30. Annual spring and fall banding totals for Alder Flycatcher (1994 to 2008).

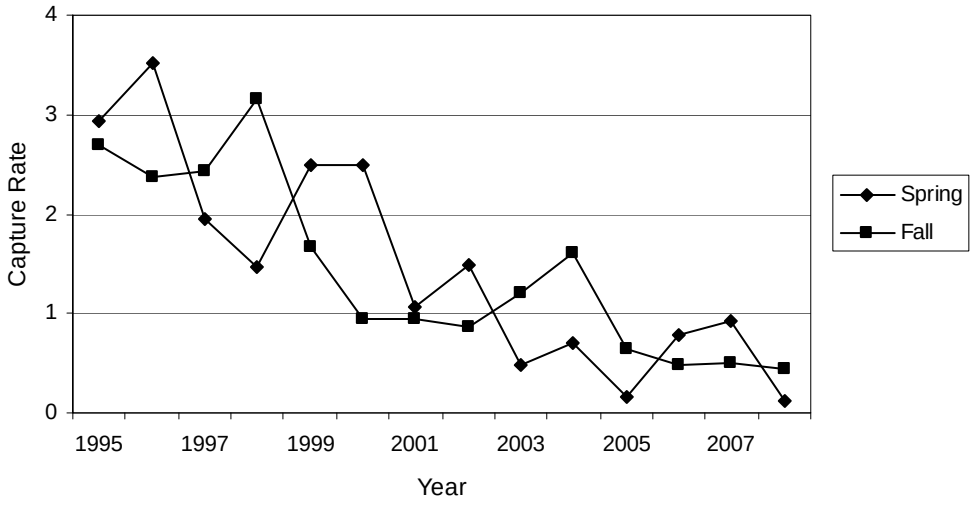

Figure 31. Annual spring and fall capture rates for Alder Flycatcher (1994 to 2008).

Least Flycatcher (*Empidonax minimus*)

Least Flycatchers are a common species observed at the LSLBO during migration, but typically detected in small abundances. Detections in the spring are slightly higher than the fall (cumulative DT spring average is 165 and 97 in the fall). Spring DTs are generally below 10 birds a day and detections are equally proportioned between observations and banding. Several dates have recorded large passages, including 439 counted on May 24, 1994. Fall migration passage is spread throughout the season and DTs remain fewer than 20 birds. Banding accounts for 53% of fall detections. The lower fall DT is partially due to conservative identification. Differentiating *Empidonax* flycatchers (Alder and Least Flycatchers) is difficult when the birds are not singing or being banded.

Least Flycatchers begin to arrive at the LSLBO during the first week of May, the earliest encounter date was on May 3, and peak migration occurs within the third week of May (Figure 32). Migration tapers off in June where most recorded observations consist of locally breeding birds. Fall migration passage begins slowly with detections consisting of likely local breeding birds (Figure 33). Passage becomes steady late in July and peaking within the first week of August. The frequency of detections reduces by mid-August, but Least Flycatchers do continue moving through in small numbers until mid-September. The latest recorded encounter was on September 25.

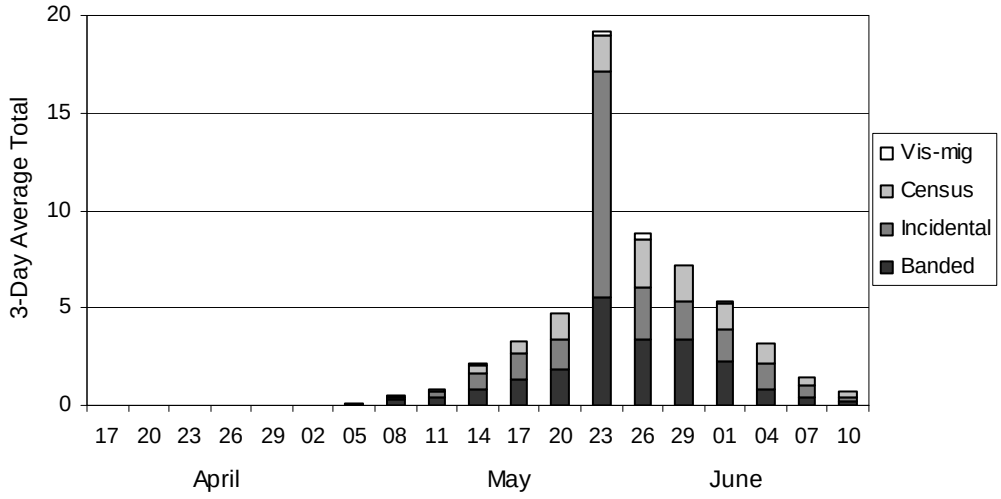

Figure 32. Least Flycatcher spring migration 3-day average Daily Total (1994 to 2008).

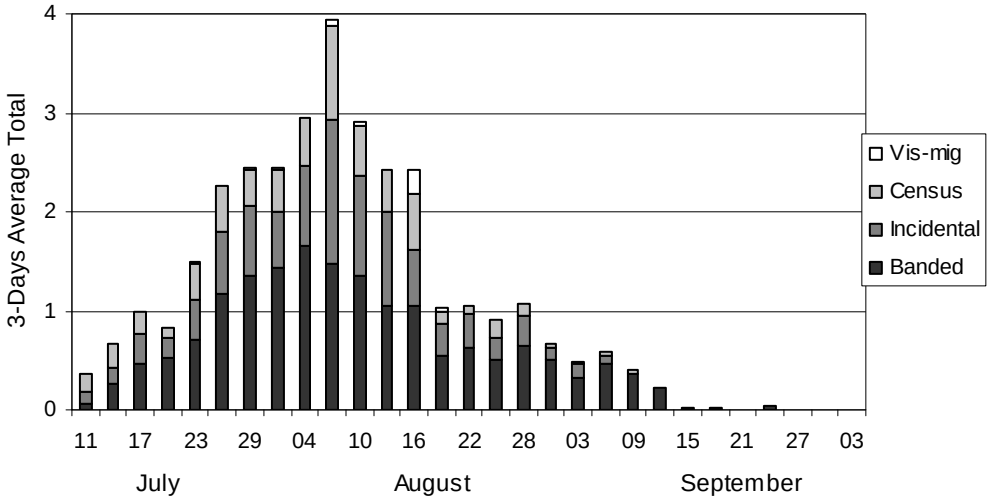

Figure 33. Least Flycatcher fall migration 3-day average Daily Total (1994 to 2008).

Least Flycatchers are one of the top ten species banded during both spring and fall migration (Tables 10 and 11). Banding totals display variability between years and seasons (Figure 34). A total of 907 (mean 61, range 7 to 165) have been banded in the spring. Not all individuals are reliably aged and sex is indeterminable by plumage. A total of 735 (mean 49, range 15 to 94) have been banded in the fall. A large proportion (88%) of the birds banded in the fall are HY. Both spring and fall capture rates have shown steady declines between 2004 and 2008 (Figure 35).

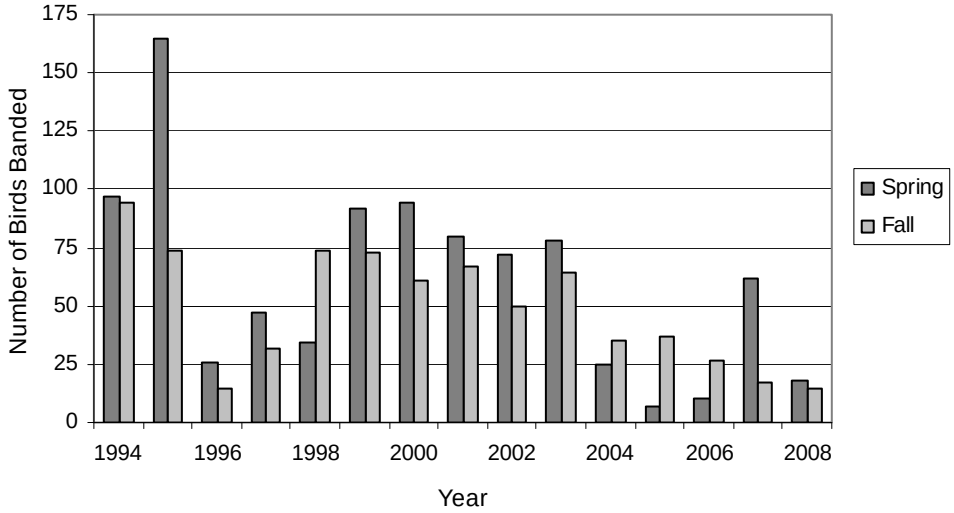

Figure 34. Annual spring and fall banding totals for Least Flycatcher (1994 to 2008).

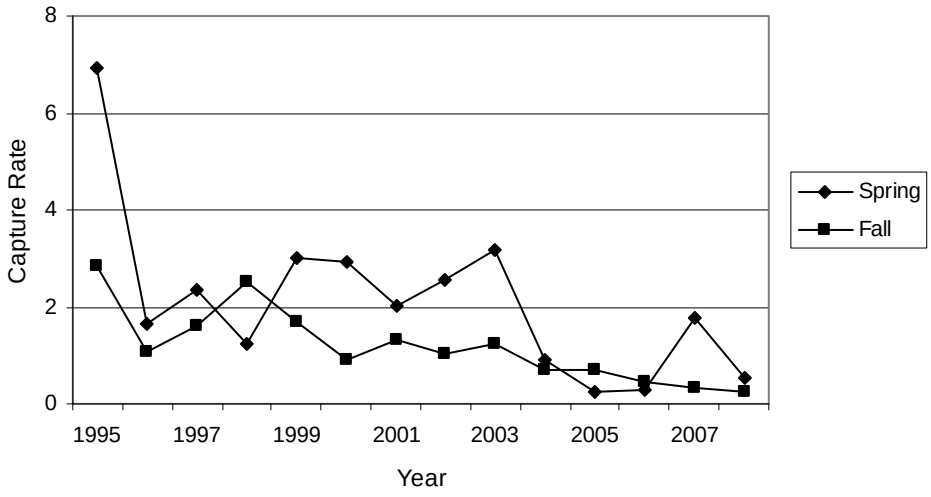

Figure 35. Annual spring and fall capture rates for Least Flycatcher (1994 to 2008).

Swainson's Thrush (*Catharus ustulatus*)

Swainson's Thrush are commonly encountered during both migration seasons (cumulative mean spring DT is 151 and 192 in the fall). Swainson's Thrush can be observed in large abundances in the spring, several dates had DTs with over 100 individuals. Overall abundance in the fall is higher than the spring, but the migratory window is spread through a longer period of time, resulting in only two dates with DTs over 20 birds. Banding accounts for the majority of the detections in both seasons, with 55% of the spring and 73% of all fall detections. They are occasionally detected on visual migration counts, with 4% of spring and less than 1% of fall detections.

Swainson's Thrush begin arriving during the first week of May, and peak migration occurs within the third week of May (Figure 36). The earliest spring sighting occurred on May 2. Very little variation in migratory passage occurs between years. A local breeding population breeds within the vicinity of the migration station. These individuals likely account for observations in June. The fall migratory window lasts from the third week of July to the end of August (Figure 37). Abundances begin to decrease throughout September, with the latest sighting occurring on September 30. Detections remain steady throughout the migratory period without any years showing distinct peaks.

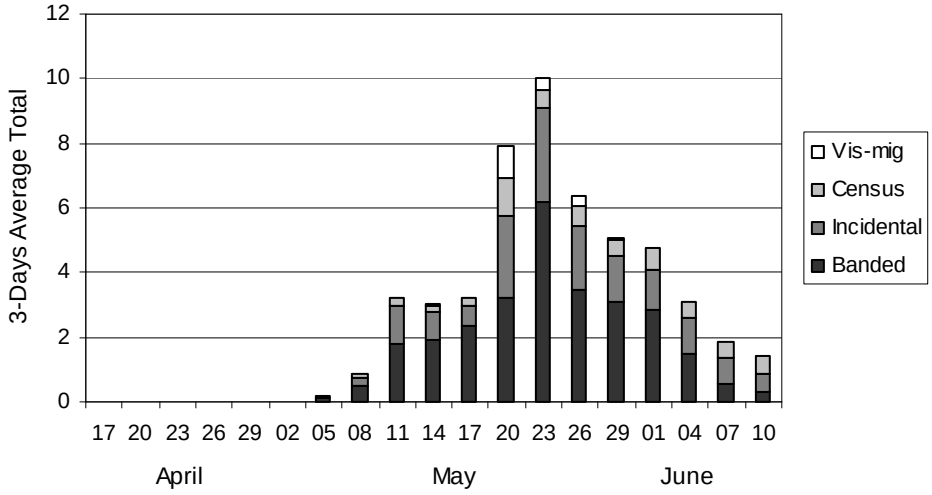

Figure 36. Swainson's Thrush spring migration 3-day average Daily Total (1994 to 2008).

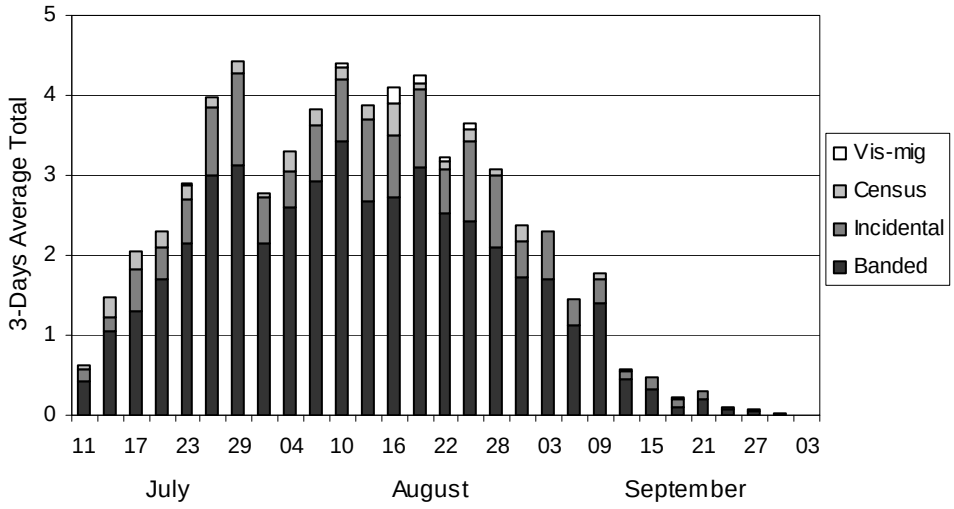

Figure 37. Swainson's Thrush fall migration 3-day average Daily Total (1994 to 2008).

Swainson's Thrush are one of the top ten species banded during both spring and fall Migration (Tables 10 and 11). Both seasons show variability in banding totals between years, but fall banding totals have been consistently high from 2004 to 2008 (Figure 38). A total of 1,184 birds have been banded in spring (mean 80, range 14 to 280). A total of 1,885 (mean 126, range 43 to 218) have been banded in the fall. A large proportion, 81%, of the individuals banded in the fall are HY birds. Capture rates have been relatively constant over the 15 years (Figure 39).

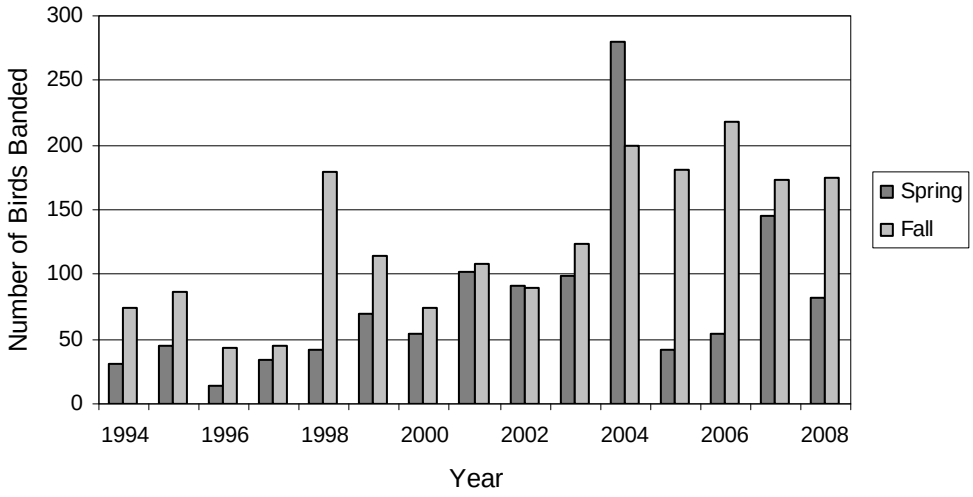

Figure 38. Annual spring and fall banding totals for Swainson's Thrush (1994 to 2008).

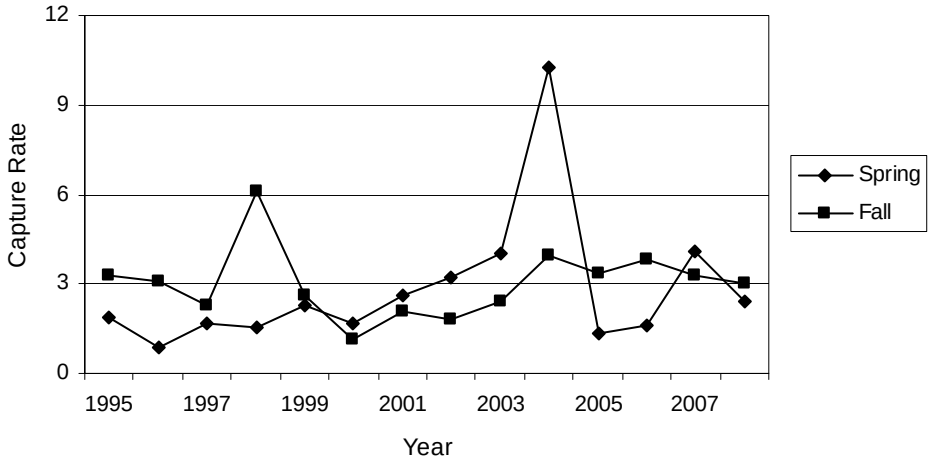

Figure 39. Annual spring and fall capture rates for Swainson's Thrush (1994 to 2008).

Orange-crowned Warbler (*Vermivora celata*)

Orange-crowned Warblers are a regular early spring and late fall migrant. They are a commonly encountered species during migration, but observed in low abundances during both the spring and fall (cumulative mean spring DT 62 and 77 in the fall). During spring migration, daily totals during peak periods range between 10 and 20 individuals. An exception occurred on several dates in 2000 where over 40 were observed. Fall abundances are slightly greater than the spring, where daily totals above 20 more commonly occur. Orange-crowned Warblers are observed through all monitoring methods, although fall banding accounts for 53% of the detections.

Orange-crowned Warblers are early spring migrants and have a long-migratory window. The first individuals arrive late-April, the earliest record is April 26 (Figure 40). Spring migration passage shows some variation. Several years recorded two distinct migratory peaks, the first early in May and the second occurred about a week later. Spring migration detections begin to drop by mid-May and observations become rare in late-May and into June. Breeding individuals are rarely detected in the vicinity of the migration station. Orange-crowned Warbler fall passage begins during the third week of August and observations are common throughout September (Figure 41). A small number of individuals have been observed late July. They have a broad migratory window, but migration is typically steady throughout that period, without variation between years or distinct migratory peaks. The latest fall record was on October 3.

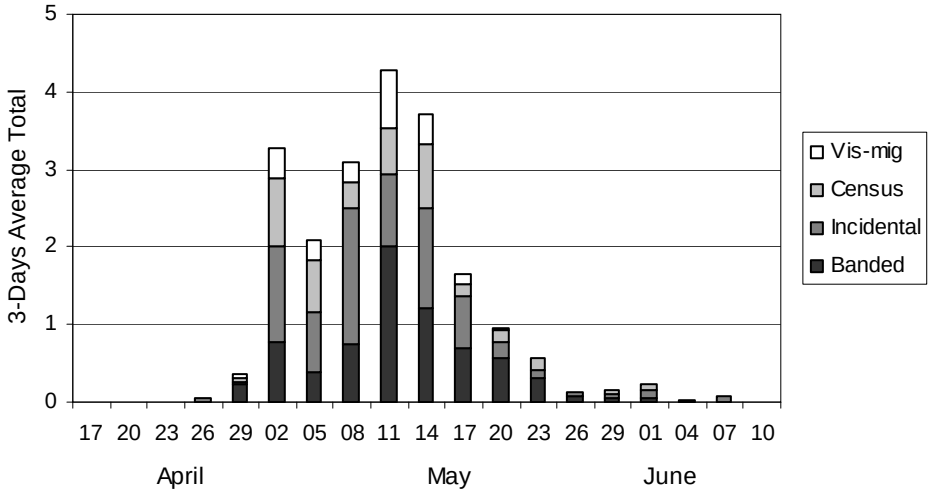

Figure 40. Orange-crowned Warbler spring migration 3-day average Daily Total (1994 to 2008).

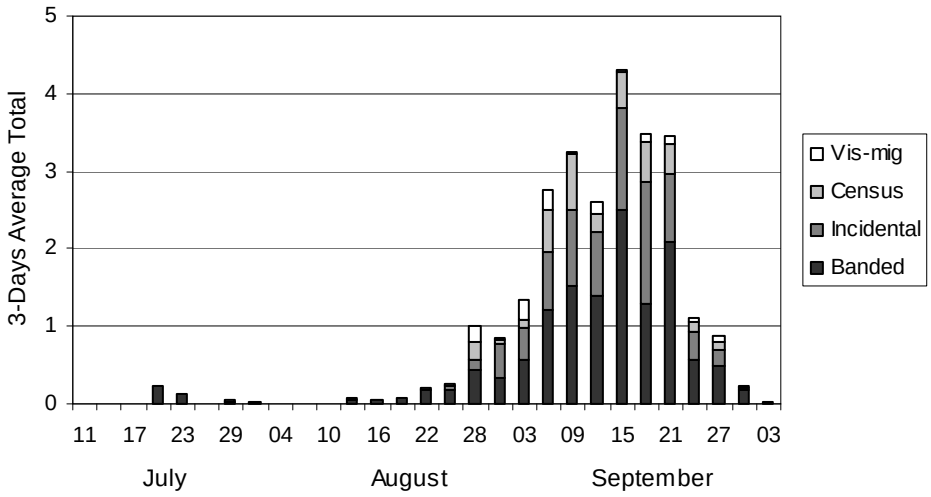

Figure 41. Orange-crowned Warbler fall migration 3-day average Daily Total (1994 to 2008).

Banding totals have shown variation between years in both seasons, with a higher number of Orange-crowned Warblers banded in the fall than the spring, with the exception of 2000 (Figure 42). A total of 301 have been banded in the spring (mean 20, range 2 to 66). Spring differential migration occurs with ASY males arriving before SY males and approximately five days before females (Figure 43). Females of both age classes arrive at the same time. A total of 598 have been banded in the fall (mean 40, range 13 to 66). A high proportion of the individuals banded were HY birds (78%). An equal proportion of HY males and HY females are banded, and differential migration patterns between the age and sex classes are not apparent. Capture rates in both the spring and fall have been declining (Figure 44).

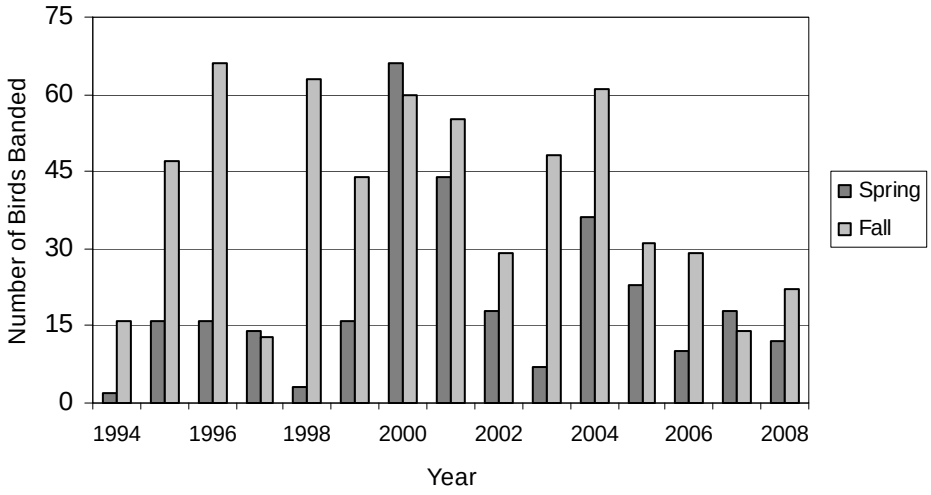

Figure 42. Annual spring and fall banding totals for Orange-crowned Warbler (1994 to 2008).

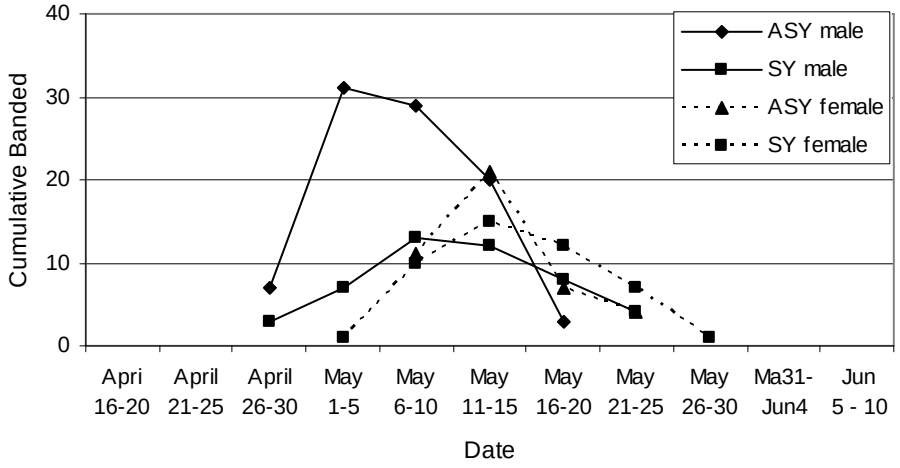

Figure 43. Capture dates in relation to age and sex for Orange-crowned Warbler (1994-2008).

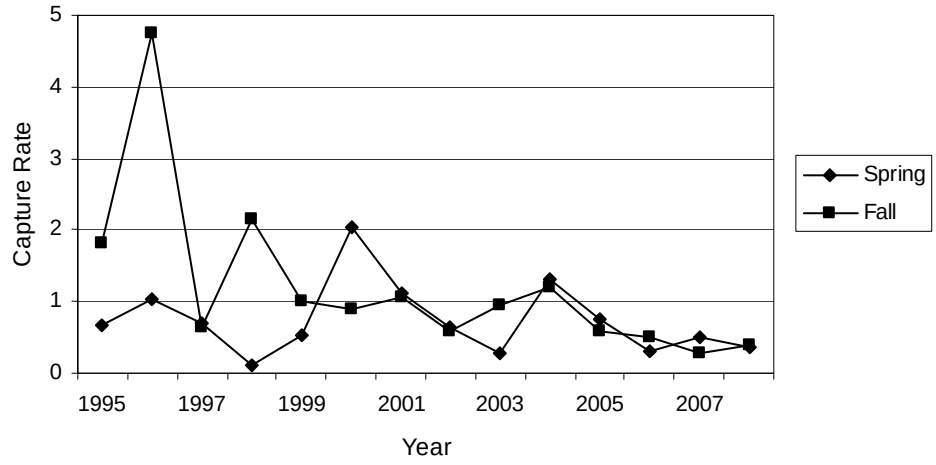

Figure 44. Annual spring and fall capture rates for Orange-crowned Warbler (1994 to 2008).

Tennessee Warbler (*Vermivora peregrina*)

Tennessee Warblers are an abundant migrant during both spring and fall migration. Abundances are considerably higher during the fall (cumulative mean spring DT 169 and 804 in the fall). Large passages can occur during spring migration and DTs regularly average 20 birds a day during peak migration periods. Heavy migration occurred in spring 2000 as the DTs surpassed 200 on two dates. Fall abundances are highly variable, in 2001 peaks reached 400 birds on three occasions whereas the top day in 2004 was 21.

Banding and visual observations account for approximately the same proportion of detections in both the spring and fall.

In the spring, small numbers of Tennessee Warblers begin moving through in mid-May and the average peak migration occurs within the third week of May (Figure 45). The earliest detection date was May 5. Tennessee Warblers are a common breeder in the area and many breeding individuals can be detected on migration counts. The majority of the sightings in June are likely local breeders. Fall migration passage has shown variability in abundance and timing between years (Figure 46). Passage is generally steady within July and August. However, heavy passage has been recorded in late July, early August, and mid-August. Peak passages have ranged from several days to almost two straight weeks in duration. Migration drops at the end of August and throughout September. The latest recorded sighting was September 27.

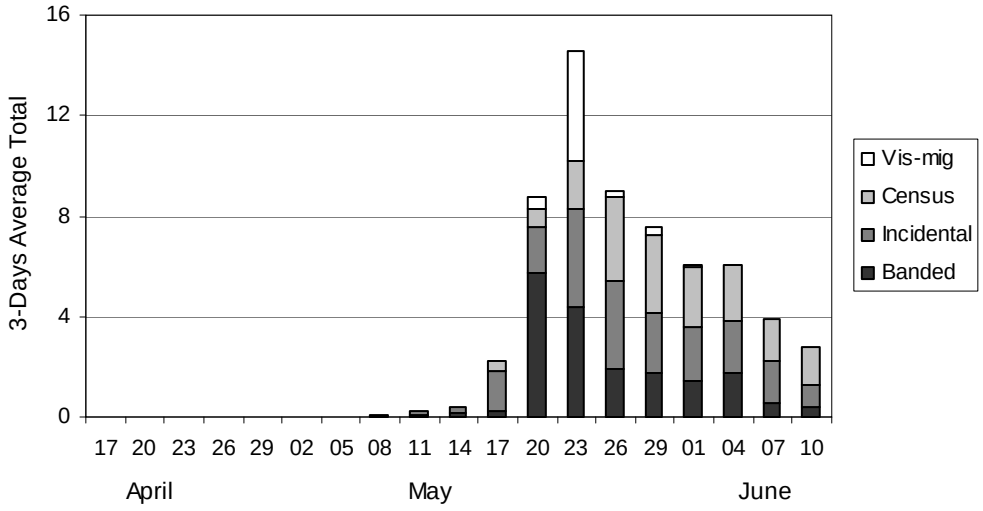

Figure 45. Tennessee Warbler spring migration 3-day average Daily Total (1994 to 2008).

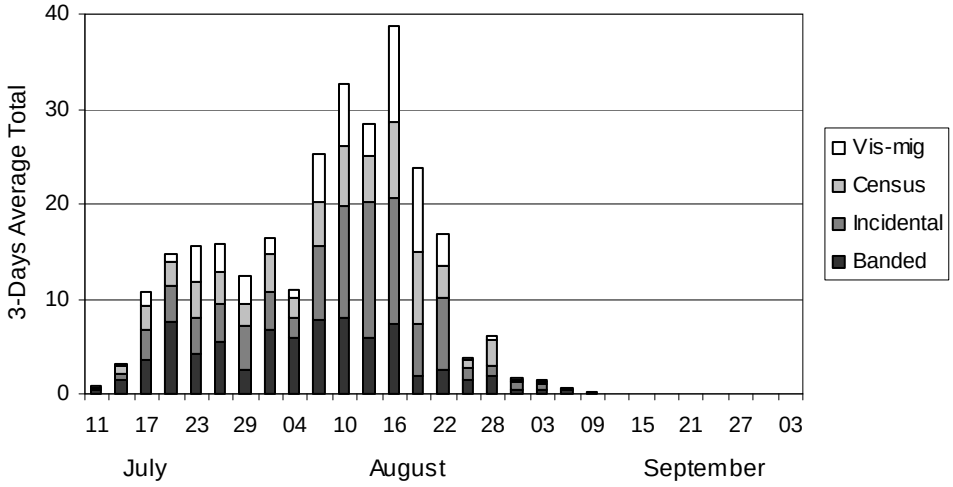

Figure 46. Tennessee warbler fall migration 3-day average Daily Total (1994 to 2008).

Tennessee Warblers are in the top banded species during both spring and fall migration (Tables 10 and 11). A higher proportion of birds are banded in the fall than the spring (Figure 47), and both seasons show a high rate of variability between years. A total of 558 have been banded in the spring (mean 37, range 3 to 167). From banding data, ASY males arrive a few days before the SY males and females (Figure 48). A total of 3,342 have been banded in the fall (mean 223, range 23 to 715). Hatch-year Tennessee Warblers account for 95% of the fall bandings. Capture rates have been decreasing over the past years for both spring and fall (Figure 49).

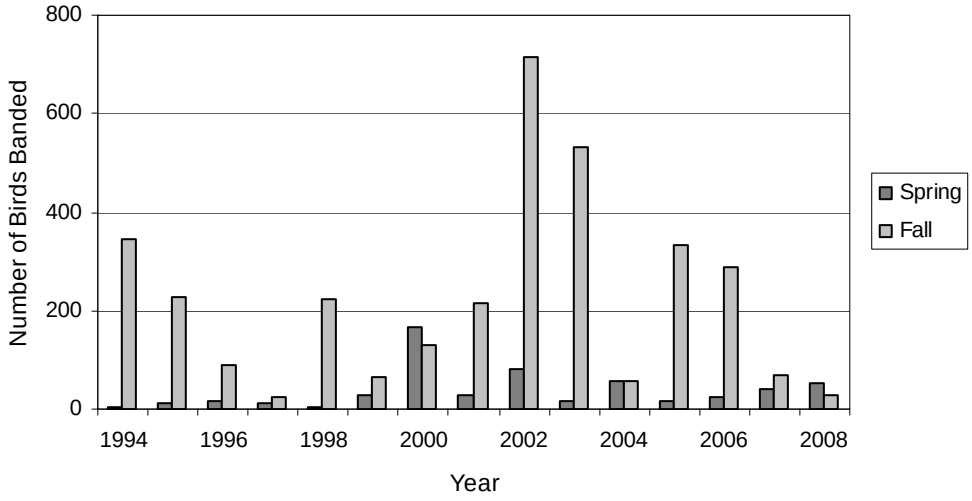

Figure 47. Annual spring and fall banding totals for Tennessee Warbler (1994 to 2008).

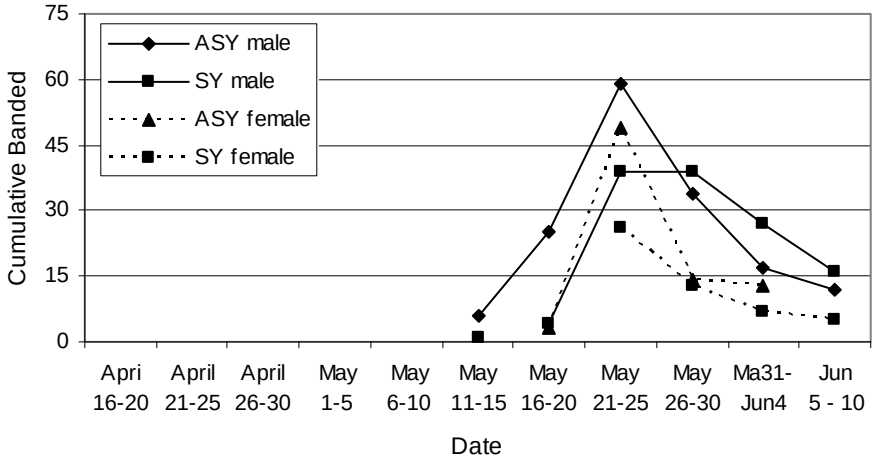

Figure 48. Capture dates in relation to age and sex for Tennessee Warbler (1994-2008).

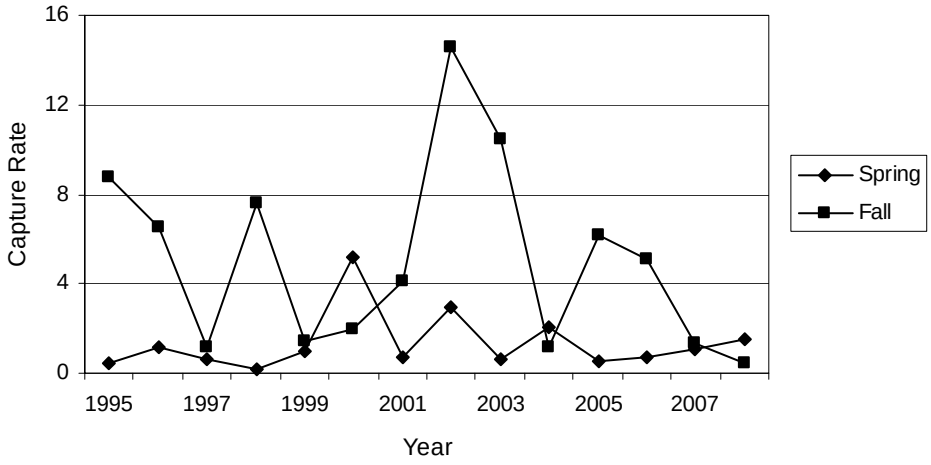

Figure 49. Annual spring and fall capture rates for Tennessee Warbler (1994 to 2008).

Yellow-rumped Warbler (Myrtle Warbler) (*Dendroica coronata*)

Myrtle Warblers are one of the most abundant migrants at the LSLBO, actively migrating during the day and easily identified in flight. Large flocks are frequently observed at the station during periods of peak migration. Spring migration DTs are variable, ranging from 93 (1994) to 11,411 (2001), with a cumulative mean of 2,470. On average, migration begins in late April, with the earliest sighting on April 19. Migration passage is

steady from early to mid-May (Figure 50). Observations of heavy migratory passage have varied between years. For example, in 2000 Myrtle Warbler migration was steady through the first three weeks of May. In 2001, over 6500 migrated through the LSLBO between April 28 to May 1 (which included one day with 2,643 detections). A second peak then occurred mid-May, but not of the same magnitude. In 2006, 1500 were observed between April 26 to May 1, then over 2,000 were counted on May 10. Individuals breed in the forest adjacent to the migration station but are infrequently detected in late May and June.

A greater abundance of Myrtle Warblers migrate through the LSLBO in the fall, but the abundance varies between years. The mean cumulative fall DT is 6,348, ranging from 144 (1996) to 18,703 (2002). On average, migration begins in the third week of July. Steady passage begins within the first week of August until mid-September, with peaks occurring during mid-August and the beginning of September (Figure 51). Observations are common through until late September, the latest sighting occurred on October 1. Like in spring migration, variation in passage timing has been observed. Migration passage in 2000 was steady from mid-August to mid-September without any obvious peaks whereas 2001 showed peaks occurring late July, mid-August, and again in mid-September. In 2007, peak migration occurred at the end of August and into the first week of September. The largest single day DT occurred on August 25, 2002 with 4,540 detections.

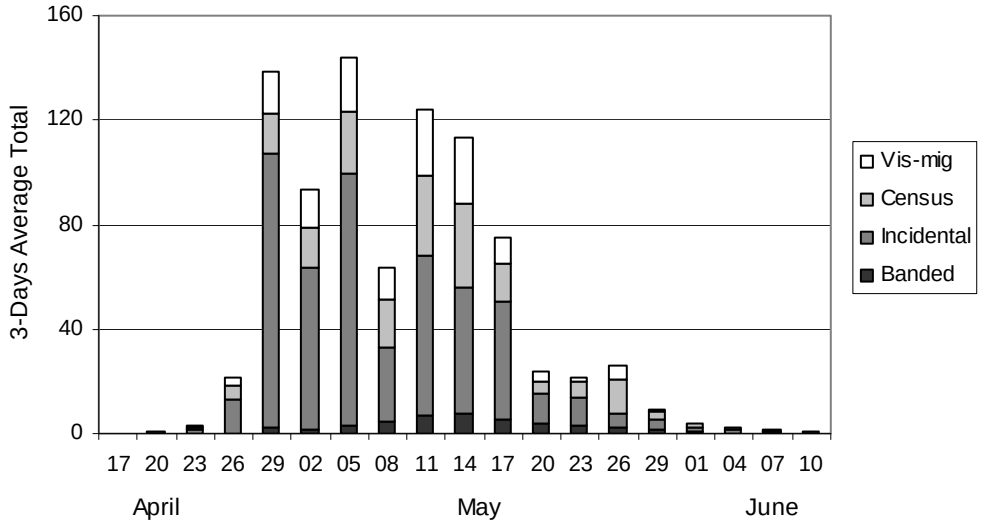

Figure 50. Myrtle Warbler spring migration 3-day average Daily Total (1994 to 2008).

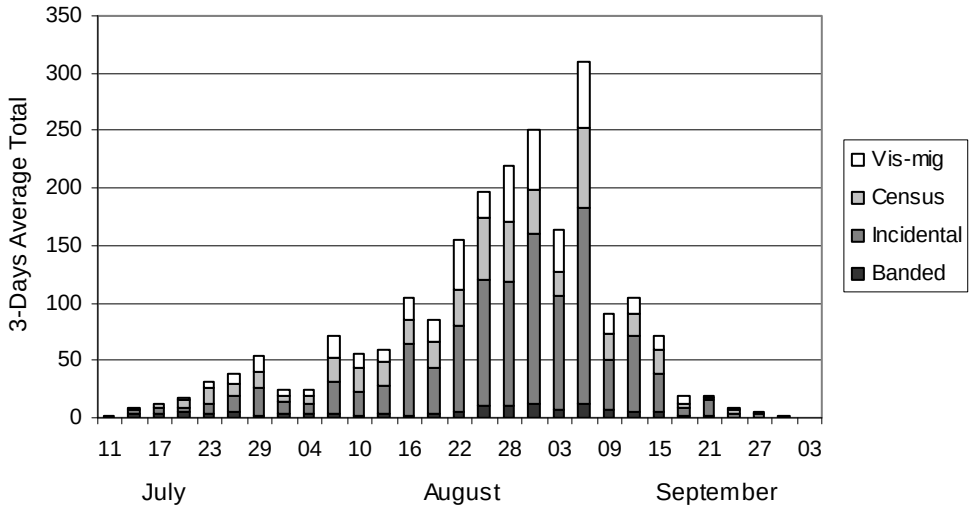

Figure 51. Myrtle Warbler fall migration 3-day average Daily Total (1994 to 2008).

A small proportion of the total Myrtle Warbler detections occur through banding (Figure 52). Even though bandings account for 5% of the total spring and 6% of the total fall DTs, Myrtle Warblers are the top banded species at the LSLBO (Tables 10 and 11). The cumulative spring banding total is 1,799 (mean 120, range 5 to 599). Differential migration patterns within the sex classes occur with males arriving approximately five days before females (Figure 53). The fall banding total is 5,366 (mean 358, range 12 to 1,270). Years with high banding totals correspond with years with years with large migratory abundances. Hatch-year birds account for 95% of all fall bandings. Capture rates have been variable from 1995 to 2003, but have leveled off from 2004 to 2008 and match the consistent low banding totals in those years (Figure 54).

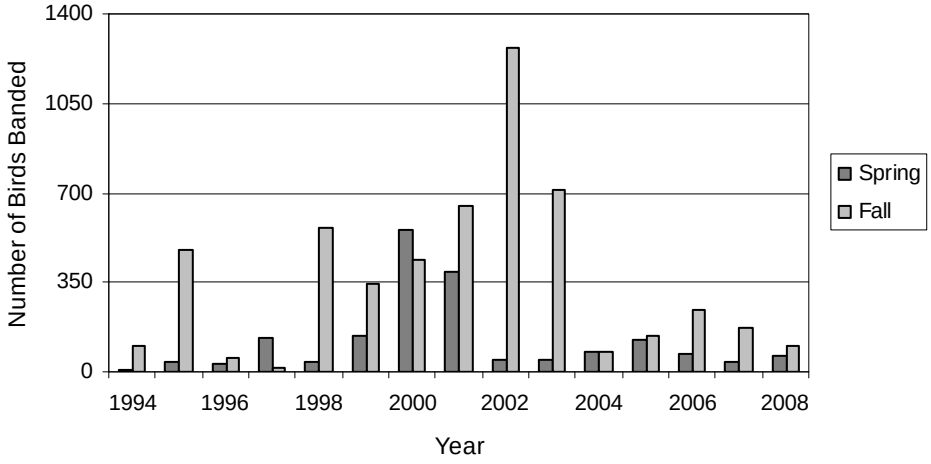

Figure 52. Annual spring and fall banding totals for Myrtle Warbler (1994 to 2008).

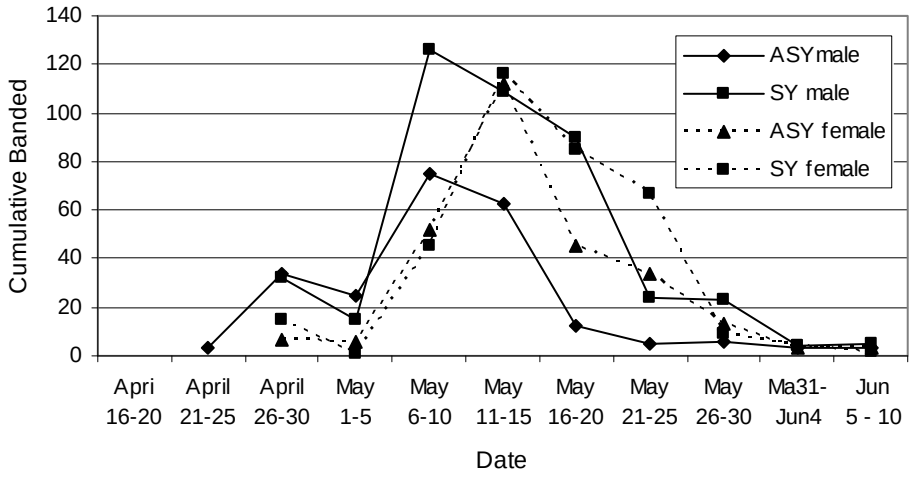

Figure 53. Capture dates in relation to age and sex for Myrtle Warbler (1994-2008).

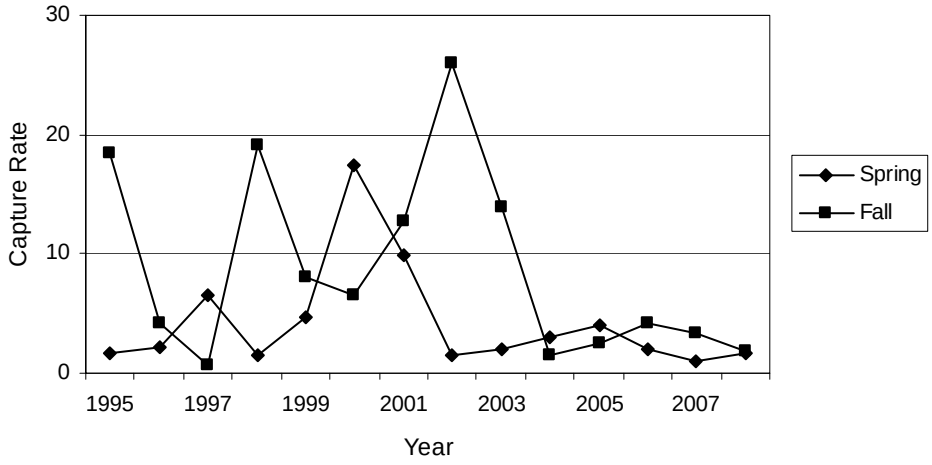

Figure 54. Annual spring and fall capture rates for Myrtle Warbler (1994 to 2008).

Magnolia Warbler (*Dendroica magnolia*)

Magnolia Warblers are regular migrants to the LSLBO, though in low abundances in both spring and fall (mean cumulative spring DT is 31 and 65 in the fall). Overall detections are low throughout the spring period, only one day recorded over ten individuals. Slightly higher abundances occur during fall migration, the highest single day count was 27 individuals. A large proportion of the detections are through banding; 46% in the spring

and 70% in the fall. Magnolia Warblers are rarely detected on active visual migration counts, with less than 1% of the spring and 3% of the fall detections.

Magnolia Warbler spring migration begins mid-May, the earliest record is May 9, and peaks late in May (Figure 55). A small number of birds breed in the vicinity of the migration monitoring site, which may account for the high number of detections in June. A small number of individuals are present when fall migration begins in mid-July, these likely represent local breeding individuals (Figure 56). Peak migration occurs between the first and second week of August and detections remain steady until the end of August. Only a small number of individuals are detected throughout September. The latest fall observation was September 24.

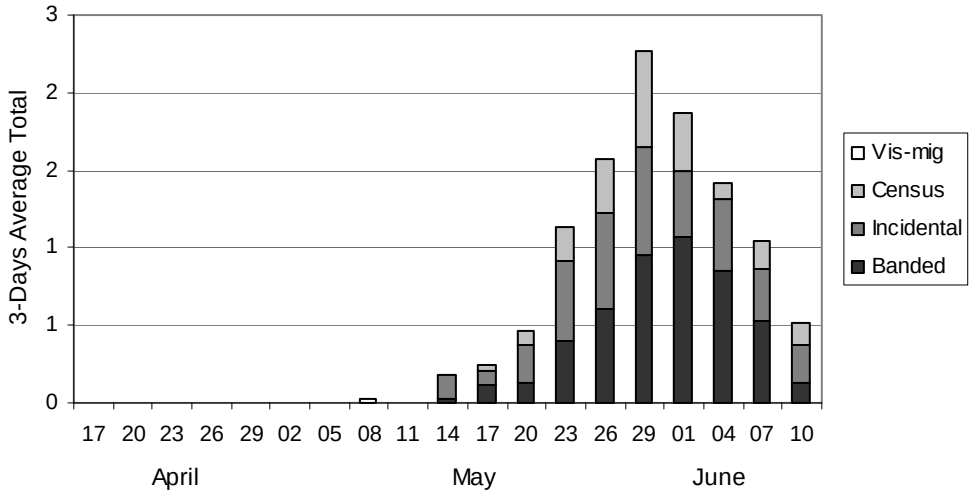

Figure 55. Magnolia Warbler spring migration 3-day average Daily Total (1994 to 2008).

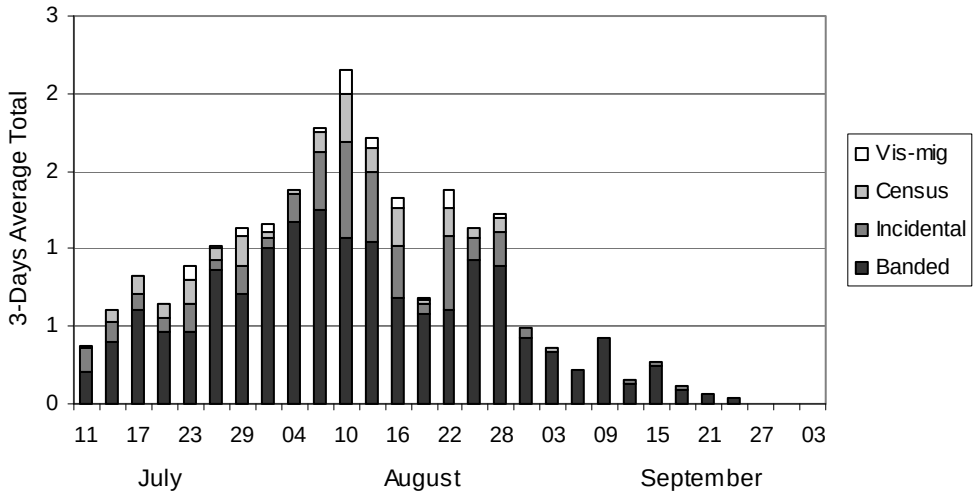

Figure 56. Magnolia Warbler fall migration 3-day average Daily Total (1994 to 2008).

Magnolia Warblers are captured in higher numbers in the fall compared to the spring (Figure 57). A total of 172 have been banded in the spring (mean 12, range 5 to 27). This compares with a total of 570 (mean 38, range 7 to 73) that have been banded in the fall. The fall banding totals show more variation between years than the spring. The fall capture rate is showing a steady decrease (Figure 58).

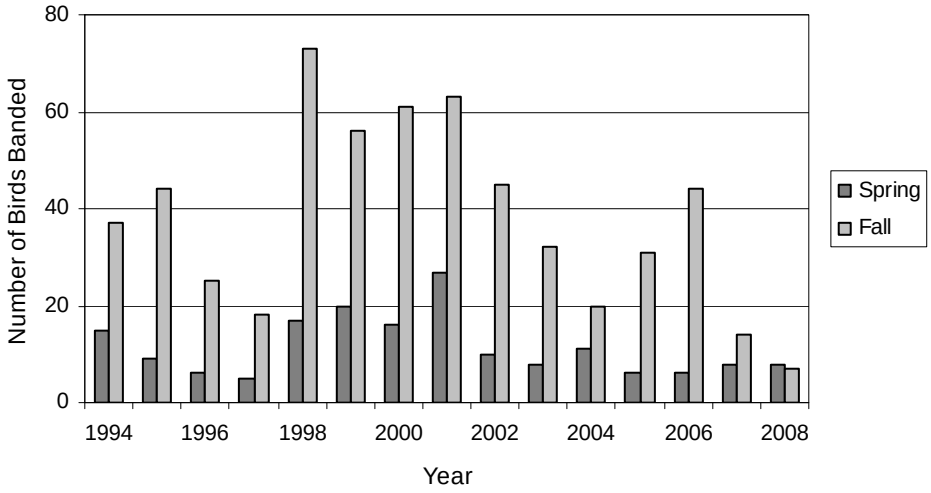

Figure 57. Annual spring and fall banding totals for Magnolia Warbler (1994 to 2008).

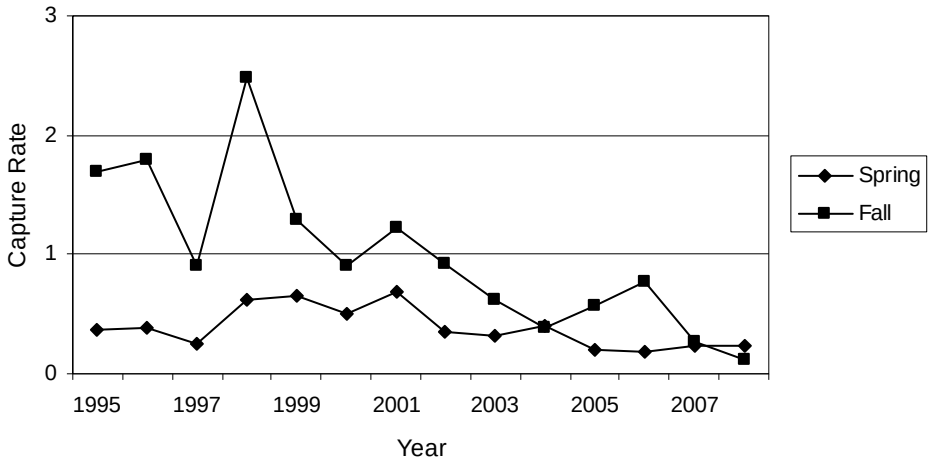

Figure 58. Annual spring and fall capture rates for Magnolia Warbler (1994 to 2008).

Black-and-white Warbler (*Mniotilta varia*)

Black-and-white Warblers are common migrants during both spring and fall migration. Their abundance is slightly lower in the spring than fall (cumulative mean spring DT is 89 and 110 in the fall). Spring detections are distributed between banding, census, and incidental observations. Banding accounts for a high proportion of the fall detections, with 57%. Black-and-white Warblers are uncommonly detected during visual migration counts, with less than 1% of the spring and 2% of the fall detections.

Individuals begin to arrive in spring migration during the first week of May. The earliest encounter was on April 28. Black-and-white Warblers are detected in low abundances throughout the spring; only four dates have recorded over 10 individuals. The bulk of spring migrants pass through from mid-May to the third week of May (Figure 59). Migration is steady throughout that time, without defined peaks or variation in the timing. Likely locally breeding individuals account for the majority of the detections in June. Fall migration is steady from mid-July until mid-August (Figure 60). Abundances in the fall remain low, with only four dates recording over 20 individuals. Some variation in migratory timing has been observed. In 2001, high numbers were observed mid-August, while numbers peaked in late July in 2007. Passage begins to slow by mid-August and sightings are rare throughout September. The latest fall record occurred on September 27.

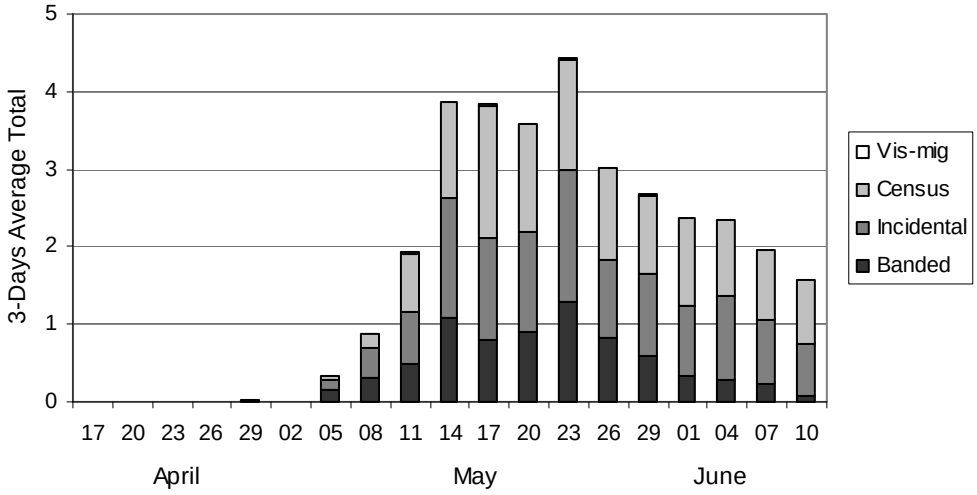

Figure 59. Black-and-white Warbler spring migration 3-day average Daily Total (1994 to 2008).

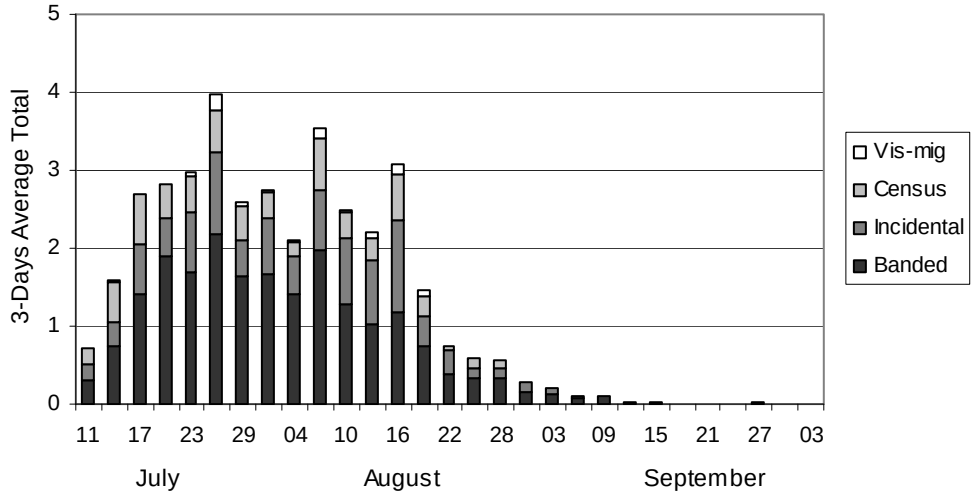

Figure 60. Black-and-white Warbler fall migration 3-day average Daily Total (1994 to 2008).

Banding totals have been relatively stable with only a slight variation between years (Figure 61). A total a total of 305 have been banded in the spring (mean 20, range 3 to 36). Differential migration occurs with both ASY and SY males arriving approximately five days before females (Figure 62). Black-and white Warblers are within the top ten fall species banded (Table 11) with a total of 856 (mean 58, range 19 to 89). HY birds make up a large proportion, 87%, of the total fall bandings. The capture rate in both the spring and fall have been relatively stable (Figure 63).

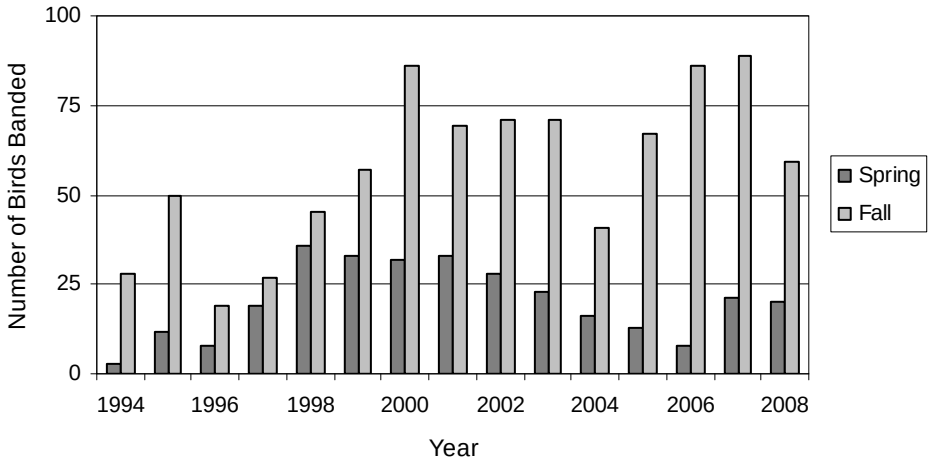

Figure 61. Annual spring and fall banding totals for Black-and-white Warbler (1994 to 2008).

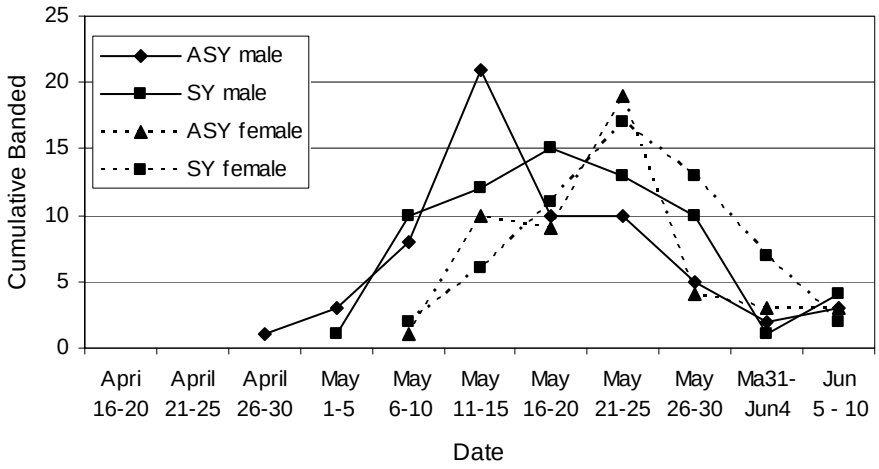

Figure 62. Capture dates in relation to age and sex for Black-and-white Warbler (1994-2008).

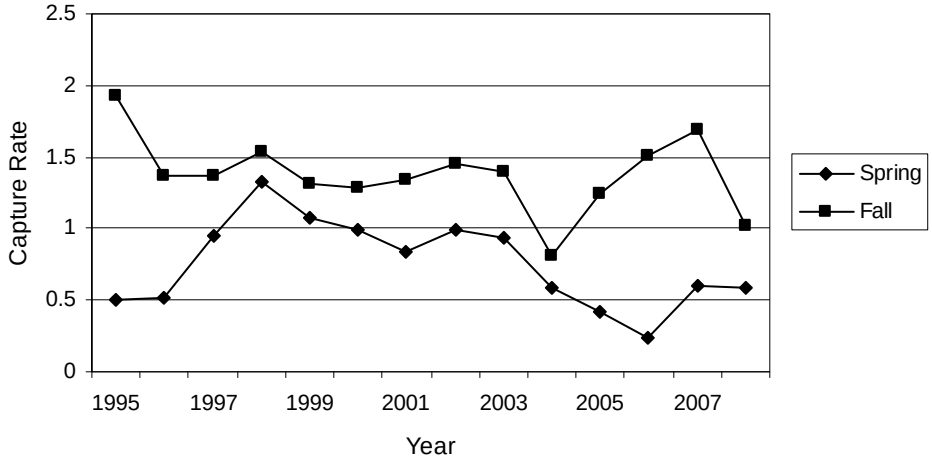

Figure 63. Annual spring and fall capture rates for Black-and-white Warbler (1994 to 2008).

American Redstart (*Setophaga ruticilla*)

American Redstarts are a commonly encountered species during both spring and fall migration (cumulative mean DT of 261 in the spring and 676 in the fall). Abundance during spring migration is variable between years, but during peak migration periods DTs have surpassed 50 detections on several occasions. American Redstarts are detected in overall larger abundances in the fall with the highest DT of 242 recorded on July 31, 1998. Detections during spring migration are equally based on observations and banding. Banding plays a larger role in fall, with 47% of the cumulative DT attained through banding records. Visual migration counts detect a small portion of the migratory birds, with approximately 3% of the total observation in both the spring and fall.

American Redstarts begin arriving at the site in the spring by mid-May (Figure 64), though earliest encounter occurred on April 26. Migration passage quickly picks up and peaks by the end of May. The forest surrounding the migration station is ideal breeding habitat, and locally breeding individuals account for some of the detections in late May and in June. Strong fall migration activity occurs from mid-July to mid-August (Figure 65). Slight variation in migratory timing has occurred between years, but the overall pattern shows two distinct peaks, the first within the third week of July and the second occurring in the first week of August. Fall passage sharply declines after mid-August and detections are uncommon in September. The latest fall record was on September 23.

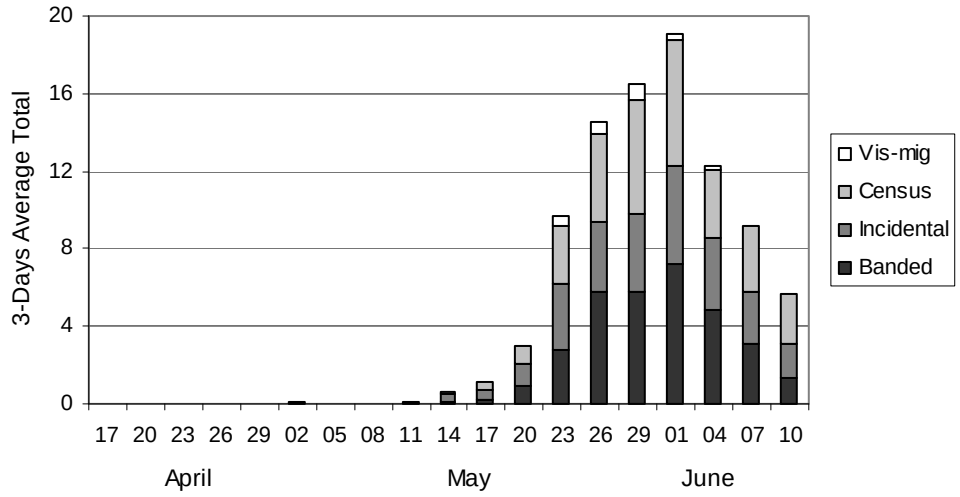

Figure 64. American Redstart spring migration 3-day average Daily Total (1994 to 2008).

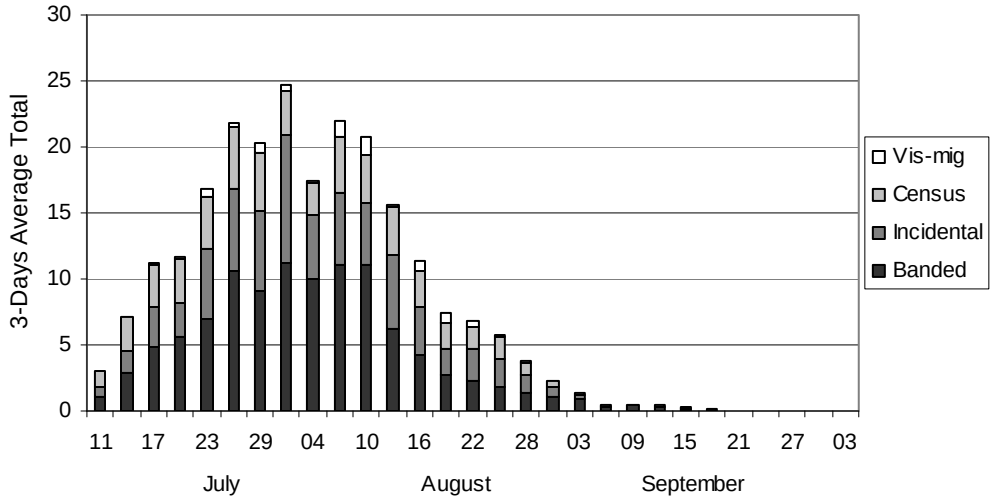

Figure 65. American Redstart fall migration 3-day average Daily Total (1994 to 2008).

American Redstarts are one of the top species banded through both spring and fall migration (Tables 10 and 11). Yearly banding totals show variation in both the spring and the fall, with large numbers banded in the falls of 1998 and 2000 (Figure 66). A total of 1,255 have been banded in the spring (mean 84, range 31 to 20). American Redstarts exhibit differential migration with ASY males arriving about five days before females and SY males arriving approximately two days before females (Figure 67). There is no observed difference in timing between ASY and SY females. A total of 4,230 (mean 282,

range 164 to 488) have been banded in the fall, in which 85% have been HY birds. Capture rates have been declining since 1995, which is more pronounced in the fall (Figure 68).

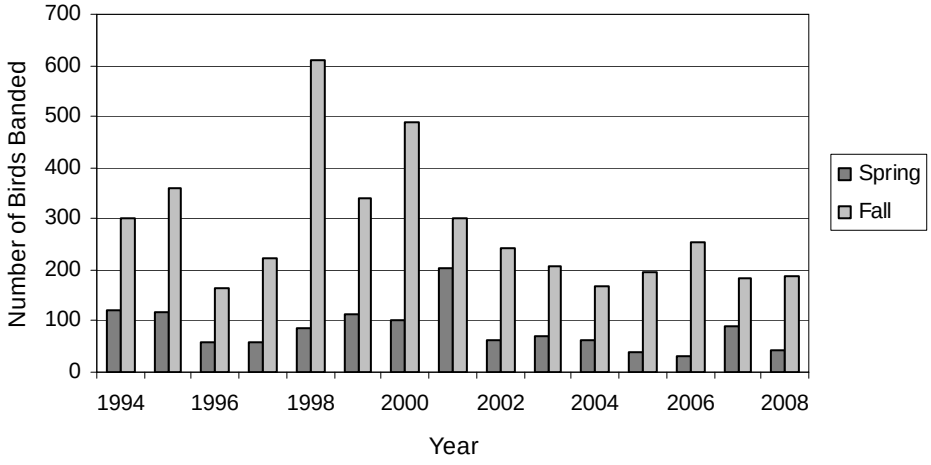

Figure 66. Annual spring and fall banding totals for American Redstart (1994 to 2008).

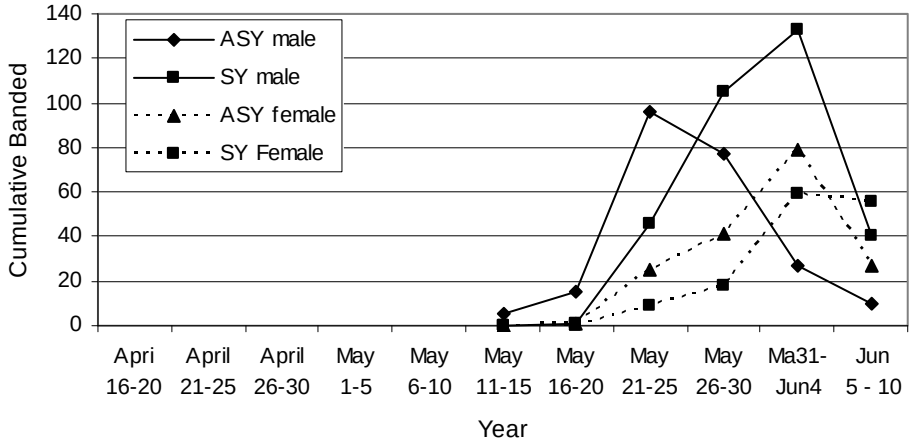

Figure 67. Capture dates in relation to age and sex for American Redstart (1994-2008).

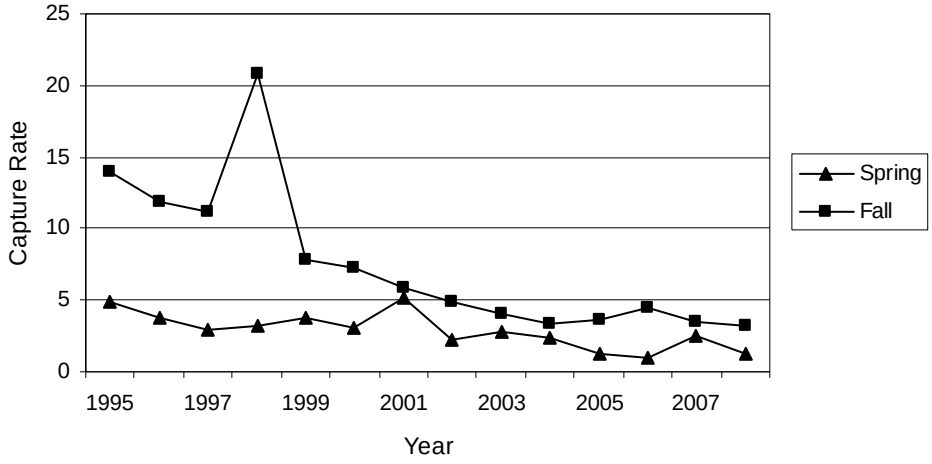

Figure 68. Annual spring and fall capture rates for American Redstart (1994 to 2008).

Ovenbird (*Seiurus aurocapillus*)

Ovenbirds are a common species encountered at the LSLBO during migration. Observations are higher in the fall than the spring (cumulative mean spring DT is 72 and 123 in the fall). Overall spring abundances are low, with a total of six dates with over ten individuals detected. Slightly higher abundances are detected in the fall; DTs have surpassed 20 individuals on several dates. Banding plays and important role for monitoring Ovenbirds, which is more prevalent in the fall. Most spring observations are of individuals singing in the surrounding forest, and banding accounts for 27% of the total detections. In the fall, visual observations are uncommon, and banding accounts for 89% of the total detections. Less than 1% of the detections have occurred on active visual migration counts in both the spring and the fall.

Spring migration passage begins mid-May, but the earliest detection was May 7 (Figure 69). Migration peaks within the third week of May and abundance remains high until the first week of June. There is a strong presence of local breeders at the migration station, and detections from late May until early June are a mix of migrants and local breeding individuals. Ovenbirds have a long migratory window throughout the fall (Figure 70). Most years show a steady passage throughout the fall season without any large peaks or seasonal variation. Detections occur early in the season, likely from the local breeders, but abundances begin to rise late in July and remain steady until late August. Detections become less common as September progresses, the latest detection occurred on September 21.

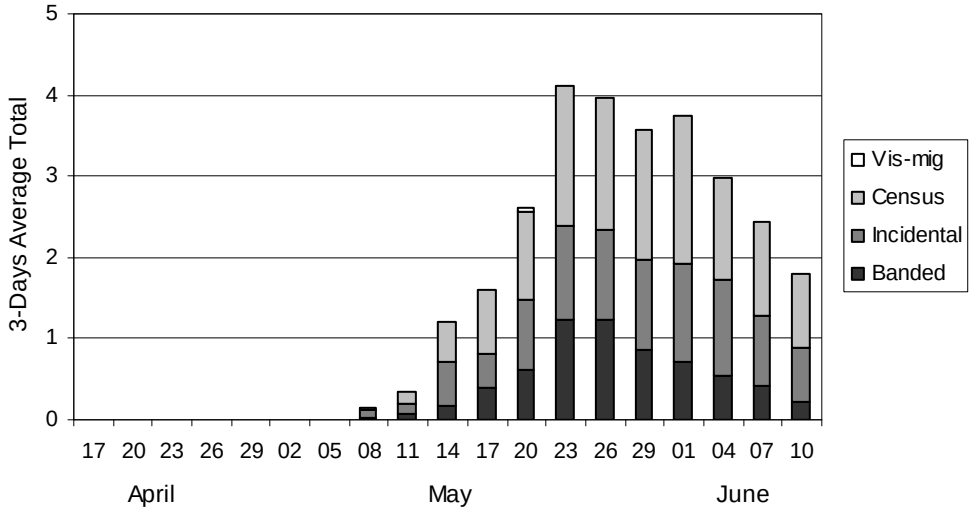

Figure 69. Ovenbird spring migration 3-day average Daily Total (1994 to 2008).

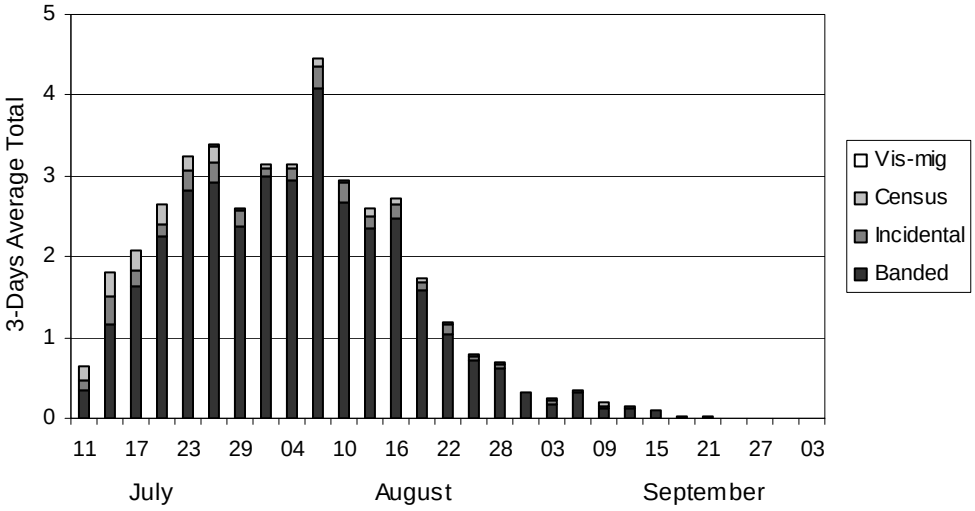

Figure 70. Ovenbird fall migration 3-day average Daily Total (1994 to 2008).

A total of 270 Ovenbirds have been banded during spring migration (mean 18, range 3 to 44). They are banded in far higher numbers during the fall with a total of 1,372 banded (mean of 92, range 14 to 222) and are one of the top ten species banded (Table 11). Both seasons have shown slight variation in yearly banding totals, but the totals are increasing (Figure 71). The fall banding totals have remained steady from 1999 to 2004, but have the numbers have increased from 2005 to 2008. Hatch-year birds account for 86% of the Ovenbirds banded in the fall. Capture rates have not shown a high degree of variation, but have been increasing in both the spring and fall (Figure 72).

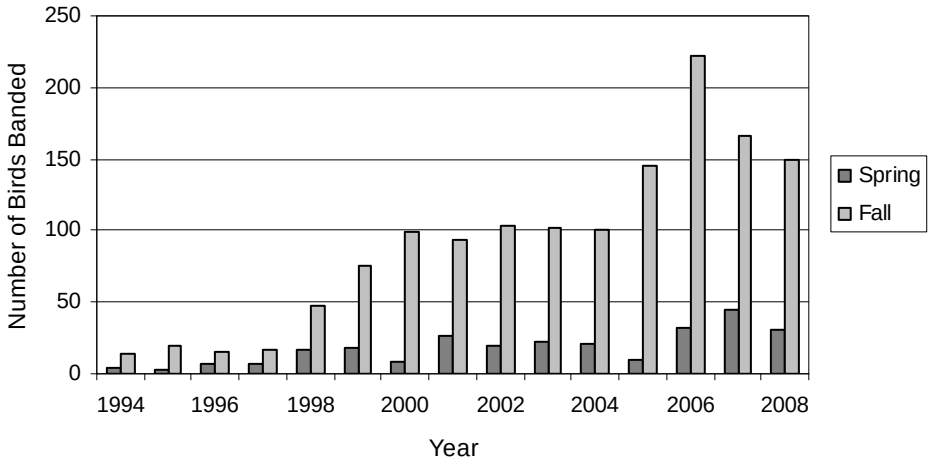

Figure 71. Annual spring and fall banding totals for Ovenbird (1994 to 2008).

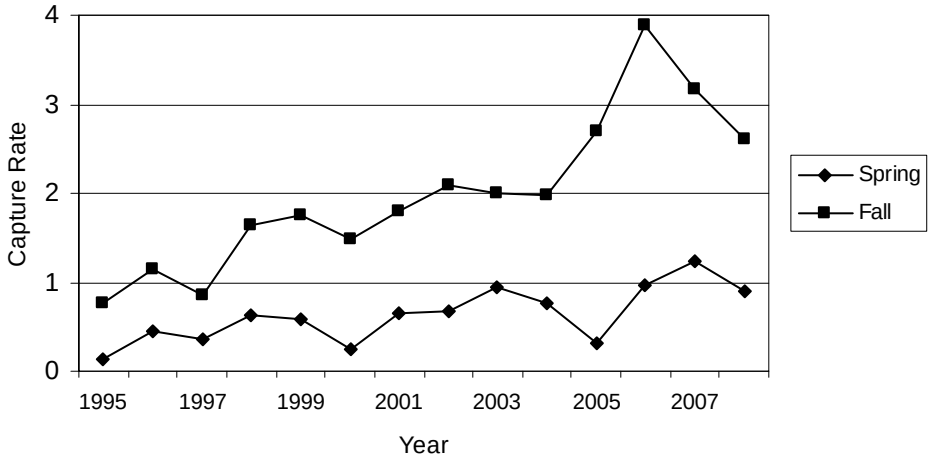

Figure 72. Annual spring and fall capture rates for Ovenbird (1994 to 2008).

Northern Waterthrush (*Seiurus noveboracensis*)

Northern Waterthrush are regular migrants through the area, but are detected in low abundances (mean cumulative spring DT is 29 and 27 in the fall). Only three dates in the spring have recorded a DT with over 10 individuals. No more than 10 individuals have ever been recorded on a single day in the fall. The majority of the detections occur through banding; with 61% of the spring and 76% of the fall detections). Less than 1% of the detections were recorded on active visual migration counts in both the spring and fall.

Northern Waterthrush spring migration begins mid-May, with migration peaking within the third week of May. The earliest date detected was in May 6 and detections rarely occur in June (Figure 73). Breeding individuals are rarely observed in the immediate vicinity of the migration station, but suitable breeding habitat can be found in areas near the banding station. Northern Waterthrush are detected steadily from mid-July until the end of August during fall migration (Figure 74). The average migration peaks mid-August, a defined migratory peak is difficult to determine because of the low abundance of individuals passing through. Passage slows throughout September, however individuals are still detected for most of the month. The latest fall record occurred on September 27.

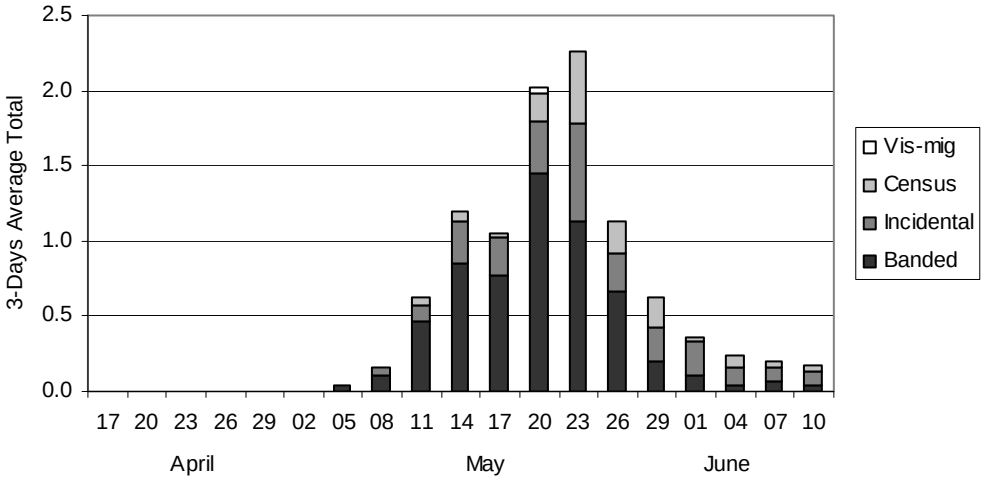

Figure 73. Northern Waterthrush spring migration 3-day average Daily Total (1994 to 2008).

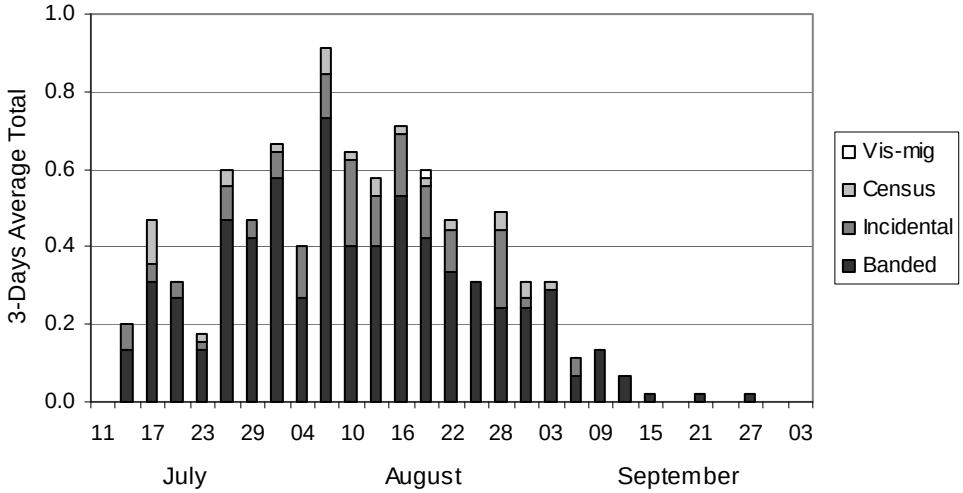

Figure 74. Northern Waterthrush fall migration 3-day average Daily Total (1994 to 2008).

Northern Waterthrush are banded in approximately equal numbers in the spring and fall and neither season has a consistent higher banding total (Figure 75). A total of 255 have been banded in the spring (mean 17, range 2 to 36), and 287 banded in the fall (mean 19, range 7 to 31). Fall shows a similar pattern with many other warbler species with a high proportion of HY birds banded (85%). Banded totals have varied between years and seasons. This variation is mirrored by the capture rates, which have remained steady (Figure 76).

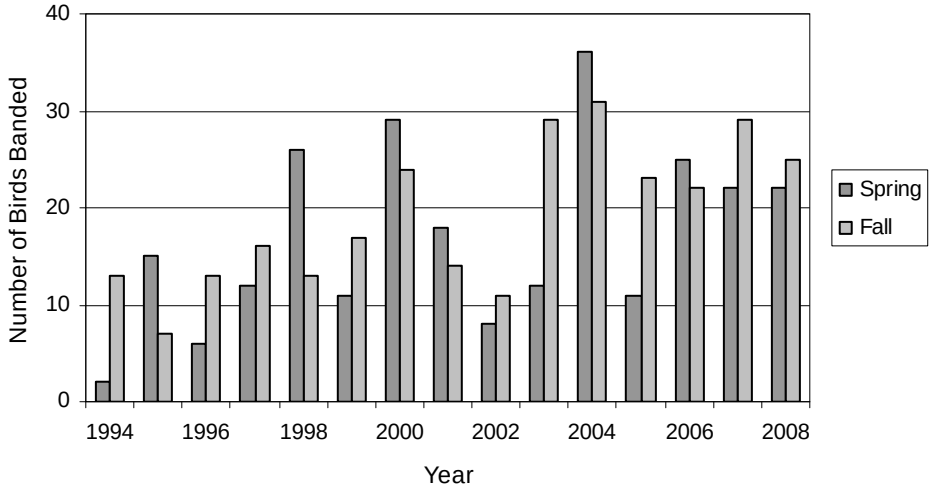

Figure 75. Annual spring and fall banding totals for Northern Waterthrush (1994 to 2008).

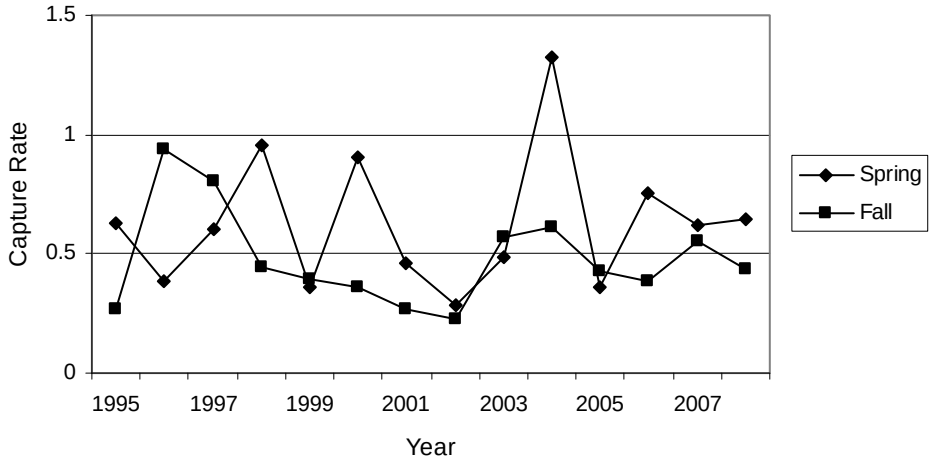

Figure 76. Annual spring and fall capture rates for Northern Waterthrush (1994 to 2008).

Canada Warbler (*Wilsonia canadensis*)

Canada Warblers are commonly encountered during migration, arriving late in the spring and departing early in the fall. They are encountered in lower abundances in the spring than fall (cumulative mean DT spring is 81 and 164 in the fall). Canada Warblers are not observed in large abundances in daily monitoring. The highest spring DT was 20 and DTs during the fall have surpassed 30 birds on two dates. In the spring, they are detected equally on incidental observations, census, and banding. A higher number are detected through banding in the fall, which accounted for 57% of the total detections. Only a small number of the total detections are through visual migration counts; less than 1% in the spring and 1% in the fall.

Spring migration typically begins the third week of May, with the earliest sighting occurring on May 12 (Figure 77). Spring migration is concentrated over the period between late May and early June with little variation in timing between years. Individuals that breed within the vicinity of the migration site and are likely detected in early June mixed with migrants. Migration passage typically occurs between late July and the first week of August (Figure 78). Some variation in timing has been documented, 1998 and 2001 recorded the peak migration in mid-August. Detections sharply decrease by mid-August, becoming uncommon in September. The latest sighing was on September 20.

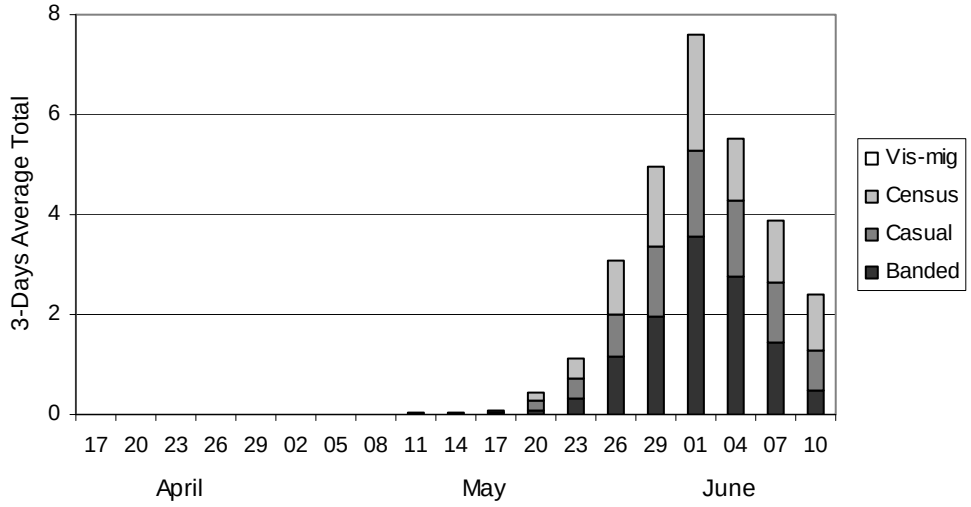

Figure 77. Canada Warbler spring migration 3-day average Daily Total (1994 to 2008).

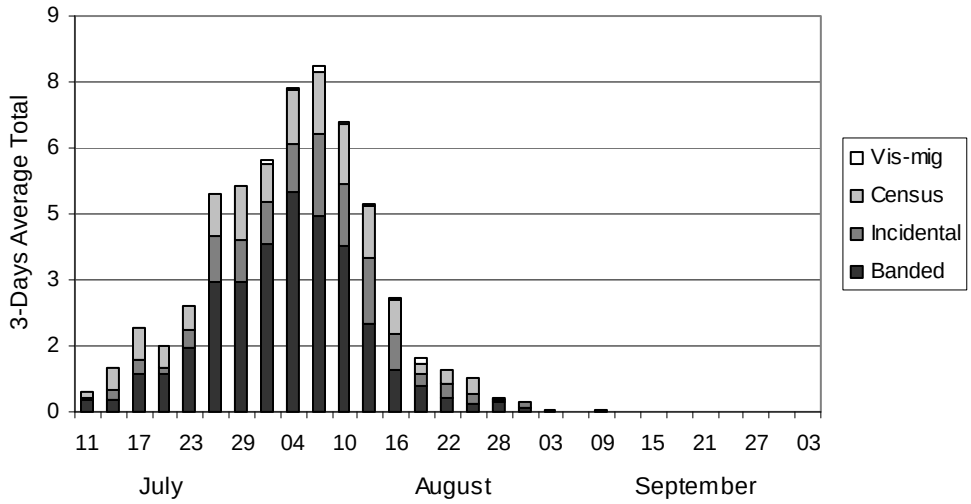

Figure 78. Canada Warbler fall migration 3-day average Daily Total (1994 to 2008).

Canada Warblers are banded in larger numbers every fall than the spring, with some variation between years (Figure 79). A total of 477 have been banded in the spring (mean of 32, range 20 to 57). Banding records indicate that the ASY and SY males arrive at the same time, and females follow several days after. (Figure 80). Canada Warblers are within the top ten banded species during fall migration (Table 11) with a total of 1271 (mean 85, range 53 to 113). The proportion of HY birds banded in the fall is high at 91%. The capture rates at the LSLBO are similar in both spring and fall, only being slightly higher in the fall from 2000 to 2008 (Figure 81). Both seasons show a drop from 1995 to 1999, but have been relatively stable from 2000 to 2008.

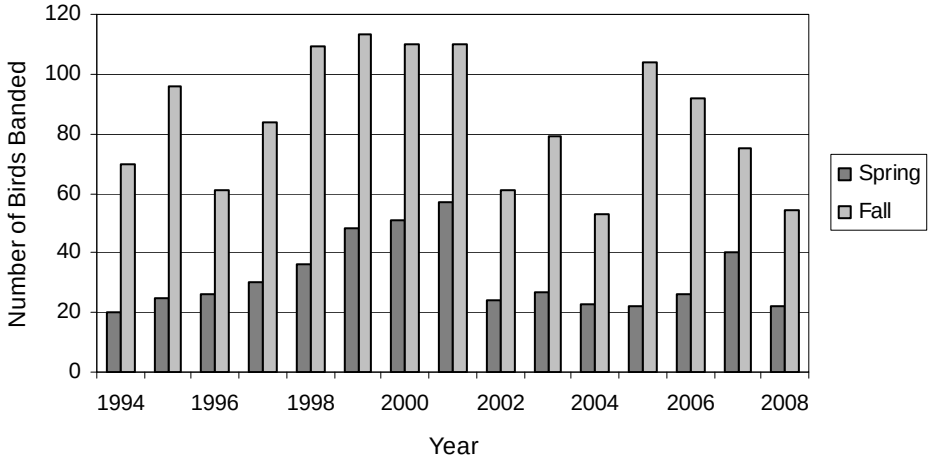

Figure 79. Annual spring and fall banding totals for Canada Warbler (1994 to 2008).

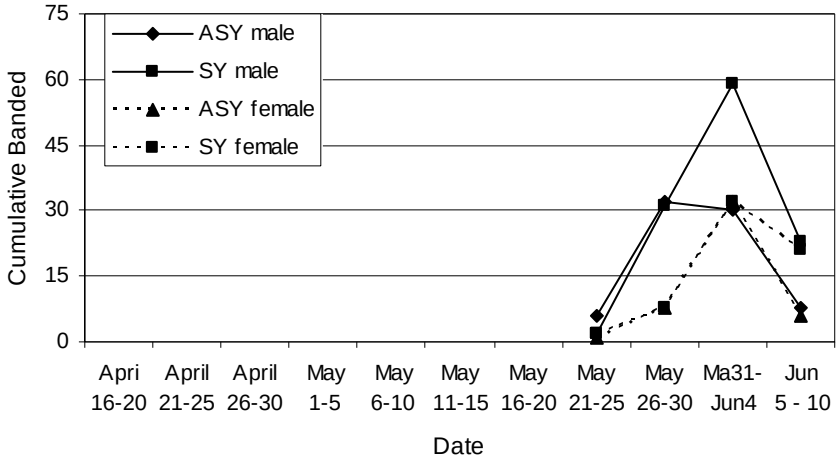

Figure 80. Capture dates in relation to age and sex for Canada Warbler (1994-2008).

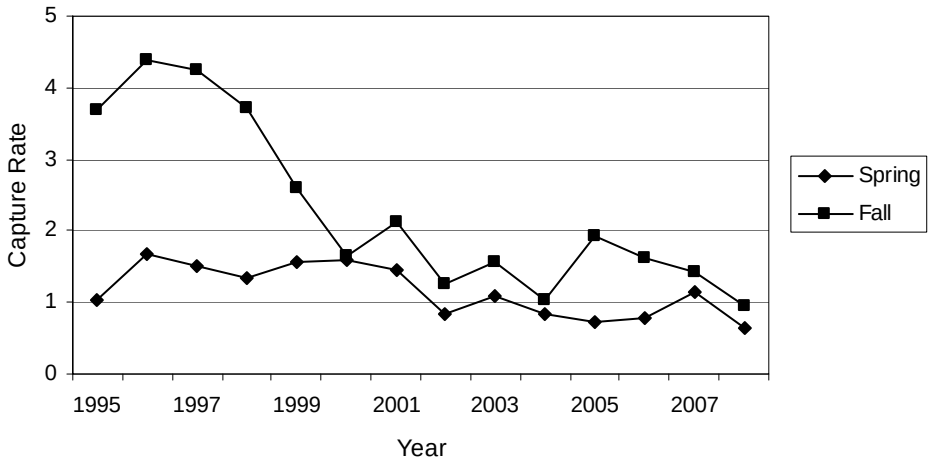

Figure 81. Annual spring and fall capture rates for Canada Warbler (1994 to 2008).

Chipping Sparrow (*Spizella passerina*)

Chipping Sparrows are one of the most abundant species detected during spring migration (cumulative mean DT for spring is 2,366 and 201 in the fall). Large spring migration passages have been recorded on several years. The highest single day DT occurred on May 19, 2001 with 3,454 individuals detected. Visual observations account for the majority of the detections. For instance, 21% of the spring and 15% of the total fall detections occurred on visual migration counts. Banding accounted for 5% of the total spring and fall detections.

Spring migration begins during the second week of May (Figure 82) with the earliest sighting on May 3. Peak migration occurs during a two week period lasting from mid-May to the end of May. Sightings in June are uncommon, even though there is a small local breeding population near the monitoring sight. Although the peak migration is concentrated within a two week period, there is high variability in the abundances and timing between years. In 1999, the peak occurred from May 20 to 23 with just over 200 detected each day. In 2000, a major passage occurred from May 10 to 26. Each day had over 200 detections, four of which had totals surpassing 1,000. The 2001 peak occurred from May 13 to 24, with over 500 counted every day except for the 19th, which had 3,454. 2004 had a single day peak of 1,353 on May 12, and then experienced a smaller peak late in May. Large abundances were not encountered every year. Each year from 2005 to 2008 recorded one single day high that ranged from 200 to 500 detections, but DTs for the remainder of those years were much lower.

Chipping Sparrows are detected in much lower abundances during fall migration. Detections are sparse until the end of July, with the peak abundances occurring from late-July until mid-August (Figure 83). Detections become very uncommon late-August and into September. The latest sighting occurred on September 23. Yearly variation in abundances and migration timing has been observed. On most years, there is one peak of abundance that occurs within late-July and mid-August. Three years, 2005, 2006, and 2008, had very few sighting the Chipping Sparrows through the entire fall season.

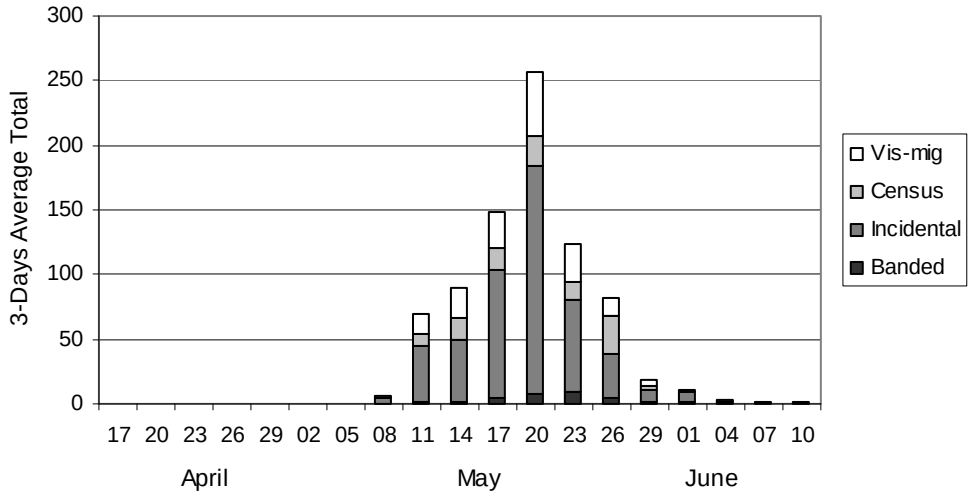

Figure 82. Chipping Sparrow spring migration 3-day average Daily Total (1994 to 2008).

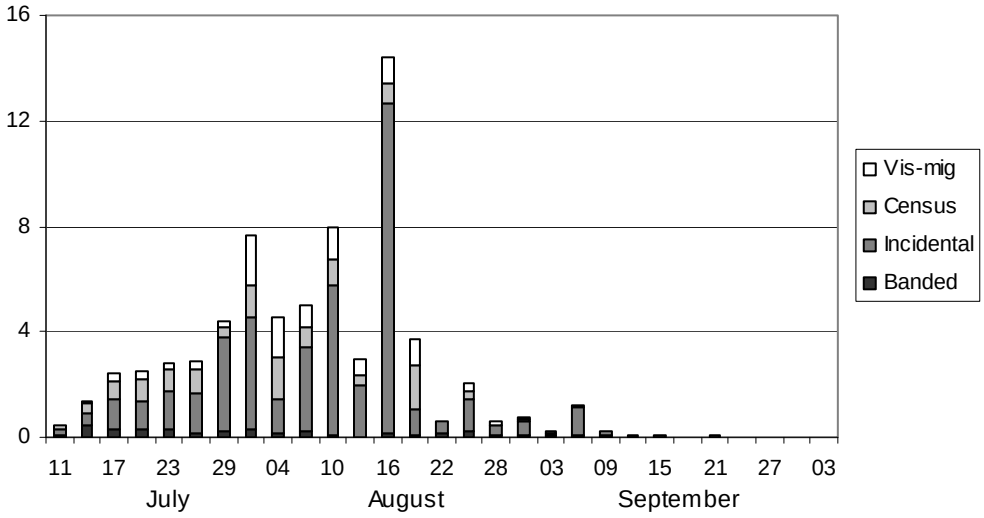

Figure 83. Chipping Sparrow fall migration 3-day average Daily Total (1994 to 2008).

Even though 5% of the total detections occur through banding, Chipping Sparrows are one of the top banded species during spring migration (Table 10), but banded in very low numbers in the fall (Figure 84). A total of 1,411 have been banded in the spring, but with a high variability in banding totals between years (mean 94, range 5 to 592). Fall banding is much slower with 148 banded (mean 10, range 1 to 28). The spring capture rate is influenced by the years with large banding totals, and the fall capture rate is negligible in comparison (Figure 85).

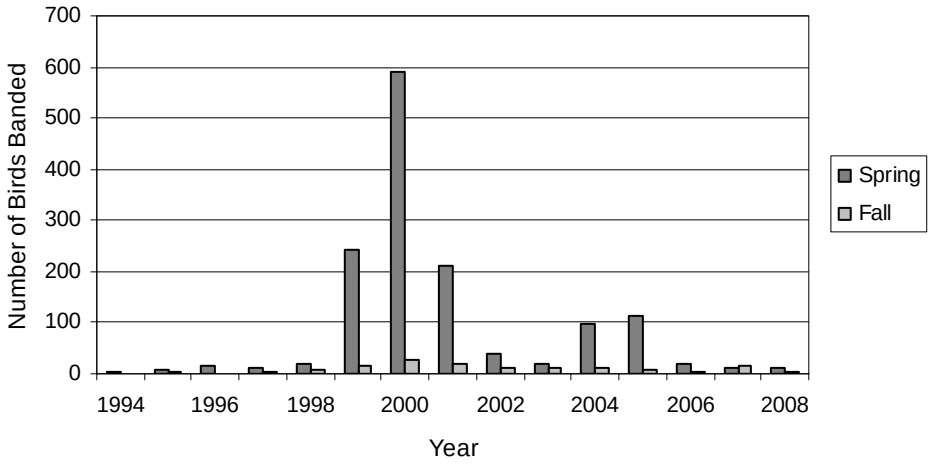

Figure 84. Annual spring and fall banding totals for Chipping Sparrow (1994 to 2008).

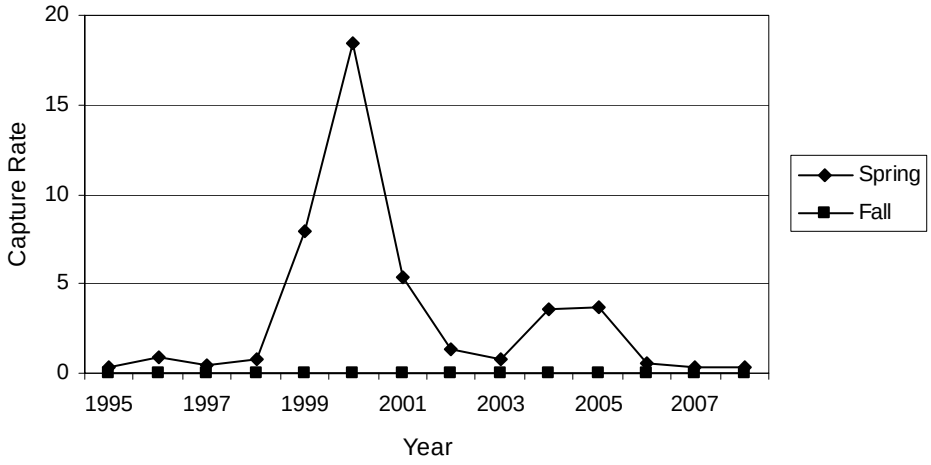

Figure 85. Annual spring and fall capture rates for Chipping Sparrow (1994 to 2008).

Lincoln's Sparrow (*Melospiza lincolnii*)

Lincoln's Sparrows are a common species encountered at the LSLBO, although they are present in low abundance (mean cumulative spring DT is 72 and 51 in the fall). Overall passage of Lincoln's Sparrows during both spring and fall migration occurs in low numbers; the highest DT spring record is 12, and two dates occurred in the fall with over 10 detections. A large proportion of detections occur though banding, accounting for 33% of the spring and 50% of the total fall detections. They are rarely detected on visual migration counts, with less than 1% of the spring detections and no records in the fall.

Detections of Lincoln's Sparrows begin within the first week of May (Figure 86). The earliest spring record was May 1. The average peak migration occurs from mid-May to the third week of May. A number of individuals breed within the migration site. These birds are regularly documented and account for the majority of the observations in late May and June. Fall migration does not exhibit a distinct migratory window (Figure 87). Observations remain steady from mid-July until the end of September. This can be due to several factors including the general low abundance, seasonal variations, and local breeders remaining in the area. The latest record was on September 30, which occurred on several years.

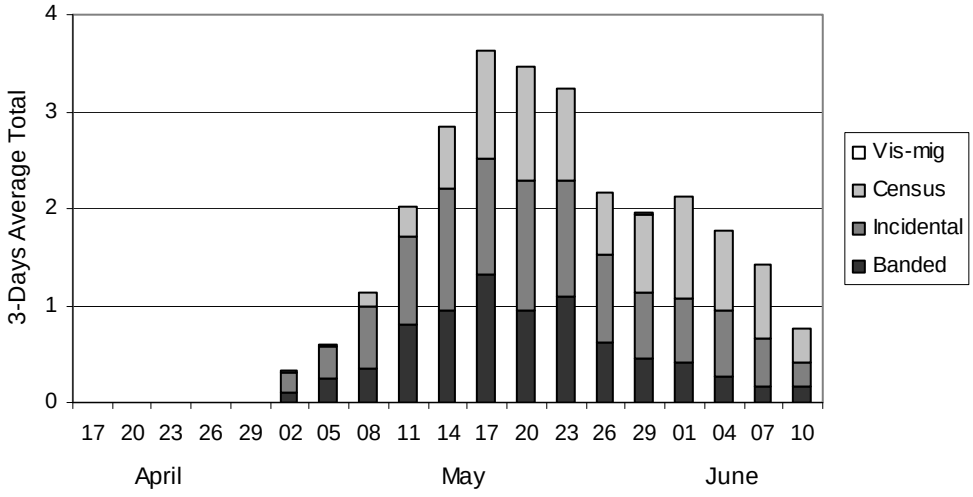

Figure 86. Lincoln's Sparrow spring migration 3-day average Daily Total (1994 to 2008).

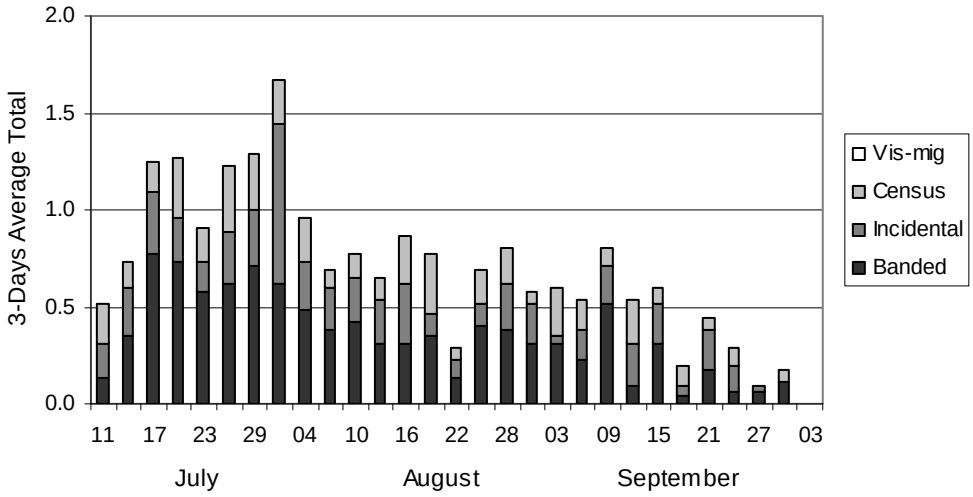

Figure 87. Lincoln's Sparrow fall migration 3-day average Daily Total (1994 to 2008).

Lincoln's Sparrows are banded in small numbers every spring and fall, with highly variable totals between years and seasons (Figure 88). A total of 255 (mean 17, range 6 to 43) have been banded in the spring and 368 (mean 25, range 9 to 48) in the fall. Capture rates mirror the variation in banding totals and do not show any distinct changes over the 15 years (Figure 89).

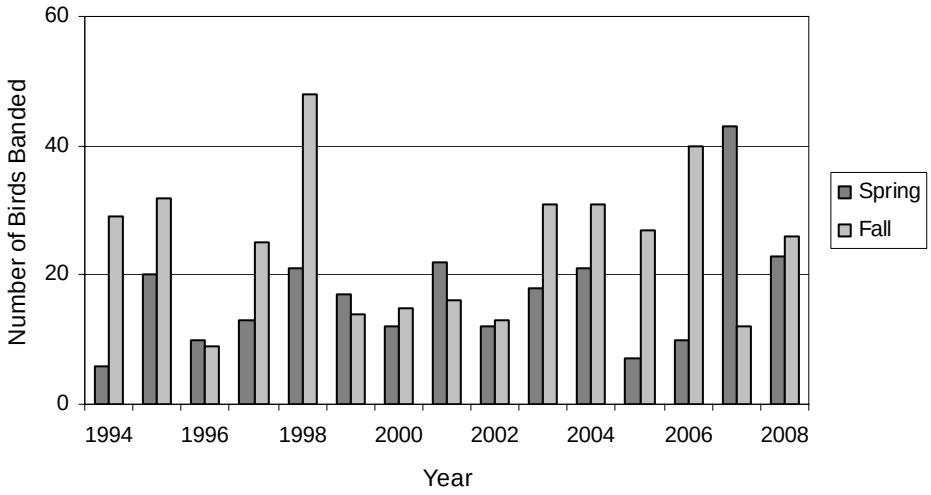

Figure 88. Annual spring and fall banding totals for Lincoln's Sparrow (1994 to 2008).

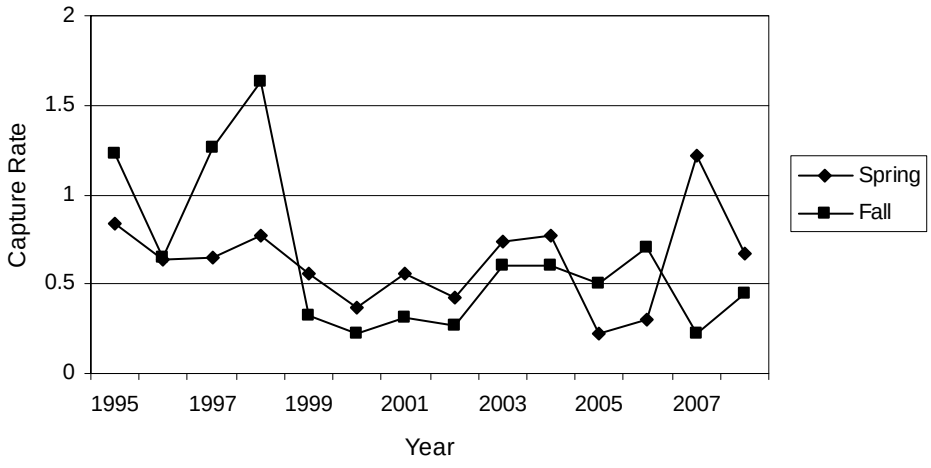

Figure 89. Annual spring and fall capture rates for Lincoln's Sparrow (1994 to 2008).

White-throated Sparrow (*Zonotrichia albicollis*)

White-throated Sparrows are commonly encountered during both spring and fall migration (mean cumulative DT in the spring is 365 and 201 in the fall). During peak periods of spring migration, DTs range from 20 to 30 individuals. The highest spring DT occurred on May 15, 1998 with 132 detections. Fall migration generally lower abundances than spring throughout the season, with the highest DT at 20. The proportion of total detections through banding is equal proportions between the spring and fall (23% and 25%, respectively). Visual migration detections are low in both monitoring seasons, with less than 1% of the spring and 3% of the total fall detections.

White-throated Sparrow migration begins in early May, through the earliest spring record was April 26, and peaks mid-May (Figure 90). Some variation in spring migration timing has been documented. In 1996, the peak migration occurred in late May, but occurred the first week of May in 2007. Breeding individuals can be detected on migration counts and it is likely that the majority of observations from late May and through June are local breeders. White-throated Sparrows are detected throughout the entire fall season. Their presence is strongest in July and steady throughout August and the first half of September (Figure 91). Their abundance diminishes during the last half of September, but sightings are common. The latest sighting was October 2. During the fall there is little variation in timing between years and detections are steady throughout the entire season, without defined peaks.

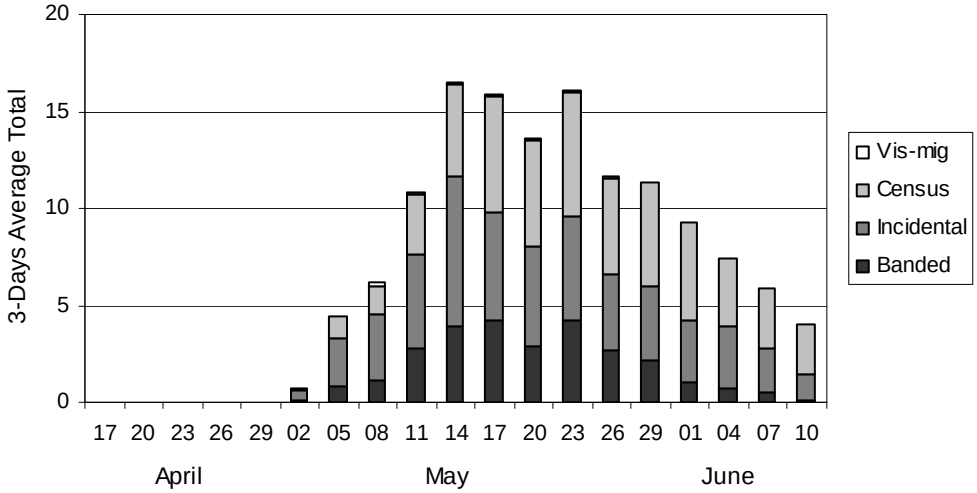

Figure 90. White-throated Sparrow spring migration 3-day average Daily Total (1994 to 2008).

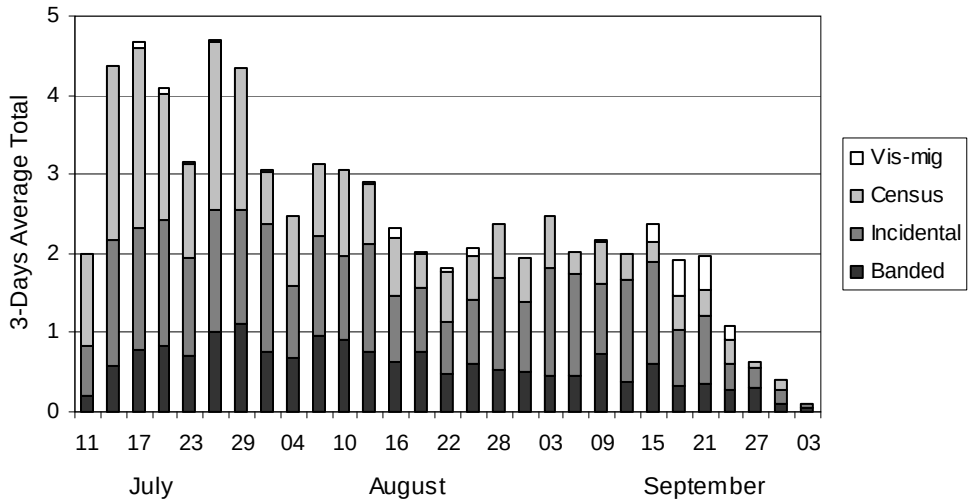

Figure 91. White-throated Sparrow fall migration 3-day average Daily Total (1994 to 2008).

White-throated Sparrows are one of the top ten species banded in the spring (Table 10) with a total of 1,018 banded (mean 68, range 28 to 136). Spring banding totals have remained relatively steady over the 15 years (Figure 92). The large banding total in 2007 coincided with a large observed passage early in May. Fall banding totals are almost consistently lower than the corresponding spring, with a total of 607 banded (mean 41, range 21 to 76). The proportion of HY birds banded is lower, 76%, than many of the other species analyzed in these accounts. Spring capture rates have shown some variability, but fall capture rates have remained steady from 1999 to 2008 (Figure 93).

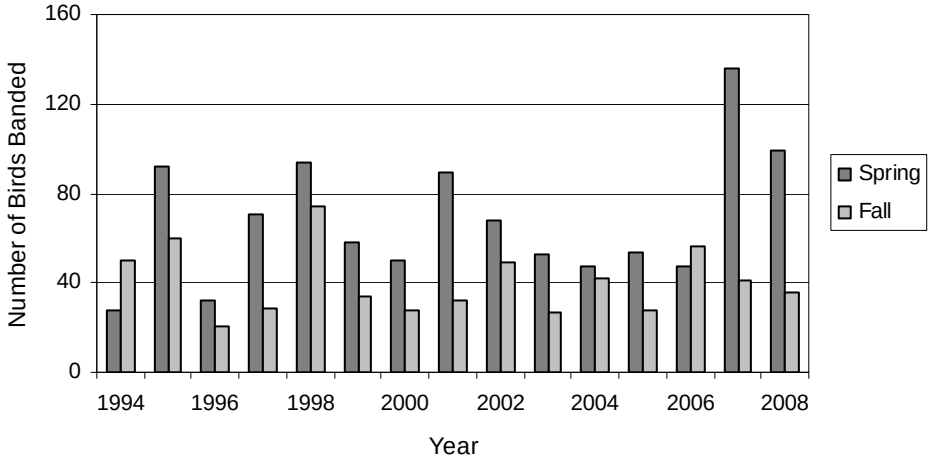

Figure 92. Annual spring and fall banding totals for White-throated Sparrow (1994 to 2008).

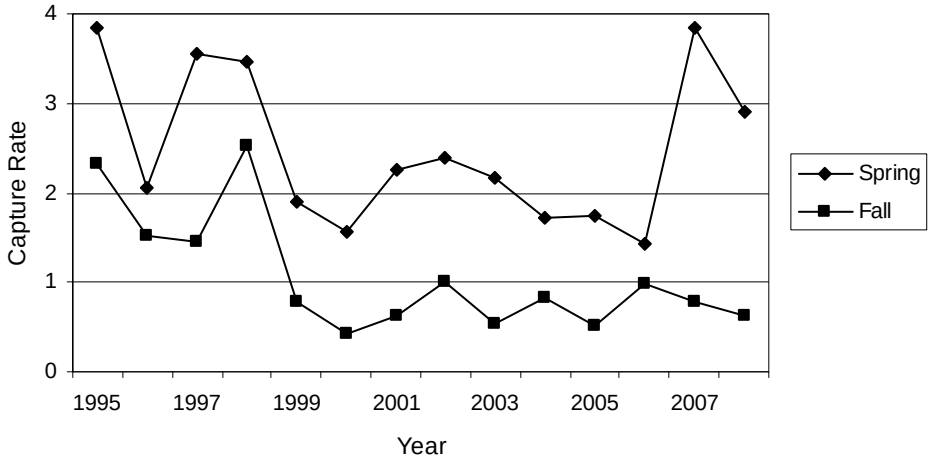

Figure 93. Annual spring and fall capture rates for White-throated Sparrow (1994 to 2008).

White-crowned Sparrow (*Zonotrichia leucophrys*)

White-crowned Sparrows are early spring and late fall migrants through the LSLBO and present in low abundances during both seasons (cumulative mean spring DT is 42 and 45 in the fall). The only subspecies to be recorded during migration activities is Gambel's White-crowned Sparrow (*Z.l. gambelii*). In the spring, small numbers are observed during migration; only three dates recorded over 20 individuals. Detections in the fall are generally lower than the spring; eight dates recorded over 10 individuals. Banding accounted for 20% of the spring and 33% of the total fall detections. Very few individuals are detected on visual migration counts, accounting for 2% of the total spring and 3% of the total fall detections.

Spring migration begins late April and early May, peaking in mid-May (Figure 94). Sightings become rare in late May. The earliest spring observation was April 27 and the latest spring observation was June 1. Some seasonal variation in migration timing has been documented, with migration peaks occurring early May and mid-May. Fall migration detections typically begin within the third week of August (Figure 95). The earliest sighting was on August 9. Peak observations occur between the second and fourth week of September. The latest date of observation was October 4. September 16, 1998 was 43 on September 16, which accounts for the spike in the graph. DTs are steady over the migratory period, with the exception of September 16, 1998, where 43 were recorded.

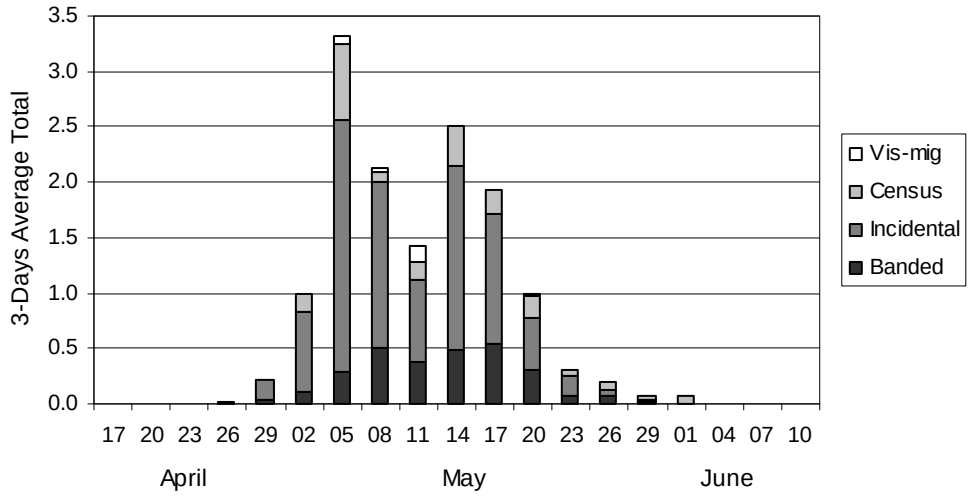

Figure 94. White-crowned Sparrow spring migration 3-day average Daily Total (1994 to 2008).

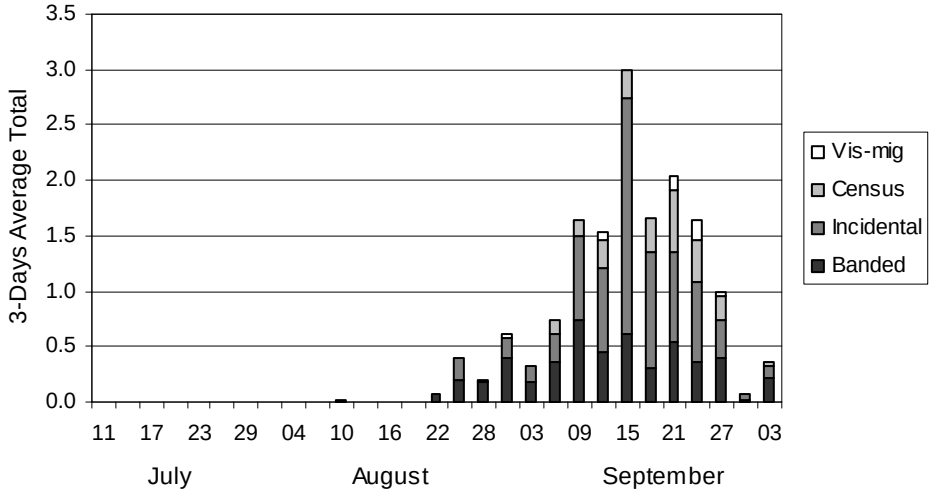

Figure 95. White-crowned Sparrow fall migration 3-day average Daily Total (1994 to 2008).

White-crowned Sparrows are banded in low numbers during both spring and fall migration (Figure 96). A total of 123 have been banded in the spring (mean 8, range 0 to 27). Fall banding totals are slightly higher, with a total of 208 banded (mean 14, range 4 to 31). Fall shows more variation in the banding totals. The majority of the individuals banded in the fall are HY birds, at 82%. Capture rates have been steady throughout the spring, but follow a decreasing trend in the fall (Figure 97).

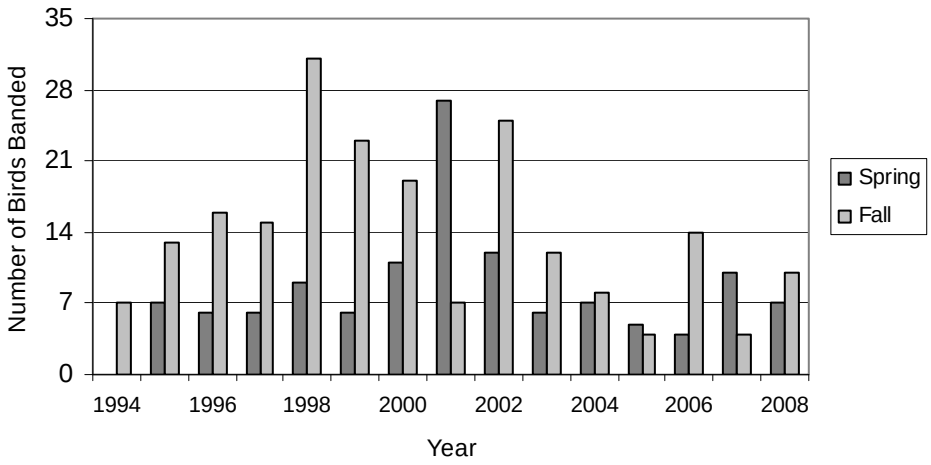

Figure 96. Annual spring and fall banding totals for White-crowned Sparrow (1994 to 2008).

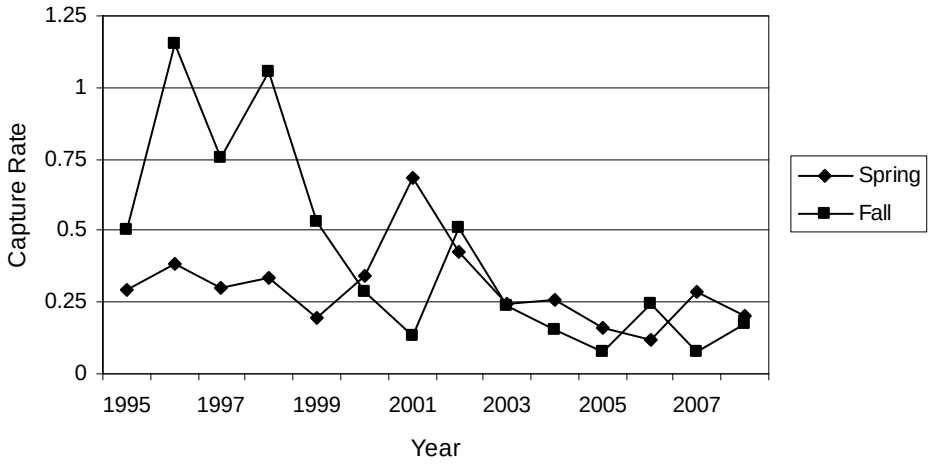

Figure 97. Annual spring and fall capture rates for White-crowned Sparrow (1994 to 2008).

Dark-eyed Junco (*Junco hyemalis*)

The majority of the detections are Slate-coloured subspecies (*J.h. hyemalis*), but the rare Oregon subspecies (*J.h. oreganus*) is detected. Dark-eyed Juncos are observed early in the spring and late fall migrant. No individuals were recorded in the spring of 1994, due

to migration monitoring beginning in mid-May. Cumulative mean DT for spring (excluding 1994) is 215 and 118 in the fall (including 1994). Banding accounts for 10% of the total spring detections and 30% of the total fall detections. Visual migration counts detected 20% of the total spring detections, but only 5% of the total fall detections.

Spring migration is variable on both timing and abundance and the average timing is influenced by single years that recorded heavy migratory passage (Figure 98). Recorded passages have occurred within the third week of April to the first week of May. Six years (1996, 1997, 1998, 2004, 2005, and 2006) recorded very few observations. A large passage was recorded in 2001 from April 19 to 22 (where 642 birds were observed on the 20), then a second passage on May 1. Monitoring began on April 19 in 2002, and the peak passage did not occur until May 5. Heavy passage in both 2007 and 2008 occurred late April. Sightings become rare after the first week of May. However, the latest spring sighting occurred on June 5, which was likely a locally breeding individual. Fall migration generally begins in late August, with peak migration occurring the last two weeks of September (Figure 99). The latest fall observation was October 4. Sightings are rare in July and first half of August. Detections in the fall are more common than the spring, but variation in abundances to occur. For example, the peak DT in 2000 was 329, but only14 in 2003.

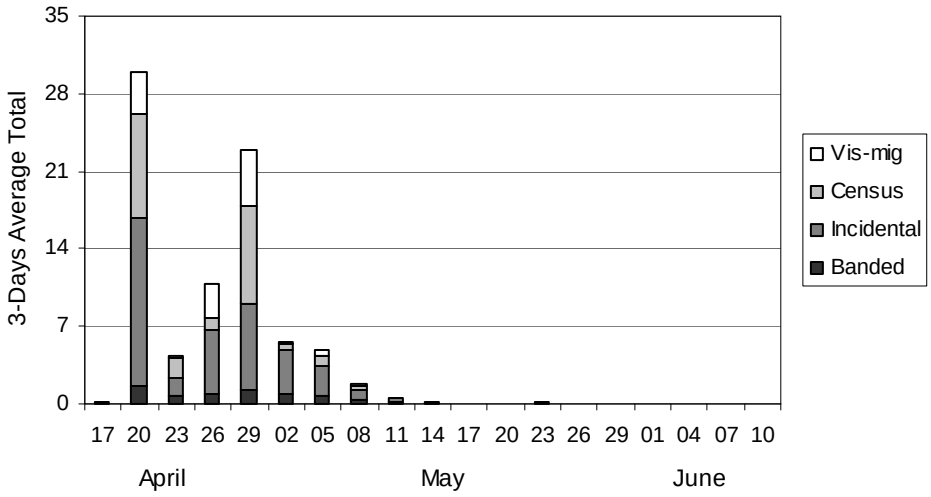

Figure 98. Dark-eyed Junco spring migration 3-day average Daily Total (1994 to 2008).

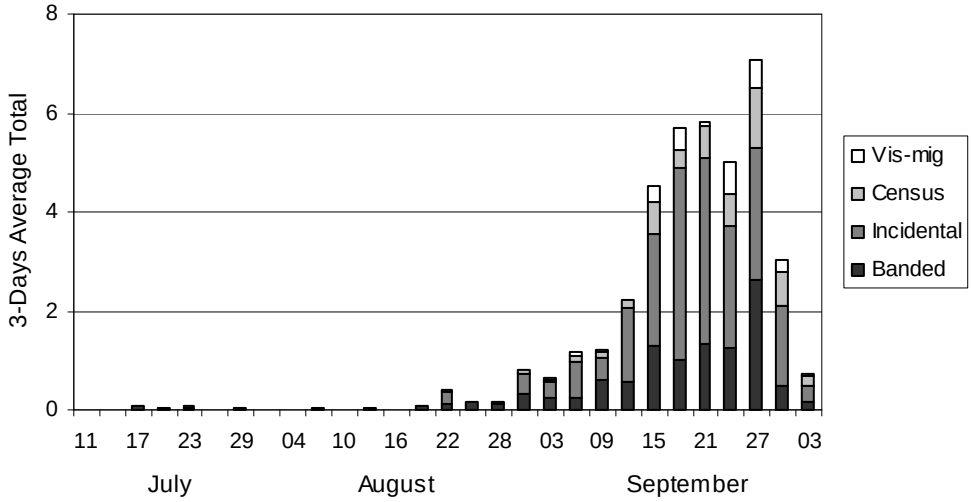

Figure 99. Dark-eyed Junco fall migration 3-day average Daily Total (1994 to 2008).

Banding totals in both the spring and fall are highly variable (Figure 100). A total of 292 have been banded in the spring (mean 20, range of 0 to 108) and 494 banded in the fall (mean of 33, range 6 to121). The years with low spring banding totals are consistent with the years with few sightings. Since banding accounts for an increased proportion of the fall detections, years with low sightings also have low banding totals. Capture rates also reflect this variability in both spring and fall (Figure 101).

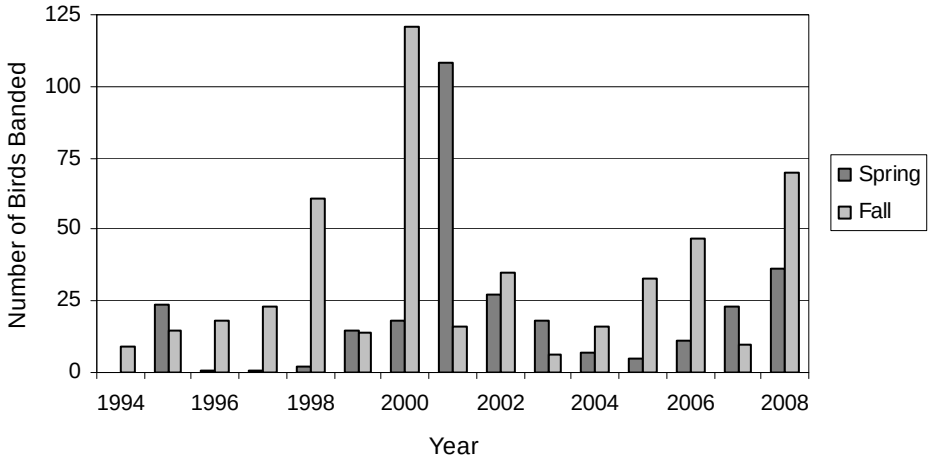

Figure 100. Annual spring and fall banding totals for Dark-eyed Junco (1994 to 2008).

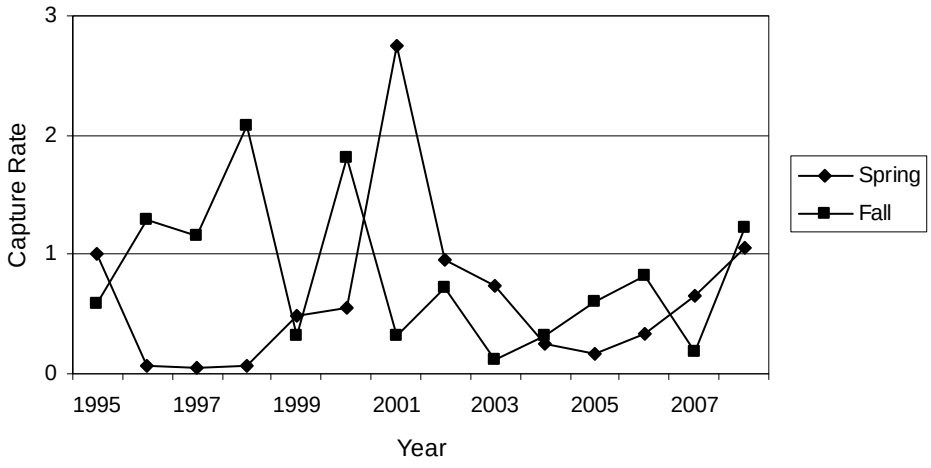

Figure 101. Annual spring and fall capture rates for Dark-eyed Junco (1994 to 2008).

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Appendix 1. Migration Monitoring Records

The following table is a complete list of all 226 species observed during spring and fall migration monitoring activities. Species are listed in taxonomical order and separated by family. For each species, the cumulative total from 1994 to 2008 is listed. The proportion of the total detections through each monitoring method is included. The average number of days sighted for each year and the first and last date of sightings for each migration season is listed.

	Percent of Total Spring Detections				Spring	Av.	Spring Sight Records		Percent of Total Fall Detections				Fall	Av.	Fall Sight Records	
	Banded	Vis-Mig	Census	Incidental	DT	Detect	Earliest	Latest	Banded	Vis-Mig	Census	Incidental	DT	Detect	Earliest	Latest
Gaviidae																
Red-throated Loon *Gavia stellata*	0.0	0.0	0.0	100.0	4	0.1	May-27		0.0	0.0	0.0	0.0	0	0.0		
Common Loon *Gavia immer*	0.0	6.3	29.3	71.5	1678	28.1	Apr-28	Jun-13	0.0	8.0	30.3	1.1	2640	37.5	Jul-07	Oct-04
Pacific Loon *Gavia pacifica*	0.0	57.1	0.0	42.9	7	0.2	May-15	Jun-07	0.0	0.0	0.0	0.0	0	0.0		
Yellow-billed Loon *Gavia adamsii*	0.0	0.0	100.0	0.0	1	0.1	Jun-08		0.0	0.0	0.0	100.0	1	0.1	Aug-02	
Podicipedidae																
Pied-billed Grebe *Podilymbus podiceps*	0.0	0.0	39.1	95.7	23	0.3	Apr-28	May-22	0.0	60.0	40.0	0.0	5	0.3	Aug-13	Sep-21
Horned Grebe *Podiceps auritus*	0.0	5.9	23.5	82.4	17	0.6	Apr-27	Jun-09	0.0	1.2	42.8	81.8	837	9.4	Jul-12	Oct-06
Red-necked Grebe *Podiceps grisegena*	0.0	0.7	40.3	69.8	804	14.9	Apr-24	Jun-13	0.0	1.6	32.7	74.5	1485	27.9	Jul-07	Oct-01
Eared Grebe *Podiceps nigricollis*	0.0	0.0	0.0	100.0	28	0.3	May-07	Jun-09	0.0	0.0	47.3	58.1	93	2.5	Aug-10	Sep-23
Western Grebe *Aechmophorus occidentalis*	0.0	5.4	41.6	53.7	298	3.5	May-07	Jun-12	0.0	2.8	18.8	84.1	1004	10.4	Jul-13	Oct-04
Pelecanidae																
American White Pelican *Pelecanus erythrorhynchos*	0.0	6.7	24.7	74.1	652	7.3	May-01	Jun-14	0.0	1.6	26.8	78.0	1886	32.5	Jul-07	Oct-03
Phalalcrocoracidae																
Double-creasted Cormorant *Phalacrocorax auritus*	0.0	11.6	27.7	60.7	173	2.0	Apr-21	Jun-12	0.0	17.5	3.5	78.9	57	0.9	Jul-21	Sep-16
Ardeidae																
Great Blue Heron *Ardea herodias*	0.0	11.9	10.2	78.0	59	2.6	Apr-18	Jun-06	0.0	7.9	15.9	77.8	63	3.2	Jul-11	Sep-28
Anatidae																
Greater White-Fronted Goose *Anser albifrons*	0.0	27.0	6.8	67.4	56001	6.7	Apr-21	May-17	0.0	31.1	3.1	68.0	9806	4.5	Aug-15	Sep-29
Snow Goose *Chen caerulescens*	0.0	3.7	1.5	92.0	1453	1.3	Apr-30	Jun-05	0.0	10.0	12.6	77.4	1809	0.9	Sep-11	Sep-30
Brant *Branta bernicla*	0.0	0.0	0.0	0.0	0	0.0			0.0	0.0	0.0	100.0	2	0.1	Sep-07	
Canada Goose *Branta canadensis*	0.0	13.6	11.0	76.6	5434	24.5	Apr-16	Jun-13	0.0	11.6	18.3	78.1	6273	19.3	Jul-12	Oct-04
Trumpeter Swan *Cygnus buccinator*	0.0	0.0	50.0	50.0	8	0.3	May-03	May-27	0.0	0.0	0.0	0.0	0	0.0		
Tundra Swan *Cygnus columbianus*	0.0	19.8	12.2	69.3	3453	5.2	Apr-17	Jun-04	0.0	18.8	50.8	49.2	191	0.5	Sep-29	Oct-04
Wood Duck *Aix sponsa*	0.0	0.0	0.0	100.0	1	0.1	May-03		0.0	0.0	0.0	0.0	0	0.0		
Gadwall *Anas strepera*	0.0	0.0	28.8	80.3	132	2.3	Apr-26	Jun-11	0.0	0.0	0.0	100.0	19	0.2	Jul-19	Jul-30

	Percent of Total Spring Detections				Spring	Av.	Spring Sight Records		Percent of Total Fall Detections				Fall	Av.	Fall Sight Records	
	Banded	Vis-Mig	Census	Incidental	DT	Detect	Earliest	Latest	Banded	Vis-Mig	Census	Incidental	DT	Detects	Earliest	Latest
Eurasian Wigeon *Anas Penelope*	0.0	0.0	0.0	100.0	1	0.1	May-15		0.0	0.0	0.0	0.0	0	0.0		
American Wigeon *Anas Americana*	0.0	5.5	35.4	70.4	2208	25.2	Apr-17	Jun-14	0.0	0.2	44.7	72.9	468	4.6	Jul-13	Oct-01
Mallard *Anas platyrhynchos*	0.0	5.0	49.0	65.3	5344	38.0	Apr-17	Jun-13	0.0	0.8	48.4	77.6	5063	31.8	Jul-07	Oct-06
Blue-winged Teal *Anas Penelope*	0.0	4.9	42.2	62.7	734	10.2	May-01	Jun-13	0.0	0.0	35.7	86.7	996	4.8	Aug-01	Sep-28
Northern Shoveller *Anas clypeata*	0.0	6.2	40.7	68.0	646	5.7	Apr-24	Jun-10	0.0	0.0	47.6	66.7	84	1.1	Aug-08	Oct-04
Northern Pintail *Anas acuta*	0.0	24.9	16.5	64.6	551	2.5	Apr-19	Jun-05	0.0	0.0	44.1	55.9	59	1.5	Aug-01	Oct-04
Green-winged Teal *Anas crecca*	0.0	5.0	39.9	63.1	928	11.8	Apr-18	Jun-13	0.0	8.9	18.8	79.5	112	2.2	Aug-01	Oct-04
Canvasback *Aythya valisineria*	0.0	0.0	23.5	85.3	34	0.5	May-03	May-24	0.0	0.0	0.0	100.0	2	0.1	Jul-18	Jul-23
Redhead *Aythya americana*	0.0	0.0	35.3	64.7	17	0.3	May-01	May-16	0.0	85.7	0.0	14.3	7	0.2	Aug-05	Aug-27
Ring-necked Duck *Aythya collaris*	0.0	0.0	42.1	81.6	38	1.2	Apr-23	May-23	0.0	0.0	0.0	0.0	0	0.0		
Greater Scaup *Aythya marila*	0.0	0.0	0.0	100.0	48	0.5	Apr-28	May-24	0.0	0.0	0.0	0.0	0	0.0		
Lesser Scaup *Aythya affinis*	0.0	6.1	22.3	78.2	426	2.5	Apr-21	Jun-06	0.0	26.2	16.7	57.1	42	0.3	Jul-29	Aug-19
Harlequin Duck *Histrionicus histrionicus*	0.0	0.0	0.0	100.0	1	0.1	Jun-07		0.0	0.0	0.0	0.0	0	0.0		
Surf Scoter *Melanitta perspicillata*	0.0	14.0	23.6	67.6	3548	8.3	May-03	Jun-10	0.0	0.0	0.0	100.0	7	0.2	Jul-30	Sep-05
White-winged Scoter *Melanitta fusca*	0.0	18.7	18.5	62.9	763	5.9	May-04	Jun-13	0.0	4.4	5.5	90.1	91	0.7	Aug-12	Sep-25
Long-tailed Duck *Clangula hyemalis*	0.0	16.1	25.6	63.5	3725	5.1	May-02	Jun-05	0.0	0.0	0.0	0.0	0	0.0		
Bufflehead *Bucephala albeola*	0.0	4.9	38.7	71.4	576	12.7	Apr-23	Jun-12	0.0	4.3	65.3	63.2	1670	9.3	Jul-14	Oct-06
Common Goldeneye *Bucephala clangula*	0.0	2.6	57.1	68.0	10538	39.9	Apr-17	Jun-14	0.0	4.6	54.0	64.9	5071	35.4	Jul-07	Oct-06
Hooded Merganser *Lophodytes cucullatus*	0.0	0.0	0.0	100.0	1	0.1	Jun-04		0.0	0.0	0.0	100.0	2	0.1	Sep-12	
Common Merganser *Mergus merganser*	0.0	3.1	32.4	75.6	8330	34.1	Apr-19	Jun-14	0.0	2.5	24.9	76.3	3109	24.9	Jul-07	Oct-06
Red-breasted Merganser *Mergus serrator*	0.0	2.3	30.4	74.4	1709	18.5	Apr-24	Jun-14	0.0	5.0	20.0	75.0	60	1.1	Jul-14	Sep-28
Ruddy Duck *Oxyura jamaicensis*	0.0	0.0	0.0	100.0	3	0.1	May-08		0.0	0.0	0.0	100.0	5	0.1	Aug-25	
Accipitridae																
Osprey *Pandion haliaetus*	0.0	2.1	11.5	90.2	234	11.5	Apr-26	Jun-13	0.0	3.1	19.6	84.0	607	26.3	Jul-07	Sep-25

	Percent of Total Spring Detections				Spring	Av	Spring Sight Records		Percent of Total Fall Detections				Fall	Av.	Fall Sight Records	
	Banded	Vis-Mig	Census	Incidental	DT	Detect	Earliest	Latest	Banded	Vis-Mig	Census	Incidental	DT	Detects	Earliest	Latest
Bald Eagle *Haliaeetus leucocephalus*	0.0	2.8	20.5	85.1	751	28.0	Apr-16	Jun-13	0.0	3.5	28.3	82.3	1533	47.6	Jul-08	Oct-06
Northern Harrier *Circus cyaneus*	0.0	19.7	11.0	71.9	1033	20.5	Apr-16	Jun-13	0.0	20.4	12.7	67.6	490	18.3	Jul-13	Oct-02
Sharp-shinned Hawk *Accipiter striatus*	22.4	12.2	7.9	59.2	304	12.8	Apr-18	Jun-11	9.8	12.1	14.4	66.9	2671	39.8	Jul-13	Oct-05
Cooper's Hawk *Accipiter cooperii*	0.0	45.5	0.0	54.5	11	0.6	Apr-19	May-22	3.6	82.1	7.1	60.7	28	1.5	Jul-12	Sep-24
Northern Goshawk *Accipiter gentiles*	0.0	33.3	25.0	66.7	12	0.7	Apr-26	May-22	3.1	18.8	9.4	65.6	32	1.9	Aug-01	Oct-05
Broad-winged Hawk *Buteo platypterus*	0.0	36.4	9.1	54.5	11	0.6	Apr-17	Jun-07	0.0	26.5	13.2	60.3	68	1.4	Jul-14	Sep-29
Swainson's Hawk *Buteo swainsoni*	0.0	0.0	0.0	0.0	0	0.0			0.0	50.0	0.0	50.0	2	0.1	Sep-09	Sep-25
Red-tailed Hawk *Buteo jamaicensis*	0.0	15.6	7.8	77.3	128	6.4	Apr-17	Jun-12	0.0	24.2	2.7	74.5	149	6.1	Jul-13	Oct-03
Rough-legged Hawk *Buteo lagopus*	0.0	20.0	2.9	80.0	35	1.7	Apr-18	May-21	0.0	14.3	0.0	85.7	7	0.4	Sep-08	Oct-01
Golden Eagle *Aquila chrysaetos*	0.0	0.0	0.0	100.0	5	0.3	Apr-17	May-18	0.0	100.0	0.0	0.0	1	0.1	Aug-25	
Falconidae																
American Kestrel *Falco sparverius*	1.7	20.0	13.3	66.7	60	2.8	Apr-19	Jun-05	0.0	8.0	12.0	81.3	75	3.0	Jul-21	Sep-26
Merlin *Falco columbarius*	0.0	3.3	19.5	82.9	246	13.6	Apr-17	Jun-13	0.0	9.9	21.8	73.0	385	17.9	Jul-12	Sep-29
Gyrfalcon *Falco rusticolus*	0.0	0.0	0.0	0.0	0	0.0			0.0	0.0	0.0	100.0	1	0.1	Sep-30	
Peregrine Falcon *Falco peregrinus*	0.0	27.6	10.3	69.0	29	1.8	Apr-22	Jun-13	0.0	25.0	31.3	56.3	16	1.0	Aug-14	Sep-26
Phasianidae																
Ruffed Grouse *Bonasa umbellus*	0.0	0.1	47.1	77.7	696	30.9	Apr-18	Jun-13	0.0	1.4	8.7	91.5	355	13.6	Jul-15	Oct-06
Sharp-tailed Grouse *Tympanuchus phasianellus*	0.0	50.0	50.0	0.0	2	0.1	May-01		0.0	0.0	0.0	0.0	0	0.0		
Rallidae																
Sora *Porzana carolina*	0.0	0.0	33.3	66.7	3	0.2	May-27	Jun-12	0.0	0.0	0.0	100.0	1	0.1	Aug-04	
American Coot *Fulica Americana*	0.0	0.0	18.4	81.6	38	0.3	May-10	May-22	0.0	0.0	0.0	0.0	0	0.0		
Gruidae																
Sandhill Crane *Grus canadensis*	0.0	14.7	6.0	80.3	7491	5.9	Apr-19	Jun-06	0.0	27.3	7.5	55.4	5107	3.1	Aug-18	Sep-30
Charadriidae																
Black-bellied Plover *Pluvialis squatarola*	0.0	0.0	0.0	100.0	83	0.3	May-02	Jun-01	0.0	17.1	22.9	68.6	35	0.7	Sep-22	Oct-06

	Percent of Total Spring Detections				Spring	Av.	Spring Sight Records		Percent of Total Fall Detections				Fall	Av.	Fall Sight Records	
	Banded	Vis-Mig	Census	Incidental	DT	Detect	Earliest	Latest	Banded	Vis-Mig	Census	Incidental	DT	Detect	Earliest	Latest
American Golden Plover *Pluvialis dominica*	0.0	0.0	0.0	100.0	5	0.1	May-26	Jun-03	0.0	18.2	9.1	72.7	11	0.3	Sep-22	Sep-29
Semipalmated Plover *Charadrius semipalmatus*	0.0	13.8	10.3	65.5	29	0.7	May-01	Jun-03	0.0	11.1	0.0	88.9	9	0.4	Jul-17	Aug-30
Killdeer *Charadrius vociferus*	0.0	8.8	20.4	77.8	445	15.8	Apr-18	Jun-13	0.0	2.2	10.9	87.0	46	2.3	Jul-07	Oct-03
Recurvirostridae																
American Avocet *Recurvirostra Americana*	0.0	0.0	12.8	92.3	39	1.1	May-13	Jun-07	0.0	0.0	0.0	0.0	0	0.0		
Scolopacidae																
Spotted Sandpiper *Actitis macularia*	0.0	1.9	34.5	78.1	690	19.1	Apr-28	Jun-13	0.0	9.9	29.6	66.1	749	21.3	Jul-07	Sep-22
Solitary Sandpiper *Tringa solitaria*	0.0	11.1	20.6	74.6	63	2.7	Apr-25	Jun-08	0.0	5.3	10.5	89.5	19	0.6	Jul-29	Aug-29
Greater Yellowlegs *Tringa melanoleuca*	0.0	12.9	20.9	71.9	688	9.0	Apr-21	Jun-09	0.0	4.6	20.9	81.1	724	10.3	Jul-11	Oct-05
Lesser Yellowlegs *Tringa flavipes*	0.0	11.1	20.9	70.1	800	5.7	Apr-18	Jun-09	0.0	5.8	18.9	84.2	587	4.2	Jul-14	Sep-15
Upland Sandpiper *Bartramia longicauda*	0.0	0.0	100.0	0.0	1	0.1	May-17		0.0	33.3	0.0	66.7	3	0.2	Jul-29	Aug-22
Whimbrel *Numenius phaeopus*	0.0	100.0	100.0	0.0	5	0.1	Jun-01		0.0	0.0	0.0	0.0	0	0.0		
Marbeled Godwit *Limosa fedoa*	0.0	0.0	0.0	100.0	2	0.1	May-18	May-20	0.0	0.0	0.0	0.0	0	0.0		
Ruddy Turnstone *Arenaria interpres*	0.0	0.0	0.0	100.0	4	0.1	May-20	May-21	0.0	0.0	0.0	0.0	0	0.0		
Sanderling *Calidris alba*	0.0	0.0	21.1	78.9	19	0.1	May-23	Jun-08	0.0	1.3	73.1	25.6	78	0.5	Aug-29	Sep-18
Semipalmated Sandpiper *Calidris pusilla*	0.0	0.0	73.9	26.1	23	0.2	May-15	May-19	0.0	0.0	0.0	100.0	100	0.5	Jul-28	Sep-21
Least Sandpiper *Calidris minutilla*	0.0	41.9	0.0	58.1	31	0.4	May-11	Jun-06	0.0	1.1	40.2	58.7	92	0.9	Jul-17	Sep-04
Baird's Sandpiper *Calidris bairdii*	0.0	30.6	1.6	88.7	62	0.5	May-16	Jun-06	0.0	5.0	8.4	95.0	119	1.1	Jul-18	Sep-12
Pectoral Sandpiper *Calidris melanotos*	0.0	0.0	0.0	100.0	1	0.1	May-19		0.0	5.9	58.8	35.3	17	0.4	Aug-13	Sep-29
Short-billed Dowitcher *Limnodromus griseus*	0.0	36.1	0.0	63.9	72	0.1	May-15		0.0	0.0	0.0	0.0	0	0.0		
Long-billed Dowitcher *Limnodromus scolopaceus*	0.0	100.0	0.0	0.0	35	0.1	May-12		0.0	0.0	0.0	0.0	0	0.0		
Common Snipe *Gallinago gallinago*	0.0	0.0	22.5	85.0	40	2.3	Apr-25	Jun-04	0.0	0.0	100.0	0.0	1	0.1	Aug-13	
Wilson's Phalarope *Phalaropus tricolor*	0.0	0.0	0.0	0.0	0	0.0			0.0	0.0	0.0	100.0	6	0.1	Aug-13	
Laridae																
Bonaparte's Gull *Larus philadelphia*	0.0	15.1	18.6	69.1	392	2.2	Apr-29	Jun-08	0.0	0.9	8.1	91.0	111	1.2	Jul-14	Sep-09

	Percent of Total Spring Detections				Spring	Av.	Spring Sight Records		Percent of Total Fall Detections				Fall	Av.	Fall Sight Records	
	Banded	Vis-Mig	Census	Incidental	DT	Detect	Earliest	Latest	Banded	Vis-Mig	Census	Incidental	DT	Detect	Earliest	Latest
Franklin's Gull *Larus pipixcan*	0.0	16.0	9.1	75.0	12925	21.3	Apr-23	Jun-10	0.0	7.9	19.0	77.1	58661	16.7	Jul-10	Sep-13
Mew Gull *Larus canus*	0.0	9.5	14.8	88.1	337	2.6	May-05	Jun-01	0.0	0.0	33.3	66.7	3	0.2	Jul-29	Aug-31
Ring-billed Gull *Larus delawarensis*	0.0	3.3	30.9	72.8	1202	15.3	Apr-18	Jun-13	0.0	4.1	29.3	69.7	7765	31.8	Jul-07	Oct-05
California Gull *Larus californicus*	0.0	4.1	15.4	80.5	169	2.9	Apr-26	Jun-08	0.0	6.4	15.7	77.9	453	2.6	Jul-12	Sep-23
Herring Gull *Larus argentatus*	0.0	2.4	26.4	73.5	1026	17.1	Apr-17	Jun-14	0.0	8.9	27.6	64.4	550	8.2	Jul-12	Oct-03
Glaucous Gull *Larus hyperboreus*	0.0	0.0	0.0	0.0	0	0.0			0.0	0.0	0.0	100.0	1	0.1	Sep-24	
Caspian Turn *Sterna caspia*	0.0	50.0	16.7	66.7	6	0.3	May-16	Jun-02	0.0	24.1	7.4	68.5	54	0.9	Jul-23	Sep-19
Black Turn *Chlidonias niger*	0.0	5.8	9.3	90.7	86	0.5	May-19	Jun-05	0.0	0.0	1.5	98.5	203	0.6	Jul-12	Sep-03
Common Turn *Sterna hirundo*	0.0	5.5	22.7	76.3	688	9.9	Apr-28	Jun-13	0.0	6.8	13.0	81.5	2693	18.6	Jul-11	Sep-24
Forster's Turn *Sterna forsteri*	0.0	7.7	15.3	79.4	413	4.9	May-06	Jun-10	0.0	0.5	28.1	74.5	648	8.5	Jul-14	Sep-26
Stercorariidae																
Parasitic Jaeger *Stercorarius parasiticus*	0.0	0.0	0.0	100.0	1	0.1	Apr-29		0.0	0.0	0.0	100.0	2	0.1	Sep-06	Sep-07
Columbidae																
Rock Pigeon *Columba livia*	0.0	0.0	0.0	0.0	0	0.0			0.0	0.0	0.0	100.0	1	0.1	Aug-30	
Mourning Dove *Zenaida macroura*	0.0	26.1	13.0	69.6	23	1.3	May-05	Jun-05	0.0	0.0	0.0	0.0	0	0.0		
Stigidae																
Great-horned Owl *Bubo virginianus*	0.0	0.0	0.0	100.0	2	0.1	May-16	May-19	0.0	0.0	0.0	100.0	5	0.2	Sep-07	Sep-10
Northern Pygmy Owl *Glaucidium gnoma*	0.0	0.0	0.0	0.0	0	0.0			100.0	0.0	0.0	0.0	2	0.1	Aug-19	Sep-23
Barred Owl *Strix varia*	0.0	0.0	8.3	91.7	12	0.7	Apr-21	May-29	0.0	0.0	0.0	100.0	4	0.2	Jul-23	Sep-21
Long-eared Owl *Asio otus*	0.0	0.0	0.0	100.0	2	0.1	Apr-25	May-03	0.0	0.0	0.0	0.0	0	0.0		
Short-eared Owl *Asio flammeus*	0.0	0.0	50.0	50.0	2	0.1	Apr-26	May-04	0.0	0.0	0.0	100.0	3	0.2	Sep-06	Sep-12
Northern Saw-whet Owl *Aegolius acadicus*	0.0	0.0	0.0	100.0	3	0.2	May-05	May-30	0.0	0.0	0.0	100.0	1	0.1	Aug-26	
Caprimulgidae																
Common Nighthawk *Chordeiles minor*	0.0	33.3	0.0	66.7	12	0.7	May-21	Jun-12	0.0	28.6	0.0	71.4	14	0.7	Jul-17	Sep-08

	Percent of Total Spring Detections				Spring	Av.	Spring Sight Records		Percent of Total Fall Detections				Fall	Av.	Fall Sight Records	
	Banded	Vis-Mig	Census	Incidental	DT	Detect	Earliest	Latest	Banded	Vis-Mig	Census	Incidental	DT	Detects	Earliest	Latest
Trochilidae																
Ruby-throated Hummingbird *Archilochus colubris*	12.5	4.2	12.5	75.0	24	1.3	May-21	Jun-10	18.9	5.4	18.9	62.2	37	2.3	Jul-07	Aug-22
Rufous Hummingbird *Selasphorus rufus*	0.0	0.0	0.0	100.0	3	0.1	May-21	May-26	0.0	0.0	0.0	0.0	0	0.0		
Alcedinidae																
Belted Kingfisher *Ceryle alcyon*	0.0	7.1	14.2	81.9	127	7.0	Apr-23	Jun-12	0.0	9.7	22.6	75.5	155	8.6	Jul-07	Sep-25
Picidae																
Yellow-bellied Sapsucker *Sphyrapicus varius*	14.3	6.0	29.6	56.9	385	15.5	Apr-28	Jun-13	40.7	3.3	12.9	47.8	209	7.8	Jul-09	Sep-28
Downy Woodpecker *Picoides pubescens*	2.4	0.0	28.9	77.1	83	4.9	Apr-19	Jun-04	18.0	1.5	20.3	69.5	266	15.0	Jul-09	Oct-06
Hairy Woodpecker *Picoides villosus*	3.1	1.0	34.4	64.6	96	5.7	Apr-18	Jun-10	6.9	1.5	29.7	70.8	202	12.3	Jul-07	Oct-06
Three-toed Woodpecker *Picoides tridactylus*	0.0	0.0	0.0	100.0	1	0.1	May-10	Sep-14	0.0	0.0	0.0	100.0	1	0.1		
Black-backed Woodpecker *Picoides arcticus*	0.0	0.0	0.0	100.0	2	0.1	May-01	May-24	0.0	0.0	0.0	100.0	1	0.1	Sep-17	
Northern Flicker *Colaptes auratus*	0.7	23.9	29.6	54.9	1642	25.1	Apr-22	Jun-13	4.4	1.7	25.6	74.4	180	10.0	Jul-09	Sep-24
Pileated Woodpecker *Dryocopus pileatus*	0.0	0.0	32.5	80.5	246	14.2	Apr-16	Jun-13	0.5	6.8	29.3	74.1	205	12.1	Jul-10	Oct-04
Tyrannidae																
Olive-sided Flycatcher *Contopus cooperi*	0.0	21.4	14.3	50.0	6.00	0.4	23-May	Jun-10	14.3	0.0	0.0	0.0	14	0.8	Jul-31	Aug-30
Western Wood-pewee *Contopus sordidulus*	5.2	1.7	17.2	79.3	58	3.1	May-05	Jun-13	25.4	1.7	15.3	64.4	59	3.4	Jul-13	Sep-14
Yellow-bellied Flycatcher *Empidonax flaviventris*	87.0	0.0	0.0	13.0	46	2.5	May-10	Jun-13	96.9	0.0	0.0	3.1	32	2.0	Jul-12	Sep-07
Alder Flycatcher *Empidonax alnorum*	50.5	0.0	30.1	26.6	1334	14.8	May-12	Jun-14	52.7	0.8	21.7	32.4	1821	36.9	Jul-07	Sep-27
Least Flycatcher *Empidonax minimus*	37.5	1.3	22.0	43.8	2480	25.0	May-03	Jun-13	52.4	1.3	18.6	29.6	1455	33.9	Jul-07	Sep-25
Eastern Phoebe *Sayornis phoebe*	12.9	0.7	25.5	81.3	939	29.1	Apr-23	Jun-13	9.2	1.8	26.6	74.5	271	11.7	Jul-07	Sep-13
Say's Phoebe *Sayornis saya*	0.0	11.5	8.1	83.8	148	4.1	Apr-28	May-21	0.0	16.7	16.7	70.0	30	1.3	Aug-12	Sep-14
Eastern Kingbird *Tyrannus tyrannus*	0.0	14.1	20.3	70.3	64	2.3	May-04	Jun-10	0.0	28.9	17.9	55.8	190	5.5	Jul-23	Sep-17
Laniidae																
Northern Shrike *Lanius excubitor*	0.0	100.0	0.0	0.0	1	0.1	May-18		33.3	0.0	0.0	66.7	3	0.2	Sep-24	Oct-05

	Percent of Total Spring Detections				Spring	Av.	Spring Sight Records		Percent of Total Fall Detections				Fall	Av.	Fall Sight Records	
	Banded	Vis-Mig	Census	Incidental	DT	Detect	Earliest	Latest	Banded	Vis-Mig	Census	Incidental	DT	Detects	Earliest	Latest
Vireonidae																
Blue-headed Vireo *Vireo solitarius*	9.9	0.0	25.6	73.6	121	6.8	May-06	Jun-10	68.9	1.4	8.1	24.3	74	4.1	Jul-13	Sep-22
Warbling Vireo *Vireo gilvus*	16.0	0.0	21.0	64.2	81	3.9	May-08	Jun-12	49.4	1.2	27.2	22.2	81	4.3	Jul-12	Sep-11
Philadelphia Vireo *Vireo philadelphicus*	10.9	1.8	38.2	54.5	55	2.9	May-18	Jun-13	62.2	0.4	13.4	25.6	238	9.3	Jul-11	Sep-20
Red-eyed Vireo *Vireo olivaceus*	19.2	0.0	61.6	32.5	770	15.5	May-09	Jun-14	27.1	0.5	40.5	39.9	1651	35.7	Jul-07	Sep-23
Corvidae																
Gray Jay *Perisoreus canadensis*	7.1	0.0	3.6	92.9	28	1.6	May-17	Jun-13	0.0	0.0	6.3	93.8	16	0.8	Jul-17	Sep-26
Blue Jay *Cyanocitta cristata*	2.6	9.2	18.7	74.9	390	14.4	Apr-18	Jun-13	4.7	6.1	19.7	76.4	623	24.2	Jul-12	Oct-05
Black-billed Magpie *Pica hudsonia*	0.0	4.5	24.5	76.9	376	13.5	Apr-18	Jun-13	0.1	5.3	19.3	79.6	1122	21.6	Jul-12	Oct-06
American Crow *Corvus brachyrhynchos*	0.0	5.1	33.5	75.0	2599	35.3	Apr-16	Jun-14	0.0	4.5	24.5	79.5	3980	36.6	Jul-09	Sep-30
Common Raven *Corvus corax*	0.0	3.0	27.1	79.4	1230	35.7	Apr-17	Jun-14	0.0	10.9	22.9	74.7	3890	55.5	Jul-08	Oct-06
Alaudidae																
Horned Lark *Eremophila alpestris*	0.0	70.0	5.0	25.0	60	0.7	May-12	May-26	0.0	8.1	29.7	86.5	37	0.9	Sep-01	Sep-28
Hirundinidae																
Tree Swallow *Tachycineta bicolor*	0.1	21.4	19.9	62.9	3727	17.0	Apr-21	Jun-12	0.0	32.6	12.6	58.8	895	4.4	Jul-12	Sep-07
Bank Swallow *Riparia riparia*	0.0	22.4	32.6	48.1	1583	3.2	May-11	Jun-11	0.0	29.7	26.2	51.6	516	2.9	Jul-16	Aug-30
Cliff Swallow *Petrochelidon pyrrhonota*	0.0	62.4	1.5	36.1	133	0.7	May-20	Jun-01	0.0	12.5	12.5	75.0	8	0.3	Jul-23	Aug-18
Barn Swallow *Hirundo rustica*	0.0	20.3	8.1	71.6	148	4.5	May-10	Jun-12	0.0	23.9	12.5	65.8	184	4.5	Jul-08	Sep-19
Paridae																
Black-capped Chickadee *Poecile atricapillus*	13.9	2.2	32.2	61.1	1484	32.4	Apr-16	Jun-13	11.2	11.3	22.3	61.8	6521	56.9	Jul-07	Oct-06
Boreal Chickadee *Poecile hudsonicus*	4.0	0.0	32.0	80.0	25	0.7	Apr-25	May-21	0.7	11.0	9.8	75.0	356	6.3	Jul-09	Oct-06
Slittidae																
Red-breasted Nuthatch *Sitta canadensis*	2.1	2.4	33.9	72.9	292	17.0	Apr-18	Jun-13	10.2	5.9	21.9	66.4	950	30.9	Jul-09	0ct6
White-breasted Nuthatch *Sitta carolinensis*	9.1	0.0	9.1	81.8	11	0.7	Apr-22	Jun-05	10.5	5.3	21.1	63.2	38	1.9	Jul-07	Sep-28
Certhiidae																
Brown Creeper *Certhia americana*	10.0	0.0	20.0	70.0	10	0.6	Apr-21	Jun-05	70.4	0.0	7.4	22.2	27	1.8	Jul-12	Sep-30

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	Banded	Vis-Mig	Census	Incidental	DT	Detect	Earliest	Latest	Banded	Vis-Mig	Census	Incidental	DT	Detect	Earliest	Latest
Troglodytidae																
Rock Wren *Salpinctes obsoletus*	0.0	0.0	0.0	100.0	1	0.1	May-15		0.0	0.0	0.0	0.0	0	0.0		
House Wren *Troglodytes aedon*	42.1	5.3	15.8	36.8	38	2.1	May-09	Jun-09	38.9	0.0	5.6	55.6	18	1.1	Jul-13	Sep-25
Winter Wren *Troglodytes troglodytes*	1.4	0.0	37.7	82.3	350	19.8	Apr-25	Jun-10	7.3	0.0	25.0	76.0	96	5.7	Jul-09	Sep-30
Marsh Wren *Cistothorus palustris*	50.0	0.0	25.0	25.0	4	0.3	May-07	May-21	100.0	0.0	0.0	0.0	1	0.1	Sep-24	
Regulidae																
Golden-crowned Kinglet *Regulus satrapa*	11.1	0.0	22.2	66.7	9	0.6	Apr-22	May-28	21.3	0.0	10.4	68.6	328	7.5	Jul-28	Oct-04
Ruby-crowned Kinglet *Regulus calendula*	15.6	0.8	34.3	66.1	641	21.7	Apr-19	Jun-11	24.9	1.9	20.5	57.4	857	21.3	Jul-07	Oct-06
Turdidae																
Mountain Bluebird *Sialia currucoides*	0.0	40.0	40.0	60.0	5	0.3	Apr-26	Jun-07	0.0	0.0	0.0	0.0	0	0.0		
Townsend's Solitaire *Myadestes townsendi*	0.0	0.0	0.0	100.0	4	0.2	Apr-21	May-02	0.0	0.0	0.0	0.0	0	0.0		
Veery *Catharus fuscescens*	100.0	0.0	0.0	0.0	6	0.3	May-08	Jun-08	0.0	0.0	0.0	0.0	0	0.0		
Gray-cheeked Thrush *Catharus minimus*	96.6	0.0	0.0	3.4	87	3.1	May-09	Jun-04	100.0	0.0	0.0	0.0	18	1.1	Aug-29	Sep-21
Swaison's Thrush *Catharus ustulatus*	55.6	3.5	11.8	31.3	2258	26.9	May-02	Jun-14	73.1	0.8	5.0	21.4	2875	45.3	Jul-07	Sep-30
Hermit Thrush *Catharus guttatus*	27.8	0.3	31.3	46.3	367	11.5	Apr-24	Jun-09	83.8	0.0	1.0	20.2	302	12.3	Jul-08	Oct-05
American Robin *Turdus migratorius*	0.8	14.9	25.6	67.8	22418	40.1	Apr-17	Jun-14	7.3	9.3	26.0	64.2	1243	28.9	Jul-07	Oct-06
Varied Thrush *Ixoreus naevius*	0.0	0.0	0.0	100.0	7	0.3	Apr-20	May-09	75.0	0.0	0.0	25.0	4	0.3	Jul-31	Sep-18
Mimidae																
Gray Catbird *Dumetella carolinensis*	45.5	0.0	9.1	54.5	11	0.5	May-25	Jun-02	0.0	0.0	0.0	0.0	0	0.0		
Northern Mockingbird *Mimus polyglottos*	100.0	0.0	0.0	0.0	1	0.1	Jun-03		0.0	0.0	0.0	0.0	0	0.0		
Sturnidae																
European Starling *Sturnus vulgaris*	0.0	14.4	4.4	83.1	160	2.3	Apr-19	Jun-04	0.0	0.0	0.0	0.0	0	0.0		
Motacillidae																
American Pipit *Anthus rubescens*	0.0	17.4	12.6	70.9	4406	10.3	Apr-19	May-31	0.0	9.9	11.4	78.3	5476	18.1	Jul-14	Oct-04
Bombyccillidae																
Bohemian Waxwing *Bombycilla garrulus*	0.0	0.0	0.0	100.0	2	0.1	Apr-22	May-04	0.0	0.0	0.0	0.0	0	0.0		

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	Banded	Vis-Mig	Census	Incidental	DT	Detect	Earliest	Latest	Banded	Vis-Mig	Census	Incidental	DT	Detects	Earliest	Latest
Cedar Waxwing *Bombycilla cedrorum*	0.2	18.9	18.1	66.0	3052	8.8	May-19	Jun-14	0.9	16.8	26.4	60.4	13096	50.5	Jul-07	Oct-05
Parulidae																
Tennessee Warbler *Vermivora peregrina*	32.8	9.8	31.5	36.2	2530	20.6	May-05	Jun-13	28.5	19.7	22.7	33.5	12061	33.2	Jul-09	Aug-31
Orange-crowned Warbler *Vermivora celata*	34.3	10.8	19.4	35.8	927	13.3	Apr-26	May-31	52.6	4.7	14.1	30.9	1160	17.4	Jul-20	Sep-30
Nashville Warbler *Vermivora ruficapilla*	0.0	0.0	0.0	0.0	0	0.0			100.0	0.0	0.0	0.0	3	0.2	Jul-31	Aug-29
Yellow Warbler *Dendroica petechia*	21.1	3.2	47.4	39.2	3539	26.5	May-04	Jun-14	36.1	7.5	31.9	32.9	6637	37.9	Jul-07	Sep-22
Chestnut-sided Warbler *Dendroica pensylvanica*	26.7	0.0	40.0	33.3	15	0.5	May-21	Jun-12	93.8	0.0	0.0	6.3	16	0.7	Jul-24	Aug-24
Magnolia Warbler *Dendroica magnolia*	46.4	0.2	20.7	37.0	468	14.1	May-09	Jun-14	69.8	3.1	9.5	18.5	967	27.9	Jul-07	Sep-24
Cape May Warbler *Dendroica tigrina*	80.0	0.0	0.0	20.0	10	0.4	May-15	May-30	82.2	0.0	4.2	13.6	118	4.9	Jul-20	Sep-28
Yellow-rumped Warbler *Dendroica coronata*	5.2	16.9	22.4	60.5	37055	38.8	Apr-19	Jun-13	5.8	21.0	24.0	53.6	95213	56.7	Jul-07	Oct-06
Black-throated Green Warbler *Dendroica virens*	1.3	0.0	22.1	81.8	154	8.5	May-06	Jun-14	68.7	3.0	11.2	17.2	134	5.9	Jul-12	Sep-07
Blackburnian Warbler *Dendroica fusca*	0.0	0.0	0.0	0.0	0	0.0	Jan-00		100.0	0.0	0.0	0.0	1	0.1	Sep-02	
Palm Warbler *Dendroica palmarum*	41.1	5.7	8.9	44.7	246	7.1	Apr-30	Jun-03	47.2	5.6	8.6	38.6	197	6.5	Jul-19	Oct-06
Bay-breasted Warbler *Dendroica castanea*	22.2	0.0	44.4	44.4	9	0.4	May-15	Jun-06	82.8	0.0	5.1	12.1	99	4.4	Jul-14	Sep-07
Blackpoll Warbler *Dendroica striata*	67.2	2.0	4.6	27.9	305	5.3	May-07	Jun-07	80.0	0.5	6.5	13.5	215	8.1	Jul-17	Sep-28
Black-and-white Warbler *Mniotilta varia*	26.8	0.3	46.1	44.9	1263	27.5	Apr-28	Jun-14	57.0	2.3	17.0	27.1	1643	30.4	Jul-07	Sep-27
American Redstart *Setophaga ruticilla*	37.3	2.8	35.9	30.6	3924	21.4	Apr-26	Jun-14	47.3	3.3	22.5	30.6	10141	45.7	Jul-07	Sep-23
Ovenbird *Seiurus aurocapillus*	27.2	0.2	52.8	39.5	1079	23.5	May-07	Jun-14	88.7	0.1	5.2	7.4	1840	32.9	Jul-07	Sep-21
Northern Waterthrush *Seiurus noveboracensis*	60.8	0.5	14.5	27.7	441	13.3	May-06	Jun-13	75.6	0.2	5.9	18.2	406	16.5	Jul-08	Sep-27
Connecticut Warbler *Oporornis agilis*	28.6	0.0	21.4	57.1	14	0.9	May-10	Jun-10	86.4	0.0	0.0	13.6	22	1.3	Jul-10	Sep-01
Mourning Warbler *Oporornis philadelphia*	54.1	0.3	25.1	23.8	370	10.9	May-19	Jun-14	82.6	0.2	6.5	10.9	603	19.1	Jul-09	Sep-17
MacGillivray's Warbler *Oporornis tolmiei*	0.0	0.0	0.0	0.0	0	0.0	Jan-00		100.0	0.0	0.0	0.0	2	0.1	Aug-20	
Common Yellowthroat *Geothlypis trichas*	28.9	0.1	46.4	31.4	950	16.6	May-10	Jun-14	33.9	0.8	36.5	34.0	918	28.0	Jul-07	Sep-27
Wilson's Warbler *Wilsonia pusilla*	57.0	0.0	14.5	29.1	172	4.9	May-13	Jun-09	74.4	4.3	7.7	14.6	507	16.5	Jul-25	Oct-01

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	Banded	Vis-Mig	Census	Incidental	DT	Detect	Earliest	Latest	Banded	Vis-Mig	Census	Incidental	DT	Detects	Earliest	Latest
Canada Warbler *Wilsonia canadensis*	44.6	0.2	34.2	30.8	1219	16.7	May-12	Jun-14	57.2	1.0	22.6	21.8	2452	32.0	Jul-08	Sep-20
Thraupidae																
Western Tanager *Piranga ludoviciana*	4.7	1.9	23.5	70.9	213	10.3	May-06	Jun-13	13.9	12.4	21.7	53.9	757	16.9	Jul-12	Sep-10
Emberizidae																
American Tree Sparrow *Spizella arborea*	17.3	9.4	25.8	49.6	1021	6.7	Apr-18	May-17	34.4	11.0	22.0	37.8	601	6.9	Aug-31	Oct-05
Chipping Sparrow *Spizella passerina*	4.3	20.7	14.8	63.3	35498	25.5	May-03	Jun-13	5.4	14.7	18.2	64.9	3008	19.2	Jul-07	Sep-21
Clay-coloured Sparrow *Spizella pallida*	21.8	4.5	31.6	50.3	2808	25.0	May-01	Jun-14	22.8	1.2	40.3	43.8	657	17.5	Jul-07	Sep-30
Vesper Sparrow *Pooecetes gramineus*	4.3	0.0	21.7	65.2	23	1.3	May-01	Jun-05	100.0	0.0	0.0	0.0	1	0.1	Sep-10	
Lark Sparrow *Calamospiza melanocorys*	0.0	0.0	0.0	100.0	2	0.1	May-26	May-31	0.0	0.0	0.0	0.0	0	0.0		
Savannah Sparrow *Passerculus sandwichensis*	18.2	8.0	21.8	56.4	362	9.8	Apr-21	Jun-10	55.0	0.0	13.3	31.7	120	6.2	Jul-17	Sep-17
Le Conte's Sparrow *Ammodramus leconteii*	3.1	0.0	66.0	36.1	97	3.7	May-01	Jun-14	6.7	0.0	33.3	60.0	15	1.0	Jul-14	Sep-21
Neslon's Sharp-tailed Sparrow *Ammodramus nelsoni*	0.0	0.0	0.0	100.0	1	0.1	May-07		0.0	0.0	0.0	0.0	0	0.0		
Fox Sparrow *Passerella iliaca*	20.2	3.2	37.1	45.2	124	2.3	Apr-22	May-13	85.2	0.0	7.4	11.1	27	1.7	Jul-13	Sep-30
Song Sparrow *Melospiza melodia*	6.8	1.2	69.3	54.9	1682	36.1	Apr-21	Jun-14	14.3	1.0	61.0	48.4	943	22.7	Jul-07	Sep-23
Lincoln's Sparrow *Melospiza lincolnii*	33.1	0.1	37.1	45.2	1076	26.3	May-01	Jun-13	50.4	0.0	23.6	29.0	887	28.3	Jul-07	Sep-30
Swamp Sparrow *Melospiza georgiana*	48.2	3.6	27.3	20.9	110	4.3	Apr-26	Jun-06	84.7	0.0	4.8	10.5	124	5.6	Jul-15	Oct-01
White-throated Sparrow *Zonotrichia albicollis*	22.6	0.7	44.0	43.3	5467	33.4	Apr-26	Jun-14	25.2	2.8	35.4	44.2	3007	51.2	Jul-07	Oct-02
Harris's Sparrow *Zonotrichia querula*	37.5	12.5	37.5	12.5	8	0.5	Apr-19	May-27	25.0	0.0	16.7	58.3	12	0.5	Aug-28	Sep-30
White-crowned Sparrow *Zonotrichia leucophrys*	20.3	1.9	15.2	63.8	632	10.9	Apr-27	Jun-01	33.4	3.1	15.4	50.1	677	13.5	Aug-09	Oct-05
Dark-eyed Junco *Junco hyemalis*	10.1	19.5	34.5	57.8	2970	10.4	Apr-17	Jun-05	29.5	5.6	14.3	52.1	1613	14.7	Jul-17	Oct-06
Lapland Longspur *Calcarius lapponicus*	0.0	5.0	35.4	62.6	704	3.6	Apr-21	Jun-02	0.2	12.6	19.8	68.9	1289	9.6	Aug-27	Oct-04
Smith's Longspur *Calcarius pictus*	0.0	100.0	0.0	0.0	1	0.1	May-09		0.0	0.0	0.0	0.0	0	0.0		
Snow Bunting *Plectrophenax nivalis*	0.0	24.8	53.5	41.6	101	1.5	Apr-17	May-20	0.0	11.1	41.7	47.2	36	0.9	Aug-25	0ct-06
Cardinalidae																
Rose-breasted Grosbeak *Pheucticus ludovicianus*	6.2	7.1	40.2	55.5	674	17.9	May-04	Jun-10	20.2	6.8	29.5	49.5	1044	19.9	Jul-07	Sep-06

	Percent of Total Spring Detections				Spring	Av.	Spring Sight Records		Percent of Total Fall Detections				Fall	Av.	Fall Sight Records	
	Banded	Vis-Mig	Census	Incidental	DT	Detect	Earliest	Latest	Banded	Vis-Mig	Census	Incidental	DT	Detects	Earliest	Latest
Lazuli Bunting *Passerina amoena*	100.0	0.0	0.0	0.0	1	0.1	Jun-06		0.0	0.0	0.0	0.0	0	0.0		
Icteridae																
Red-winged Blackbird *Agelaius phoeniceus*	0.0	17.3	21.6	66.0	8849	23.4	Apr-20	Jun-12	0.1	34.2	17.0	52.2	2064	9.0	Jul-07	Sep-25
Western Meadowlark *Sturnella neglecta*	0.0	0.0	0.0	100.0	3	0.2	May-01	May-22	0.0	0.0	0.0	0.0	0	0.0		
Yellow-headed Blackbird *Xanthocephalus xanthocephalus*	0.0	1.8	14.0	84.2	57	1.0	May-11	Jun-08	0.0	25.9	7.4	66.7	27	0.6	Jul-17	Sep-06
Rusty Blackbird *Euphagus carolinus*	0.0	35.4	21.5	50.8	1157	3.5	Apr-22	Jun-09	0.0	49.3	20.0	42.0	150	0.8	Aug-07	Oct-06
Brewer's Blackbird *Euphagus cyanocephalus*	0.0	69.5	57.6	23.7	59	0.3	Apr-22	May-20	0.0	0.0	75.0	25.0	16	0.1	Jun-14	Aug-02
Common Grackle *Quiscalus quiscula*	0.0	21.9	14.9	67.8	1022	6.5	Apr-19	Jun-12	0.7	21.1	21.1	63.1	426	6.6	Jul-17	Sep-29
Brown-headed Cowbird *Molothrus ater*	0.1	25.0	20.2	57.8	3228	23.2	Apr-21	Jun-11	2.1	13.4	14.8	70.4	142	2.1	Jul-14	Sep-11
Baltimore Oriole *Icterus galbula*	3.4	19.3	20.2	63.9	119	4.7	May-05	Jun-13	12.5	0.0	50.0	37.5	8	0.5	Jul-22	Aug-16
Fringillidae																
Pine Grosbeak *Pinicola enucleator*	0.0	0.0	100.0	0.0	1	0.1	May-05		0.0	0.0	0.0	0.0	0	0.0		
Purple Finch *Carpodacus purpureus*	1.1	14.9	14.5	72.8	744	10.7	Apr-18	Jun-06	5.8	14.5	16.8	67.0	816	12.6	Jul-17	Sep-30
Red Crossbill *Loxia curvirostra*	0.0	0.0	0.0	0.0	0	0.0			0.0	5.9	0.0	94.1	17	0.3	Jul-24	Sep-01
White-winged Crossbill *Loxia leucoptera*	0.0	4.3	36.2	59.6	47	0.4	Apr-27	Jun-12	0.1	10.8	22.1	68.7	1108	7.5	Jul-07	Sep-01
Common Redpoll *Carduelis flammea*	0.0	22.6	16.3	62.5	3838	2.2	Apr-16	May-10	0.0	0.0	0.0	100.0	11	0.1	Sep-04	
Hoary Redpoll *Carduelis hornemanni*	0.0	0.0	0.0	100.0	12	0.1	May-12		0.0	0.0	0.0	0.0	0	0.0		
Pine Siskin *Carduelis pinus*	0.6	14.3	23.1	67.6	3008	16.4	Apr-20	Jun-14	0.3	16.7	12.9	69.4	49717	43.9	Jul-07	Oct-06
American Goldfinch *Carduelis tristis*	0.0	5.8	29.2	65.0	120	3.3	May-01	Jun-10	2.8	19.4	22.2	58.3	36	1.6	Jul-09	Sep-24
Evening Grosbeak *Coccothraustes vespertinus*	0.1	16.3	14.2	69.9	1418	15.9	Apr-16	Jun-11	0.0	17.2	20.7	68.0	1167	13.5	Jul-09	Oct-02
Passeridae																
House Sparrow *Passer domesticus*	0.0	0.0	100.0	0.0	1	0.1	May-20		0.0	0.0	0.0	0.0	0	0.0		

Appendix 2. Banding Totals

The following charts include the total number of banded birds each year during spring and fall migration for each species during standard migration monitoring. Numbers listed in bold indicate the highest banding total for that species.

Spring Migration Monitoring Banding Totals

Species	1994	1995	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008	Total
American Kestrel			**1**													**1**
Sharp-shinned Hawk			2	**9**	1	2	**9**	6	5	4	3	7	3	5	2	**58**
Northern Flicker	1						2			2			1		**3**	**9**
Yellow-bellied Sapsucker	2	4	4	3	3	2	2		1	5	5		4	4	**7**	**46**
Downy Woodpecker								**1**							**1**	**2**
Hairy Woodpecker							**1**	**1**								**2**
Western Wood-Pewee	1						1	**2**								**4**
Yellow-bellied Flycatcher		3	3	1	4	**7**	4	3		5	2	1	2	1	2	**38**
Alder Flycatcher	79	70	55	39	40	76	**80**	42	42	12	19	5	26	33	4	**622**
Least Flycatcher	97	**165**	26	47	34	92	94	80	72	78	25	7	10	62	18	**907**
Eastern Phoebe		1	2	3	1	6	8	**15**	12	3	8	3	10	9	13	**94**
Blue-headed Vireo		1					**4**	2	1	1				1		**10**
Warbling Vireo	1	1	1	1	**3**	1	2						1	1		**12**
Philadelphia Vireo		1		**2**	1			1			1	1				**7**
Red-eyed Vireo	6	16	13	12	2	**21**	18	15	3	6	5	6	6	3	2	**134**
Blue Jay			1					1	1		**4**	1	1		1	**10**
Gray Jay		**1**			**1**											**2**
Black-capped Chickadee	2	5	3	2	4	4	7	20	6	3		3		**55**	5	**119**
Boreal Chickadee														**1**		**1**
Red-breasted Nuthatch							**4**								**4**	**8**
Brown Creeper															**1**	**1**
House Wren		1		1			1	**5**	1	2	1	1	1	2		**16**
Winter Wren					1			1						1	**2**	**5**
Marsh Wren					**1**	**1**										**2**
Golden-crowned Kinglet								**1**								**1**
Ruby-crowned Kinglet		3	1	2	1	4	5	5	9	**20**	16	15	7	4	6	**98**
Veery		**4**					1			1						**6**
Gray-cheeked Thrush		1			3			9	6	6	**23**	2	9	16	5	**80**
Swainson's Thrush	31	45	14	34	41	69	54	102	92	99	**280**	42	54	145	82	**1184**
Hermit Thrush			3	2	4	4	2	6	4	3	**17**	13	12	13	16	**99**
American Robin	4	12	8	4	6	11	**20**	11	13	7	8	4	12	9	11	**140**
Gray Catbird	1				1			**2**	1							**5**

Spring Migration Monitoring Banding Totals

Species	1994	1995	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008	Total
Northern Mockingbird					**1**											**1**
Cedar Waxwing		1				1	1				1				1	**5**
Tennessee Warbler	3	11	18	13	4	30	**167**	27	83	16	55	16	23	39	53	**558**
Orange-crowned Warbler	2	16	16	14	3	16	**66**	44	18	7	36	23	10	18	12	**301**
Yellow Warbler	17	33	17	25	18	108	**145**	91	23	12	53	14	5	9	4	**574**
Chestnut-sided Warbler		1		1		1					1					**4**
Magnolia Warbler	15	9	6	5	17	20	16	**27**	10	8	11	6	6	8	8	**172**
Cape May Warbler							**7**	1								**8**
Yellow-rumped Warbler	5	39	34	132	39	141	**559**	389	44	49	81	123	67	37	60	**1799**
Black-throated Green Warbler		**1**						**1**								**2**
Palm Warbler	1	5	1	6	6	16	**26**	7	7	4	5	4	1	6	3	**98**
Bay-breasted Warbler		**1**												**1**		**2**
Blackpoll Warbler		2	4	5	2	16	**49**	11	6	1	8	8		1		**113**
Black-and-white Warbler	3	12	8	19	**36**	33	32	33	28	23	16	13	8	21	20	**305**
American Redstart	120	118	59	58	87	113	101	**202**	63	70	64	38	31	89	42	**1255**
Ovenbird	4	3	7	7	17	18	8	26	19	23	21	10	32	**44**	31	**270**
Northern Waterthrush	2	15	6	12	26	11	**29**	18	8	12	36	11	25	22	22	**255**
Connecticut Warbler						1		**2**	1							**4**
Mourning Warbler	3	18	6	12	13	20	17	12	13	10	13	9	15	**30**	7	**198**
Common Yellowthroat	17	29	8	17	17	27	21	15	12	17	10	9	10	**37**	7	**253**
Wilson's Warbler	9	7	8	6	4	2	**23**	5	8	3		3		12	3	**93**
Canada Warbler	20	25	26	30	36	48	51	**57**	24	27	23	22	26	40	22	**477**
Western Tanager	1					1	1	2	1					**3**		**9**
American Tree Sparrow		15	2	7		4	24	**47**	14	6	6		2	10	40	**177**
Chipping Sparrow	5	8	14	10	20	242	**592**	211	39	18	97	113	19	13	10	**1411**
Clay-colored Sparrow	9	21	9	16	26	71	**167**	76	36	22	72	16	8	30	11	**590**
Le Conte's Sparrow				1							1			1		**3**
Fox Sparrow		3	1	1		2	2	1	2		1			2	**9**	**24**
Savannah Sparrow		4	2	5	2	6	**14**	13	4	1	6	2	2	3	2	**66**
Lincoln's Sparrow	6	20	10	13	21	17	12	22	12	18	21	7	10	**43**	23	**255**
Song Sparrow	1	7	1	4	6	3	8	2	7	6	7	3	10	**22**	8	**95**
Vesper Sparrow				**1**												**1**

Spring Migration Monitoring Banding Totals

Species	1994	1995	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008	Total
Swamp Sparrow	1	**14**	3	4	5	2	2	1	2	2	4			7	3	**50**
Harris's Sparrow		1		1							1					**3**
White-throated Sparrow	28	92	32	71	94	58	50	89	68	53	47	54	47	**136**	99	**1018**
White-crowned Sparrow		7	6	6	9	6	11	**27**	12	6	7	5	4	10	7	**123**
Dark-eyed Junco		24	1	1	2	15	18	**108**	27	18	7	5	11	23	36	**296**
Rose-breasted Grosbeak		5	2	2	**6**	3	1	4	**6**	1	4		2	3	1	**40**
Lazuli Bunting											**1**					**1**
Red-winged Blackbird		1		1			1									**3**
Brown-headed Cowbird		**1**			**1**											**2**
Baltimore Oriole			**2**				**2**									**4**
Purple Finch						**2**		1		1			1		**2**	**7**
Pine Siskin				**8**	2		4			1						**15**
Evening Grosbeak			**1**													**1**
TOTAL	**497**	**903**	**447**	**676**	**672**	**1354**	**2546**	**1903**	**866**	**692**	**1133**	**625**	**534**	**1085**	**731**	**14664**

Fall Migration Monitoring Banding Totals

Species	1994	1995	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008	Total
Sharp-shinned Hawk	5	13	5	9	12	11	**27**	25	13	20	**27**	21	17	16	20	**241**
Cooper's Hawk					**1**											**1**
Northern Goshawk													**1**			**1**
Northern Pygmy-Owl									**1**		**1**					**2**
Northern Flicker		1			1					1	1		**2**	1	1	**8**
Yellow-bellied Sapsucker		3	2			2			1	3	7		**9**	2	8	**37**
Downy Woodpecker		3			3	2	**7**	2	4	**7**		1	2	4	6	**41**
Hairy Woodpecker					**3**		2		2			1	1	2	**3**	**14**
Pileated Woodpecker															**1**	**1**
Olive-sided Flycatcher										**1**						**1**
Western Wood-Pewee	2	1			1	2	**4**	2		2					1	**15**
Yellow-bellied Flycatcher	**7**			1	3	2	3	1	1	5	5	1			1	**30**
Alder Flycatcher	**165**	70	33	48	93	72	64	49	42	61	82	35	27	26	25	**892**
Least Flycatcher	**94**	74	15	32	74	73	61	67	50	64	35	37	27	17	15	**735**
Eastern Phoebe	1	1			1	1	2	3	**4**	3		1	1	2		**20**
Northern Shrike							**1**									**1**
Blue-headed Vireo	4	**8**	3		3	6	6	5	2	1	4	3	2	2		**49**
Warbling Vireo	4	8	1		**10**	3	5	1	2	1	1	2		2		**40**
Philadelphia Vireo	6	**27**	4	1	22	16	6	13	10	5		14	15	1	4	**144**
Red-eyed Vireo	28	51	7	24	**47**	38	39	24	18	32	19	23	21	9	11	**391**
Blue Jay	1		1		2	2	1	2	1		2	1	**6**	1	5	**25**
American Magpie						**1**										**1**
Black-capped Chickadee	31	55	52	12	38	29	**128**	17	56	36	23	21	19	11	26	**554**
Boreal Chickadee	**7**	3	2	2			4	3	1		1	1				**24**
White-breasted Nuthatch						1							**3**			**4**
Red-breasted Nuthatch		19	9		9	9	2	**24**	2	5	2	1	1	10	2	**95**
Brown Creeper		1			2	2	1	**3**		2		1	**3**	1	**3**	**19**
House Wren				1		1	1				1		**2**	1		**7**
Winter Wren										1		**2**		1	1	**5**
Marsh Wren													**1**			**1**
Golden-crowned Kinglet	1	4			**29**	4	4		11	2		3	1	1	7	**67**
Ruby-crowned Kinglet	15	13	23	4	14	12	**38**	7	23	13	16	11	12		4	**205**
Gray-cheeked Thrush			1		**3**		1	2		1	**3**		2	2	2	**17**
Swainson's Thrush	75	86	43	45	179	114	75	108	89	124	200	181	**218**	173	175	**1885**
Hermit Thrush	4	4	5	1	15	23	27	7	**46**	6	12	16	13	15	22	**216**

Fall Migration Monitoring Banding Totals

Species	1994	1995	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008	Total
Varied Thrush				**1**								**1**	**1**			**3**
American Robin	3	6	2	1	10	1	7	1	**16**	3	1	8	15	1	12	**87**
American Pipit					**1**											**1**
Cedar Waxwing	11	**24**	6	1	3	1	9		11	5	5	6	5	2		**89**
Tennessee Warbler	347	228	90	23	224	63	129	214	**715**	534	57	332	289	69	28	**3342**
Orange-crowned Warbler	16	47	**66**	13	63	44	60	55	29	48	61	31	29	14	22	**598**
Nashville Warbler		1								**2**						**3**
Yellow Warbler	127	**216**	67	40	192	213	208	181	169	151	85	179	172	100	101	**2201**
Chestnut-sided Warbler		2			2	**3**	2					**3**				**12**
Cape May Warbler	9	10	1	5	5	12	1	5	11	9	1	3	**13**	6	2	**93**
Magnolia Warbler	37	44	25	18	**73**	56	61	63	45	32	20	31	44	14	7	**570**
Yellow-rumped Warbler	104	479	58	12	561	346	435	652	**1270**	711	79	140	243	173	103	**5366**
"Audubon's" Warbler					**1**	**1**										**2**
Black-throated Green Warbler		4	1		9	4	**19**	15	8	6	1	9	8	2		**86**
Blackburnian Warbler		**1**														**1**
Palm Warbler	2	5	17	6	7	10	8	4	**20**	7	2		2	2	1	**93**
Bay-breasted Warbler		3	2		13	5	5	5	4	4	3	13	**19**	5	1	**82**
Blackpoll Warbler	7	22	5	1	22	10	19	17	**24**	9	14	8	5	3	3	**169**
Black-and-white Warbler	28	50	19	27	45	57	86	69	71	71	41	67	86	**89**	59	**865**
American Redstart	300	361	164	222	**610**	341	488	302	242	208	169	195	256	184	188	**4230**
Ovenbird	14	20	16	17	48	76	99	93	103	102	101	145	**222**	166	150	**1372**
Northern Waterthrush	13	7	13	16	13	17	24	14	11	29	**31**	23	22	29	25	**287**
Connecticut Warbler		1		2	2	**4**			**4**		1	**4**				**18**
Mourning Warbler	38	43	13	**44**	38	41	31	29	29	28	18	36	38	21	30	**477**
MacGillivray's Warbler				**2**												**2**
Common Yellowthroat	26	**38**	3	18	36	32	20	13	9	14	14	6	17	6	6	**258**
Wilson's Warbler	**61**	48	7	23	44	32	27	27	15	15	20	16	9	12	12	**368**
Canada Warbler	70	96	61	84	109	**113**	110	110	61	79	53	104	92	75	54	**1271**
Western Tanager	2	5		2	**14**	4	4	8	11	**14**	**14**	5	13	3	3	**102**
American Tree Sparrow		17	31	18	23	3	**46**	1	33	2	2	1	12	3	7	**199**
Chipping Sparrow	1	2	1	4	8	14	**28**	21	13	13	11	9	4	14	5	**148**
Clay-colored Sparrow	1	2	2	4	23	8	6		**30**	14	8	19	5	5	8	**135**
Le Conte's Sparrow											**1**					**1**
Fox Sparrow		2	2		1		3	1	3		**4**		3	2	1	**22**

Fall Migration Monitoring Banding Totals

Species	1994	1995	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008	Total
Savannah Sparrow	4	4	4	2	**13**	6	5	2	3	2	1		5	4	7	**62**
Lincoln's Sparrow	29	32	9	25	**48**	14	15	16	13	31	31	27	40	12	26	**368**
Song Sparrow	4	5		5	9	3	3	1	6	**14**	9	11	**14**	9	13	**106**
Vesper Sparrow															**1**	**1**
Swamp Sparrow	**21**	17	2		12	1	4		5		4	8	9	4	6	**93**
Harris's Sparrow						**1**	**1**								**1**	**3**
White-throated Sparrow	50	60	21	29	**74**	34	28	32	49	27	42	28	56	41	36	**607**
White-crowned Sparrow	7	13	16	15	**31**	23	19	7	25	12	8	4	14	4	10	**208**
Dark-eyed Junco	9	15	18	23	61	14	**121**	16	35	6	16	33	47	10	70	**494**
Lapland Longspur				**1**						**1**						**2**
Rose-breasted Grosbeak	13	8	2	3	18	15	6	12	17	11	16	**21**	20	**21**	13	**196**
Red-winged Blackbird					**2**											**2**
Common Grackle											1			**2**		**3**
Brown-headed Cowbird							**1**					**1**			**1**	**3**
Baltimore Oriole													**1**			**1**
Purple Finch	**6**	4	3	3	2	1	**6**	2	4		1	1	5	1	**6**	**45**
White-winged Crossbill							**1**									**1**
American Goldfinch							**1**									**1**
Pine Siskin	30		23	1	**33**	2	28		3	6	3	2		4		**135**
TOTAL	**1840**	**2387**	**976**	**891**	**3068**	**2051**	**2683**	**2353**	**3496**	**2616**	**1391**	**1907**	**2241**	**1412**	**1361**	**30673**