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SUMMARY OF RAPTOR BANDING RECORDS AT THE BIRD BANDING LAB

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ABSTRACT.—The USGS Bird Banding Laboratory (BBL) maintains a database of all bird-banding data from North America. These files contain more than 70 million records. Data that are stored electronically (i.e., from 1960 and later) comprise 61 million records. Of these, 1.86 million represent raptors. As expected, the more common species are the more commonly banded. Sharp-shinned Hawk (*Accipiter striatus*), American Kestrel (*Falco sparverius*), Red-tailed Hawk (*Buteo jamaicensis*), and Cooper's Hawk (*Accipiter cooperii*) are the most commonly banded diurnal raptors. Among owls, Northern Saw-whet Owl (*Aegolius acadicus*) is by far the most commonly banded. Most raptor banding has taken place at migration monitoring stations, with nestling-banding making up another large percentage. Although banding data are most valuable when associated with subsequent encounters, much interesting distributional and migration information can be found in the banding database itself. Because the BBL stores information regarding the status of banded birds, we can demonstrate the increases or decreases over time in the use of auxiliary markers such as coded leg bands, geolocators, or transmitters.

KEY WORDS: *banding data*; *Bird Banding Lab*; *raptor ringing*; *summary*.

RESUMEN DE LOS REGISTROS DE ANILLADO DE AVES RAPACES EN EL LABORATORIO DE ANILLAMIENTO DE AVES

RESUMEN.—El Laboratorio de Anillamiento de Aves del USGS (LAA) mantiene una base de datos de todos los datos de anillamiento de aves de América del Norte. Estos archivos contienen más de 70 millones de registros. Los datos que se almacenan electrónicamente (i.e., a partir de 1960) abarcan 61 millones de registros. De éstos, 1.86 millones corresponden a aves rapaces. Como era de esperar, las especies más comunes son las más comúnmente anilladas. *Accipiter striatus*, *Falco sparverius*, *Buteo jamaicensis* y *Accipiter cooperii* son las aves rapaces diurnas más anilladas. Entre los búhos, *Aegolius acadicus* es la especie más frecuentemente anillada. La mayoría del anillado de rapaces ha ocurrido en estaciones de monitoreo de migración, en que el anillado de polluelos forma un gran porcentaje de las aves anilladas. Aunque los datos de anillamiento son más valiosos cuando se pueden asociar con encuentros subsecuentes, los datos de anillado en sí, también pueden entregar una cantidad de información interesante sobre la distribución y migración. Debido a que el LAA almacena información sobre el estado de las aves anilladas, podemos demostrar los aumentos o disminuciones en el tiempo en el uso de marcadores auxiliares, tales como anillas en las patas codificadas, geolocalizadores o transmisores.

[Traducción del equipo editorial]

The USGS Bird Banding Laboratory (BBL), in cooperation with the Canadian Wildlife Service Bird Banding Office, has the responsibility of storing and managing all bird banding data from North America, including data predating the existence of the BBL. These files contain more than 70 million records, representing almost every species regularly occurring in North America. Banding data prior to 1960 are primarily stored on paper and only available electronically for individual birds for which there was a subsequent encounter reported. Complete banding data from 1955–59 are available in a partially summarized electronic format, and all data from 1960 forward are stored electronically. There are approximately 61 million banding records in the BBL database from 1960–2009. Of these, 1.86 million, or 3.0%, represent raptors, 1.41 million (75.8%) being diurnal raptors and 450 000 (24.2%) being owls. Altogether, 54 species of raptors are represented. Data are available from the BBL upon request, and are supplied in electronic format.

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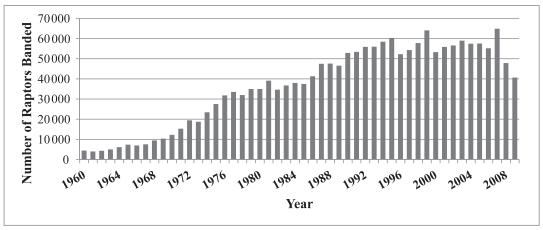

Figure 1. Numbers of raptors banded per year, showing increase in raptor banding activity (USGS Bird Banding Laboratory 2010).

SUMMARY OF BANDING RECORDS

Numbers of raptors banded since 1960 have increased dramatically, with the strongest growth during the 1970s. Increase in annual numbers banded slowed considerably in the 1980s, reached a plateau, and even decreased slightly in the 1990s and 2000s (Fig. 1). Numbers banded in the 1970s were approximately four times those of the 1960s, and that number doubled in the 1980s, and increased another 1.5 times in the 1990s, with a very slight decrease in the 2000s. The increase in raptor banding is most likely a reflection of increased interest and improved capture techniques and not necessarily a reflection of population changes.

The geographical distribution of raptor banding data, like most banding data, shows a strong correlation with human-population centers. However, major raptor migration concentration areas also are significant. Figure 2 shows the geographic distribution of raptor banding in North America during the period of 1960 to 2009. The patterns of low and high activity reflected in this summary map have remained consistent across time.

The five most commonly banded raptors since 1960 are Sharp-shinned Hawk (*Accipiter striatus*, 450 468), American Kestrel (*Falco sparverius*, 285 697), Red-tailed Hawk (*Buteo jamaicensis*, 190 816), Northern Saw-whet Owl (*Aegolius acadicus*, 185 789) and Cooper's Hawk (*Accipiter cooperii*, 122 271). The former three species showed steady increases over the five decades, with a slight decrease in the 2000s, whereas the last two showed almost exponential increases. For Northern Saw-whet Owls, this increase certainly is a reflection of improved luring techniques and increased interest in banding. The increase in numbers of Cooper's Hawks banded may mirror an actual population increase (Curtis et al. 2006).

Raptors are banded under several types of circumstances. For example, many species are predominantly banded as nestlings, whereas others are predominantly banded as post-fledgling hatch-year and adult birds, usually during migration. A small minority are banded following rehabilitation (Table 1). Two extremes are Ferruginous Hawks (*Buteo regalis*), for which 96.3% of bandings are of nestlings and Sharp-shinned Hawks, for which only 0.3% of bandings are of nestlings. The American Kestrel is an example of a species near the median, with approximately 43% of banding records representing nestlings. Such information is important when considering the potential usefulness of BBL data.

QUALITY CONTROL AND DATA MANAGEMENT AT BBL

In considering the BBL data, it is important to understand the nature of the data, how they were gathered, how they were processed, how they were vetted, and how they are coded. In the early years (through the mid-1990s) banding data were received on paper ''schedules.'' These contained minimal information and were hand-entered into the main database, leaving much room for human error. In the late 1980s, the first attempts to collect data electronically were made. In the 1990s, improvements were made to electronic data-submission systems, culminating in the introduction of BAND-OPS in 1995 and Band Manager in 1999, data-entry programs provided to banders. Although these programs helped lighten the workload of the BBL, the data entered were no more complete than the data from the paper schedules. In 2006, the program Bandit was introduced, with many improvements over Band Manager, including many more data fields. The main BBL database was also improved at this time, in order to store more fields, among them ''bander remarks,'' ''how aged,'' ''how sexed,'' and BBL comments. With the inclusion of more fields, the dependence on paper schedules for additional details was eliminated and the BBL was able to suspend the requirement for paper submissions.

In the main BBL database most fields of data are stored as numeric codes, such as 4 = male and 5 = female or 3370 = Red-tailed Hawk. It is important to understand that until recently, the data were reported and entered as numeric codes. Entering numeric codes rather than their English equivalents increased the likelihood of error. As a bander filled out the paper schedules, as well as during data entry, a simple number transposition, such as typing 559 instead of 599 resulted in a completely different datum entered. As a result of such mishaps, many errors occur in the database. This is demonstrated

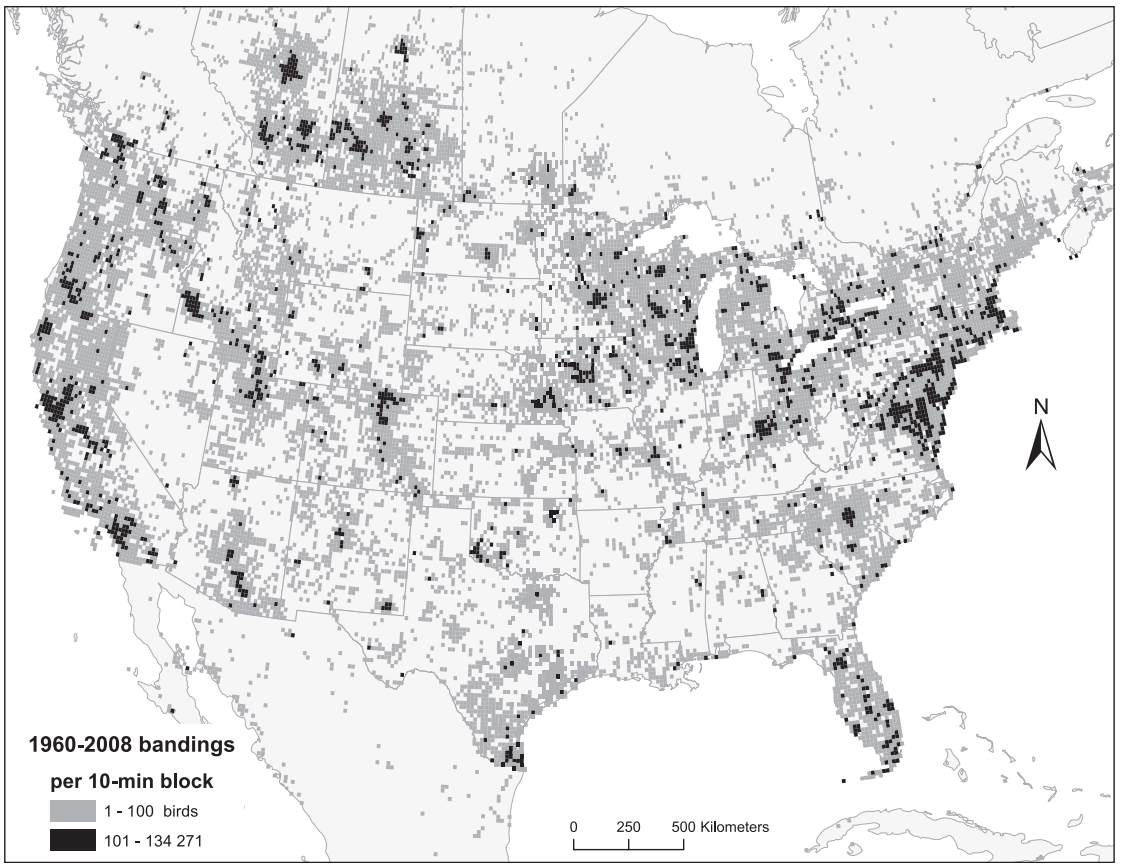

Figure 2. Geographic distribution of raptor banding in North America, 1960 to 2009, demonstrating a bias toward human-population centers (USGS Bird Banding Laboratory 2010).

by reviewing the ''status and additional information'' codes, which are encoded details of any additional handling and marking of a bird at banding. Among the raptor data in the BBL files are 153 birds that have the code for ''All primaries clipped or pulled,'' 37 with ''Neck Collars,'' two with ''Reward Bands'' and other codes that clearly do not reflect what was actually done to the birds. The code for ''All primaries clipped or pulled'' is typically used with projects involving the transporting of geese, and is certainly not something that would be done to a raptor. Likewise, neck collars and reward bands are waterfowl-related auxiliary markers that would never be used on raptors. Electronic data submission has greatly reduced the occurrence of such errors, but the older erroneous records remain, because the time needed to find and correct them is not available. We often caution data users that, ''if it looks too unusual to be true, it probably is not true.'' Even with improvements in data collection, banding data are not without human error. Banders are often confused by the BBL age codes, for example. A common error is the use of the age code ''HY'' (''Hatch Year''—a bird-of-the-year capable of sustained flight) when the correct code should be ''L'' (''Local''—a nestling or recently fledged bird). A researcher focused on data from birds banded as nestlings would be wise to consider this.

A serious limitation with both the banding and encounter data is the fact that the BBL has never attempted to gather ancillary data such as weather conditions or a measure of effort. Varying weather conditions and amount of effort can have an effect on quantity and quality of data. These ancillary data are generally recorded by the banders, and may be available from them, but are not stored at the BBL.

All BBL data, bandings and encounters, have been subjected to many data-quality checks or audits to

Table 1. Ten raptor species most commonly banded as rehabilitated birds with percentages of the total rehabilitated raptors banded as of December 31, 2007. (USGS Bird Banding Laboratory 2010).

SPECIES	NUMBER OF BANDED REHABILITATED BIRDS	PERCENT OF TOTAL
Red-tailed Hawk (*Buteo jamaicensis*)	9264	19
American Kestrel (*Falco sparverius*)	6172	13
Great Horned Owl (*Bubo virginianus*)	5590	12
Eastern Screech-Owl (*Megascops asio*)	5348	11
Barred Owl (*Strix varia*)	3200	7
Cooper's Hawk (*Accipiter cooperii*)	2207	5
Bald Eagle (*Haliaeetus leucocephalus*)	2197	5
Barn Owl (*Tyto alba*)	2055	4
Northern Saw-whet Owl (*Aegolius acadicus*)	1232	3
Swainson's Hawk *(Buteo swainsoni)*	1116	2
Other	10 377	19
Total	**48 758**	**100**

ensure the highest possible quality under the circumstances–over one million banding records and over 80 000 encounter records submitted per year. Current audits include the comparison of species code against known distributional ranges and migration times, the comparison of age codes to time of year, and the comparison of coordinates to state boundaries, among others. These automated checks were not present in the very early days of the program and have been added and refined over time, so earlier data are more likely to contain errors. Today there are 47 separate data checks to which all incoming banding data are subjected. As part of the data-input process, records that fail these checks are held apart from the main database until they can be examined and corrected or bypassed. Thus, at any given time, there can be as many as 5% of incoming records awaiting final validation. In some instances, this may constitute a significant portion of a data request.

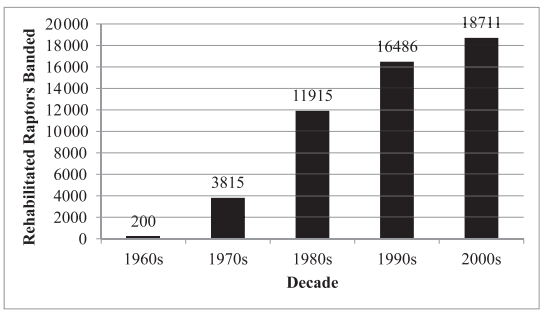

Figure 3. Number of rehabilitated raptors banded in North America by decade, including all raptor species. (USGS Bird Banding Laboratory 2010).

USES OF BANDING DATA

Banding data are most useful when subsequent encounters are involved (Lutmerding et al. 2012), but there is interesting information to be gleaned from the banding data alone. Because the BBL has included the status and additional information codes in the database, it is possible to examine the data for spatial and temporal changes in the use of auxiliary markers, blood-sampling, or other marking or sampling techniques. For example, changes in bird-tracking technology are reflected in the BBL data. Over 200 000 records indicate that some sort of auxiliary marker was used. By examining the trends, it is possible to document increases and decreases in the use of radio transmitters, colored leg bands, and other auxiliary markers.

Rehabilitation of raptors has been a common practice for many decades, and many of these birds have been banded. BBL files contain over 43 000 records of rehabilitated banded raptors. For the 1960s, there are only 200 rehabilitated raptors in the database, but by the 2000s there are almost 19 000. Each decade has shown a steady increase (Fig. 3). The largest numbers of rehabilitated birds are reported from the states and provinces with the highest human populations.

Banding data can serve as a ''reservoir'' of information about raptor distribution. Although banding efforts have not been consistent or controlled by any set of data-collection standards, and the database does not include a measure of effort, it is still possible, when the data are displayed graphically or as range maps, to see minor changes in distribution over time. It may also be possible to plot migration movements based on

numbers reported from major banding stations. Currently, the raptor banding database remains a vast, underused potential resource in raptor research.

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