Overview of National Bird Population Monitoring Programs and Databases

Gregory S. Butcher[1], Bruce Peterjohn[2], and C. John Ralph[3]

Abstract — A number of programs have been set up to monitor populations of nongame migratory birds. We review these programs and their purposes and provide information on obtaining data or results from these programs. In addition, we review recommendations for improving these programs.

INTRODUCTION

Management action to protect wildlife requires good information on status and trends of wildlife species that need protection. Some try to shortcut the process by monitoring the status and trends of habitats, assuming that if habitat is intact, then all wildlife species preferring that habitat will be protected. However, a number of factors can cause one or more wildlife species to disappear from appropriate habitat, including disease, predation, weather extremes, lack of food, and subtle habitat deterioration. In addition, migratory birds can disappear from appropriate habitat due to problems during seasons when the species is away from the habitat under consideration. Thus, the Monitoring Working Group of Partners In Flight strongly recommends that managers have access to current information on status and trends of all birds under their jurisdiction.

In their Needs Assessment (Butcher 1992), the Monitoring Working Group made a number of recommendations to improve monitoring of birds in North America: (1) improve the Breeding Bird Survey (BBS), (2) establish a national system of habitat-specific point counts, (3) establish a new system to monitor northern-breeding species during migration (especially birds breeding in the boreal forests of Canada and Alaska), (4) improve analysis of hawk migration counts, (5) include neotropical migrants in contaminants monitoring programs, (6) analyze constant-effort mistnetting and nest searching to evaluate their validity as indices of reproductive and survival rates, and (7) analyze banding data to link wintering and breeding grounds and to determine survival rates.

Monitoring bird habitats was considered just as important as monitoring bird population levels. Specific recommendations included: (1) summarize what is already known about avian habitat requirements, (2) identify habitat types important to birds but not currently monitored, (3) compare bird trends to trends of their required habitats, (4) identify species most likely to be limited by a particular habitat, (5) for these species, determine the effect of management practices on suitability of their habitat and determine status and trends of limiting habitat, (6) create a common vocabulary of habitats that corresponds with management activities, (7) monitor habitats along BBS routes, and (8) study effect of land use practices (human activities in addition to habitat) on bird populations.

Much more monitoring will be required on government lands; this will require a compromise between quantity and quality of information collected and cost. It is vital that all agencies inventory their lands to measure presence, distribution, and relative abundance of neotropical migrants in specific habitats in all seasons. Inventory and monitoring should be linked to specific management activities that might affect migrants. Some recommendations are: (1) 50% of all monitoring should be systematic, encompassing all habitat types and all bird species, (2) 25% of monitoring effort should be allocated to rare habitat types and rare bird species, (3) 25% of monitoring effort should be allocated to studies of reproductive and survival rates, (4) monitoring should emphasize breeding season first, wintering season second, and migration season third, (5) some effort should be spent to determine importance of particular areas as migration stopover sites, (6) states should be involved in monitoring, (7) the Monitoring Working Group should collate information on costs of running various monitoring schemes, and (8) a National Interagency Data Center for monitoring information should be formed to which all participants in Partners In Flight should contribute.

[1]*Cornell Laboratory of Ornithology, 159 Sapsucker Woods Road, Ithaca NY 14850; Current Address: American Birding Association, P.O. Box 251, Etna NY 13062.*

[2]*Breeding Bird Survey, Office of Migratory Bird Management, U.S. Fish and Wildlife Service, Laurel MD 20708.*

[3]*USDA Forest Service, Redwood Sciences Laboratory, 1700 Bayview Drive, Arcata CA 95521.*

Partners In Flight is an international program, and a tremendous need exists for monitoring both birds and their habitats south of the United States border. Specific recommendations include: (1) coordinate bird monitoring with existing biodiversity conservation programs, (2) fund local scientists to do training and fieldwork, (3) promote long-term relationships between U.S.-based and local scientists, (4) determine objectives and priorities of a coordinated international monitoring program for migratory birds and endemics, (5) monitor habitats using remote sensing and GIS techniques, (6) combine bird and habitat information to extrapolate effects of habitat change on wintering bird populations and endemics, (7) promote local analysis of remote sensing data, (8) promote habitat-specific point counts as a major bird monitoring technique, (9) teach local observers to identify birds by sight and sound, (10) promote mistnetting as a major bird monitoring technique, (11) establish bird banding protocols for Latin America and the Caribbean, preferably in cooperation with the U.S. Bird Banding Laboratory, (12) seek sources of long-term funding, but support short-term projects if long-term funding is not available, (13) plan a series of meetings south of the U.S. border to promote monitoring, and (14) prepare a bird monitoring handbook for Latin America and the Caribbean that addresses both migratory birds and endemics.

In addition to the many recommendations for monitoring, the Needs Assessment provided a theoretical perspective on monitoring, reviewed major bird and habitat monitoring programs in North America, provided a bibliography of habitat classification schemes for North America, provided a comparison of the kinds of data collected using a variety of bird monitoring techniques, and provided a preliminary list of high priority species.

The Needs Assessment was prepared under the auspices of Partners In Flight by participants at the Monitoring Working Group meeting in Arlington, Virginia, on September 4 & 5, 1991. Revisions were suggested by many of the participants and a few others through April 15, 1992. Meeting participants were divided into five subgroups: Monitoring Theory and Practice, North American Bird Monitoring, North American Habitat Monitoring, Agency-specific Bird Monitoring, and International Monitoring. Each group was asked to identify goals, describe existing programs and problems, and identify research needs and recommendations.

The Monitoring Working Group will continue, and many issues will be revisited. Thus, the group welcomes comments and suggestions for revision. Please direct these comments to the Chair of the group, Greg Butcher, American Birding Association, P.O. Box 251, Etna NY 13062, (607) 254-2412, FAX: (607) 254-2441, or to another member of the Working Group.

Many states and agencies are implementing new point count programs. It is hoped that a new national data center will be organized to store point count and other data. Contact the author or other representatives of the Monitoring Working Group for progress reports.

Many states have special research and monitoring programs for birds. Contact the Nongame Program of the state fish and wildlife agency, or contact Naomi Edelson, International Association of Fish and Wildlife Agencies, 444 North Capitol Street, Suite 534, Washington DC 20001.

Many states have also implemented a Computerized Fish and Wildlife Information System covering individual species and their characteristics. Information on these databases can be obtained from the Fish and Wildlife Information Exchange, 2206 S. Main Street, Suite B, Blacksburg VA 24060. The exchange also has a number of national databases, including the BBS, endangered species information system, and marine and coastal species information system. New databases are being acquired by the Exchange.

NORTH AMERICAN BIRD MONITORING

Goal Statement

To identify a suite of data collection methods and analytical techniques that would adequately monitor populations of all neotropical migrant species in every geographic region of the continent, and would monitor demographics of a select group of neotropical migrant species in all regions of the continent.

Existing Programs

This subgroup identified a number of existing survey programs that have potential to contribute to a national monitoring scheme. These programs fit into two major categories: those measuring population trends and those measuring demographic parameters.

I. Population Trends.

A number of international and national programs provide information on population trends. They can be classified into four groups based on sampling procedure used to obtain data: point counts, spot-mapping, area searches, and banding.

A. Point counts

1. Breeding Bird Survey (BBS)
   a. Purpose: To monitor populations of North American breeding birds.
   b. Geographic extent: North America (United States and Canada).
   c. Resolution: 1-16 routes per degree block of latitude and longitude.
   d. Frequency: Once per year.
   e. Methods: Randomly placed roadside counts throughout North America. Each route is run once during the breeding season, and consists of 50 3-minute point counts spaced 1/2 mile apart. 3500 routes total, about 2200 run each year, all done by volunteers.
   f. Availability and form of data: Data available in many forms to researchers with no charges; summaries of population trends printed regularly.
   g. Status: Ongoing, 1966-present.
   h. Contact: Bruce Peterjohn, FWS, Breeding Bird Survey, Laurel, MD 20708, (301) 498-0330, FAX: (301) 497-6335.
   i. Cooperators: Joint venture between Canadian Wildlife Service (CWS), FWS, state/provincial coordinators, and thousands of volunteers.

2. Forest Bird Monitoring Program
   a. Purpose: To determine species of birds breeding in forest stands of known vegetation and in a known landscape.
   b. Geographic extent: Ontario, similar projects in Vermont and Connecticut.
   c. Resolution: Single unlimited distance point counts, grouped by five points to cover a forest stand of about 25 hectares.
   d. Frequency: Each point is visited twice per year.
   e. Methods: Unlimited distance point counts.
   f. Availability and form of data: Contact Dan Welsh (address under h.).
   g. Status: Ongoing since 1987.
   h. Contact: Dan Welsh, CWS, 49 Camelot Drive, Nepean, Ontario, CANADA, K1A 0H3, (613) 952-2405.
   i. Cooperators: CWS and volunteers.

3. Hawk Migration Counts
   a. Purpose: To monitor populations of diurnal raptors as they fly by particular locations chosen for good visibility or for possibility that migrant raptors are concentrated at those sites.
   b. Geographic extent: Most sites are in eastern U.S., although more western sites are being added each year.
   c. Resolution: Unknown.
   d. Frequency: Some sites covered daily during spring or fall migration seasons; many sites covered each weekend during migration; others covered sporadically.
   e. Methods: Most hawkwatch sites have a single official counter each day; some sites have one or a few individuals for an entire season. Counters mostly observe with naked eye and binoculars.
   f. Availability and form of data: Data published in Hawk Migration Studies, the journal of the Hawk Migration Association of North America (HMANA). Many sites fill out standard HMANA forms; data from some sites have been computerized.
   g. Status: Many sites ongoing; Hawk Mountain counts date back more than 50 years.
   h. Contact: Seth Kellogg, 377 Loomis Street, Southwick MA 01077; Steve Hoffman, . Western Foundation for Raptor Conservation, Box 304, Albuquerque NM 87103; Hawk Mountain, Route 2, Kempton PA 19529.
   i. Cooperators: FWS, many others.

B. Spot-mapping

1. Breeding Bird Census (BBC)
   a. Purpose: To determine population densities of breeding birds in specific habitats.
   b. Geographic extent: North America (United States and Canada).
   c. Resolution: Plots of 10-200 hectares, chosen by local observers.
   d. Frequency: Most sites censused only once; a few have been done for 50+ years.
   e. Methods: Each year more than 100 BBCs are done on plots of uniform vegetation. The BBC uses spot-mapping method, which requires at least eight visits to a study site during the breeding season (Anonymous 1970). Many BBCs are accompanied by quantitative vegetation studies (James and Shugart 1970, James 1978).
   f. Availability and form of data: A computerized database exists of more than 4,000 BBCs dating back to 1937. BBCs published each year in Supplement to Journal of Field Ornithology; previous years published in publications of National Audubon Society.
   g. Status: Ongoing, 1937-present.

h. Contact: Sam Droege, Office of Migratory Bird Management, Patuxent Wildlife Research Center, Laurel MD 20708, (301) 498-0940.
i. Cooperators: Association of Field Ornithologists (publisher of supplement), National Audubon Society (original sponsor of BBC program).

C. Area searches

1. Breeding Bird Atlases (BBAs)
   a. Purpose: To determine distribution and reproductive status of breeding birds.
   b. Geographic extent: 28 U.S. states and seven Canadian provinces have completed or will soon complete atlas projects (Smith 1990).
   c. Resolution: Varies by state, often blocks that are three miles by three miles, occasionally one latilong (one degree of latitude by one degree of longitude).
   d. Frequency: Most BBAs are five-year projects; some have suggested that atlases should be repeated perhaps 20 years later, but no North American atlas has yet been repeated.
   e. Methods: Volunteers go out into an atlas block during the height of breeding season, seeking evidence of breeding. Evidence ranges from "possible" through "probable" to "confirmed" breeding (adult feeding young, nest with eggs, etc.). Some but not all atlases include quantitative methods to estimate abundance of breeding birds. See Smith (1990) for details.
   f. Availability and form of data: Varies by state and province. Most atlases are fully computerized, but may be difficult to access once atlas is completed.
   g. Status: Varies by state and province. Many completed in the past few years; rest will be completed in next few years.
   h. Contact: Most recent list of contacts by state and province is available from Sally Laughlin, North American Ornithological Atlas Committee, P.O. Box 157, Cambridge VT 05444, (802)644-5651, for $2.
   i. Cooperators: Most atlases have been cooperative ventures between the state wildlife department and the state bird club, often with a variety of other cooperators.

2. Audubon Christmas Bird Count Database (CBC)
   a. Purpose: Count: To provide a forum to express recreational and conservation interest in birds during the winter holiday season. Database: To monitor population dynamics of North American birds in winter.
   b. Geographic extent: 1,600 locations in North America, Hawaii, West Indies, Mexico, and Central America.
   c. Resolution: 15-mile diameter circles.
   d. Frequency: Once per year.
   e. Methods: A variety of methods are used to collect data; most frequent methods include travel by foot or motorized vehicle during the day and night and counting birds at feeders by stationary observers (Butcher 1990). Most analyses control for effort when comparing numbers of birds through space or time (Bock and Root 1981, Butcher and McCulloch 1990).
   f. Availability and form of data: Data published by National Audubon Society as an issue of American Birds. Data available from the FWS database by species or by count location on paper or in a computer file.
   g. Status: Ongoing, 1900-present. Database: 1960-89; FWS may add more recent years and Latin American locations.
   h. Contact: Count Organizer: Geoff LeBaron, American Birds, 950 Third Avenue, New York NY 10022, (212) 546-9191. CBC Database: Sam Droege, Office of Migratory Bird Management, Patuxent Wildlife Research Center, Laurel MD 20708, (301) 498-0940.
   i. Cooperators: Count: Leica, most state and local bird clubs in North America. Database: John Shipman, Carl Bock, Terry Root, National Audubon Society, Cornell Lab of Ornithology.

* Banding programs will be considered in the next section, since banding allows collection of demographic data in addition to population levels.

II. Demographic Information.

At present, only three sampling procedures provide demographic information on bird populations: mistnetting, nest monitoring, and bird banding.

A. Mistnetting

1. Monitoring Avian Productivity and Survival (MAPS)
   a. Purpose: To use constant effort mistnetting to provide annual regional estimates of post-fledging productivity, adult survivorship, recruitment into adult population, and adult population size for both resident and neotropical migrant landbird species.
   b. Geographic extent: North America (U.S. and Canada).

c. Resolution: MAPS sites cover about 10 hectares.
d. Frequency: One to ten days during 12 10-day periods from May through August; repeated annually.
e. Methods: MAPS uses standardized, constant-effort mistnetting during breeding season at a continent-wide network of stations. It uses methods pioneered in Great Britain (Baillie et al. 1986, Baillie and Holden 1988, Peach and Baillie 1989, 1990, Peach 1991, Ralph et al. 1992).
f. Availability and form of data: Contact David DeSante (see address under h.).
g. Status: Ongoing since 1989.
h. Contact: David F. DeSante, The Institute for Bird Populations, P.O. Box 1346, Pt. Reyes Station CA 94956, (415) 663-1436.
i. Cooperators: FWS, FS, NPS, numerous state agencies and private organizations, many individual bird banders.

B. Nest Monitoring

1. Breeding Biology Research Database (BBIRD)
a. Purpose: To use nest monitoring to measure breeding productivity in microhabitats and across broad geographic regions.
b. Geographic extent: Program currently active in Arizona, Arkansas, California, Idaho, Utah, Texas, Minnesota, Ohio, New York, Missouri, and North Carolina; it could potentially operate throughout North America.
c. Resolution: 50 hectare study plots.
d. Frequency: Intensive nest searching throughout breeding season; nests revisited every 3-4 days.
e. Methods: Finding and revisiting bird nests, recording number of eggs and young birds in nest during each visit; plus series of point counts.
f. Availability and form of data: Contact Tom Martin (see address under h.).
g. Status: Ongoing in 11 states.
h. Contact: Tom Martin, Arkansas Cooperative Fish and Wildlife Research Unit, Biological Sciences SCEN 632, University of Arkansas, Fayetteville AR 72701, (501) 575-6709, FAX: (501) 575-4010.
i. Cooperators: State Coop Units.

2. Nest Record Program (NRP)
a. Purpose: To determine nesting habitats, nesting seasons, clutch size, incubation and nestling periods, and nesting success rates for North American birds.
b. Geographic extent: 49 continental United States; there are six regional Canadian nest record schemes.
c. Resolution: Single nest sites, plus habitat in immediate vicinity.
d. Frequency: Half the nests are revisited once or twice per week.
e. Methods: Finding and revisiting bird nests, recording the number of eggs and young birds in nest during each visit.
f. Availability and form of data: All data available as xeroxed 4x6 cards; about half data on computer. Fee charged to defray retrieval costs.
g. Status: Ongoing, 1965-present
h. Contact: Pixie Senesac, Cornell Laboratory of Ornithology, 159 Sapsucker Woods Road, Ithaca NY 14850, (607) 254-2416, FAX: (607) 254-2415.
i. Cooperators: Nebraska Ornithologists Union, Brooks Bird Club, Michigan Audubon Society, Detroit Audubon Society, Kalamazoo Nature Center, Iowa Nongame Program, Upstate New York Bluebird Society, other bird clubs and individuals.

C. Bird Banding

1. Bird Banding Laboratory (BBL)
a. Purpose: To organize and regulate bird banding permitting process in North America, especially for information on migration, movement, survival, and population status of species. Estimates of survival cannot be calculated from nongame banding information currently collected by BBL. However, some individual banders do collect that information and can be reached through BBL. BBL does not currently encourage routine collection, dissemination, and analysis of recapture and return data (see below).
b. Geographic extent: North America (U.S. and Canada).
c. Resolution: Uncertain.
d. Frequency: Variable.
e. Methods: Most birds captured with mistnets; many captured in a variety of traps. Birds banded with metal leg bands; many color-marked with plastic leg bands or by other means.
f. Availability and form of data: Bird banding data available on computer from BBL.
g. Status: Ongoing since the 1920s.
h. Contact: Bird Banding Laboratory, Office of Migratory Bird Management, Laurel MD 20708, (301) 498-0423.

i. Cooperators: CWS, three regional bird banding associations (Eastern, Inland, and Western), and a number of state and provincial associations.

A number of federal, state, and private agencies, as well as citizens, have developed (or are developing) smaller scale programs to monitor bird populations on their lands. We urge these people to adopt standard methods recommended by this working group and to contribute their data to the proposed National Data Center.

Actions to be Taken

Most programs listed above are undergoing statistical evaluation. Thus final recommendations for a system of nationwide monitoring programs cannot be made until those evaluations are complete. However, enough is known to recommend several items for immediate action.

Population Trend Monitoring Programs

Improve the Breeding Bird Survey (BBS). The BBS should continue to monitor roadside bird populations under direction of FWS and CWS. This program needs to be expanded in regions currently inadequately covered, especially portions of Canada and the western U.S. Increased cooperation and coordination with various federal and state agencies and private groups will be necessary to cover these remote areas. Responsibility for coverage of BBS routes located on federal or state lands should be that of the agency that manages that land. The critical agencies will be BLM and FS in the West and BLM, NPS, FS, and state in Alaska. On lands controlled by Native Americans, surveys should be coordinated through their natural resources group. Increases in coverage began during the 1992 field season and should continue in 1993.

Two potential biases have been identified that could compromise the meaning of population trends calculated from BBS data. Overcoming these biases will require two major actions:

Improve Coverage of North America. BBS statisticians estimate that over 80% of all neotropical migrants whose breeding range is primarily in the United States are adequately surveyed by the BBS. For some species, however, the BBS monitors only a portion of the species' entire range; core populations of many of these species are under-represented or entirely missed by BBS coverage. Boreal breeders and species whose range is primarily Mexican are two groups poorly surveyed by BBS. BBS trends for these species are not representative of the species as a whole. Presentation of "continental" BBS trend data must be qualified to factor in the match between surveyed and unsurveyed portions of species ranges.

Study the bias caused because BBS is a roadside survey. Since BBS is a roadside survey, roads are over-represented by definition. Boreal areas of Canada and Alaska and the arid lands of the western U.S. all have vast roadless areas that cannot be represented by this system. Within paved areas, the bias varies with region and hasn't been quantified. However, habitats such as peatlands, marshes, and alpine areas are probably under-represented by BBS.

While most common bird species may not occur on BBS routes in proportion to their population size, they almost always occur in sufficient numbers to calculate population trends. If population trends along roads do not mirror population trends away from roads, then roadside bias is a problem. We suggest that research into roadside bias of trends be made a high priority by agencies that use information from roadside surveys. Some work in this area is underway (e.g., R. Hutto, C. Keller and M. Fuller, R. O'Connor).

Develop a system of habitat-specific point counts to complement BBS. This system would use point counts both on and off roads. We envision the following framework:

Many details of point count methodology were worked out at the point count workshop in November of 1991. However, a sampling framework needs to be developed. Preferably, the program would be integrated and managed within EPA's EMAP system. A Canadian counterpart to EMAP sampling frame could be developed. Data would be stored at a single interagency data center where it would be analyzed and disseminated to managers and researchers.

The multiscale data collection system would be hierarchical. Information collected by governmental agencies, private organizations, and individuals would be standardized and could be recombined at different scales with the system maintained within EMAP. In this manner, local monitoring projects could provide data that would become valuable at a regional or national level.

Habitat information would be collected at each site through both remote sensing analysis and point sampling techniques.

If widely adopted in the U.S. and Canada, this program would eliminate many deficiencies associated with BBS coverage (possible roadside bias in habitat sampling or in bird sampling, lack of habitat-specificity in analyses). The EMAP scheme within the U.S. could provide a good portion of the sampling framework and logistical support. However, directly surveying boreal Canada will be expensive.

Conduct a workshop on monitoring during migration. Bird populations breeding in boreal habitats are unlikely ever to be monitored on the breeding grounds. Migration banding stations provide an opportunity to monitor these populations as they move north or south. While many migration banding stations exist, little has been done to systematically evaluate potential of these data for calculating trends. CWS is currently funding a summary of current status of migration monitoring stations. We suggest a workshop be held in 1992 or 1993 to evaluate potential

of these stations and to look at ways to validate population indices derived from migration counts. After the workshop, validation studies should be funded to experiment with methods and to determine if migration population indices can be valid. Deployment of additional stations should await validation studies.

If validation studies are positive, a series of migration monitoring stations should be established along the northern edge of more densely inhabited regions of Canada in 1994. These stations would be used to estimate population trends for species breeding to the north. These stations would be staffed with members of provincial ornithological societies with information entered and analyzed by CWS. Migration monitoring stations may also prove useful farther south; results of such stations should be compared to breeding season studies in nearby areas for validation.

Techniques should be reviewed for establishing importance of particular areas as migration stopover sites. Areas of particular importance may be mostly coastal sites (Gulf of Mexico, Atlantic Coast, Pacific Coast, Great Lakes), but might include small forest fragments in corn and wheat belts, in deserts, along riparian corridors, and in urban areas.

Point counts can be used in addition to or instead of captures to monitor birds during migration. Standardization of techniques and effort is as important during migration as it is during the breeding season. Thus, most recommendations of the point count workshop of November, 1991, apply to point counts in all seasons.

Use data from raptor migration counts. As with migration banding data, questions have been raised concerning suitability of raptor migration data for monitoring population trends. Recommended methodology such as that established by the Hawk Migration Association of North America (HMANA) will improve the quality of raptor migration data for these purposes.

Expansion of hawk migration data collection at the expense of other programs is not recommended. Current efforts in the Midwest and the East are enough to monitor trajectories of boreal populations of common raptors. Raptors breeding south of the boreal forest will be monitored more effectively by BBS and other systems being set in place. Western boreal populations are difficult to monitor because there are relatively few raptor migration concentration points in the West; however, HawkWatch International and others are expanding efforts to monitor western raptors.

Monitor exposure to toxic chemicals. Exposure to toxic chemicals may be a substantial threat to survival and reproduction of neotropical migrants. The major toxic chemicals that should be monitored are heavy metals, polychlorinated biphenyls (PCBs), and pesticides (carbamates, organophosphates, and organochlorines). Monitoring of toxic chemicals may be more important for neotropical migrants than for resident birds because a number of organochlorine pesticides that are banned in North America are still used in Latin America. We need a focused program to determine impact of organochlorines on neotropical migrants, as well as a more general program to assess impact of other listed chemicals.

FWS has had a National Contaminant Biomonitoring Program in place since the mid-1960s and is currently considering a proposal to expand that program under the name of Biomonitoring of Environmental Status and Trends (BEST). Neotropical migrants should be included in the FWS program.

The Environmental Protection Agency plans to monitor toxic chemicals as part of its Environmental Monitoring and Assessment Program (EMAP). If birds are monitored on the same scale as chemicals, the EMAP program might produce useful information on effects of toxic chemicals on birds.

Use data from other established programs. Data from other programs that collect bird population information can provide a valuable supplement to information gathered by the aforementioned programs. Some of those programs include Breeding Bird Censuses, Christmas Bird Counts, May counts, and checklist databases.

Demographic Monitoring Programs

Data on productivity, survivorship, and recruitment are essential for understanding dynamics of bird populations. These data also assist in identifying possible causes for population declines; for example, high productivity and poor survivorship for a given species may indicate that population declines are a result of factors on wintering grounds rather than breeding grounds. These demographic data would supplement population trend data obtained from other programs and are considered important for a continental monitoring program.

Constant effort mistnetting can provide habitat-specific survivorship data as well as data on productivity (although mistnets may catch some birds more typical of nearby habitats). It is less labor intensive than systematic nest searching and appears to be more suitable for a regional/continental monitoring program. Since the MAPS program has only been recently implemented, its full potential is uncertain. However, a similar program in Great Britain seems to provide useful demographic data for a number of passerine species (Baillie et al. 1986, Baillie and Holden 1988, Peach 1991).

Systematic nest searching produces habitat specific information on habitat requirements, nesting success, productivity, and population trends of neotropical migrants. These data provide an extremely useful supplement to population trend and demographic data obtained from other programs.

To understand the full capabilities of constant effort mistnetting and systematic nest searching programs, we recommend the following actions:

1. Constant effort mistnetting should be implemented as a pilot project in the northeastern and northwestern portions of the continent to test applicability in North America.

2. Efforts should be made to validate indices derived from constant-effort mistnetting by in-depth studies at a sample of sites.

3. If results of this pilot project indicate that constant effort mistnetting will provide useful demographic data for a variety of neotropical migrants, then it should be expanded to a continental program. At least 240 constant effort stations would be required to achieve continental coverage.

4. Systematic nest searching (as envisioned by the BBIRD program) should be implemented as a pilot project in at least 10 states.

5. Both mistnetting and nest searching should be simultaneously implemented at a number of sites to produce a more complete picture of habitat-specific demographic parameters and to compare usefulness of the two approaches.

6. Sites where mistnetting or nest searching are ongoing should include point count data for integration into population trend databases.

Make more use of bird banding data. The Bird Banding Lab (BBL) should promote publication of an atlas of recoveries of neotropical species by the end of 1992. More banding of neotropical species on their breeding and wintering grounds should be encouraged to better connect the breeding and winter ranges of specific populations of these species. However, banding recovery rates for birds banded in migration is so low (far less than 1%) that a specific program to increase migration banding would not be a wise use of limited funds, unless constant effort mistnetting during migration provides a valid index of trends and productivity of a defined population.

Unlike programs ongoing in Great Britain, U.S. and Canadian bird banding data maintained by BBL cannot be used to calculate estimates of survival. Information on recaptures and returns of banded birds are not stored, and without this information survival estimates cannot be calculated. A means of collecting, storing, and disseminating this information needs to be developed at BBL, along with recommendations on how to collect this information to avoid bias. A simple software package, similar to the current banding schedule generator, that permits the bander to enter, store, and mail that information to BBL is currently under development. Upon completion, data from this program would be stored at the Lab and made available to outside groups. The FWS's Office of Migratory Bird Management should assign their statistician the task of developing a standard analysis of the cumulated information with the object of determining sources of bias and the possibility of obtaining national survival estimates.

Distribution Monitoring Programs

At this time, the best source of distributional data for rare neotropical migrants are provided by Breeding Bird Atlas projects (the BBS data are better for common species). These projects can provide reliable data on current ranges. If regularly repeated, these projects can provide reliable data on range expansions and contractions. The standards for coverage should follow those developed by the North American Ornithological Atlas Committee (Smith 1990). Complete coverage of all blocks is essential to obtain data useful for establishing range changes.

Checklist databases may provide useful distributional and trend data. Successful projects based on checklists have been developed in Quebec and Wisconsin and could be applied elsewhere. These databases provide information on all seasons of the year, not just during the breeding season, and may provide useful information on changes in migrating birds. We recommend that the FWS Office of Migratory Bird Management investigate potential for developing an International Checklist Program, including validation studies.

The Measure of a Successfully Established National Bird Monitoring Program

A North American bird monitoring program will be considered to be successfully established when all of the following goals have been met:

1. Population levels of 99% of all neotropical migrant species are monitored within at least 75% of their total ranges.

2. We have a monitoring program for each species that will permit us a 90% chance of detecting a 50% decline in a species' population over a 25-year period.

3. Demographic parameters are monitored on a continental basis for 20% of neotropical migrant species so that we have a 90% chance of detecting a 50% decline in productivity between years. Demography of rare and declining species should be studied in species-specific research projects.

4. Significant distributional changes of all neotropical migrant species in North America are being monitored and described.

AGENCY-SPECIFIC BIRD MONITORING

Introduction

Local monitoring programs face a number of challenges. The money used to implement monitoring programs is usually limited, is usually not considered part of the base operating expenses, and is often taken from other nongame projects. In some cases monitoring is not optional but mandated by law. Whether or not monitoring is mandated, close inspection of the purpose behind monitoring, long-term expense of the system, and statistical design should be considered prior to the project's start.

The need for monitoring does not decrease with time. Design of a permanent system must be flexible enough to withstand most long-term changes projected for the site. With a permanent design comes permanent costs associated with collection and analysis of data. The system must be robust to changes in observers, the likelihood of not having someone on staff who is capable of censusing birds, and changes in access to sampling sites.

Any monitoring system for neotropical birds will miss some species. In almost all cases, common species will be most accurately tracked while rare species will be missed. However, rare and uncommon species are usually in the most need of monitoring and protection. In such circumstances, the monitoring program will need to be supplemented by an inventory program and a research program focused on species of special concern.

Given that not all agency managers will have budgets to develop all-inclusive monitoring programs, compromises will be made. Fortunately, monitoring is not an all-or-nothing proposal. Inexpensive techniques exist that, while coarse, give managers some notion of species presence and perhaps an index to relative abundance and population changes. For this purpose, we recommend habitat-specific point counts as the most likely method of choice.

Goal Statement

To standardize collection of bird and habitat monitoring data on properties managed by public and private groups.

Existing Programs

These will be compiled in the project directory of Partners In Flight.

Actions to be Taken

This subgroup addressed the questions pertaining specifically to monitoring needs of agencies and nongovernmental organizations (NGOs) and their abilities to carry out such programs. If a specific need was especially important to a certain agency or NGOs, it is indicated in parentheses. Monitoring needs are listed below in approximately their priority.

Agency-expressed needs for monitoring neotropical migrants.

Determine the effects of managing habitat on populations of birds (land management agencies). This is a primary goal of the program. Management activities include, but are not limited to: timber, mining, and grazing activities; recreational uses; fire suppression and prevention; water removal; and herbicide application.

Determine standards to identify trends of species that need monitoring, research, or management before they become candidates for listing (FWS). This is being addressed by Theory and Practice Subgroup and is the subject of two recent publications (Sauer and Droege 1990, O'Connor in press).

Determine status of neotropical migrants by regional patterns, by habitat, and by management practices. This is the overall purpose of the monitoring program. Regional priority lists are being developed by the regional working groups.

Determine most effective monitoring practices for each habitat. This is being addressed by North American Bird Monitoring Subgroup. In fact, monitoring techniques may not vary greatly among habitats; point counts, mistnets, and nest searches are equally valid (and have similar constraints) in all habitats.

Establish an interagency data management center, for purposes of national and/or regional coordination, implementation, and data management. The data management center would be responsible for tabulation, consultation, interpretation, and dissemination of data collected during the program.

Produce a directory of existing monitoring programs. This action is nearly completed. A national directory should be distributed to every agency and individual involved in Partners In Flight.

Produce a training manual for monitoring and standardize monitoring methods to insure compatibility of format and methods. Ralph et al. have published Field Methods for Monitoring Landbirds and Managing and Monitoring Birds Using Point Counts: Standards and Applications. These are available by writing C.J. Ralph, Redwood Sciences Laboratory, 1700 Bayview Drive, Arcata CA 95521. In addition, this paper and the Needs Assessment (Butcher 1992) include many recommendations for standardizing techniques.

Set up a protocol and curriculum for training, as well as facilities and materials (e.g., song tapes) for doing so. We suggest that non-governmental organizations are in an excellent position to provide much of this training.

Needs suggested by the Monitoring Working Group

Build a network of monitoring programs with compatible, independent, statistically valid projects. The statistical power of any monitoring program depends on the questions asked, the abundance of the species, and the scale considered. The statistical power and sample sizes needed will determine costs and practicality.

Insure that a proportion of overall monitoring in a given area be systematic, encompassing all habitat types and all bird species. At least 50% of sampling should be in proportion to frequency of habitat types. The other 50% should be determined by local or regional agencies; this effort might be allocated to rare habitats likely to host rare species.

Spend about 25% of monitoring effort on demographic monitoring. Statistical power of demographic techniques is less well known than for techniques for status and trends. We need research on power of these techniques, and we will need to shift proportions as needs become apparent.

Concentrate monitoring efforts on breeding season first, with less effort during winter and migration. In northern U.S. and Canada, 60-80% of effort should occur during breeding season, with 10-15% during migration and during winter (of course, this winter work would not directly relate to Partners in Flight). In southern U.S. and Latin America, 50-60% of effort should occur during breeding season, 10-20% during migration, and 20-40% during northern winter.

Research appropriate techniques for documenting the importance of migration stopover sites and for monitoring boreal-breeding birds during migration. Such documentation may be difficult, but stopover sites may be critical for many species. In appropriate habitat, birds may be studied during migration to determine trends of species otherwise unobtainable. CWS is currently reviewing techniques, and there may be a workshop in 1992 or 1993.

Involve state agencies as soon as possible. Not enough states are currently involved. States may require some form of cost-sharing from federal agencies in order to participate fully.

Quickly determine the cost of implementing a "typical" monitoring program of adequate sample size for each technique. Obviously, costs will limit what can be done. Some techniques will have national coordinating costs as well as local fieldwork costs. Some costs are estimated later in this document.

Share all data gathered in the program, preferably by storing data in a common format and at a national data center. We suggest that data sharing be required in all agreements within Partners In Flight.

A. Recommended Monitoring Methods

Various monitoring methods have differing applicability to questions asked by various groups involved in monitoring. Table 1 describes various methods and their strengths and weaknesses. To summarize:

1. Point Counts: Provide the most cost-effective method of estimating relative abundance of birds because they provide the most independent data points per unit of effort.

2. Spot-mapping: Can provide best density information (although there can be problems interpreting results), plus information on many aspects of life history. However, spot-mapping is extremely expensive per data point (in time and money) and is best applied for a research project or for an extremely high priority area, such as a unique local habitat threatened with development.

3. Area Search (where observers are permitted to walk around a defined area while creating a bird list): Has wide appeal to volunteer observers, but standardizing size of area involved in each count is difficult, especially in dense vegetation and rugged terrain. Costs can be somewhat high as well.

4. Strip Transects: Can use both fixed and variable distance methods. They are very good for some habitats, such as grasslands, but are much more expensive per independent data point than are point counts.

5. Variable Distance Methods: Include both point count and transect methods. All involve training observers to estimate distance to birds seen or heard. Standardization is extremely difficult, as observers vary greatly in their skills.

B. Demographic Measures

Demographic information is required to properly evaluate the causes of declines or habitat associations. If demographic features are not monitored, such studies may be initiated too late to effectively change a declining population trend. These methods sample relatively few species in any given area and are thus not generally applicable to rare species. The methods are also more expensive than censuses per data point.

Table 1. — An evaluation of a variety of monitoring methods.

	Census		Demographic				
	Point Count	Spot Map	Area Search	Variable Distance	Constant Effort Mistnets	Nest Search	
Variables Measured							
Index to abundance	Yes	Yes	Yes	Yes	Yes	Part.	
Density	No	Yes	No	Yes	No	Part.	
Survivorship		No	No	No	No	Yes	Part.
Productivity		No	No	No	No	Yes	Yes
Recruitment		No	No	No	No	Yes	No
Habitat relations		Yes	Yes	Yes	Yes	Part.	Nests Only
Nest site characters	No	No	No	No	No	Yes	
Clutch size		No	No	No	No	No	Yes
Predation/Parasitism	No	No	No	No	No	Yes	
Indivs. identified		No	No	No	No	Yes	Yes
Breeding status known	No	Yes	No	No	Part.	Yes	
General Characters							
Habitat types meas.	All	Some	Most	All	Some	Some	
Rare spp. measured	Many	Few	Many	Many	Few	Few	
Canopy spp. measured	All	All	All	All	Some	Few	
Area sampled known	Part.	Yes	Yes	Yes	No	Yes	
Training necessary	Much	Much	Mod.	Much	Much	Much	
Observer error pot.	High	High	Mod.	High	Mod.	Mod.	
Use in non-breeding	Yes	No	Yes	Yes	Yes	No	
Costs per data point	Low	High	Low	Low	High	High	
Applicable scale		Broad	Local	Broad	Broad	Broad	Local

1. Constant Effort Mistnetting: Provides information on productivity and survivorship of populations; sample size requirements for answering local or broad-scale questions are not yet known.

2. Nest Searching: Provides information on productivity at a very local scale, but is very expensive per data point and requires a relatively high degree of training. Causes of nest failures can often be inferred when nests are followed.

Costs of Monitoring

We determined approximate costs for three major activities an agency might undertake: point counts, mistnetting, and nest searches. Costs were estimated for a region, defined as an area of several thousand acres, including several drainages. All monitoring programs will require trained personnel, field forms, computerized data entry, database management, and data analysis. Details on methods are available from Ralph et al. (1992).

Extensive point counts are conducted primarily on roads to monitor relative abundances of birds and changes of abundance through time; habitat information is collected at each point. Ten to 50 points can be covered in a day; collection of habitat information requires a separate day from the collection of bird information.

Each region includes six-eight monitoring stations, each in an area of about 50 ha (125 acres). At each station, mistnetting, nest searches, and intensive point counts are done, and habitat information is collected. Mistnetting involves capturing birds, banding them, and recording data on age, sex, breeding status, molt, and survivorship. At a minimum, each monitoring station should operate 8-12 nets at least once every 10 days throughout the breeding season. Nest searching involves finding nests, monitoring their outcome, and measuring associated vegetation. A study plot should be visited at least once every three or four days to find and check nests. Point counts should be done at four to nine points at least twice during the breeding season at each monitoring station.

1. Point counts throughout region:
   - one person for two months
   - one vehicle
   - additional equipment - $500

2. Mistnetting:
- two persons for four months
- one vehicle
- additional equipment - $1,500

3. Nest searching:
- four persons for four months
- two vehicles
- additional equipment - $800

4. Point counts at monitoring stations:
- one person for one month (could be done by mistnetters or nest searchers)
- one vehicle - same as vehicle in #2 or #3 above
- additional equipment - 0

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