U.S. FISH AND WILDLIFE SERVICE BREEDING BIRD SURVEYS: HOW CAN THEY BE USED IN FOREST MANAGEMENT?

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Abstract: Since 1965, the U.S. Fish and Wildlife and Canadian Wildlife Services have sponsored annual Breeding Bird Surveys (BBSs), which are done in the United States and Canada using standard procedures. Data resulting from individual surveys may have the potential to answer certain management questions or serve to fill information gaps for relatively small geographic areas. A BBS route was begun near Downieville, California, in 1975, giving 13 years of continuous information on birds. Results suggest that, collectively, the numbers of birds and species in the area are generally stable. However, some species (for example, American robin, *Turdus migratorius*) show increasing trends, and others (for example, pileated woodpecker, *Dryocopus pileatus*) show declining trends. Increases and decreases of certain species may be correlated with such factors as altered vegetation or adverse weather conditions. Trend information for species is extremely valuable to forest managers as they make decisions that will alter the structure and composition of vegetation over the landscape. Although the information from a single BBS route appears to be useful to land managers, certain problems could result in erroneous interpretations. These include (1) encounter frequencies for some species that are too low to establish meaningful trends and (2) failure of observers to detect all species present.

To make informed decisions, land managers require detailed information about wildlife-habitat relationships before they decide to alter habitat. In addition to knowledge about these relationships, managers need the following: (1) basic inventory information on species' presence, location, and abundance, (2) baseline estimates of relative or, preferably, absolute population levels through time, and (3) monitoring procedures that can be accomplished with a limited budget.

Few data exist for most terrestrial vertebrates to meet these three needs. Universities maintain collections of specimens but generally record only information about where the specimens were collected. Agencies collect observation records on many species, especially game species and those of special interest, and often conduct general inventories of specific, limited areas. Specifically, the California Natural Diversity Data Base, maintained by the California Department of Fish and Game, compiles information on the distribution of species considered to be rare or of special concern.

Much information has been amassed by these approaches and much of it can be used as basic inventory information. Unfortunately, these data generally have not been collected using standard methods over time and sampling has generally been restricted to a few locations. Thus the data should be used only for inventory purposes.

Much more information is available for birds, especially passerines, than for any other group of terrestrial vertebrates. Potential sources of information specific to birds include the Cornell Laboratory of Ornithology Nest Record Card collection, Colonial Nesting Bird Records, and Christmas Counts, Breeding Bird Censuses, and Winter Bird Population Studies sponsored by the National Audubon Society. The field notes and other records collected by the myriad of bird watchers are also helpful when available. Most of these sources can provide useful inventory information but are usually not collected in a systematic manner. Exceptions to this general rule are the efforts sponsored by the National Audubon Society, which are based on rather loose protocols. These often break down in practice because the methods do not lend themselves to strict repeatability year after year. Furthermore, with the exception of the Christmas Bird Counts, most are not repeated over enough years to provide an adequate baseline for a monitoring program.

One potentially promising procedure that might be useful for acquiring baseline data and monitoring birds and their habitat capability is the Breeding Bird Survey (BBS), which has been used to collect data on breeding birds since 1965. This program is "an ongoing cooperative program sponsored jointly by the U.S. Fish and Wildlife Service and the Canadian Wildlife Service. Its main purpose is to estimate population trends of the many species of birds that nest in North America north of Mexico and that migrate across international boundaries. This survey provides information, both locally by ecological or political regions and on a continental scale, on (1) short-term population changes that can be correlated with specific weather incidents, (2) recovery periods following catastrophic declines, (3) normal year-to-year variations, (4) long-term population trends, and (5) invasions of exotics" (Robbins et al. 1986:1).

Robbins et al. (1986) use BBS data to detect trends in bird species' populations for relatively large geographical areas, based on data from a number of survey routes. This approach is certainly useful for large geographical areas and it minimizes problems resulting from factors such as observer variability and weather. However, information often is needed for smaller geographic units or a single habitat. How useful is a single BBS route for gathering inventory information, developing baselines, and evaluating changes in bird populations through time?

Since 1975, a BBS has been done in the vicinity of Downieville, Sierra County, California. I took responsibility for the survey in 1982 and have continued the work through 1987. Because the BBS is a standardized method to collect time-constrained counts of birds yearly, the resulting information could be useful for inventories, baseline information, and monitoring on National Forests. The approach may also be useful on lands other than those administered by the National Forest System. The objective of this paper is to evaluate the usefulness of data from the Downieville BBS route for land managers.

METHODS

In late May 1982, prior to completing my first Downieville BBS, I registered all 50 survey points to specific, locatable features of the landscape along the route to ensure repeatability through time. I also classified the vegetation at each survey point to the most appropriate Wildlife Habitat Relationships System habitat (Mayer and Laudenslayer 1988) and listed the common plant species present.

All surveys followed standard procedures established by the U.S. Fish and Wildlife Service. The route consisted of 50 points spaced approximately 0.5 mi (0.8 km) apart. The survey was completed once each year at the height of the breeding season, generally in the first 2 weeks of June, to reduce variability induced by seasonality. Each survey was initiated 0.5 hr prior to sunrise (approximately 0500 hrs, PDT). Three minutes were spent at each point identifying all birds detected by sight and sound, while an assistant on each survey recorded the information on standard BBS forms. In all years, the survey was completed within 4.5 hrs to reduce variability resulting from increasing temperatures and time-of-day effects.

Following the field work, required forms were submitted to the U.S. Fish and Wildlife Service. I then assigned bird species to one or more of four management guilds to investigate single and multiple species' changes in abundance through time. These guilds included tree-canopy feeders, hole nesters, bole (tree trunk) feeders, and ground feeders (Verner 1984). Simple regression analyses for individual species and management guilds were done using Minitab at an alpha level of 0.05.

TRANSECT

The 25 mi (40 km) transect begins in downtown Downieville, proceeds south along California Highway 49 to Goodyear's Bar, south on Mountain House Road to Pliocene Ridge Road, then west on Pliocene Ridge Road to the terminus of the transect near Plum Valley. Elevations range from 2,736 ft (830 m) at Goodyear's Bar to 4,500 ft (1,375 m) at the town of Forest, about midway through the transect.

Overstory vegetation along the transect generally consists of Douglas-fir (*Pseudotsuga menziesii*), incense cedar (*Calocedrus decurrens*), white fir (*Abies concolor*), red fir (*A. magnifica*), ponderosa pine (*Pinus ponderosa*), canyon live oak (*Quercus chrysolepis*), bigleaf maple (*Acer macrophyllum*), dogwood (*Cornus nutallii*), Pacific madrone (*Arbutus menziesii*), and California black oak (*Q. kelloggii*). Generally the wildlife habitat on the transect was classified as montane hardwood-conifer (33 sites) or mixed-conifer (12 sites). Two sites were classified as montane riparian, one as montane chaparral, and one as ponderosa pine. Along the first 8 mi (13 km) of the transect, from Downieville past Goodyear's Bar, the North Fork of the Yuba River and Woodruff Creek provide montane riparian, mesic mixed-conifer, and montane hardwood-conifer habitats. Towards the end of the transect, from near the town of Forest to Plum Valley, tree plantations, areas dominated by shrubs, for example, deerbrush (*Ceanothus integerrimus*), prostrate ceanothus (*C. prostratus*), various manzanitas (*Arctostaphylos* spp.), and more xeric conditions provide montane chaparral, drier mixed-conifer, ponderosa pine, and montane hardwood-conifer habitats.

RESULTS

Over the 13 years of surveys, 89 species and 4,744 individual birds were recorded. The most common species were the American robin (scientific names are in Table 1), Steller's jay, and black-headed grosbeak. Less common species included the American dipper, spotted owl, and flammulated owl (Table 1).

The American robin showed a significantly increasing trend in abundance (Fig. 1) over the 13-year period, but counts of Steller's jays (Fig. 2) and mountain chickadees (Fig. 3) decreased slightly but not significantly. Counts of pileated woodpeckers (Fig. 4) showed a strong and statistically significant decline.

Regression analyses for each of the guilds showed similar patterns. The tree-canopy feeders (15 species including golden-crowned kinglet, solitary and warbling vireos, orange-crowned, Nashville, yellow-rumped, hermit, and MacGillivray's warblers, and northern oriole) had a combined count of 741 and showed a significant increasing trend (Fig. 5). The hole nesters (17 species including pileated, hairy, and downy woodpeckers, mountain chickadee, plain titmouse, white- and red-breasted nuthatches, and Bewick's wren) had a combined count of 616 with no significant yearly trend (Fig. 6). Bole feeders (15 species including most of the hole nesters) had a combined count of 607 and no significant trend (Fig. 7). Finally, ground feeders (9 species including California thrasher, American robin, green-tailed,

Table 1. Total counts of the 10 most common and 11 of the least common bird species detected during the Downieville Breeding Bird Surveys, 1975-1987.

Species	Total count
Common species	
American Robin (*Turdus migratorius*)	577
Steller's Jay (*Cyanocitta stelleri*)	258
Black-headed Grosbeak (*Pheucticus melanocephalus*)	217
Dark-eyed Junco (*Junco hyemalis*)	191
Red-breasted Nuthatch (*Sitta canadensis*)	187
Band-tailed Pigeon (*Columba fasciata*)	185
Olive-sided Flycatcher (*Contopus borealis*)	175
Rufous-sided Towhee (*Pipilo erythrophthalmus*)	174
Western Wood-Pewee (*Contopus virens*)	172
Western Tanager (*Piranga ludoviciana*)	169
Uncommon species	
Hermit Warbler (*Dendroica occidentalis*)	97
Solitary Vireo (*Vireo solitarius*)	73
Yellow Warbler (*Dendroica petechia*)	64
Hermit Thrush (*Catharus guttatus*)	59
Hammond's Flycatcher (*Empidonax hammondii*)	42
Northern Pygmy-Owl (*Glaucidium gnoma*)	18
Pileated Woodpecker (*Dryocopus pileatus*)	13
Wilson's Warbler (*Wilsonia pusilla*)	9
American Dipper (*Cinclus mexicanus*)	4
Spotted Owl (*Strix occidentalis*)	1
Flammulated Owl (*Otus flammeolus*)	1

rufous-sided, and brown towhees, dark-eyed junco, and a variety of sparrows) had a combined count of 1188 without a significant yearly trend (Fig. 8).

DISCUSSION

It is difficult to identify the causes of these patterns without an intensive analysis of changes in the landscape and weather patterns over the 13-year period of the survey. Generally, one should expect declines in species that are associated with forest conditions, especially those species that are related to large expanses of forest. It is not likely that the forest along the Downieville BBS route has become regulated; that is, timber management has not occurred to the extent that acres of mature timber, plantations, and shrublands will remain relatively constant through time. Thus, one might expect species associated with mature trees to show declining trends, while those associated with younger stages of trees should show increases. The regression analyses tended to support this pattern for individual species, but trends were generally not significant. However, the guild analyses, involving larger counts, generally showed stable conditions.

Weather conditions may also be a factor to consider. Mountain chickadees (Fig. 3) showed a substantial drop in numbers encountered between 1978 and 1983. Precipitation in the nearby Grass Valley area was higher than average during the fall, winter, and spring periods of 1981-82 and 1982-83, suggesting that trends in chickadee numbers may be related to adverse weather conditions. Weather patterns could be especially important to the chickadee, because severe winters are believed to cause population declines among such permanent resident species in the Sierra Nevada (Beedy 1982, Granholm 1982, Raphael and White 1984, Hejl et al. 1988). In addition, weather and other factors in the wintering areas of migrants may have had variable effects on those species, which might be erroneously attributed to local management activities (for example, see Verner 1984)

Sizes of counts are critical for discerning significant trends. In general, data from the Downieville BBS showed that more intensive sampling would be needed to detect trends in abundance of most species, except for a few more common ones, such as the American robin. On the other hand, the analysis showed that pileated woodpeckers declined significantly in the sample area (Fig. 4), although only 13 individuals of this species were detected in the 13 years of the survey! Even though the trend was statistically significant (the regression line was significantly different from 0) the number of birds observed each year was so small, and the yearly variation so great, that I am reluctant to place much biological confidence in the declining trend for this woodpecker. Counts could be increased by repeated visits within the sampling period, adding of more points to the survey route, or spending more time at each point.

Use of guilds as tools to monitor the capability of habitats may be a useful procedure. Because guilds pool data from two or more species, total counts are higher than for individual species. Even though management guilds group species that use similar habitats in similar ways, each species nonetheless has its unique ecology, so one should not expect the demographic factors affecting the various species in a guild to be identical. Consequently, population changes of guild members would not necessarily exhibit parallel trends (see discussion in Verner 1984). Analysis of the hole-nesting guild in my data set (Fig. 6) showed a nonsignificant declining trend. However, the pileated woodpecker (Fig. 4) and mountain chickadee (Fig. 3), both hole nesters, showed stronger declining trends. Therefore, the interpretation of trends in management guilds must be done carefully to assure that management decisions based on these trends do not unwittingly result in the decline or loss of some members.

Observer variability, as Verner (1985) points out, can also be a substantial problem. BBSs are done by only one observer for a variable period of time. Thus, perhaps

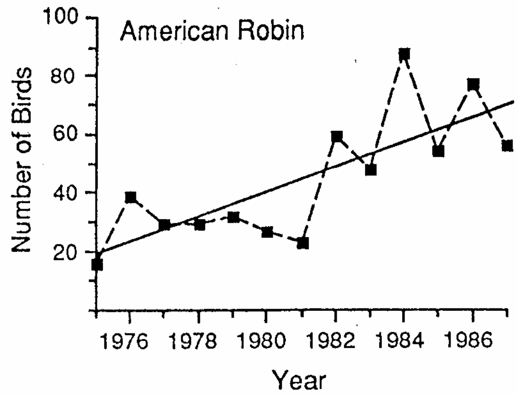

Fig. 1. Trend in counts of American robins from 1975 through 1987 ($Y = 14.73 + 4.24x$, $P < 0.01$).

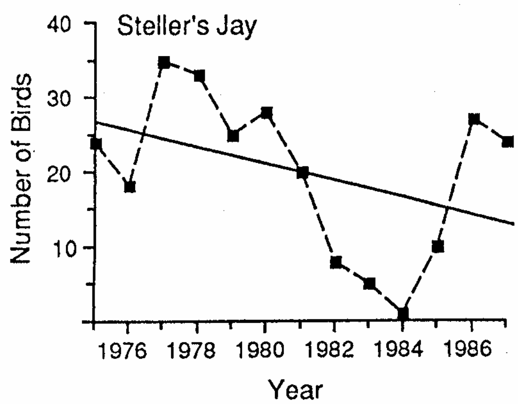

Fig. 2. Trend in counts of Steller's jays from 1975 through 1987 ($Y = 27.96 - 1.16x$, $P > 0.10$).

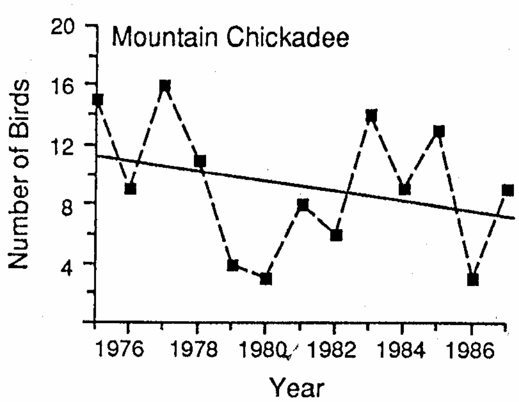

Fig. 3. Trend in counts of mountain chickadees from 1975 through 1987 ($Y = 11.58 - 0.34x$, $P > 0.10$).

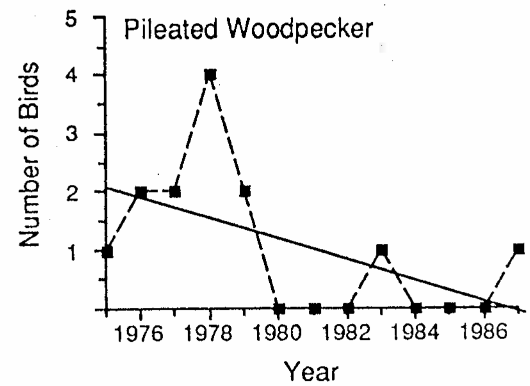

Fig.4. Trend in counts of pileated woodpeckers from 1975 through 1987 ($Y = 2.23 - 0.18x$, $P < 0.05$).

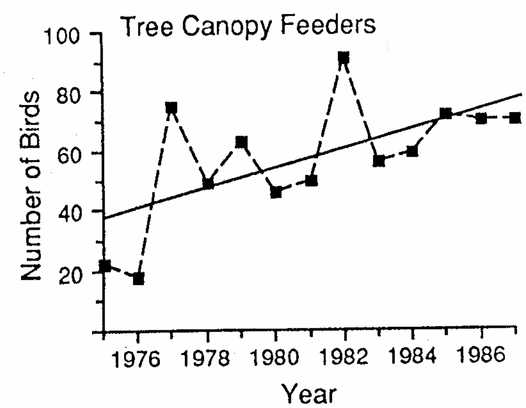

Fig. 5. Trend in pooled counts of tree-canopy feeders from 1975 through 1987 ($Y = 34.04 + 3.28x$, $P < 0.05$).

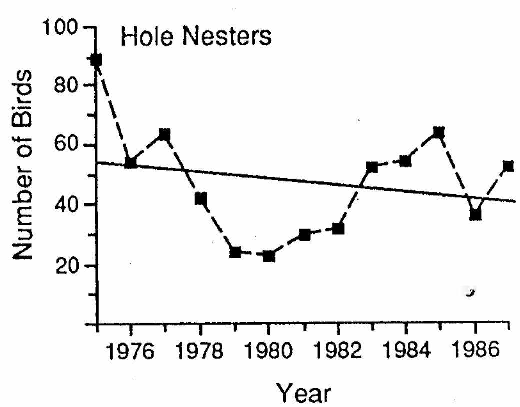

Fig. 6. Trend in pooled counts of hole nesters from 1975 through 1987 ($Y = 55.5 - 1.16x$, $P > 0.10$).

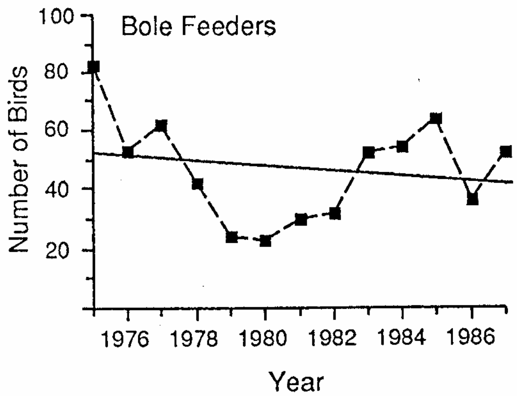

Fig. 7. Trend in pooled counts of bole feeders from 1975 through 1987 (Y = 52.92 - 0.89x, P > 0.10).

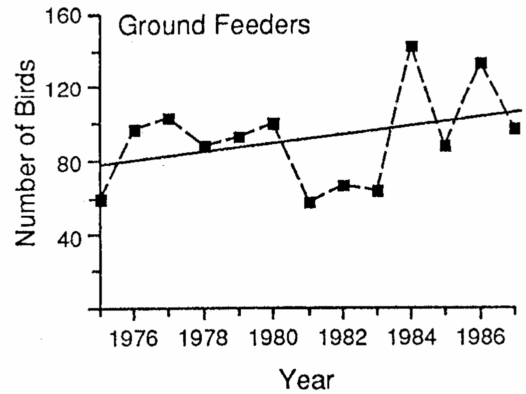

Fig. 8. Trend in pooled counts of ground feeders from 1975 through 1987 (Y = 75.08 + 2.33x, P > 0.10).

some of the perceived patterns for individual species in this study were really the result of differences between observers. For example, the first 7 years of the Downieville Survey were done by one observer and the last 6 years were done by myself. In general, I found fewer Steller's jays (Fig. 2) and pileated woodpeckers (Fig. 4) than did the previous observer.

Is the BBS approach useful in forest management? I think it is a useful approach for some species, and the cost of conducting the surveys is negligible. Information collected using BBS protocols is useful for providing general inventories of passerine birds. The system is designed to survey only diurnal birds, so it produces little information about nocturnal ones, such as owls. It also is not very useful for species with large home ranges, such as turkey vultures (*Cathartes aura*) and red-tailed hawks (*Buteo jamaicensis*), or those with restrictive habitat requirements, such as great blue herons (*Ardea herodias*). It also is not a suitable technique for surveying uncommon or rare birds, such as pileated woodpeckers.

Perhaps the greatest value of this approach is for establishing a baseline of inventory information through time. The BBS is the only approach, to my knowledge, that is standardized to a substantial degree and that has been done regularly at yearly intervals. The surveys do supply historical information, perhaps even 20 years or more for some survey routes.

As a tool for monitoring, BBSs may have some use, although trends suggested from a single route may be inaccurate. Counts tend to be low, especially of species about which information is urgently needed. They could be increased by adding survey routes in areas of interest, by increasing the number of counting points per route, or counting longer at each point. According to J. Verner (pers. comm.), adding routes would be the best strategy, followed by increasing the number of counting points per route.

The problem of observer variability cannot be overcome without a large increase in funding. Perhaps guilding procedures will help improve the utility of this technique, assuming user caution in the interpretation of results to avoid declines or losses of guild members. For example, habitat capability for the majority of cavity nesters might be maintained, yet certain members, such as pileated woodpeckers, may actually decline. Pileated woodpeckers generally use larger snags for nesting than do other species (Bull and Meslow 1977, Bull 1987). Thus, under intensive timber management, where rotation ages may preclude development of suitable snags for pileated woodpeckers, using a guild approach alone may not provide all the information needed for informed decisions.

In conclusion, BBSs are useful for inventorying birds present in an area. However, if used for developing baselines or as monitoring tools, they must be used with caution, especially for monitoring at a local level. Perhaps, as Robbins et al. (1986) suggest, BBSs should be used only for monitoring at relatively broad scales, where problems due to observer variability, weather, small chances of encounter, and other confounding factors are minimized.

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TRANS. WEST. SECT. WILDL. SOC. 24:1988

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