Managing and Monitoring Birds Using Point Counts: Standards and Applications[1,3]

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The use of population size as a measure of health of a species has been a very common tool of ornithologists for many years (Lack 1954, 1966; Hutchinson 1978). Methods for surveying population size are detailed in Ralph and Scott (1981), the excellent compendium by Cooperrider and others (1986), and the manual by Koskimies and Vaisanen (1991). Many types of counting techniques are available to estimate relative abundance and population trends. Probably the most widely used are modifications of unlimited distance point counts (Blondel and others 1981), conducted at a series of counting stations. These often represent the best compromise between economy of collection effort and precision and accuracy of the estimates of population trends or population indexes (Verner 1985).

This document presents a set of suggested standards to provide consistency between studies for managers and researchers who would like to use point counts during the breeding season to track population trends or determine associations between birds and their habitats.

The following standards for point counts were developed during the workshop. Many of the biologists attending gave papers on point count methodology. The purpose of this process was to develop the components of point count methodology sufficient to: (1) provide trend data for monitoring population changes; and (2) predict population responses to habitat manipulations. Each of the papers given at the workshop addressed specific aspects of the methodology.

National, Regional, and Tropical Applications

The methodological standards identified in this document are designed to provide a sound starting point in the development of local or regional monitoring programs. They should also function as a means of standardizing the collection of data which will facilitate comparisons among projects. The standards identified should permit any manager to develop an appropriate monitoring or research program.

Data generated from these programs will have a number of valuable uses beyond local assessments. Population trends from National Parks and other protected areas will permit comparisons of species in wilderness areas with populations from areas under active management. Comparisons can also be made with the more widespread assessments from the Breeding Bird Survey or Christmas Bird Counts. Population trends from lands managed by government agencies will permit agency-specific evaluations of population health and status. Point count data that can be associated with habitat measures can be pooled across many programs to test hypotheses regarding bird-habitat relationships (e.g., Ruggiero and others 1991) and to validate existing bird-habitat models.

Comparisons of bird-habitat relationships across different regions require the use of standardized collection techniques. Managers who are using point counts to develop bird-habitat models should feel more constrained to use standardized techniques.

Point count methodology has applicability in seasons, climates, and circumstances beyond those we discuss. Point counts have been used in both the tropics and temperate areas to monitor wintering migrants (Hutto and others 1986; Blake 1992; Lynch in this volume). Point count methodology can be applied in Latin America, but may need modifications. For example, in hot weather and in the non-breeding season, detectability declines more rapidly during the course of the day. Playbacks of sound recordings may have to play a more important part. Investigations of the applicability of the monitoring techniques discussed here for use during the winter and in Latin America need to be launched as quickly as possible.

Many of the suggested standards presented in this document will undoubtedly require future modification as components of point count methodology are tested under new conditions and in new environments.

National Data Center

In light of the additional uses these data can have to researchers and managers, it would be useful to have copies of the data sent to an accessible central repository, either a national or several regional data centers.

A crucial element in implementing a national program would be the establishment of data center(s) to help maintain uniformity of methods, provide data tabulation, advice, interpretation, analysis, and act as a conduit for providing data to agencies and researchers for analysis.

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[1] This paper was not presented at the Workshop on Monitoring Bird Populations Point Counts but is a summary of the papers.

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Developing a Local Monitoring Program

In the development of a program, managers should bear in mind that merely chronicling the population trend of a species does little in itself to suggest management options. Population size is only a retrospective tool. It tells only after the fact that a species has enjoyed an increase or suffered a decline. In order to ponder causes of changes, the biologist must couple population size with data on the internal composition of a population---its demographics (Temple and Wiens 1989). For example, data on sex ratio, age distribution, survivorship, average weight, parasitism rates, and population movements can all give valuable cues to factors or events regulating a population. Many studies have used data such as these to describe the dynamics of various populations (e.g., Hutchinson 1978, DeSante and Geupel 1987). The most common method of measuring demographics is capturing birds with constant effort mist nets. A protocol for nest searching is also being used. Both methods are detailed in Ralph and others (1993). Indeed, the Monitoring Working Group of the Neotropical Migratory Bird Conservation Program suggests (Butcher 1992) that at least 25 percent of the monitoring effort in an area go towards demographic monitoring.

As part of a manager's goal-setting process, the purposes behind the development of a monitoring program must be stated explicitly. In developing a program we suggest that the following questions be addressed:

(1) What is the intent of the monitoring?
- a. Regional trends or habitat-specific monitoring?
- b. Evaluation of all species, a target group of species, or a single species?
- c. What is the expected relationship between the results of a population change and management actions?

(2) How is the monitoring to be accomplished?
- a. What will be the protocol used for point counts?
- b. How will the samples be allocated?
- c. When will the surveys be conducted?

(3) How do we judge if the monitoring is successful?
- a. What are the initial goals of precision?
- b. What analytical methods will be used to determine if goals are met?

Once the above questions are answered, then the biologist can implement the point counts using the following recommendations. Each recommendation is then followed by a justification prepared by the participants in the workshop.

Recommendations and Justifications

Establishing the Dispersion of Stations

*** 1. Census stations should be systematically located with a random starting point, either on roads or off roads.**

Location of stations where each point count is to be conducted is a crucial component of any monitoring program to avoid biased estimates of both trend and habitat associations (Pendleton, in this volume). If the goal is to estimate population trends for an entire management unit, then point counts should be spaced evenly throughout that unit. Completely random samples such as this ensure no bias, but may be impractical to locate and survey in the field. Under these conditions, stations placed systematically along the road system in an area, without regard to current habitat configurations, may be the best option (Bart and Robson, in this volume). Systematic samples with a random starting point are often used in field experiments (Cochran 1977). Because systematic sampling ensures coverage throughout a study area, and samples are often limited in monitoring programs, systematic samples may be preferable to random samples for many sampling objectives (Sauer and others, in press). These samples are generally accepted as equivalent to random samples when no pattern exists in the environment. However, if sample stations are not independent because of, for instance, a pattern in the habitats, estimates from systematic samples may be biased (Sukhatme and others 1984). Consequently, care must be taken to avoid placement of a systematic sample along known gradients in bird abundance, such as all stations being placed along a road that follows a riparian corridor.

Stratification of Census Stations

*** 2. Stratification of census stations by habitat should occur only if habitat-specific population estimates are required.**

If the goal is to estimate population trends for an entire management unit (e.g., Welsh, in this volume), then stratification by habitat may not be appropriate. Stratification is appropriate when the management unit can be divided into discernible habitats differing in distribution or abundance of birds (Howe and others, in this volume). Unfortunately, habitats can change quite rapidly in a managed area, and initial stratification by habitat may not be appropriate after such a change. If consistent habitats can be identified, careful consideration should be made of edges and other types not readily classified to avoid bias in a regional estimate (Freemark and Rogers, in this volume). Elimination of these edge habitats from the sample is acceptable only when, for example, the sampling is designed to provide estimates for differences between major habitats in the area, but not an overall characterization.

Bird-Habitat Modeling

*** 3. Placement of stations for bird-habitat modeling should avoid boundaries between habitat types, if possible.**

Investigation of the relationship between bird abundance and habitat requires some means of associating bird counts with habitat types. A random or systematic sampling of bird communities across the entire landscape will cause some stations to fall on or near the boundaries of habitat types. These data can be used to form post hoc associations with habitat and will reflect the variation in habitat conditions within a landscape and along the continuum of habitat. Under some circumstances, a better design would be to systematically place sampling stations within the interior of habitat types so as to sample only those well defined habitats.

If the station has two or more habitat types within the distance that birds are detected, the birds at each station can be allocated to the different habitat types. For instance, at a station with a field and forest juxtaposed, birds detected in the field can be separated from forest birds. However the edge between the habitat types, with its own mixture and often augmentation of bird populations, may confound the relationship between birds and habitat (Howe and others, in this volume). In cropland situations, however, Freemark and Rogers (in this volume) found no significant differences in bird numbers between edges and interior of fields.

The underlying question is: how can samples be allocated within a certain habitat type? The easiest way of ensuring that stations measure birds within a given habitat is to stratify habitats and place edges and other questionable areas into separate strata. Samples should never be allocated so that a portion of the region could not be sampled. However, locations of stations can be constrained to be a certain distance away from the boundaries. This distance would logically be the radius that birds could be normally detected from the station. For most species this is under 100 m (see "Distance between stations").

Road Versus Off-Road Counts

*** 4. Observers should attempt to carry out censuses primarily on tertiary roads, then secondary roads, avoiding wide, primary roads. Off-road censuses should be carried out in major habitats not covered by road systems. These off-road censuses should be done on trails, if possible.**

Laying out a systematic or randomly located point count system on the ground requires large amounts of time. Sampling stations must be located and their positions permanently marked. Once sampling begins, a substantial amount of time must be spent travelling between the stations to do the surveys. The longer it takes to get between sampling stations, the fewer stations an observer can census during a day or a season. It is essential that before decisions are made as to using roads or off-road counts, the investigator must decide what population is being sampled. However, once those decisions are made, some general guidelines can be suggested.

If a road system exists in the region where monitoring is planned, the option of setting up samples along roadsides should be strongly considered. Using roads, travel time can be reduced to as little as 1 minute to 2 minutes between sampling stations. Under optimal road conditions, up to 40 5-minute point counts can be conducted in one morning. In an off-road situation, the number of point counts one observer can conduct during a morning varies between 3 and 15 counts.

Using roads as a means of traveling between counting stations is logistically appealing. Unfortunately, roadside habitats usually do not sample all of the available habitats, and they can have habitat features unique to themselves. In these situations, a collection of both on- and off-road surveys can be created that best fits local conditions.

In most cases the presence of a road modifies the surrounding habitats (Hutto and others, Keller and Fuller, Rotenberry and Knick, in this volume). However, Hutto and others (in this volume) have shown that in the case of tertiary road systems (i.e., narrow dirt roads), birds are counted in approximately the same proportions both on roads and off. Keller and Fuller (in this volume) found that along secondary roads, through forested environments, edge species are more abundant at the road edge versus away from the road. However, they also found that obligate forest interior species were detected at nearly the same rates along roadsides as they were in interior stations. Ralph and others (unpublished data) found in Alaska and California an increase in individuals along roads, but determined it was likely to be partially due to increased observability of birds along the road path. Road counts may increase detection rates by enabling the observer to miss fewer silent, flying birds. Finally, Rotenberry and Knick (in this volume) found little differences between on- and off-road densities of shrubland birds. While many regions and habitat types have not been investigated, it seems reasonable to assume that measures of relative abundance taken from counts along roadsides will be different from those in interiors. This is not to say, however, that one is preferable to the other, merely that they will be different. This difference is less likely to be the case when secondary and tertiary roads are used. If the goal is to monitor population trends, using roadsides will greatly increase data collection efficiency, as long as there is *no* reason to believe that bird populations or habitats along roadsides are changing at a different rate than the rest of the landscape. An example would be when woodlands along roads are left as a buffer while the remainder of the landscape is cleared. In the case of monitoring populations in relationship to habitat, roadside counts would be appropriate as long as the investigator also monitored the concomitant vegetation changes, as would also occur in off-road counts.

Number of Sampling Stations

*** 5. The number of samples necessary to meet the program objectives should be derived from the statistical evaluation of pilot data.**

Once the appropriate sampling framework has been established, the number of sampling stations needs to be determined. Because of the long-term nature of most monitoring programs, an evaluation of the number of samples necessary to meet the defined goals will help the manager assess the feasibility of meeting the stated goals before funding commitments are made.

Among the factors influencing sample size are:

(1) The sampling methods.-In point counts, the average number of birds per station and the variance of individual counts are determined in part by how the counts are conducted. Time of sampling at a point and replication of counts both affect the allocation of samples. Barker and Sauer (in this volume) review some of the tradeoffs. Once the decisions

are made regarding how to sample (using the guidelines here), the number of samples can be determined.

(2) The parameter to be estimated.---If population trends are of interest, methods discussed in Sauer and Droege (in review) can be used. If average counts by habitat or region are of interest, standard statistical procedures can be applied (Thompson and Schwalbach, in this volume). All sample size allocation procedures require some initial estimates of the parameter of interest and the variance of individual observations (Johnson, Pendleton, in this volume). These initial estimates can come from either a pilot study in the area, or from existing data from a comparable study. The type of display of the data can also be important, such as the discussion by Sauer and others (in this volume) of the use of maps in showing bird distribution.

(3) The target species.-If many species are of interest, one has to adopt a strategy to either: (a) allocate sufficient samples to accurately estimate the populations of all species; (b) select a subset of crucial species, and allocate samples only with regard to the subset; or (c) allocate samples to adequately estimate populations of a fixed percentage of the different species of interest. In practice, strategy "a" is unlikely to be feasible, and "c" will poorly sample important species. Therefore, option "b" may be best, requiring identification of critical species and sampling so that all species in this group are adequately estimated.

The number of stations adequate to characterize the birds of a given area, such as a watershed, or a habitat within a watershed, depends upon the number and dispersion of birds in the area and the probability of detecting birds. Only a few common species are detected at many of the stations, even in uniform habitat. In the absence of pilot data, an absolute minimum of at least 30 stations should be established in a given habitat. The discussion in Barker and Sauer (in this volume) also addresses this question. The minimum of 30 is based on several lines of evidence, given below.

(1) Buskirk and McDonald (in this volume) found that after 100 minutes of observation at a single point (the equivalent of 20 5-minute counts), the number of new individuals and species accumulated became very stable.

(2) Morrison and others (1981) also found stabilization in density estimates after about 100 minutes of counting. While a larger area of a given habitat would have greater variance, we would expect that 30 5-minute counts (150 minutes) would largely account for the difference.

(3) Petit and others (in this volume) found that more than 15 stations were needed to document the number of species, although in larger stands (70 ha - 200 ha), the rate of accumulation of new species was declining when 15 stations had been counted.

(4) DeSante (1986) felt that about 50 points were needed to distinguish common from rarer species.

(5) Smith and others (in this volume) determined that 20 point counts accommodated variability in total individuals, and 40 counts for number of species. Although they found that minimum sample size varied widely, most of the values were less than 70 counts, and many fell into the range of 40 to 60. They felt that about 50 counts per factor level should be sufficient to detect most of the biologically meaningful differences in a study, for instance between different forest patch sizes or habitat types.

With 30 stations or fewer, analyses will be possible for only the most common species. Sample sizes for rare or difficult to detect species may require a substantially greater number of sampling stations than 30.

Required sample size to characterize a larger area, such as a National Forest, would be higher, probably in the range of 300 to perhaps 1000 points, depending upon the rarity of the species involved. Thompson and Schwalbach (in this volume) found that 100, to as much as 1000, points would be able to detect a 20 percent change in the commoner species in their area, with three 10-minute counts at each point. Hanowski and Niemi (in this volume) calculated that 360 to 450 point counts, located in 120 and 150 stands, respectively, sampled with 10-minute counts, could detect a 25 percent change in bird numbers for the common species in a National Forest. For the Spotted Owl, Bart and Robson (in this volume) suggested about 750 stations per state would be necessary. If one assumes that 25 points can be censused in a day (Ralph and others 1993), 500 stations would require 20 person-days, or one person-month.

Count Period at Each Station

*** 6. Time spent at each count station should be 5 minutes, if travel time between counting stations is less than 15 minutes, and 10 minutes if travel time is greater than 15 minutes.**

The amount of time spent counting birds at each sampling station is a compromise between acquiring an accurate picture of the birds present at a single station and increasing the statistical power of the effort by sampling a larger number of stations and birds. A number of researchers have investigated this relationship (Verner 1988; Barker and Sauer, in this volume). All studies have found that at any single sampling station an observer quickly records the majority of the species and individuals within the first few minutes (Gates, Petit and others, in this volume). The statistical efficiency, as measured by the total number of new individuals per hour of field work, reaches a peak at 3-5 minutes (Buskirk and McDonald, Lynch, Savard and Hooper, Thompson and Schwalbach, Welsh, in this volume). The greatest efficiency of shorter counts, however, occurs as a result of increasing the number of stations. The number of stations counted can be more than doubled by the use of 3- versus 10-minute counts.

Evaluation of the data, largely from wooded and brushy habitats, lead us to propose a standard of 5 minutes (Gates, Lynch, Petit and others, Savard and Hooper, Thompson and Schwalbach, in this volume). A minimum count length of 3 minutes is possible under certain circumstances for a direct comparison with Breeding Bird Surveys. However, a 5-minute count period should be the standard for counts that have travel times between stations of less than 15 minutes, and 10-minute counts should be the standard for regions with travel times of greater than 15 minutes (Buskirk and McDonald, Petit and others, Savard and Hooper, Welsh, in this volume).

During the workshop, many felt that the minimum time could have been set at 6 minutes, because it conveniently separates into two 3-minute segments, the Breeding Bird Survey standard. However, 5 minutes is the most commonly used duration in the literature and is the European standard (Koskimies and Vaisanen 1991); thus 5 minutes would promote comparisons with already existing data sets.

*** 7. When a 5-minute point count is used, data should be separated into those individuals seen or heard during the first 3 minutes and those additional individuals heard in the remaining minutes. If a 10-minute point count is used, data should be separated into three segments of 3-, 2-, and the final 5-minute periods.**

This will facilitate comparisons of data collected by projects using shorter point counts.

Distance Between Stations

*** 8. The minimum distance between point count stations is 250 m.**

*** 9. Birds previously recorded at another sampling station should not be recorded again.**

There are many reasons for having point counts as far apart as possible. The closer the distance between stations, the more likely an observer will count the same bird twice, thus overestimating the number of individuals. In addition, the farther apart the stations, the more likely that vegetation and other factors have changed, providing greater statistical independence between stations. On the other hand, the greater the distance between sampling stations, the longer it will take to travel between those stations, and the larger the area required to establish a given number of stations. Fortunately, relatively few birds have voices that travel great distances, and because these are normally easy to track when the observer is moving between stations, the chance of double counting is low. The choice of a standard minimum distance of 250 m between counts is based upon the fact that for most species, in virtually all habitats, more than 95 percent of individuals are detected within 125 m of the observer (Scott and others 1981). In addition, the maximum detection of virtually all individuals of most species is less than 250 m (Wolf and others, in this volume). In open environments, this minimum distance should be increased due to the greater detectability of birds. Along roads, where travel by vehicle is possible, distances of 500 m or more should be used (Freemark and Rogers, in this volume).

Counting Radius

*** 10. All individual birds detected at a station should be recorded.**

Care should be taken to tally only the minimum number of different individuals as determined by concurrent recordings, counter singing, or other individual recognition methods, such as plumage differences. The use of a map (see below) can help in this effort. This will help to prevent the counting of individuals more than once (Welsh, in this volume), resulting in an overestimate of the individuals present.

*** 11. Birds detected within a radius of 50 m surrounding the census station should be recorded separately from those at all distances.**

Species vary in their conspicuousness and thus their detection probabilities. These differences in detectability make between-species comparisons of absolute abundance difficult (Dawson and others, Lynch, in this volume). If point counts are used primarily to monitor population changes, counting individuals of all species seen or heard at a single station will maximize the amount of data taken (Gates, Petit and others, in this volume). If, however, comparisons of abundance between species are important, then data collected from within a 50-m radius of the station center can be used for among-species comparisons of abundance (Verner 1985) by assuming that: (a) all the birds within 50 m of the observer are detectable; (b) observers do not actively attract or repel birds; and (c) birds do not move into or out of the count circle during the counting period. A variety of standard distances have been employed by observers, with 50 m in forested environments being the most common. If the habitat is exceptionally dense, a distance of 25 m may be used, and observations should be separated into 25, 50, and greater than 50 m, to allow comparisons between studies. This occurs in many habitats, but especially the tropics (Lynch, in this volume). In open habitats, such as in crops or grasslands, 100 m may be most appropriate (Savard and Hooper, Cyr and others, in this volume).

Alternatively, if the distances to observed birds can be accurately estimated, it is possible to calculate the density of the more common species by estimating detection rates with variable circular plot methods (Reynolds and others 1980). Relatively precise estimation of distances is necessary to use this technique appropriately, and it is best applied using highly trained observers and only in bird communities with relatively few and conspicuous species (Verner 1985).

If unlimited distance point counts are being used to investigate the relationship between birds and interior (as opposed to edge) habitats, then it is very important that the stations be located well within the interior of the habitat so that birds from outside habitats are not recorded. If the habitat being investigated is to include edge habitats, then stations can be located with impunity.

Replication of Stations Versus Establishing Additional Stations

*** 12. It is usually better to increase the number of statistically independent sampling stations than to repeatedly count a smaller number of stations.**

Replication of counts at a single station, either during same day or on different days, will yield better estimates of species abundance and community composition of birds at that single station (Petit and others, Smith and others, in this volume). In some cases there is not enough room in an area

to establish additional stations without overlapping with those already established. In this case, as in the case of increasing the number of total sampling stations, replicating the point counts will increase the precision of the estimates of bird population size, albeit less efficiently than adding new independent stations. The choice depends upon the definition of the population that the investigator wishes to sample: is the population from a small area, or a large one?

In general, a station should be sampled only once each season. Counts can be repeated if the goal is good estimates of the community at certain, specific stations, such as a small area of rare wetland habitat.

Under circumstances where replication is required, determining the optimal number of replicates requires the accumulation of pilot data for each species. At some number of replicates, the gain in numbers of individuals detected will be offset by the amount of additional time it takes to collect those data, as shown by papers from this workshop (Petit and others, Smith and others, in this volume).

Time Periods for Counts

*** 13. Breeding season point counts should be conducted during the time of day and time of year when the detection rate of the species being studied is most stable.**

The visibility or detectability of a species varies with time of year and time of day (Best 1981; Robbins 1981a; Lynch, Buskirk and McDonald, in this volume). At some point during the breeding season, most species exhibit a period of several weeks when detectability is relatively stable. Unfortunately, among species, those time periods often only partially overlap (Buskirk and McDonald, in this volume). Within the breeding season, late May, the month of June, and the first week in July are best for counting most passerines in temperate North America. However, stable counting periods can be in early May in more southern areas and may extend later in the boreal zones.

The rate of calling and singing also varies with the time of day. Examining pilot data is the best way to determine when detection rates are the most stable. In general, the period between official sunrise and the ensuing 3-4 hours is usually relatively stable (Lynch, in this volume). Buskirk and McDonald (in this volume) found no significant decline, except for short, 3-minute counts, in the 5 hours after dawn. For most species, the number and rate of birds singing in the period between dawn (first light) and sunrise, are somewhat higher than those in the rest of the morning. For maximum comparability in detection probabilities for species among stations, it will be best to start counting birds at sunrise rather than at first light.

An exception to the rule of starting counts at sunrise can be made if: (1) counts are used to calculate population trends and (2) the order of the counts are the same in relation to the time of day. For example, if stations 1-3 are always counted during the first one-half hour before sunrise; 4-20 are always counted during the stable early morning period; and 21-30 are always during the late morning hours, then comparisons among years using these stations counted in this order are possible.

Appropriate Weather Conditions

*** 14. Birds should not be surveyed when it is raining, during heavy fog, or when noise from wind-blown vegetation interferes with counting.**

Very windy and rainy conditions almost always decrease the number of birds detected on point counts (Robbins 1981b). The degree to which these conditions affect the counts will depend upon the species and habitats surveyed. In some cases slight breezes can significantly depress the number of birds heard. In open environments, lack of trees and their associated noises permit the collection of count data under relatively heavy winds (D. Bystrak, pers. comm.). Verner (1985) has recommended that no surveys be conducted with winds greater than 11 km/hr, during precipitation, and under foggy conditions. Others have suggested limits between 12 and 20 km/hr (Anderson and Ohmart 1977, Robbins 1981b). If an observer feels that noise from wind or rain is causing a loss of observations greater than 10 percent, then counting should end. An appropriate way to determine the loss of detections is the inability to detect birds at longer distances as the wind or rain increases.

Number of Observers at a Single Station

*** 15. Only one observer should be permitted to count birds at a single station.**

Additional observers at a station modify the rate of detection of birds and therefore reduce comparability with other stations with a single observer (Howe and others, in this volume). This recommendation is based on our experience that even the best observers do not record all the potentially detectable species or individuals during the count period. It is easy for a bird to fly by while an observer records data or looks the other way. When many birds are calling, it is also easy to miss a bird that calls once or only faintly. Because all point counts are only partial samples, consistency of effort is critical in maintaining the comparability of counts.

Observer Training

*** 16. Only observers able to identify all the targeted birds by sight and sound should participate in a monitoring or research project using point counts.**

It cannot be overemphasized that the success of any bird monitoring or research project hinges on the caliber of the observers collecting the data. Given the normally high turnover in the technicians that do the bulk of data collection, comparability among observers is critical. If differences among observers are very great, they could eliminate most (if not all) of the power of a monitoring program to detect changes in bird populations (Faanes and Bystrak 1981, Kepler and Scott 1981). The high number of species in the tropics presents special problems for training, as is discussed elsewhere in this paper.

The ability to identify birds by sight, and especially by sound, is a skill that usually takes several years to develop, unless an intensive training program can be undertaken. An ornithology course or several trips into the woods is only partial

preparation. Any individual who will be participating in a program to monitor birds should have identification skills comparable to that of the local experts. Training may not be difficult if only one species is being monitored, but if every species at each station is counted, then the training of raw recruits is almost certainly too time-consuming to be feasible. Training in estimating distances to individual birds is also important if any density estimates are to be made, as Welsh (in this volume) found.

We recommend that any applicant's ability to survey birds should be tested. Unfortunately, no completely valid testing procedure exists (see Hanowski and Niemi, in this volume). However, by using known, qualified observers as a gauge, it is possible to quickly ascertain the suitability of an observer. Both the benchmark observer and the new observer need to simultaneously count birds under circumstances similar to those to be imposed by the project. Any deficiencies in the new observer's ability to identify birds will be quickly apparent.

While most projects will rely on observers already trained in the art of bird identification to do their field work, new observers will eventually be needed to replace those who depart. To help in the long-term development of a pool of observers who have the skills necessary to identify bird by sound, agencies can promote the learning of bird songs. Permitting novice bird counters to work with experienced birders is the quickest way to learn bird songs. Bird tapes will also help new observers work on their identification. We suggest that the following is adequate for training: (a) use a syllabus that outlines a standard training program for censusing; (b) a regional vocalization tape should be available (these usually do not have complete songs and calls of all species and every effort should be made to obtain a complete one); (c) a test tape should evaluate each observer's correct identifications; (d) simultaneous consumng with an experienced observer during 3- or 5-minute road counts, with immediate feedback as to the number and directions of birds, will speed learning; and (e) all observers should have a hearing test. Based on our collective experience in training observers, we feel that as a general rule of thumb, species composition between simultaneously counting observers should be near 90 percent, and the number of individuals should be within 80 percent.

Recording Data

*** 17. A standard field form should be used to ensure compatibility of data taken between participants in the program.**

Appendix A contains a sample field sheet, and standard database software can be used for recording point count information from this sheet.

Using a map is an efficient way to record data, especially in counts longer than 3 minutes. Maps help in keeping track of locations of birds, allow accurate quality checks, and permit a variety of data to be taken. Shortcuts can facilitate data taking, such as: use of single letters for the commonest 10 to 15 species, as well as standardized behavior codes for separating birds, recording movements, and showing simultaneous observations.

Age, Sex, and Behavioral Classification of Birds

*** 18. Juvenile birds or birds that fledged during the current breeding season should be recorded separately.**

*** 19. Birds that were detected flying over the station, rather than detected from within the vegetation, should be recorded separately.**

Birds detected while counting can often be identified to the age and sex of the individual. However, because birds are largely detected through the sounds they make, and because there are numerous differences among species as to which sex vocalizes, regular collection of sex data should be considered of secondary importance. By contrast, numbers of fledgling birds increase as the breeding season advances. To reduce the bias associated with seasonal increases in the numbers of fledglings, numbers of fledglings should be recorded separately.

Birds that are detected flying over the plot are less likely to be breeding or associated with the habitat surrounding the station than an individual near the ground or in vegetation. Exceptions, of course, include such species as raptors, swallows, and swifts. Birds flying over do, however, live in the general area and can be recorded.

The Priority of Breeding Season Surveys

*** 20. Most effort expended conducting point counts should occur during the breeding season.**

While the focus has been on breeding season for many surveys, migration and winter habitats are vital to many species' survival. Species have been found to show habitat dependencies during this season, while they were non-specific in breeding (Manuwal and Huff 1987). Winter counts are important because many species are limited by their ability to survive the winter and many spend 8-10 months on the wintering grounds. Fixed-width transect counts and playbacks may be necessary in this season, although they limit comparisons with other methods. Migration counts can be used for northern or high altitude species and to identify important stopover sites. However, migration and winter counts are difficult to interpret because of high variability, and their feasibility remains to be determined (Robbins 1972, Cyr and others, in this volume).

Based on our experience, we suggest that for the northern United States and Canada, breeding season counts should make up 70 percent to 80 percent of the effort in any area, and migration and winter counts, 10 percent to 15 percent each. In the southern United States and Latin America, we suggest 50 percent to 70 percent during breeding, 10 percent to 20 percent during migration, and 20 percent to 40 percent in the northern winter. We feel that this will allocate effort according to the likely management importance of the data in different seasons, as well as reflect funding priorities.

Modifications for Specialized Groups of Birds

*** 21. Point count techniques can often be modified to better survey cryptic or uncommon birds.**

Playbacks of species calls can dramatically increase the detection of almost any species (Johnson and others 1981). They do, however, preclude comparisons with unaided surveys. Nocturnal point counts can be used to survey owls and caprimulgids and are especially effective when used in conjunction with taped calls. Playbacks have been used to good effect during the winter season and in the tropics (Sliwa and Sherry 1992; Lynch, in this volume; Gauthreaux, personal communication). Methods of censusing raptors, night-singing birds, and marsh birds are suggested in the excellent compendium of Koskimies and Väisänen (1991).

Additional Recommendations:

The following recommendations should help further standardize the collection of point count data among projects.

*** 22. Counts should begin immediately when the observer reaches the census station.**

*** 23. A bird flushed within 50 m of a station's center, as an observer approaches or leaves a station, should be counted as being at the station if the observer feels that this individual was not seen during the count period. It is advisable that this be recorded separately.**

*** 24. If a flock is encountered during a census period, it may be followed after the end of the period to determine its composition and size. An observer should follow such a flock for no more than 10 minutes. This is especially useful during the winter.**

*** 25. A bird giving an unknown song or call may be tracked down after count period for confirmation.**

*** 26. No attracting devices or records should generally be used, except in counts for specialized groups of birds.**

*** 27. Latitude and longitude for each location should be recorded at least to the nearest 10 seconds from accurate topographic maps.**

*** 28. Recording data into a tape recorder can help to minimize the time that an observer spends looking at the sheet of paper while recording, thus maximizing visual observations.**

Conclusions

The use of standardized methods that we suggest will enable comparisons with other studies. The quality of the data, however, is at least as important, and depends upon the continued dedication and training of the observers, cooperation of various agencies and investigators, and the rapid and accurate compilation of results. We feel that the cooperative effort that went into these standards shows the sincerity that all involved will continue to put toward this effort.