The Raptor Population Index (RPI) Project In Its Second Year

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This is an update for readers of *Hawk Migration Studies* on the efforts of the Raptor Population Index (RPI) partnership to generate information on the population trends of North American raptors. I have organized the new developments of RPI into sections that coincide with the seven-step process of transforming data into information. In this system, data are collected, entered, archived, queried, analyzed, synthesized and delivered. At the end of this report, I discuss RPI in the larger context of biological data repositories and ways that the information generated in your monitoring site can obtain added value by collaborating in this initiative.

Data Collection

Data collection is perhaps the step of the process that is most frequently challenged in citizen science projects (Bhattacharjee 2005). Is the field data collected reliable? Many mechanisms exist to ensure data is adequately collected; one of them is the adoption of a set of conventions to obtain field records.

Since 1975, HMANA has promoted the use of a standard protocol for raptor migration counts. What is a data collection protocol? It is a set of instructions on how to record observational data during raptor migration counts. The original version, comprised of a data sheet and a brief set of instructions, has been adjusted over time and further customized at many monitoring sites.

Some sites developed an evolved version of the basic protocol to reduce its ambiguity. As a result, we now have several versions of the basic standard and possibly as many styles to collect data at monitoring sites. Although the basics are the same, there can still be room for "noise" that might echo in later stages of the seven-step process.

In order to revise the existing HMANA standards, I collected nine different protocols (see a list of contributing sites in the Acknowledgements section.) I organized the "revised" version into four sections:

(1) An introductory section with information on the rationale and objectives of the revised protocol;

(2) A Monitoring Site Specifics section intended to document details of the locality(ies) in use (e.g. "fixed," "mobile," and/or part of a "survey line") and the season of coverage;

(3) The species coverage and criteria to discern migrants vs. non-migrants, and finally

(4) A section on data recording and data storage (HMANA 2006a).

This revised protocol also includes revised tables for

(a) Weather and observation codes;

(b) Species names, sex, and color morphs;

(c) Wind speed, precipitation, height of flight, etc.,

(d) Form for seasonal metadata.

Metadata (the "data that describes other data") is generally overlooked and poorly documented. How many people participated during the season? What are their qualifications? Which species are monitored? Which units (e.g. metric, English) are used in the weather data recordings? What optical equipment is used? Is there a training scheme in place before starting the field season? Is the site staffed by professional biologists or volunteer citizen scientists? These are all questions that can help to interpret the data at later stages. The revised protocol is available in our web site (HMANA 2006a).

Data Entry

The transfer of data from paper forms into electronic formats is the largest challenge of RPI. Laurie Goodrich from Hawk Mountain leads the entry of data from paper forms into HawkCount.org. How big is this task? The estimate is that over 1,000,000 hours of observation, some 100,000 data sheets, exist in storage. These forms come from >1,800 sites across North and Middle America (HMANA 2006b).

According to Laurie, data are stored in many different ways. The most common form is on paper data sheets, but many monitoring sites have entered their data in diverse electronic formats, from spreadsheets of daily totals to more developed electronic databases such as those used by HawkWatch International and Holiday Beach. Fewer sites are active in HawkCount.org or have completed transferring their data into this online database.

Laurie led a small group of dedicated volunteers to enter the data of some key sites for the initial RPI analyses. What makes a site "key"? The length of their available data and the consistency of data collection over time. Not all the sites that have contributed data to HMANA have had the necessary continuity to perform population trend analyses (a minimum of 10 years); many "orphan" sites were dropped after a few years of operation. Although this may preclude them from

contributing to RPI, their data is still important to improve our understanding of raptor migration. In addition, some sites have taken the lead by uploading their own historical data into HawkCount.org (Table 1).

Data Archiving

As of the end of January 2006, Jason Sodergren, HMANA's webmaster, reports a total of 163 active sites in HawkCount.org (Table 2.) Most sites uploaded their data in daily format, but some sites such as Waggoner's Gap, Pennsylvania; Holiday Beach, Ontario, and Beamer, Ontario, have over 25 years of data in hourly format.

Data Analysis and Synthesis

Long term data from selected sites are currently under analysis. The statistical models to generate annual indices and to calculate long term trends were recently described by Chris Farmer, David Hussell and David Mizrahi in a manuscript submitted to the peer-reviewed ornithological journal *The Auk*.

In summary, the procedure consists of standardizing the count day/season of each monitoring site. For each species, the model:

(1) Identifies the daily window during which 95% of the migrants are counted.

(2) Selects the seasonal passage window when the middle 95% of the individuals were counted across all years.

(3) Models curvilinear effects of wind speed and direction on number of hawks counted.

(4) Calculates indices of passage rate (date-adjusted estimated geometric means).

(5) Obtains trends in annual passage rates by fitting a polynomial regression model to the time series of annual indices.

(6) Re-parameterizes the year terms to determine the significance of these trend estimates (Francis and Hussell 1998; Farmer et al. unpublished ms.).

The analyses already completed include seven sites from the Northeast/Great Lakes region for the period 1975-2004. In addition, Chris Farmer and Jeff Smith are finishing the analyses of eight sites from the western United States for times varying between 9 and 22 years ending with 2005. Some of these sites analyzed their data a few years ago (Hoffman and Smith 2003) using a different estimate of population change (the "annual passage rate" or number of raptors per 100 hours of observation) so this update will also serve to compare estimates generated by two different methods.

Subsequent analysis will include data from 1994-2005 from Tadoussac, Québec, and two Gulf sites, Corpus Christi, Texas (1997-2005), and Veracruz, Mexico (1992-2005).

Data Delivery

The results of different population trend analyses will be published in peer-reviewed journals and other publications. Results of a seven-site northeastern-Great Lakes region analysis and Veracruz analysis will be presented this fall during a Raptor Migration Ecology and Conservation symposium as part of the IV North American Ornithological Conference in Veracruz, Mexico (http://www.naoc2006.org/en/program.htm).

Efforts are underway to publish a monograph entitled *The Status of North American Raptors*, edited by Keith Bildstein, Jeff Smith, and myself, due in September 2007 during the Raptor Research Foundation-HMANA joint meeting in Pennsylvania. Results from different sites are currently posted in the RPI web site (http://www.rpi-project.org/).

A Way Forward

Last year, Parr and Cummings (2005) stated that "the rapid advancement of fields such as molecular biology, genomics, and molecular evolution is due, in large part, to pervasive data sharing." The same growth and development rate, however, has not been observed in other fields, such as population biology and conservation. Why? Two reasons are cited: (1) The desire of researchers to use their own data without competition, and (2) The belief that there are barriers to combine data sets that are different.

RPI has made several improvements to make information widely available. The first reason cited above does not directly apply to RPI since most raptor migration monitoring sites have generously shared their data by classifying it as "Category 1 Data," which allows more freedom for data use (see HMANA data use policies at http://hmana.org/data_policies/).

Parr and Cummings' (2005) "barriers for data sharing" include many that are purely logistical, such as the availability of online safe repositories. HawkCount.org has filled that need for people interested in raptor migration. Many other similar data repositories are covering other specific needs and are also slowly integrating themselves into increasingly large warehouses and collaborative schemes that enable different datasets to be combined (e.g. The Global Biodiversity Information Facility and the National Biodiversity Information Inventory).

Other barriers for using large datasets include the availability of appropriate techniques to analyze them, which require large computing power and technical skills beyond the standard desktop application. RPI is developing the appropriate

analytical procedures for the data available (Farmer et al. unpublished ms.).

What can your individual site do to contribute to this collective goal? I encourage your monitoring site to continue collecting good quality field records and adopt (and strictly reinforce) the revised HMANA standards for data collection. As many of the sites listed (Table 1), your site can help with the enormous task of transferring historical hourly count data into electronic format. Your help puts RPI closer to its goals of producing statistically defensible indices of annual abundance and trends for each migratory raptor species and frequently updated species' assessments that are widely available to participating count sites, the scientific community, conservation agencies, and the public. More developments await as we enter the second year of this exciting project.

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Table 1. *Raptor monitoring sites working on transfer of historical data into HawkCount.org.*

Site Name	Location (near)
Rose Tree Park	Media, PA
Franklin Mountain	Albany, NY
Snickers Gap	Leesburg, VA
Fort Smallwood	Pasadena, MD
Kiptopeke State Park	Cape Charles, VA
Beelzebub Street	South Windsor CT
Whippoorwill Hill	Newton, CT
East Shore Park	New Haven, CT
Booth Hill	West Hartland, CT
Chestnut Hill	Litchfield, CT
Taft School	Watertown, CT
Niagara Peninsula Hawkwatch	Grimsby, Ontario
Southeastern Michigan Raptor Research	Ann Arbor, MI

Table 2. *Current status of data electronically stored in HawkCount.org.*

Status	No. of Sites
Active sites	163
Sites with data	149
Sites with hourly data	109
Sites with over 10 years of data	6
Sites with >25 years of data in hourly format	3

Table 3. *Status of RPI data analysis per site.*

Site	Time series (yr)	Status
Lighthouse Point, CT	30	Completed
Montclair, NJ	30	Completed
Cape May, NJ	30	Completed
Hawk Mountain, PA	30	Completed
Waggoner's Gap, PA	30	Completed
Holiday Beach, Ontario	30	Completed
Hawk Ridge, MN	30	Completed
Tadoussac, Québec	10	Underway
Goshute Mountains, NV	22	Near completion
Lipan Point, AZ	15	Near completion
Bridger Mountains, MT	15	Near completion
Wellsville Mountains, UT	20	Near completion
Yaki Point, AZ	9	Near completion
Manzano Mountains, NM	21	Near completion
Chelan Ridge, WA	9	Near completion
Bonney Butte, OR	12	Near completion
Corpus Christi, TX	9	Data preparation
Veracruz, México	14	Data entry