

The North American Bird Banding Program: Into the 21st Century

EXECUTIVE SUMMARY

The panel examined the legal, scientific, and philosophical underpinnings of the Bird Banding Program [BBP], with emphasis on the U.S. Bird Banding Laboratory [BBL], but also considering the Canadian Bird Banding Office [BBO]. In this report, we review the value of banding data, enumerate and expand on the principles under which any modern BBP should operate, and from them derive our recommendations. These are cast into a Mission Statement, a Role & Function Statement, and a series of specific recommendations addressing five areas: (1) permitting procedures and practices; (2) operational issues; (3) data management; (4) BBL organization and staffing; and (5) implementation. Our major tenets and recommendations are as follows:

- banding provides valuable data for numerous scientific, management, and educational purposes, and its benefits far outweigh necessary biological costs and fiscal costs, especially those incurred by the BBL and BBO;
- because of the value of banding data for management of avian resources, including both game and nongame birds, government support of the program is fully justified and appropriate;
- all banding data, if collected to appropriate standards, are potentially valuable; there are many ways to increase the value of banding data such as by endorsing, promoting, and applying competence and/or training standards for permit issuance; promoting bander participation in well- designed projects; and by encouraging the use of banding data for meta-analytical approaches; the BBL should apply, promote, and encourage such standards, participation, and approaches;
- the BBP should be driven by the needs of users, including scientists and managers;
- all exchange of data and most communication between banders and the BBL should become electronic in the near future;
- the computer system at the BBL should be modernized to one designed for a true client-server relationship and storage of data in on-line relational databases;
- the BBL should continue to maintain high quality control and editing standards and should strive to bring all data in the database up to current standards; however, the BBL should transfer a major portion of the responsibility for editing banding data to the bander by providing software that will permit the bander to edit his/her own data electronically before submission to the BBL;
- the BBL should build the capacity to store additional data tied to original band records able to be pre-edited and submitted electronically, such as recapture data, appropriate data from auxiliary marking (e.g., resightings of color-marked birds), and other data that gain value when pooled from many banders (e.g., measurements); however, the BBL should only accept such data if they are collected using standardized methods and as part of an established program designed to utilize such data;
- now is the time to consider options for implementing a Western Hemisphere banding program, with leadership from the BBL;
- the Patuxent Electronic Data Processing Section should become part of the BBL;
- additional scientific and technical staff must be added to the BBL;

- an Implementation Team should be formed to expedite our recommendations, following some timetables outlined in this document.

I. INTRODUCTION

I. A. Background

The North American Bird Banding Program [BBP] has for many years been administered by the Bird Banding Laboratory [BBL] at Patuxent Wildlife Research Center in Laurel, Maryland, in conjunction with the Canadian Bird Banding Office [BBO] in Hull, Quebec. The BBL was transferred from the U.S. Department of the Interior's [DOI] Fish and Wildlife Service [USFWS] to DOI's newly established National Biological Service [NBS] in November 1993. (In October 1996 the NBS itself was transferred intact [as the Biological Resources Division, or BRD] into the U.S. Geological Survey [USGS].) The creation of the NBS thus became the catalyst for a review of the scientific underpinnings of the BBL, and by extension the entire BBP, including consideration of its staffing and computer equipment needs. This review is especially timely considering the revolution in computer access and the development of worldwide electronic communication that has occurred during the past decade, and which can be expected to expand considerably in the 21st century.

I. B. Panel Composition

To this end, P.A. Buckley was asked by the NBS Directorate to assemble a Panel to address the question of the scientific and philosophical underpinnings of the BBL (reformulating them if necessary), and then to enumerate what is required to bring the BBL/BBP into line with a new BBL/BBP mission statement and with prevailing (and especially future) data management practices.

It was clear from the outset that representation by individuals familiar with the diverse aspects of the banding program would be essential for the broad view required. Thus, the Panel as finally composed consisted of the following persons:

Dr. P.A. Buckley (Chair): Senior Scientist, Biological Resources Division, U.S. Geological Survey, Graduate School of Oceanography, University of Rhode Island, Narragansett, RI, USA.

Dr. Peter Blancher, Chief, Migratory Bird Populations Division, Canadian Wildlife Service, National Wildlife Research Centre, Hull, Quebec, Canada.

Dr. Peter Cannell, Director and Science Editor, Smithsonian Institution Press, Washington, DC, USA.

Dr. David F. DeSante, Founder and Director of The Institute for Bird Populations, Point Reyes Station, California, USA.

Dr. Charles M. Francis, Senior Scientist, Bird Studies Canada / Long Point Bird Observatory, Port Rowan, Ontario, Canada.

Dr. Chandler S. Robbins, Research Wildlife Biologist, Patuxent Wildlife Research Center, Laurel, Maryland, USA.

Dr. Graham Smith, Chief, Population and Habitat Assessment Section, Office of Migratory Bird Management, U.S. Fish and Wildlife Service, Patuxent Wildlife Research Center, Laurel, Maryland, USA.

All members of the panel are or have been active banders, and collectively represent nearly 200 person-years of hands-on experience with bird banding in all its aspects. The panel has members experienced in working with most groups of birds, including passerines, gamebirds (especially waterfowl), raptors, colonial waterbirds, and shorebirds. Nearly all of us currently have, or have had in the past, direct connections with the non-scientist banding community. The interests of both the U.S. and Canadian governments were represented, as well as those of various other entities, including the flyway councils, universities, bird observatories, and private research institutes. Lastly, we are all active research scientists (many of us having university affiliations) with hands-on experience analyzing banding data for publication in the scientific literature, as well as applying them to management questions.

I. C. Objectives of the Panel

Our charge was to make recommendations of a programmatic and conceptual nature, designed to allow the BBL/BBP to better fulfill its mission. The list of specific items we would address was agreed to interactively with the NBS Directorate, with subsequent modifications by the Panel as we proceeded with our discussions.

Within this framework, we set the following objectives:

1. to articulate the scientific, philosophical, and legal rationale for a North American banding program in terms of its purposes, justifications, and broad-scale costs;
2. to provide a new Mission Statement and a new Role & Function Statement for the BBL/BBP;
3. to define where we believe the BBP should be heading, and provide some attainable goals;
4. to provide guidelines, within the context of the Mission Statement, on issues such as bander training, permitting, data editing, and data storage;
5. to recommend any needed changes in the overall BBL/BBP operations and practices;
6. to bring data management at the BBL in line with present and future standards, especially recognizing the growing computer literacy and increased availability of personal computers;
7. to make recommendations about BBL staffing and equipment needs and changes;
8. to reassess and, if necessary, expand the role that the BBL should play in a broad, integrated Western Hemisphere banding program.

We did not consider budgetary aspects in our review, or the question of agency location of the BBL within the Department of the Interior; we had no mandate to do either. However, we did consider the overall cost-effectiveness of the measures we were proposing, especially in the context of the cost of the entire Bird Banding Program.

The Panel did not specifically address the workings of the Canadian Bird Banding Office. Nonetheless, the principles and recommendations we enunciate for the BBP and BBL are equally applicable to the BBO.

Other potential topics intentionally not addressed included: collecting permits (and their possible relation to banding permits); decisions concerning individual BBL staff and other issues related to implementing our recommendations; any matters involving the relationship and interactions between individual banders and the BBL (e.g., instances of permit denial or revocation); and details of future relations among the BBL, the Migratory Bird Management Office, and the Biological Resources Division of the U.S. Geological Survey.

I. D. Operation of the Panel

Early in the process, the NBS Directorate agreed with our request that all groups actually or potentially affected by our recommendations have the opportunity to respond to them, and that, moreover, our recommendations would be circulated while still in draft so users' reactions and comments, if appropriate, could be incorporated. It was also agreed that the final document would be disseminated as widely as possible, including circulation to banders (potentially through the BBL's series of communiqués entitled "Memo to all Banders," known colloquially as MTABs), electronic publication (such as on the OSNA or Patuxent web pages), and, if the document seemed suitable, through publication in one of the North American ornithological journals.

We assembled for our first meeting at Patuxent Wildlife Research Center in May 1995, and followed that with a second at Cape May, NJ, in October 1995 in conjunction with the Partners in Flight conference being held there. Announcements

about our existence and requests for comments were placed in various ornithological and banding outlets (both print and electronic); presentations were made at scientific and banding organization meetings; and comments were solicited verbally from interested parties on any topics related to the banding program and the banding lab. We were also provided with access to the minutes/transcripts of previous meetings to discuss the future of the BBL.

We received verbal input in person and by phone, and written input by mail, fax, and email; everything able to be copied went unedited to all Panelists. Material was still coming in as late as May 1996, and every suggestion we received was considered by the Panel. Space and other restrictions prevent us from going into detail on possible recommendations that were never made.

A preliminary presentation of the Panel's recommendations was made to the NBS Directorate in Washington DC by the Panel Chair in March 1996, and a draft report was presented to the agency in October 1996, after extensive review by panel members, to ensure that it was representative of the views of all members. This draft was widely circulated for review both within and outside of the agency, and numerous comments were received, both supportive and critical. In July 1997, the panel reconvened for two days at Patuxent to consider the reviews. In many cases, this led to clarification of our ideas and more detailed expression of them, and in a few cases to minor changes in our recommendations. These changes were presented verbally to the Patuxent Wildlife Research Center Director during the meeting, and have been incorporated into this final document.

II. LEGAL, SCIENTIFIC, AND PHILOSOPHICAL UNDERPINNINGS OF THE BIRD BANDING PROGRAM

II. A. Purposes and Justification for Banding Birds

The basic purposes and justification for banding birds are that it provides certain data vital for scientific research into bird populations and for the conservation and management of those populations. While some of these data can be provided in other ways, banding typically remains the most cost-effective approach. Banding, recovery, recapture, and resighting data remain critical for the conservation and management of birds. Their use in the setting of annual species and bag limits for game birds provides an immediate and widely appreciated example. At the level of basic scientific knowledge, banding is also a valuable tool for obtaining information about avian populations, movements, behavior, etc., regardless of any immediate conservation or management value. Lastly, banding has legitimate and widespread educational values over and above its scientific value.

It is not always appreciated, especially by governmental bodies and the public, exactly how valuable good banding data are, and the important uses to which they are routinely put. Examples include:

1. **Providing knowledge about movements of birds** - e.g., establishing migration routes; finding links between breeding and wintering grounds; delineating separate populations; tracking range expansions and colonizations; measuring dispersal within populations; quantifying gene exchange among populations;
2. **Estimating demographic parameters and determining dynamics of bird populations** - e.g., estimating annual production of young birds or age-dependent annual survival rates; building models of population dynamics for predicting extinction probabilities; separating population sources and sinks; comparing survival rates of experimental or rehabilitated birds to those of wild birds;
3. **Management of gamebirds** - e.g., delimiting flyways; estimating harvest pressure for input to the establishment and modification of hunting regulations; measuring differential vulnerability to harvest and other risks by species, age, sex, and geographic location;
4. **Ecological research requiring individual recognition** - e.g., estimating territory size, habitat selection, dominance hierarchies, molt patterns, or parasite burdens of individuals; examining importance of migrant stopover areas through individual stopover times and weight gains;

5. **Monitoring populations and individuals** - e.g., monitoring Endangered or Threatened species; identifying populations declining from decreased reproductive output or from diminished recruitment; establishing population trends and validating other techniques of population monitoring;
6. **Educating the public about science and birds** - e.g., teaching, in the hand, about birds, their movements, their plumage differences, and how molt proceeds; reinforcing stewardship responsibilities.

It must be emphasized that the maximum value of banding data is realized only when: (a) accurate and standardized (or well-documented) data are taken; (b) these data are stored centrally and made readily available to analysts and researchers; and (c) the data are used, and the results published.

II. B. Costs Associated with Banding Birds

Any work involving millions of birds will inevitably incur both biological and monetary costs.

The biological cost of the BBP is that some birds will be injured or die as a result of being trapped, handled, or banded. In all careful banding programs, the numbers are small relative to those banded, but everyone also agrees that every effort must be made to reduce the number to as close to zero as possible. These costs can be mitigated by increasingly efficient training in the capture, handling, and welfare of birds, and by certification of banders. These areas are now being examined by the new North American Banding Council. Licensing, the province of the BBL, follows upon training and certification, and all BBL staff are committed to maintaining high standards and training for all those licensed to band birds. Research on new capture techniques, on identifying species particularly susceptible to handling effects, and on the differential responses of various birds to band sizes and materials is underway in many quarters and will, without doubt, aid in reducing morbidity and mortality from banding-related activities.

The monetary cost of the BBP is difficult to estimate, since it involves thousands of banders, volunteers, and agencies outside of the BBL and BBO. At a minimum, many millions of dollars and hundreds of person-years are spent collecting, analyzing, and reporting on banding studies each year. A small fraction of this cost falls on the BBL and BBO.

Assuring the accuracy of banding data, storing the data in a central location, and making them available to analysts and researchers constitute the major monetary costs to the BBL, and these can be mitigated by increasing the efficiency of the BBL's operations. We have addressed a significant portion of this report to that end.

II. C. Justification for a Federal Bird Banding Laboratory

Protection, conservation, and management of migratory birds are justified and mandated in the U.S. by the Migratory Bird Treaty Act of 1918 (as amended) and in Canada by counterpart legislation, the Migratory Birds Convention Act of 1917 (as amended). Inasmuch as bird banding is a valuable tool for conserving and managing bird populations, and the existence of an efficient and centrally run BBP is the best way to maximize the value of data from bird banding while mitigating the associated fiscal and biological costs, U.S. government funding of the BBL and Canadian government funding of the BBO, and by immediate extension the entire BBP, are entirely appropriate.

II. D. Basic Principles Governing the Operation of the BBL/BBO and BBP

It is also appropriate to state in this document what we believe to be some scientific and philosophical principles and ideas that should underlie development and operation of the BBP and the BBL going into the 21st century. Some of these were enumerated in Section II. A., but all deserve elaboration.

1. All banding data are potentially valuable if collected carefully and under appropriate animal welfare guidelines. At the same time, the relative value of banding data, and thus the value to cost ratio, varies greatly with the type of banding and is generally much greater when part of well-designed or directed research projects. It would be difficult and probably a waste of effort for the BBL/BBO to try to determine for which projects the costs exceed the potential value of the data. A more fruitful approach is to put effort into increasing the value of banding data (e.g.,

by steering banders to particularly valuable projects, increasing bander training opportunities, encouraging greater reporting of recovered bands), and decreasing the costs (e.g., through electronic data entry and data checking by banders). Both avenues hold great promise.

2. The value of banding data, particularly if not part of an individual research project, can be greatly enhanced by steering banders toward multi-bander projects that require large amounts of data to answer particular research questions. Thus, the BBL/BBO should work with researchers to identify banding efforts that are most needed and should actively encourage multi-bander research projects so identified. Nevertheless, we do not endorse a policy requiring a peer-reviewed, approved research plan before a banding permit can be issued or changes made to an existing one. Not only would the logistics, delays, and expenses attendant on such reviews be unacceptable, but peer reviews would be fatally weakened by the inability to enforce the proposed line of research, especially when banders are not being paid by the permitting agency. A project outline submitted with the request for issuance or renewal of a permit may still be useful as a basis for steering some banders to more valuable projects, as well as for determining training requirements and need for bands.

The same basic principles apply to banding experimental birds (e.g., rehabilitated birds) as wild birds, namely that carefully conducted banding with accurately recorded information (such as age, sex, species, and treatment) is of potential value, but this value is greatly enhanced if the banding is conducted as part of a well-designed research project.

3. The BBP should be driven in all its actions by the needs of the users of banding data: scientists analyzing them to determine basic biological parameters, or land managers charged with stewardship of bird populations. Thus, banding data should be archived in ways easily accessible and useful to such users, and the BBL should routinely canvass its users for suggested improvements in these areas. Users of banding data should be largely responsible for determining criteria for data collection and editing; users should work together with BBL staff, whose chief role in this case would be to endorse and promote acceptable criteria.
4. Bander training is an important means of ensuring high quality data and minimizing costs to captured birds and should be a primary basis for issuance or renewal of a banding permit. Inaccurate or incomplete data on banded birds are, at best, of little value, and, at worst, could detract from the value of the data base as a whole. Training should be encouraged for both new and existing banders to ensure that they are aware of, and able to use, new developments in bird handling techniques, species identification, ageing, and sexing methods, as well as data entry, processing, and management procedures.
5. Desktop computers, both PCs and Macintoshes, are not universal yet, but are ubiquitous. Increasingly, the public is becoming more computer-literate. Rapid improvements in computer hardware and software now allow easy entry, editing, transmittal, storage, retrieval, and analysis of data such as those obtained from banding. We believe now is the time for an immediate, major push by the BBL toward electronic entry of all data by banders (thereby replacing schedules and similar documents and the labor attendant on their handling). Similarly, the use of toll-free telephone numbers to report recoveries allows the electronic processing of much of those data. It is time to begin changing communications between the BBL and its numerous *clients*, wherever possible, to electronic media. The goal should be, to the extent possible, to approach a *paperless BBL*.
6. Banders often collect much accessory data from individual birds, such as recapture information, molt, measurements, condition indices, parasites, and the like. If these could be collected in a standardized fashion by many banders, and archived at the BBL, they would be of great value to a large number of research and management questions. Yet these measurements have rarely been taken systematically, and their reporting and central archiving have up to now been discouraged by the BBL for reasons of data handling, storage, and retrieval.

We believe that with the ready availability of desktop computers and the new ease of electronic data transmission, checking, and storage, the ability to archive these data centrally has been greatly increased. Now is a good time for data users to work with BBL to determine what ancillary data is most usefully stored centrally at BBL, and to begin development of data collection standards. We assume that these data would then be routinely submitted to, and archived

by, the BBL in electronic form. We also believe that the foregoing comments apply equally well to much data obtained from auxiliary-marking programs (e.g., color-marking, wing-tagging, etc.).

7. Criteria for species identification, ageing and sexing methods, and the degree to which they can be applied need to be developed by experts with the needs of data users foremost in mind. Because the BBL has limited staff, most criteria will necessarily be developed by experts outside the BBL (Pyle et al.'s 1987 [and forthcoming, 1997 revised] manual is an obvious example). Once such criteria have undergone peer review, it is imperative they be endorsed by the BBL, and their use strongly promoted by the BBL. Data gathered using such standards should therefore be more easily and speedily accepted by the BBL. To these ends, encouragement and support by the BBL for the development of such external standards is not only appropriate but essential.
8. We considered the issue of banding data ownership. Banders, many of whom are volunteers, spend enormous amounts of time, effort, and money in banding hundreds of thousands of birds each year. In so doing they are rendering a considerable public service. To this end, banders are entitled to some kind of intellectual claim on the data derived from their efforts, should they desire to exercise it; for many scientists, these data are integral to their research careers. At the same time, allowing wide access to data increases the potential for their use to answer biological and management questions. The increased value of data pooled from many banders, and the value of these data for management, is the basis for the U.S. and Canadian government involvement in data editing, storage, retrieval etc. We conclude that the bander/data collector ordinarily has reasonable prior rights to the use of data he/she collected, especially for scientific publication, which should be recognized by any potential users of the data. However, these rights should not be without limits. The current BBL/BBO policy on use of data reflects this balance fairly well.
9. The geographical ambit of the BBP is a question of some immediacy, given that many bird species in the U.S. and Canada are migratory and shared with other countries in the Western Hemisphere, and given manifold concerns about neotropical migrants, the Partners-in-Flight program, and attention focused on the conservation of neotropical avian biodiversity. We do not propose to speak for, let alone dictate to, our Hemisphere neighbors, yet we have interests in common.

There is an urgent need for coordination of banding throughout the Western Hemisphere for many reasons: to ensure that valuable data on migrants are not lost for want of a central archive or through duplication of band numbers; to encourage banding and stewardship of *all* birds in other countries, thus helping to conserve habitat for North American migrants; to understand ecological interactions between resident and migrant birds; and to increase recoveries on their wintering grounds of birds banded in North America. The BBP is uniquely placed to play a leadership role in launching such a scheme, and is also in a strong position to assist Hemisphere countries with development of their own banding schemes, either by providing advice or through development of cooperative programs along any one of many potential scenarios.

10. We discussed both the broad concept of privatizing the entire BBP and the more limited proposal to charge users for the bands they use. While there are some benefits to each, they are outweighed by problems such as administrative costs, potential loss of volunteer banders who provide large amounts of nongame data, the need for quick access to data by the government departments with management responsibilities (who remain the largest users of banding data), and the fact that nearly all gamebird banding, which generates most recoveries and hence carries the highest administrative costs, is already being done by government employees.

III. RECOMMENDATIONS

III. A. Mission Statement and Role & Function of the BBL

Mission: The BBL exists to facilitate provision of high-quality data on the biology and population ecology of migratory birds that can be gained from having large numbers of individually-marked animals. These data can be used effectively for the conservation and management of birds in the U.S., Canada, and elsewhere, as provided by the U.S. Migratory Bird Treaty Act of 1918 (as amended), the Canadian Migratory Birds Convention Act of 1917 (as amended), and any other pertinent treaties, conventions, agreements, and laws.

Role & Function: In meeting its mandate, the BBL must provide state-of-the-art service to bird-banders as well as to other users of bird banding data, including at least the following activities:

1. issuing banding permits, high-quality bird bands, and technical assistance to qualified banders; and promoting, endorsing, and applying training standards developed in house or elsewhere to improve qualifications of permittees and the quality of their data;
2. receiving, editing, and centrally archiving banding data, including original banding data, recoveries, and other data tied to band numbers; this activity is facilitated by providing software to allow banders to edit and submit high-quality data electronically;
3. serving as a clearinghouse for requests for data and information on all aspects of banding, including issuing periodic summary reports on banding activities, uses of banding data, etc.;
4. taking measures to maintain and increase the value of banding data, for example by endorsing and applying data standards developed in-house or elsewhere; by promoting bander participation in well-designed projects (both individual projects and joint projects such as MAPS or the Cornell Cavity Nesting Network); and by promoting increased reporting of recoveries by the public;
5. facilitating communication among banders and among users of banding data to promote the use of new and better techniques;
6. working closely with other governments and banding centers to coordinate banding efforts in North America and in the Western Hemisphere, and exchange information on banding worldwide.

While not be among the **primary** responsibilities of the BBL, it can, and on occasion should, play a key role in the following activities: (a) developing new band materials and new techniques for banding, and (b) aiding the design of computer programs for improved data analysis and easier use of banding data. Even though perhaps less directly related to the BBL mission, actually doing biological research and analyzing banding data might also on occasion be appropriate BBL staff activities.

III. B. Specific Recommendations

Recommendations below are arrayed in several groups, though there is necessarily some overlap between groups, and a few items could arguably go into different sections. They address: (1) **Permitting Procedures and Practices**; (2) **Operational Issues**; (3) **Data Management**; (4) **BBL Organization and Staffing**; and (5) **Implementation**.

1. Permitting Procedures and Practices

- a. ***There should be written guidelines detailing the criteria that must be met for the issuance of new permits and the renewal of existing permits.*** These should be based upon the principles outlined in Section II. D., especially paragraphs 1, 2, and 4, and should be periodically reviewed and revised as needed.
- b. ***New banders should be required to meet training standards before licensing.*** These should at least (1) embrace competence in techniques of capture, handling, species identification, ageing, sexing, record keeping (including the use of computers), and understanding of the scientific uses (and therefore constraints) to which banding data may be put; and (2) minimize adverse effects on the birds being banded and on their dependent young. Demonstration of training, as per the efforts of the North American Banding Council, especially when the use of mist-nets or other techniques having the potential to harm birds is anticipated, should assume a primary role in permit issuance.

- c. **Likewise, there should be written guidelines for the revocation or the non-reissuance of existing permits.** We strongly advocate suspension (and institution of such a category if it does not already exist) or revocation of permits following (1) failure to submit acceptable schedules after having been so notified; (2) failure to meet, within a reasonable time frame, new standards for handling, identification, ageing, or sexing as they are developed; or (3) excessive mortality of birds that can be tied to bander irresponsibility or negligence.

2. Operational Issues

- a. **We recommend that the government agencies responsible for the North American Banding Program look into options to implement a coordinated banding scheme with other countries in the Western Hemisphere.** There is a real need for more and better coordinated Hemispheric banding efforts in order to implement effective conservation and management strategies for North American breeders, as well as for resident Neotropical species. This would include coordination of band numbers, development of data standards so that all data can be computerized on a unified scheme (including data for Neotropical residents), and development of cooperative research projects. The BBL is well-placed to play a leadership role in the technical aspects of getting such a scheme implemented. EURING provides one model of how such a scheme could operate, though many others are also possible.
- b. **We endorse the current policy concerning use of banding and recovery data.** The policy balances the need to recognize that contributors of banding data have a reasonable prior right to analysis and publication of data resulting from their banding, while at the same time allowing use of banding data by others.
- c. **We recommend that the BBL aggressively promote, including advertising, the reporting of all recoveries by toll-free telephone numbers and any other reporter-friendly techniques available.** As a consequence, we also recommend that the BBL plan for a substantial increase in the numbers of recoveries.
- d. **We recommend that the BBL anticipate and plan for an increase in banding data, at an annual growth rate of at least 5%.**
- e. **We recommend that the BBL should plan and budget to always have on hand at least a two-year supply of all band sizes and types.**
- f. **We recommend that the BBL support development of new and better materials for bands, and ways of imprinting letters and numbers on them to ensure longer life, extended legibility, and easy discrimination of similar characters.**
- g. **We recommend that the BBL encourage (by funding where appropriate) research to improve species identification, ageing, and sexing criteria, followed by peer-reviewed publication of the results of those studies.**
- h. **We recommend frequent, peer-reviewed revisions of the Bird-Banding Manual, and its being made available in electronic form (e.g., email; WWW; diskette) as quickly as possible.**
- i. **We recommend that the BBL expand its efforts to involve partners (e.g., BBO, USFWS, banding associations), data users, and banders in decision-making and, as early as possible, in the promulgation of new rules, regulations, procedures, and standards.** In addition to avoiding potential conflicts, these efforts should adequately fill the need, frequently recommended to us, for an ombudsman to represent to the BBL the complaints, interests, and suggestions of banders who are not necessarily scientists or data analysts.

- j. **We recommend that the BBL/BBO should continue to be responsible for authorizing the use of auxiliary markers, based on submission of a research outline, and for ensuring that members of the public receive prompt responses to reports of these markers.** We also recommend that the BBL should ultimately be responsible for coordination of auxiliary marker schemes, but we endorse the current procedure of delegating some of this responsibility (e.g., allocation of particular marker types, colors, and placement combinations) to specialist groups, and of requiring some users to deal directly with reports of their auxiliary markers by the general public. This is an important area that will continue to need attention by BBL biologists, particularly as we anticipate a substantial growth in the use of auxiliary markers for many research projects, especially in view of their value for greatly enhancing recovery rates, etc.
- k. **We recommend that reporting procedures allow use of site latilong coordinates to the level of precision the bander is able to determine.** For many studies (e.g., MAPS) a finer grid is required and available, especially now that handheld Global Positioning Systems (GPS) have become inexpensive and readily available. As a minimum, replacing the old 10-minute standard by a 1-minute standard is now appropriate, but provision should be made for storing even greater precision when it is available and appropriate to a research project.
- l. **We support the idea of phasing BBL's system of MTABs into electronic form for more efficient and widespread distribution.** We also urge that the BBL and the BBO publish joint annual reports which should also be available electronically.

3. Data Management

- a. **We recommend that electronic input of all data by banders, as well as exchange of data in both directions between the BBL and banders, is a goal to be reached as swiftly as possible.** The number of banders who do not own computers is a shrinking minority (a small proportion of existing banders may never switch to computers and this can be accommodated). We recognize that recoveries by non-banders will still continue to reach the BBL by every means conceivable, and there is little that can be done to change that beyond promoting expanded public use of (especially) toll-free telephone numbers, email, and the like.
- b. **We recommend that immediate priority be given to development of user-friendly computer software to enable the shift described above. We strongly recommend that this software include automatic screening/editing features so that banders will be able to edit their own data before sending them on to the BBL.** This will speed up BBL's data-handling and reduce the number of rejected/suspicious entries received from banders. If outside contractors are selected, BBL staff should work exceptionally closely with software developers. Software should be made available for all computer platforms commonly used by banders; at present, these include both Macintoshes and IBM-compatible PCs.
- c. **We recommend that the BBL build the capacity to process and store pre-edited recapture data, auxiliary marking data, and additional data such as molt, morphometrics, weight, fat, etc.** These are potentially very important sources of biological information that are not being systematically stored for analysis in North America. In particular, recapture data, including next day captures, are of particularly high value, frequently exceeding the value of recoveries for studies of demography or movements. The potential load on the BBL is large, so at least initially BBL should accept such data only if (1) they are collected using standardized methods as part of an established program designed to use such data; and (2) responsibility for computerizing and editing these data are borne virtually entirely by the banders through standard data entry and editing programs that the BBL will participate in developing and distributing.
- d. **We recommend that the BBL immediately undertake a modernization of their current minicomputer / terminal-based system to a system with a true client-server relationship, and that**

permits the storage of all data in on-line relational databases. We recommend that immediate plans be made for obtaining the necessary hardware to enable such a shift, and that frequent upgrading and replacement of hardware be planned and budgeted. We leave the details of the particular system to those charged with implementing our recommendations, but suggest that careful consideration be given to utilizing an outside computer-system engineer as a consultant in the design and implementation of the new system.

- e. *We recommend that the BBL's standard database be reformatted quickly to incorporate new data fields such as data quality flags, how-aged and how-sexed codes, and any additional data that are to be stored centrally as per recommendation (c) above.* We firmly believe the initial BBL costs of meeting this goal will be quickly offset by the increased efficiency achieved by the handling of these data entirely electronically.
- f. *We recommend that the new data base be designed with maximal flexibility, to allow easy modification to accommodate new types of data as needs arise, and that flexible software routines be developed to facilitate extraction of data from the central database for data analysis.*
- g. *We recommend that the current level of data-editing by the BBL be maintained or enhanced; it is more efficient for data to be checked and edited once centrally than for this effort to be duplicated by several data users, and the BBL is in a much better position than data analysts to contact banders regarding any queries of the data.* Effort required by the BBL to achieve this level should decrease over time as banders convert to editing and submitting their data electronically.
- h. *We recommend that high priority be given to cleaning historical data that have been computerized but not fully edited and/or corrected. We also recommend that some consideration be given to bringing non-computerized historical data, including those pre-1955, into alignment with contemporary standards and computerizing them, as the costs involved are probably outweighed by the benefits potentially accruing from resuscitated, vetted, and readily accessible long-term datasets.*
- i. *We recommend that banding data never be deleted from master files unless proven erroneous. Merely doubtful data should be so flagged, and unusual or suspect data that have already been verified should likewise be distinctly tagged.*

4. BBL Organization and Staffing

- a. *We recommend that the Electronic Data Processing Section at Patuxent Wildlife Research Center be reorganized, charged solely with meeting the needs of the BBP, and become part of the BBL.* New positions for an experienced microcomputer/desktop programmer, a database manager, and a systems analyst would materially aid this shift in function.
- b. *We suggest that additional staffing is necessary, and should include expertise in at least the following three areas: (1) a combination data-analyst/biologist with strong training in biometrics;(2) a non-gamebird biologist with expertise in avian zoogeography, ageing/sexing criteria, and species delimitation, perhaps involving neotropical species; and (3) a gamebird biologist with a strong population background.* These persons will aid the Director in the growth and development of the new program for the BBL/BBP, particularly through their ability to work with and understand the needs of users of the banding data. We also assume no further loss of BBL FTEs, and that presently vacant positions will be expeditiously filled in line with our recommendations here and immediately below.
- c. *We recommend that several biological technicians with demonstrated capabilities in avian distribution, ageing, sexing, and identification also be added to the BBL staff, augmented by*

adequate numbers of editing and clerical staff. These persons will support the scientists on the BBL staff, and their actual numbers will be determined by need, especially as our recommended computerization update occurs.

- d. **We recommend that enhanced links be made between other researchers at Patuxent and the BBL, including through cross-appointments, to provide additional expertise related to bird-banding data and their use that may not be present within the BBL staff.**
- e. **We recommend that an integrated career ladder for staff at the BBL be developed so that staff can be retained while increasing in experience and competence.**
- f. **We recommend that the position of Director of the BBL, recognizing its global prominence and expanding role, be elevated to GS-15.** Requirements for the position of Director should include knowledge and experience in banding programs, a research track record, and considerable management skill.

5. Implementation

- a. **We recommend that an Implementation Team be appointed immediately to effect the recommendations that we have made in this document**
- b. **Our overall priorities are to improve efficiency of the Banding Lab and improve the quality of banding data. Thus our highest priorities for implementation are:**
 - i. **reorganization of the BBL, to be completed as soon as possible;**
 - ii. **development of user-friendly software allowing banders to pre-edit and submit all data electronically, to be completed by 30 September 1999; and**
 - iii. **modernization of the BBL database, to be fully operational by 30 September 2000.**
- c. **We recognize that extra funds will be needed to bring about all of the changes we outline, particularly in the short term. However we believe these changes will bring about a more efficient operation and greatly increased value to the whole Bird Banding Program.**
- d. **We recommend that all of the changes that are adopted be promoted widely, nationally and internationally, in the scientific, land management, and bird-banding communities.**

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We received suggestions as to what topics we should cover (as well as, sometimes, exactly what we should say), from a number of interested banding data users, as well as banders and concerned citizens. They are listed following, and we trust we have omitted no one; if so, it was entirely unintentional and we offer our apologies up front.

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