Chapter 6

Using Landbirds As an Indicator Species Group

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Conservation Issues and Previous Research

The broad goal of conservation biology is to maintain "biodiversity," which has been defined as the diversity of life at all levels of biological organization, from genes to landscapes (Office of Technology Assessment 1987). A variety of laws, beginning with the Organic Administration Act of 1897 through the Multiple-Use Sustained-Yield Act of 1960 to the National Forest Management Act of 1976 [16 USC 1604(g)(3)(B)], either encourage or mandate that the U.S. Forest Service provide for the diversity of plant and animal communities. The Code of Federal Regulations [36 CFR 219.19(a)(1 and 6)] specifies that this be accomplished by monitoring vertebrate indicator species as a means to ensure the maintenance of populations of all native vertebrate species. Numerous laws require essentially the same thing of the U.S. Fish and Wildlife Service, the Bureau of Land Management, and many state agencies.

Because of the operational difficulties of implementing the aforementioned legislation, agencies typically attempt to accomplish this task by assuring the maintenance of a small number of "indicator" species that, in turn, supposedly assure the maintenance of the complete range of vertebrate species (Severinghaus 1981). Agencies such as the U.S. Forest Service also typically work at a regional (or smaller) level to implement such legislation (Morrison and Marcot 1995).
Thus, I wish to focus attention here toward avian conservation efforts at the within-region level and away from avian conservation programs that are national in scope (e.g., BBS, CBC, BBIRD, MAPS; Desante and Rosenberg, this volume), even though the latter may provide data that influence management decisions at the local level.

Which species should serve as indicators for implementation of the National Forest Management Act? The earliest suggestion (Graul, Torres, and Denney 1976; Graul and Miller 1984) was to use a series of the more stenotopic species. If we choose the most stenotopic species as indicators, however, it is unlikely that the maintenance of viable populations of all species can be assured throughout their historic ranges (as required by the National Forest Management Act of 1976, for example) unless we use enough of them to cover the entire range of ecological conditions.

Landres (1983); DeGraaf, Tilghman, and Anderson (1985); Roberts and O’Neil (1985); Fry et al. (1986); and Roberts (1987) subsequently suggested using representative species from different ecological guilds (guild indicators), but empirical data do not support the idea that population trends of species within a guild mirror one another at all closely (Mannan, Morrison, and Meslow 1984; Szaro 1986; Block, Brennan, and Gutiérrez 1987; Bayer and Porter 1988; Reader 1988). Consequently, the suggestion to use selected species from each of a variety of guilds has been met with criticism (Hutto, Reel, and Landres 1987; Landres, Verner, and Thomas 1988; Morrison, Marcot, and Mannan 1992).

Verner (1984) suggested using management-guild indicators, which he defined as groups of species that are suspected to respond in a similar way to changes in the environment. The latter, whole-guild approach avoids the problems inherent in the guild-indicator approach because it is designed to identify species that would be expected to share either the negative or positive effects of land management activity because they share a particular forest zone. Even here, however, the problem is that populations are affected by numerous factors that operate at different times of the year (Sherry and Holmes 1995). Thus, it is quite possible for the declining populations of one member of a management guild to be hidden by a general increase in the populations of others. In fact, using population trend data from the Breeding Bird Survey, Paige (1990) showed that there is really no group of species whose population trends mirror one another and that, therefore, would serve as a good group for a combined-species analysis.

Many are now coming to believe that we need some sort of ecosystem-level approach whereby we maintain and monitor the full range of “ecosystems.” Some (Franklin 1993b, 1994) claim that this is the only way some species will be conserved because we cannot monitor all of them. Others argue that an ecosystem approach is destined to fail because we cannot even define an ecosystem (Orians 1993)—we have a hard enough time trying to define what a species is for conservation purposes (Rojas 1992). Still other discussions revolve around the rec-

Given the difficulties of working with indicators based on the ecosystem level of biological organization, sentiment seems to be converging toward something like that expressed by Noss (1990), who suggests using a hierarchical approach that includes monitoring compositional, structural, and functional elements at a variety of spatial scales. This plays on earlier ideas (expressed by Franklin 1988) that a preoccupation with compositional diversity has come at a cost in terms of awareness of structural and functional diversity. Neither Noss nor Franklin recommends creating a composite index of biological integrity; rather, they recommend monitoring a variety of parameters across combinations of elements and levels. Thus, at the species level of biological organization, we will need to know what is present (composition) and something about the demographics associated with those species (function), as advocated by DeSante and Rosenberg (this volume). While species are not likely to be the only indicators of ecosystem health, it is likely that we will continue to use them as indicators at that particular level of biological organization, which brings us right back to the question of which species to use.

The most recent recommendations include those of Kremen (1992), who suggests using ordination techniques to identify groups of species that might be best sets for monitoring purposes; Mills, Soulé, and Doak (1993), who suggest using species that come closest to being “keystone” elements; and Noss (1990), who suggests five types of species that should be included as indicators: (1) ecological indicators—species that speak for others, (2) keystones—pivotal species on which many others depend, (3) umbrellas—species with large area requirements, (4) flagships—species that serve as rallying points for conservation efforts, and (5) vulnerables—species most prone to extinction in human-dominated landscapes.

Features of Previous Research
That Improved Conservation

The indicator approach has clearly stimulated a lot of valuable discourse on alternative methods of indicator species selection, and while the methods of species selection were being debated, we have also learned a lot about the specific needs of selected indicator species. Specifically, we have used knowledge from field studies to assess the probable effects of alternative land-use practices on indicator species. These assessments have taken one of three approaches. One has been to build models that can predict the suitability of a patch of land for a particular
species—e.g., Habitat Suitability Index (HSI) models (Fish and Wildlife Service 1981); Habitat Capability (HC) models (Hurley, Salwasser, and Shimamoto 1982); and Pattern Recognition (PATREC) models (Williams, Russell, and Seitz 1978). Another approach has been to build models that might predict effects on groups of species—e.g., Integrated Habitat Inventory and Classification System (Bureau of Land Management 1982); Life Form System (Thomas 1979); and various guild models (Severinghaus 1981; Verner 1984). The third approach has been to use habitat-analysis models—e.g., Wildlife and Fish Habitat Relationships program (Nelson and Salwasser 1982) or HSI-based Habitat Evaluation Procedures (Schamberger and Farmer 1978; Fish and Wildlife Service 1980). All three modeling approaches generally include information from a variety of spatial scales and have, at the very least, opened our eyes to the complexity of determining what constitutes suitable habitat for any given species.

Research Needed to Further Conservation

If we are going to retain the use of indicator species in conservation efforts, we must recognize that, from a purely theoretical standpoint, the indicator species approach to maintaining populations of all vertebrate species cannot be expected to work well (Hutto, Reel, and Landres 1987; Landres, Verner, and Thomas 1988). Specifically, because no two species occupy the same niche, the maintenance of several indicators cannot be expected to assure the maintenance of all other species, despite arguments to the contrary (e.g., Tracy and Brussard 1994). There is little reason to expect that a small group of species will serve as much more than a crude "coarse filter." Evidence from the Northern Spotted Owl (Strix occidentalis) scenario shows that current conservation plans do not come close to meeting needs of fish, the Marbled Murrelet (Brachyramphus marmoratus), and other species (Franklin 1994).

From a practical standpoint, the indicator species approach has not worked very well either. There are at least four reasons for the practical failure of this approach to conserve vertebrates in general, and birds in particular. First, because we cannot monitor all species, we spend excessive amounts of time trying to decide which species to monitor (Thibodeau 1983), and when all is said and done, the majority of indicator species are still relatively restricted to a combination of Threatened and Endangered species, and those taken for food, sport, or hides. The transition from an ecologically narrow "game production" mentality to truly broad-based conservation biology has been slow at best. In addition, we are destined to keep adding species to the list of difficult-to-monitor "indicators" because most agencies are required to include (the ever increasing number of)
Threatened and Endangered species. We cannot develop and maintain regional monitoring programs for an ever increasing number of rare species (Franklin 1993b).

Second, the only way we might expect a subset of species to represent the needs of all others is for the subset to subsume the ecological conditions of all others. Unfortunately, the indicator lists are almost certainly too short and too ecologically narrow to accomplish such a task. Some forests in the USFS (U.S. Forest Service) Northern Region, for example, have as few as five "Management Indicator Species," and no forest includes more than twenty-two on its list (table 6.1). Moreover, most indicators are traditionally managed game species and fur bearers, which, coupled with the small number, brings the efficacy of such indicator groups into question.

Third, the cost required to monitor traditional indicator species has been prohibitive because of the techniques needed to monitor rare species. Consequently, there is virtually no monitoring of either population trends or land-use effects on selected indicator species, even though such monitoring has been legally mandated for more than twenty years.

Lastly, despite what many view as an enormous success story associated with the few indicator species that are monitored (e.g., elk), numerous vertebrate species, including fish (Moyle and Williams 1990; Frissell 1993), amphibians (Barinaga 1990; Blaustein and Wake 1990; Phillips 1990), and migratory songbirds (Terborgh 1989; Askins, Lynch, and Greenberg 1990; Robbins, Sauer, and Peterjohn 1993), are apparently falling through the cracks.

These limitations suggest that wildlife biologists in agencies such as the Forest Service, Fish and Wildlife Service, and Bureau of Land Management may need to change the approach they use to meet their legal mandates to maintain wildlife populations. While the agencies themselves are in the midst of changing their operational emphases away from maximizing the production of certain commodities toward both sustainable commodity production and the maintenance of ecological systems, this is an ideal time to either abandon (e.g., Morrison and Marcot 1995) or modify the current indicator species approach.

**Proposed Modification of the Current Indicator Approach**

What kind of change might serve to improve the existing indicator species approach? I argue here for inclusion of one or more indicator species "survey groups" as part of any comprehensive indicator scheme. I define an indicator species survey group as any group containing a large number of species that can be monitored simultaneously through a single survey method. Sparrow et al. (1994) provide arguments why butterflies might make a good indicator group in this sense. Specifically, I recommend broadening the list of desired indicator species to include most landbird species because most can be detected using a simple point-count survey methodology. In fact, I would suggest that there is no
Table 6.1. Numbers of big game, furbearer, endangered bird and mammal, non-endangered bird, amphibian, and fish species used as indicator species for management of U.S. National Forests (Northern Region)

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<thead>
<tr>
<th>Species Group</th>
<th>Forest</th>
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<tr>
<td>Big Game Mammals</td>
<td>1</td>
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<tr>
<td>Furbearers</td>
<td>1</td>
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<tr>
<td>Endangered Mammals and Birds</td>
<td>4</td>
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<tr>
<td>Non-endangered Birds</td>
<td>3</td>
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<tr>
<td>Amphibians</td>
<td>0</td>
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<td>Fish</td>
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Total Number of Indicator Species 11 8 9 8 22 11 12 5 12 7 21 9 13

Big Game Mammals are Mountain Goat (Oreamnos americanus), Bighorn Sheep (Ovis canadensis), Moose (Alces alces), Elk (Cervus elaphus), White-tailed Deer (Odocoileus virginianus), Mule Deer (Odocoileus hemionus), Black Bear (Ursus americana), and Mountain Lion (Felis concolor); Furbearers are Lynx (Lynx canadensis), Bobcat (Lynx rufus), Wolverine (Gulo gulo), Fisher (Martes pennanti), Pine Martin (Martes americana), and Beaver (Castor canadensis); Endangered Species are Caribou (Rangifer tarandus), Wolf (Canis lupus), Grizzly Bear (Ursus arctos), Black-footed Ferret (Mustela nigripes), Bald Eagle (Haliaeetus leucocephalus), Whooping Crane (Grus americana), and Peregrine Falcon (Falco peregrinus); Non-endangered Birds are Trumpeter Swan (Cygnus buccinator), Northern Goshawk (Accipiter gentilis), Golden Eagle (Aquila chrysaetos), Prairie Falcon (Falco mexicanus), Blue Grouse (Dendragapus obscurus), Ruffed Grouse (Bonasa umbellus), Sage Grouse (Centrocercus urophasianus), Greater Prairie Chicken (Tympanuchus cupido), Sharp-tailed Grouse (Tympanuchus phasianellus), Barred Owl (Strix varia), Hairy Woodpecker (Picoides villosus), Three-toed Woodpecker (Picoides tridactylus), Pileated Woodpecker (Dryocopus pileatus), Cassin’s Kingbird (Tyrannus vociferans), Hermit Thrush (Catharus guttatus), Ovenbird (Seiurus aurocapillus), Yellow Warbler (Dendroica petechia), Spotted Towhee (Pipilo erythrophthalmus), Brewer’s Sparrow (Spizella breweri), Lark Sparrow (Chondestes grammacus), and Northern Oriole (Icterus galbula); Amphibian is Tailed Frog (Ascaphus truei); Fish are Arctic Grayling (Thymallus arcticus), Brook Trout (Salvelinus fontinalis), Bull Trout (Salvelinus confluentus), Cutthroat Trout (Oncorhynchus clarki), Rainbow Trout (Oncorhynchus mykiss), Chinook Salmon (Oncorhynchus tshawytscha), and Largemouth Bass (Micropterus salmoides). Forest Abbreviations are: BE=Beaverhead, BI=Bitterroot, IP=Idaho Panhandle, CL=Clearwater, CU=Custer, DE=Deerlodge, FL=Flathead, GA=Gallatin, HE=Helena, KO=Kootenai, LC=Lewis and Clark, LO=Lolo, and NE=Nez Perce.
better tool than a landbird monitoring program to enhance the effectiveness of wildlife conservation efforts. Why?

1. Landbirds are not only the most visible of vertebrate species, they also advertise their presence and identity through vocalizations. Thus, systematically collected field data are much easier and less expensive to gather for landbirds than for traditionally managed species that require trapping, radio tagging, locating, and so forth.

2. Because patterns of occurrence in the field are easily uncovered, the foundation of field data on which habitat suitability (HSI) models are built is potentially much stronger for landbirds than for most of the existing management indicator species.

3. Using a single survey method, one can collect data on nearly two hundred bird species simultaneously. Many species will not be monitored well, but having to manage for the maintenance of those that can be monitored will probably bring us much closer to maintaining populations of all vertebrates than would the still prevalent approach of managing entirely on the basis of a select few indicator (mostly game) species. This is especially true if we combine landbird monitoring with continued management for the traditional indicator species.

4. Having to manage for the maintenance of many landbird species will force movement toward management at broader spatial scales. This is because the indicator species list will now be large enough and ecologically broad enough to reveal some species that will benefit from, and others that will be harmed by, any proposed land-use activity. This would appear to lead managers into a no-win situation because any proposed land-use alternative will hurt something, but the way out of this apparent dilemma is to expand one’s focus beyond the immediate project area. In fact, realizing that local populations of some species will invariably be harmed by any proposed land-use action forces us to expand our perspective toward broader landscapes. It is only at the landscape level that we can provide a plan or vision that will provide enough of each landscape element to maintain the populations of, and honestly claim “no effect” on, all vertebrate species. The local extinction of a species due to some land management activity is fine as long as the suitability for that same species is expected to increase at the same time in another part of the landscape (due to some other land-use activity or ecological succession, for example).

Because we will never fully understand the habitat requirements of all vertebrate species, I still believe the indicator approach is necessary; it merely needs to be applied in a way that avoids the pitfalls of managing entirely on the basis of the needs of just a few high-profile species. My goal in this chapter is to use a selection of preliminary results from a newly established landbird monitoring
program (published in their entirety in Hutto [in press]) to illustrate why land-
birds (primarily songbird species) are likely to be excellent conservation tools, 
and why they are likely to figure prominently in any change in the way wildlife 
bioologists manage for the maintenance of all vertebrate species.

Methods
A complete description of the methods used to obtain the data summarized here 
is available in Hutto and Hoffland (1996) and Hutto (in press). Basically, a series 
of 646 10-point transects were geographically stratified by 7.5-minute topo-
graphic quad maps and were permanently marked in the field in 1994. Bird sur-
veys were conducted at these points in the same year and at an additional 2,355 
points distributed among 309 transects between 1989 and 1993 as part of an effort 
to acquire data from vegetation cover types that were likely to be undersampled 
on USFS lands. Thus, bird occurrence data were collected from 8,815 points 
between 1989 and 1994. A 10-minute point count was conducted at each of the 
sampling points along a transect. Points were visited once between mid-May and 
early July in a given year. On the return trip after all point counts had been con-
ducted, observers stopped at each point again to record a variety of vegetation 
information within a prescribed area surrounding each point. For the purposes 
of this report, I present bird occurrence data in relation to a single vegetation 
variable—the vegetation cover type within which the point count was positioned 
(COVTYPE).

Each sample point, therefore, fell within one of a range of possible vegetation 
cover types defined according to a scheme based on a combination of the pos-
sible dominant plant species in the tallest vegetation layer and the possible ver-
tical and horizontal vegetation structure. Thus, the basic cover type framework 
is one that included so-called "climax" vegetation types and, for the conifer forest 
types, which take on a very different structure from the climax type after 
disturbance, a series of successional stages (pre-shrub, low-shrub, tall-shrub, and 
pole-sapling stages). I then combined potential types to create a smaller series of 
eighteen vegetation types prior to model building. For conifer forest types, I 
deﬁned eleven categories represented by six relatively mature and relatively 
undisturbed forest types (cedar-hemlock, spruce-fir, lodgepole pine, mixed 
conifer, Douglas fir, and ponderosa pine) and five early successional or post-treat-
ment types (post-fire, clearcut, seed-tree cut, shelterwood cut, and group-selection cut). The remaining seven categories were the open and riparian types 
(sagebrush, grassland, agriculture, marsh, riparian shrubs, Cottenwood/Aspen, 
and residential).

Unfortunately, because sample points occurred across the landscape in clusters 
of 10 (per transect), multiple samples of a given cover type within a single tran-
sect are not statistically independent estimates of bird composition within that 
cover type. Nevertheless, I used individual points as sample units for calculating 
the probability of occurrence on a 10-minute point count in a given cover type
because (1) transects themselves make meaningless habitat sample units when they cross multiple cover types, and (2) the danger of being misled because of pseudoreplication of points within a cover type has been largely eliminated by the tremendous geographic spread of points for each cover type (Hutto in press).

To determine habitat associations, I excluded points that were positioned within 100 m of the edge of another cover type to reduce the chance that birds would have been detected within a cover type that differed from that recorded at the census point. I had to include data from the entire set of points positioned within each of the three riparian types (marsh, riparian shrub, and riparian bottomland), however, because most of those cover type patches were so small or narrow, so that, by default, a point located within one of those types was also within 100 m of another cover type as well. To further reduce the chance of linking the occurrence of a bird species to a habitat within which it did not occur, I used only bird detections that were estimated to be within 100 m of the observer. Thus, the number of points used to calculate the probabilities of occurrence across cover types (4,097) was substantially less than the number actually conducted in the field (8,815), but there were still at least 50 points in each of the 18 cover types).

Results

We visited a total of 8,815 points, which were distributed among 955 transects on 13 national forests in the USFS Northern Region and on various BLM, Potlatch, Plum Creek, tribal, state, and private lands adjacent to these forests. A total of 186 bird species were detected, most of which (163) were those that the point count method was designed to detect—the smaller, diurnal, visually and vocally conspicuous landbirds. The total also included 15 waterfowl and 8 shorebird species. As an indication of the efficacy of this method at detecting species known to breed in a given area, in western Montana (where transect coverage coincides with coverage reported by the Montana Bird Distribution Committee in 1996) we detected 121 (91 percent) of the 133 known breeding landbird species (excluding hawks, grouse, and owls). A total of 91 species (68 percent of the potential breeding landbird species) were detected close enough (within 100 m) and frequently enough (on 30 or more points) to construct what we believe are meaningful habitat-relationship models (see Hutto et al. [1986] for a discussion of minimum number of point counts needed to generate reliable estimates of probabilities of occurrence in a given habitat type). I would emphasize here that, although the method does not provide information on all bird species, it allows one to monitor a much larger number of species than that typical of traditional indicator species approaches.

What generalizations emerged from these simple models of bird distribution among habitats? Some landbird species are very restricted to specific, naturally occurring ecological conditions that are themselves restricted in spatial extent, or at least less extensive than they were at the turn of the century. Obviously, the
Figure 6.1. Examples of landbird species that are relatively restricted to each of several vegetation cover types. Only the latter two species are restricted to cover types that are products of human disturbance and, thereby, are more prevalent in the northern Rocky Mountain landscape now than in the pre-industrial past. Sample sizes (number of point counts) for each cover type are: cedar-hemlock (74), spruce-fir (134), lodgepole pine (215), mixed-conifer (1143), Douglas fir
(g) Brewer's Sparrow

(h) Bobolink

(i) Williamson's Sapsucker

(292), ponderosa pine (77), group selection (112), shelterwood (75), seed tree (116), clearcut (365), post-fire (338), sagebrush (100), grassland (481), agriculture (56), marsh (75), riparian shrub (296), Cottonwood/Aspen (102), residential (46).
loss of any one of these cover types will mean the loss of those bird species that are relatively restricted to it. Thus, it should be clear that we need to maintain each of these cover types (defined at least as finely as defined here) on the broader landscape, although it is unclear how much of each needs to be retained to maintain viable populations of any given species. Even if we are not about to lose a given cover type from the broader landscape, land-use practices within and surrounding that type may have important implications, especially for species restricted to that cover type. Below, I provide examples of the more instructive distribution patterns that emerged from our survey work (a complete list of species that illustrate each pattern can be found in Hutto [in press]):

1. Post-fire, standing-dead forests (e.g., Black-backed Woodpecker [Picoides arcticus]; figure 6.1A)—The relatively restricted distribution patterns result from the fact that these bird species depend to a great extent on standing dead trees in burned forests for feeding and nesting. Not only do we have much less of this cover type than would naturally occur because of our fire prevention policies, but salvage logging what little does manage to burn will have a negative impact on species that are either restricted to, or relatively restricted to, early postfire conditions.

2. Relatively uncut forests (e.g., Brown Creeper [Certhia americana]; figure 6.1B)—Based on observed distribution patterns among cut and uncut forest types, the cutting (even light thinning) of dense, older forests (especially the cedar-hemlock type) will have negative effects on several species that are restricted to those conditions. If we break down the relatively uncut forest types into four age categories (young, selectively cut, mature, and old growth), it becomes apparent that some of these species require not only relatively uncut, but relatively old forests as well (figure 6.2).

3. Marshes (e.g., Common Yellowthroat [Geothlypis trichas]; figure 6.1C)—The potential negative effects of wetland conversion on (mostly) privately owned lands should be obvious.

4. Riparian bottomlands (e.g., Yellow-breasted Chat [Icteria virens]; figure 6.1D)—Numerous landbird species are relatively restricted to riparian bottomlands. This fact takes on special meaning when we consider that bottomland riparian cover types make up less than 0.5 percent of all land area in the Northern Region (Mosconi and Hutto 1982), and that they incur a disproportionate amount of human activity (i.e., home building, recreation, and livestock grazing) and cowbird activity. Much of this land base is private, making publicly owned land of this type much more important a potential refuge for wildlife that might be sensitive to the human activities listed above. We currently lack, but desperately need, information on cowbird parasitism rates in relation to the presence of livestock in riparian bottomlands, and we need information on the effects of vegetation alteration and livestock presence on nesting success of riparian bottomland birds.
5. **Upland riparian stream environments** (e.g., Lincoln’s Sparrow [*Melospiza lincolnii*]; figure 6.1E)—Species restricted to upland riparian streamside vegetation may be especially sensitive to so-called “best management practices,” which have never been evaluated in terms of their effects on a wide variety of riparian-dependent terrestrial wildlife species.

6. **Grassland** (e.g., Sprague’s Pipit [*Anthus spragueii*]; figure 6.1F)—If we couple the fact that many species are restricted to grassland with the fact that many of the same species are declining on a nationwide scale, the management of those lands becomes a pressing issue. Livestock grazing is a common land-use activity in grassland environments and may be incompatible with the needs of some of these bird species (Herkert and Knopf, this volume).

7. **Sagebrush** (e.g., Brewer’s Sparrow [*Spizella breweri*]; figure 6.1G)—Once again, livestock grazing is a common land-use activity in sagebrush environments and may be incompatible with the needs of bird species restricted to such habitat (Rotenberry, this volume).
8. **Agricultural fields** (e.g., Bobolink *[Dolichonyx oryzivorus]*; figure 6.1H) — This cover type is not “naturally occurring,” but even though such environments are artificially created, the maintenance of viable populations of species that are relatively restricted to such conditions may depend on the management practices associated with such land. The main issue here is one of whether mechanical disturbance from farm machinery interferes with the reproductive biology of species that are relatively restricted to agricultural lands. If so, these environments may be acting as “ecological traps” that attract individuals but do not allow them to be successful there (Rodenhouse and Best 1983).

9. **Harvested conifer forests** (e.g., Williamson’s Sapsucker *[Sphyrapicus thyroideus]*; figure 6.1I) — No conifer-forest bird species appears to be restricted to the harvested cover types, but several occur most commonly in the variously cut forests. The potential management issue is related to the fact that harvested forests are “unnatural” in the sense that their structure consists of combinations of elements (widely or evenly spaced live trees) that simply do not exist in natural successional seres. A potential problem is that these unnatural cover types may elicit settling responses by species that are “programmed” to respond to superficially similar, but fundamentally different, early successional forest types. Thus, harvested forests could be acting as “ecological traps” (e.g., Gates and Gysel 1978), where species are being attracted to areas where suitability is poor because reproductive success and/or adult survival is affected negatively by, say, inadequate food resource levels, or abnormal high predation or parasitism rates. Because no forest bird species is entirely restricted to harvested conditions, there will always be “backup” bird populations in lightly harvested or unharvested forest as refuge from such a problem, should it exist.

**Additional Research Needs**

We need more data on occurrence of species among a broader range of existing vegetation cover types, especially cover types that result from land-use activities. As crude as such information might be, it is far better than the information provided by a typical field guide and should be the foundation beneath speculation about the projected effects of any land management plan on a given wildlife species. Armed with a solid understanding of which cover types are occupied by a given species, we can proceed with comparisons of various measures of fitness among the occupied cover types to ensure that presence is not a misleading indicator of habitat suitability. Altered habitats need much more attention than they currently receive because “unnatural” structural changes are likely to uncouple habitat selection stimuli from factors that ultimately determine an individual’s success, thereby creating “ecological traps.”
Land management agencies should be actively engaged in the process of adaptive management, whereby effects on selected species are constantly monitored by agency and other researchers so that land-use practices can be modified on the basis of this continual appraisal of land-use effects. Finally, we should seek additional groups of species that can be monitored through single field methods so that habitat relationships can be built for, and land management decisions made on the basis of, as wide a range of species as possible.

Making Research Effective for Conservation

Many patterns of restricted habitat use have been common knowledge (e.g., Grasshopper Sparrow (Ammodramus savannarum) is restricted to grasslands; Brewer's Sparrow is restricted to sagebrush), but other patterns of relatively restricted distribution were probably not as evident prior to this work. As just one example, wildlife biologists never seriously considered standing dead forests created by stand-replacement fires as critically important wildlife habitat until data on landbird distribution patterns began rolling in. Black-backed Woodpeckers appear to depend on such habitats, at least in the northern Rocky Mountains (Hutto 1995). Attention to that particular nongame species exposes a clear conflict with post-fire salvage-cutting operations. It is with attention to nontraditional management species, not to traditional species of management concern, that biologists have begun to expose costs associated with this widespread and virtually unquestioned land-use practice. The relative restriction of Brown Creepers to comparatively uncut cedar forests is also impressive and serves to emphasize the value of this cover type to wildlife species. Thus, we can gain a new understanding of critical elements and processes through species-centered environmental analysis (James, Hess, and Kufrian 1997), and we stand to benefit by expanding such analyses beyond traditionally managed species.

Prior to this survey, it was also common knowledge that many bird species were widely distributed across cover types, but we had no knowledge of the relative abundance of these bird species among cover types, especially harvested forest types. It is now evident that Orange-crowned Warbler (Vermivora celata) and Solitary Vireo (Vireo solitarius), for example, occur not only broadly across forest types, but most commonly in harvested forest types (figure 6.3), and that Williamson's Sapsucker is even relatively restricted to such types (figure 6.11). In short, the detail and region-specific nature of this information is noteworthy and should prove useful to individuals wishing to model probabilities of occurrence in planning areas that are projected to consist of alternative proportions of various cover types.
Figure 6.3. Two coniferous-forest species that illustrate monitoring data can expose subtle differences in probability of occurrence among the conifer cover types. Such resolution is essential for building accurate distribution maps in relation to cover types within a landscape.
I realize that measures of presence or probability of occurrence do not necessarily reflect suitability, but before we worry too much about whether two cover types are equally suitable, we first need to be able to predict where a species is likely to occur at all! The occurrence data described here have uncovered numerous (outlined in Hutto in press) potential "ecological trap" problems that need study. Thus, monitoring data like these can serve to focus future research efforts toward particular species or situations.

Even though populations of a species fluctuate from year to year, the relative abundances among broadly defined vegetation cover types do not (e.g., Sallabanks 1996). Thus, the value of a monitoring program such as this one should be readily apparent: objective results are possible from as little as a single year's field effort, and the results already demonstrate some clear limits within which any agency aspiring to maintain ecological integrity must work.

Programs like this one would benefit other USFS regions and (especially) other agencies, but I would in no way suggest that this sort of research should take priority over other kinds of research. In fact, the limiting factor in bird conservation seems to be a willingness to use information on land-use effects, not a shortage of such information. Wildlife conservation depends, ultimately, on attitudes of the public about the value of wildlife. And perhaps people's attitudes about wildlife conservation are less likely to be changed through results from largely descriptive research such as that which I've just described than from other kinds of research (e.g., behavioral studies). We should judge the conservation potential of proposed research on the basis of the stated research justification, period. Attempts to define research "needs" otherwise are largely misdirected; what we "need" is the widest possible variety of quality research.

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