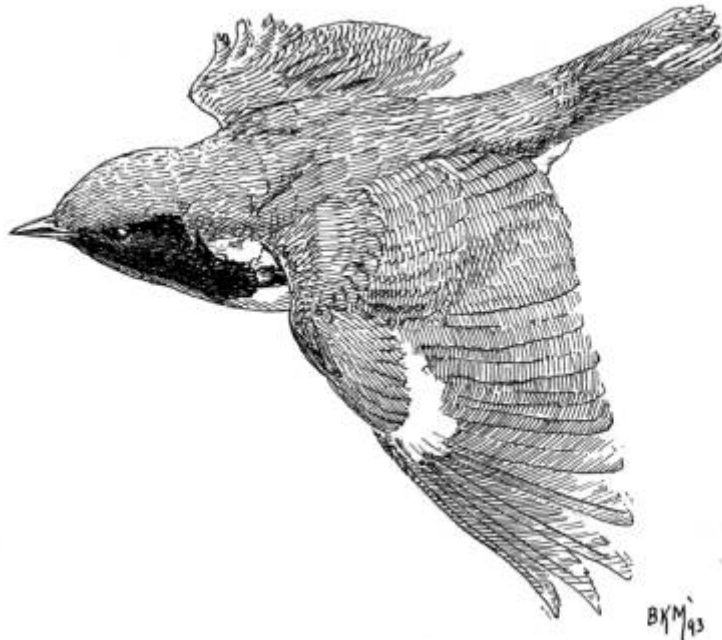


Toronto Spring Warbler Survey 2006

Annual Report



Doug Woods

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1 Toronto Spring Warbler Survey

1.1 New Format

As of fall of this year, I have taken over the Warbler Survey from Tom Flinn. My personal thanks to him for spending as much time as he did familiarizing me with the survey and helping me to understand all that is involved.

The Report is different from previous years and is the format for future years. I welcome comments, reactions and suggestions about its layout, content and approach.

Tom found the task of producing two large Reports every year daunting and I agree with him. Consequently I will produce **one reduced report focused on Toronto data only** with supporting data from other Ontario locations only when it serves to compare or contrast or otherwise throw light on the Toronto results. Other Reports can be created during the course of the year.

I believe that this Annual Report should **go to all TOC members** since the survey and the data belong to the club, not just to the participants.

I will **no longer include raw data sheets** for the various sites whether individual or combined because they are bulky, hard to read and not informative. I propose that we replace them with **informative graphs and tabular summaries**. Raw data are available to anyone who wants them. I am also happy to share the Excel and Access computer information described below with any members.

1.2 Data Computerized

All summary data for Toronto are now entered into Excel spreadsheets and an Access Database.

Excel spreadsheets exist for all Toronto sites for all years except 1984 and 1985 when data was not collected and for 1982, which was missing and has only recently been recovered.

The Access Database currently has 29,376 records: 864 records for each year comprising a record for each of the 24 birds (21 Warblers and 3 additional species) for each of the 36 days. This is summary data combining information from all Toronto sites for the year.

Database programs provide easy and flexible ways to produce summaries of the data they contain. Graphs in this Report have been created from Access data summaries, which are copied into Excel to produce graphs and perform statistical calculations.

1.3 Summary of Findings

This Report defines several measures to apply to the spring warbler migration and presents graphs showing changes since 1970.

Migration Timing

The best time to see warblers is the 3rd week in May.

Graphs of timing patterns for individual birds show the following times in May when warblers appear in peak numbers:

- Yellow-rumped Warbler (finished by end of week 2),
- Palm Warbler (weeks 1,2),
- Rose-breasted Grosbeak (weeks 2,3),
- Canada Warbler (weeks 3,4)

Migration Size

The size of the migration is nearly the same as it was in 1970 but it has fluctuated widely over the years.

Relative Bird Abundance

The relative abundance of birds has changed dramatically since the 1970s.

Population Trends

The numbers of birds reported on the Survey are changing. Yellow-rumped (+120%) and Palm Warblers (+408%) are increasing in numbers and Rose-breasted Grosbeak (-60%) and Canada Warbler (-84%) are decreasing. Trends are summarized for all birds in the study.

1.4 Season Summary

Site and visit information is summarized in the following table. Sites and observers are listed alphabetically by first name.

Site	Visits	Observers
Brookbank Ravine	28	Carol Horner, Don Graham, Jean Iron, Naish McHugh, Ron Pittaway
High Park	36	Don Barnett, Steven Favier
Moore Park	17	Harry Kerr, Mary Schuster
Mount Pleasant Cemetery	14	Attila Fust
Unwin Avenue	36	Don Peuramaki, Tom Flinn
Wychwood Park	36	Herb Elliott, Jess MacKenzie

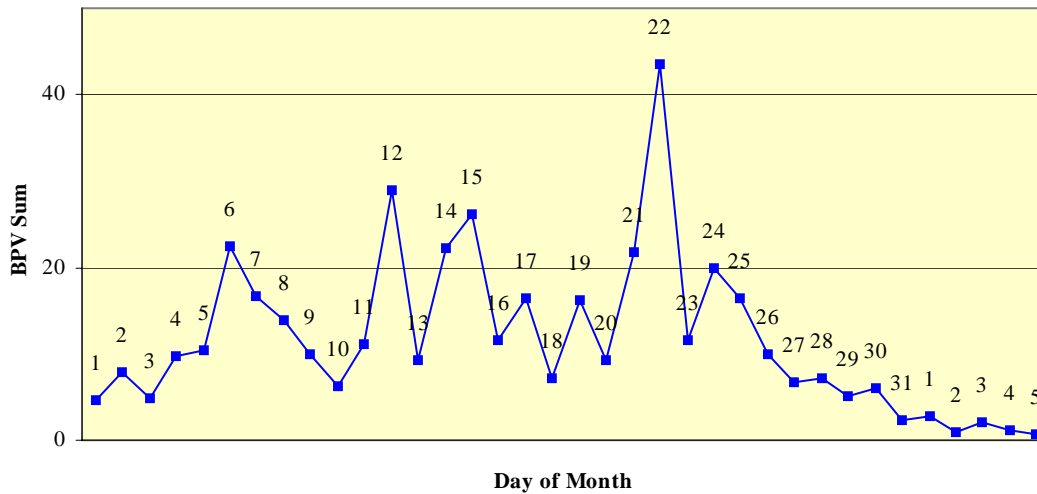
Many thanks to the observers who collected data for us for the 2006 season. Each visit means that one or more observers (typically one only) spent an hour in the morning traversing a set study plot counting the birds seen and heard. Visits are made from May 1 through June 5.

1.5 Migration Timing

Our first measure is **Migration Timing**, which is a plot of the sum of the Birds Per Visit (BPV) values¹ from all sites for the year for each day of the survey period that runs from May 1 through June 5.

1.5.1 Year 2006

Migration Timing 2006



The numbers in bold represent days of the month. The scale on the left shows the value of the BPV sum². The peak day was May 22 when all Toronto sites combined had a value slightly under 45.

This year there were 4 noticeable peak periods during the migration.

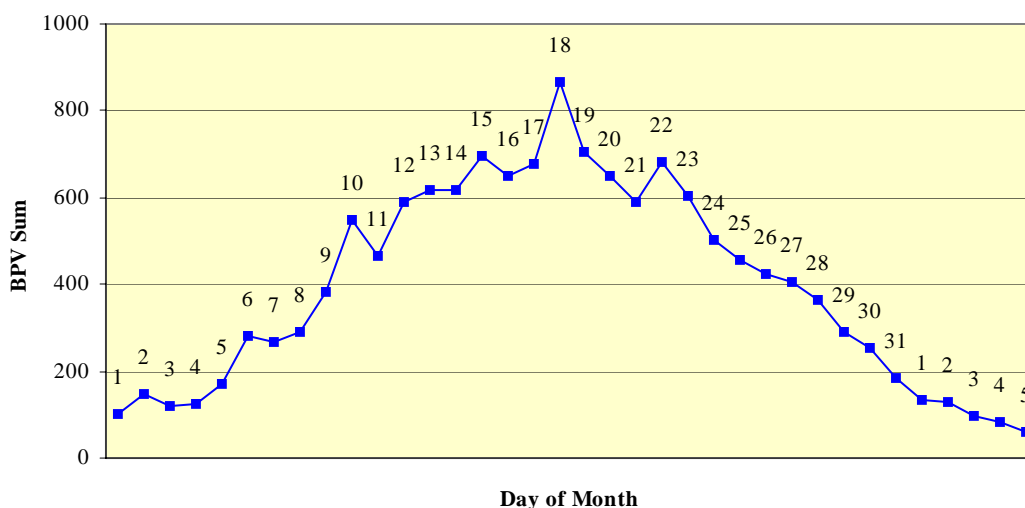
1.5.2 All Years Combined

When we combine the data for all years covered during the study to date we get the following.

¹ BPV is Birds Per Visit averaged over all Toronto sites. If 3 sites reported a total of 18 Yellow Warblers on a day the BPV for Yellow Warblers for that day is 6.0.

² BPV Sum is all BPV values for all birds for the day added together.

Migration Timing 1970 - 2006



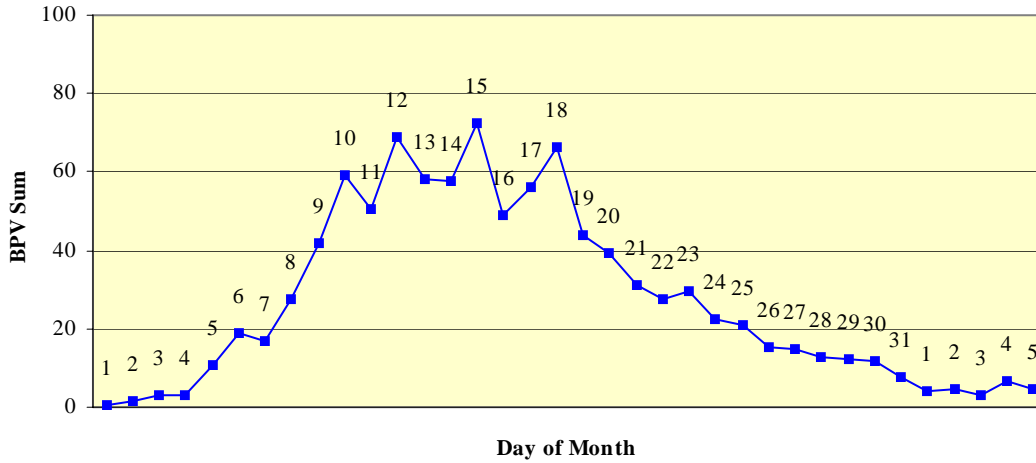
Note that the scale in this graph has been adjusted to show just under 900 birds of all species on May 18. Over the last 36-years **the best time to view migrating warblers is the third week in May.**

These two graphs can be compared, even though their scales differ since we are interested in the days rather than in the numbers of birds. We could say that the 2006 migration peaked a little later than usual (though this, of course, does not have any predictive value).

1.5.3 Individual Birds

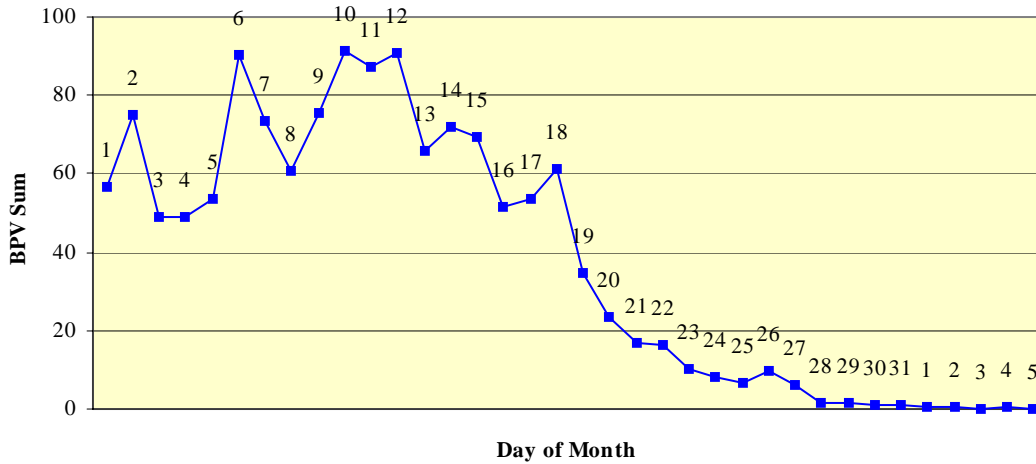
Individual birds show migration timing patterns that differ from the overall pattern. The birds shown below are selected because they are used in a later section.

Rose-breasted Grosbeak Migration Timing 1970-2006



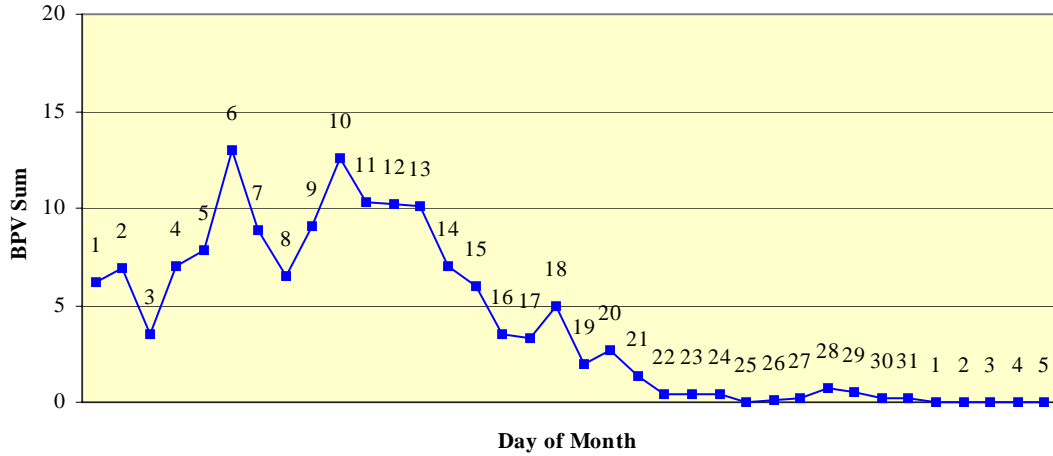
Rose-breasted Grosbeaks pass through in the 2nd and 3rd weeks of May.

Yellow-rumped Warbler Migration Timing 1970-2006



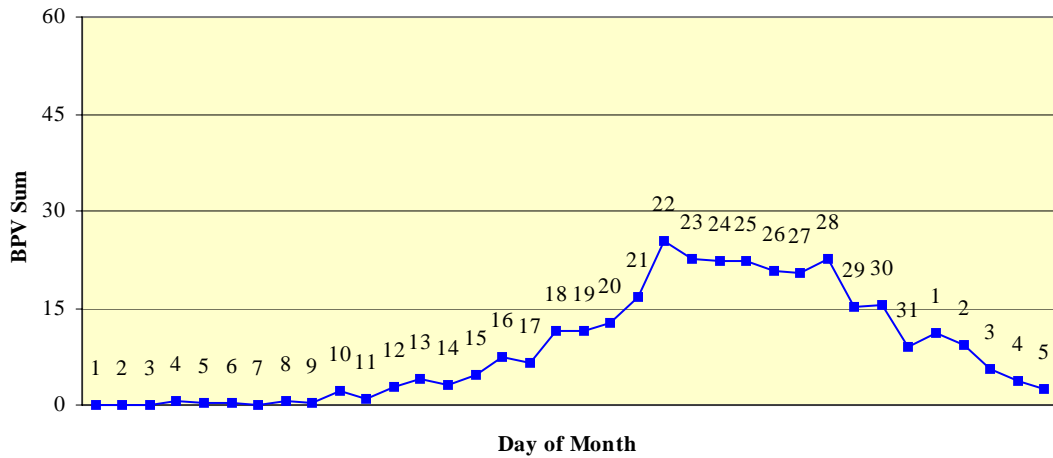
Yellow-rumped Warbler numbers drop by the end of the 3rd week in May.

Palm Warbler Migration Timing 1970-2006



Palm Warblers pass through in the first 2-weeks of May. (Note the scale change.)

Canada Warbler Migration Timing 1970-2006



Canada Warblers migrate through in weeks 3 and 4. (Note the scale change.)

1.6 Migration Size

Our second measure is **Migration Size**. For any year, this number is the sum of all the BPV values for all birds for every day³. It is a single number standing for “how many birds were observed this year”.

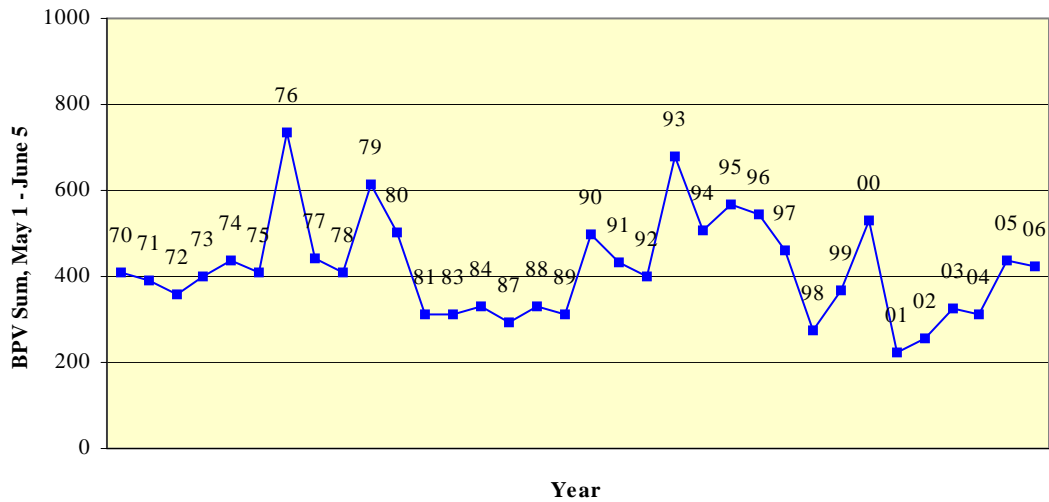
1.6.1 Year 2006

For 2006, the migration size is 424. This compares favourably with 1970 when the value was 407.

1.6.2 All Years Combined

A particularly interesting graph shows the migration size over the years.

Migration Size 1970 - 2006



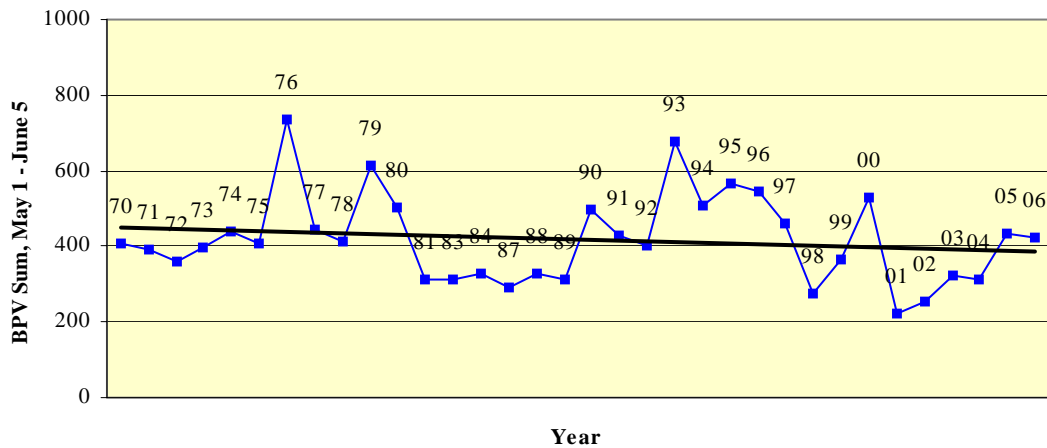
Clearly the migration size has varied widely. One way to determine the meaning of a graph such as this is to look for a trend in the numbers.

³ Details of the calculation are available on request.

1.6.3 Trend

This graph adds a **trend line** (dark) that tilts down to the right suggesting a general decrease in the migration size.

**Migration Size 1970 - 2006
Trend Line**



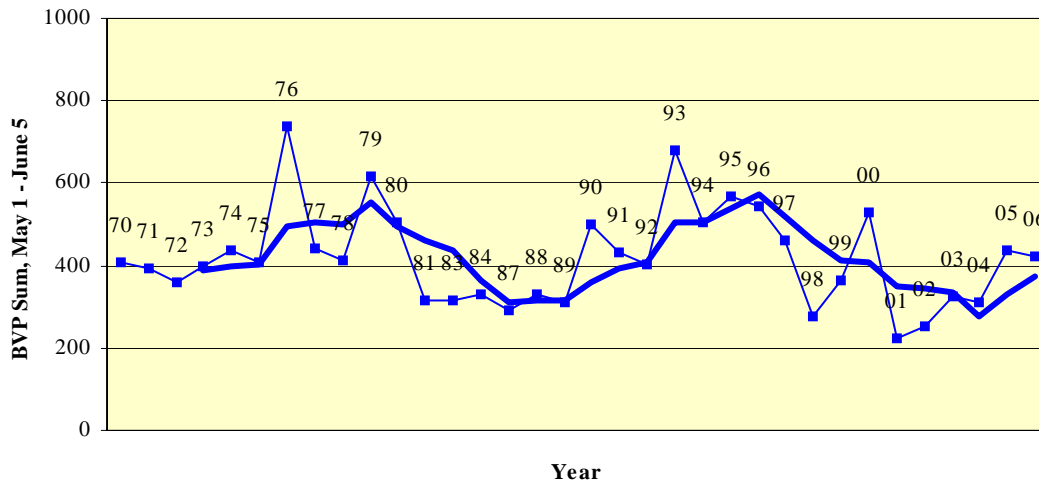
Trend can be used to give a quantitative measure of a general change. For this graph the drop in the trend line is from 449 to 388 birds, a drop of 61 representing about 13% of the 1970 value. We are tempted to conclude that migration size has declined 13% since 1970.

Unfortunately, we have no statistical reason for believing that the trend line fits the data well (it does not) and the numbers giving the 13% value are derived from the line. Because of the poor fit of the trend line we should NOT conclude that the migration size is decreasing. As we noted earlier, the value for 2006 (424) is higher than the value for 1970 (407).

1.6.4 Rolling Average

A more interesting way to look at this data is to take a **rolling 4-year average**⁴ of the values.

Migration Size 1970 - 2006 Rolling 4-year Average



The rolling average takes the average of the first four years 70,71,72,73 as its first value (shown as the value for 73), then it drops 70 and adds 74 so that its next value is the average of the four years 71,72,73,74 (shown as the value for 74) and so on.

The dark line is the rolling 4-year average line. The distance from the first high point (1979) to the next high point (1996) is 17-years; the distance from the first low point (1987) to the next low point (2004) is 17-years.

Is there a 17-year cycle in the migration size? I have never heard of such a cycle in the literature. Is it real or not? This strikes me as an exciting matter to investigate and monitor over time.

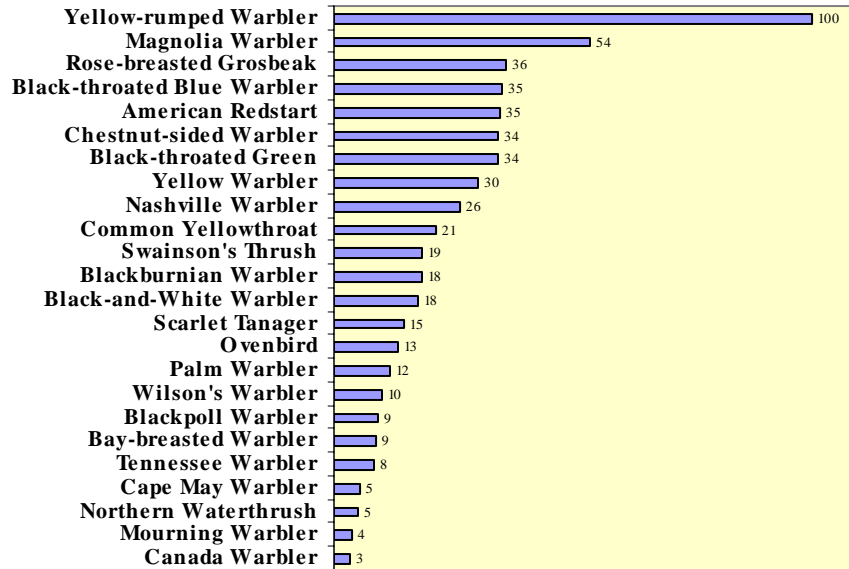
1.7 Relative Bird Abundance

A third measure for each migration year is what will here be called **Relative Bird Abundance**. This is the ranking of birds in order from highest to lowest BPV sum where the highest-ranking bird is assigned the arbitrary value 100 and all other birds assigned values proportionally.

⁴ Rolling Averages are a standard way of smoothing out curves in a Time Series graph.

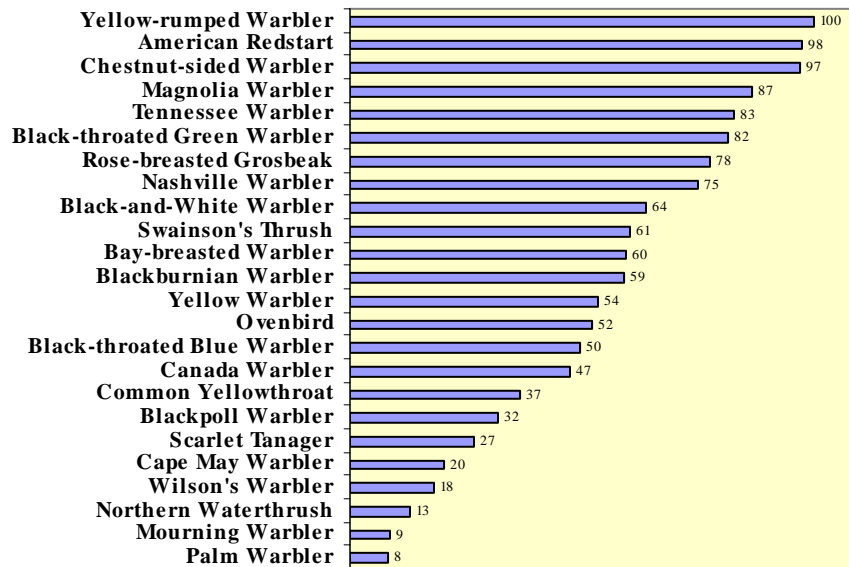
1.7.1 Year 2006

Relative Bird Abundance 2006



1.7.2 Decade 1970-1979

Relative Bird Abundance 1970s



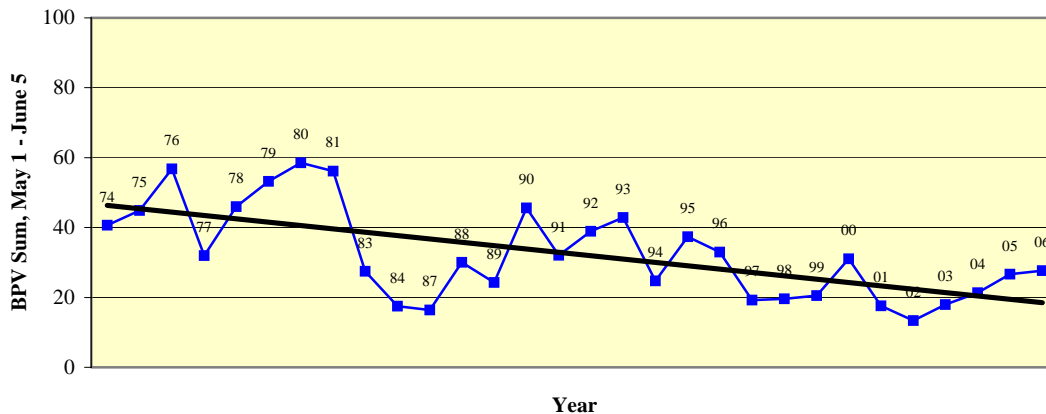
The relative population of birds is changing over time. The increase in the numbers of Yellow-rumped Warblers in the 2006 graph is obvious, but the shape of the graph is flatter than in the 70's suggesting that many warbler species have declined in numbers. This is an area for study and continued monitoring.

1.8 Population Trends

There is not space in a single Report to show population trend graphs for all birds in the study so four have been chosen to present here.

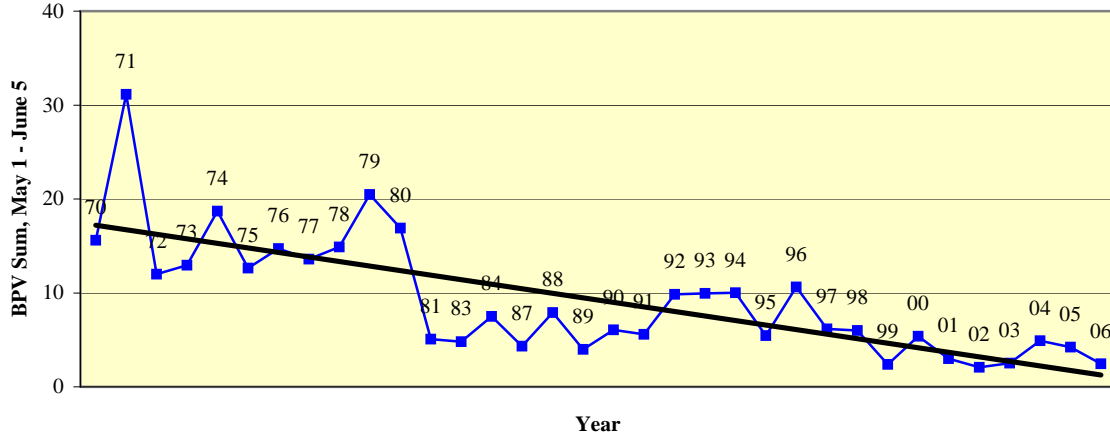
1.8.1 Individual Birds

Rose-breasted Grosbeak Migration Size 1974 - 2006



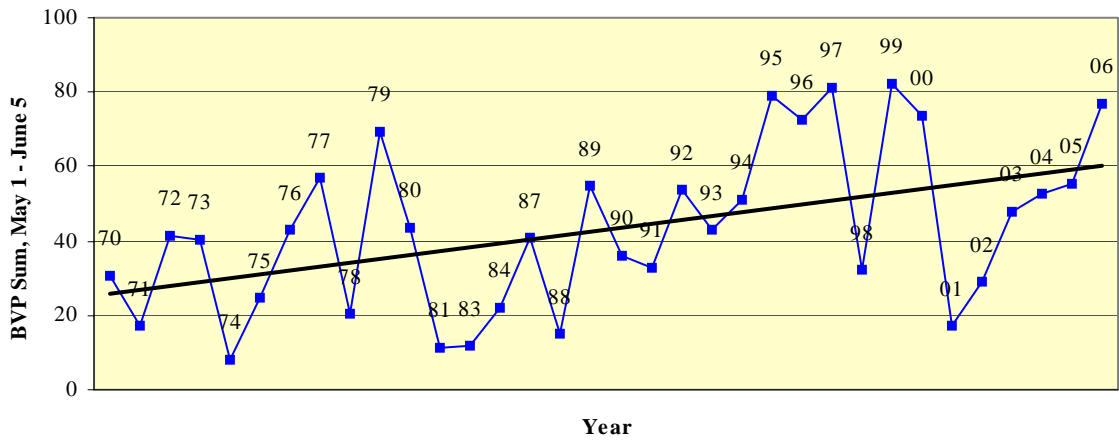
The trend line shows a 60% decline since 1974 but we should be careful about this result, because the graph fluctuates and the value has risen over the last 5-years.

Canada Warbler Migration Size 1970 - 2006



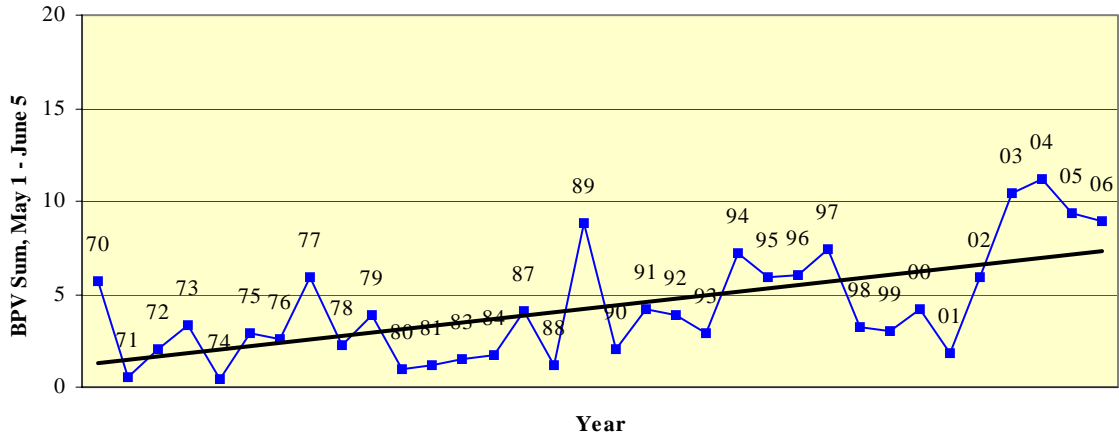
This graph does not fluctuate widely after 1980. The trend line shows an 84% drop. This looks real and serious. Comparison with Ontario data should be interesting.

Yellow-rumped Warbler Migration Size 1970 - 2006



Though the graph fluctuates, the upward trend line shows a 120% rise and is supported by the Relative Bird Abundance measure presented earlier.

Palm Warbler
Migration Size 1970 - 2006



The trend line shows a 408% rise but we have to be careful because the number of birds reported is very low. A 400% rise here means that we have only increased from 1.3 to 6.7 birds per year. However, the trend line is a good fit to the data and the rising trend is promising.

1.8.2 Population Trends Summary

The next tables show trends in the number of birds seen annually for all birds in the survey for which there is adequate data.

Birds with Rising Trends

These rising trends are significant at the 99% level⁵.

Bird	% Rise	Change in the Annual Number of Birds
Palm Warbler	408	+5.4
Yellow-rumped Warbler	120	+31.3

Birds with Falling Trends

These falling trends are significant at the 99% level.

⁵ That is, we are 99% sure that the numbers are trending up in reality.

Bird	% Drop	Change in the Annual Number of Birds
Canada Warbler	84	-14.5
Rose-breasted Grosbeak	60	-27.9
Black-and-white Warbler	45	-10.4
Blackburnian Warbler	49	-10.4 ⁶

Birds To Keep an Eye On

These falling trends are significant only at the 90% level, not at the 99% level⁷. There is reason for being cautious about whether the falling trends are real or not.

Bird	% Drop	Change in the Annual Number of Birds
Scarlet Tanager	58	-7.1
Tennessee Warbler	57	-18.5
Bay-breasted Warbler	54	-12.0
Swainson's Thrush	47	-18.4
Black-throated Green Warbler	39	-10.3
Cape May Warbler	6	-0.4

Birds with Unchanged Trends

These birds show no statistically significant trend either up or down.

Bird	
Black-throated Blue Warbler	Wilson's Warbler
Chestnut-sided Warbler	Blackpoll Warbler
Nashville Warbler	Magnolia Warbler
Ovenbird	American Redstart
Yellow Warbler	Common Yellowthroat

⁶ Not a typo. The value is exactly the same as for the Black-and-white Warbler.

⁷ We can be 90% sure but NOT 99% sure that the numbers are trending down in reality. Mixed results usually mean that we should be cautious about making claims.

1.9 Further Plans

The Annual Report is late coming out this year due to the hand over. I have not had time to investigate all the statistical issues relating to the data. I am in contact with Bird Studies Canada to get input from their statistician. I hope to get useful ideas from her about how to use our data and extract interesting and useful information from them.

Areas for further study and refinement of what I have done already are many. I **earnestly solicit ideas from the membership**. Please email or call me if you have ideas about what we might do or what we might change. My contact information is at the end of this Report.

Here are some ideas and questions that I am considering for the coming months.

Migration Timing

- Correlate migration timing to temperature, wind speed and direction and precipitation.
- Check all correlations using an appropriate statistical test.
- Does migration timing for individual birds change over time?
- Has global warming had an effect on individual birds migration timing?
- Create a timing graph for all birds. How does this compare with the GTA Area Bird Checklist values?

Migration Size

- Do other sites show a cycle over time?
- Is migration size related to weather?

Relative Bird Abundance

- Are there trends in abundance changes?
- Is there a numeric way to compare abundance graphs?
- How do our graphs compare with Ontario sites?

Population Trends

- Are there explanations for some of the trends?
- Cross-check our results with FLAP and Tommy Thompson Park Bird Research Station data to get correction factors.
- Do rolling 4-year averages show cycles for individual birds?

General

- Add pages to the TOC web site showing all graphs and statistics.
- How can we use Ontario bird observatory results to elucidate ours?
- Do patterns emerge if we group the birds into breeding eco-zones?
- Identify other statistical measures for our data.
- Describe all statistical tests for inclusion as an appendix to reports.
- Produce interim reports expanding on the annual Report.
- Produce an anniversary volume for 2007 - the 35th year of data collection.

Finally, I would like to thank again all the observers who participated in gathering this year's Warbler Survey data. Without your tireless efforts we would have no data to work with.

Doug Woods

81 Browning Ave

Toronto, ON M4K 1W1

(416) 466-4660 dougandval@magma.ca