SPECIAL SPECIES
MONITORING AND ASSESSMENT IN OREGON AND WASHINGTON:

LANDBIRD SPECIES NOT ADEQUATELY MONITORED BY THE BREEDING BIRD SURVEY

prepared for:

Oregon-Washington Partners in Flight
www.gorge.net/natres/pif.html

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October 2001

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Introduction

Population monitoring is an essential tool in bird conservation. Knowledge of a species' population status (e.g., distribution, abundance) is the first line of defense in conservation. Population monitoring also is used to detect changes in population levels (i.e., trends) and determine the effectiveness of management actions, particularly those implemented as a result of concerns about changes in population levels. For resource managers to develop and implement effective bird conservation strategies, they must have sound information on community composition and species abundance and population trends within the context of ecological and spatial parameters (Ganey and Dargen 1998). Avian population monitoring also is required by legislative enactments and natural resource management agency mandates.

In the last 10 years, considerable effort has been directed towards standardization and expansion of population monitoring for landbirds (e.g., Ralph et al. 1993, Ralph et al. 1995, Hamel et al. 1996, Leukering et al. 2000). Most of this was a direct result of concerns about declining populations of landbirds, especially migrants, and the emergence of Partners in Flight (PIF) and the Neotropical Migratory Bird Initiative. In Oregon and Washington, several recent documents have focused on aspects of landbird monitoring (i.e., Manuwal and Carey 1991, Andelman and Stock 1994, Altman 1995a, Bart and Battaglia 2000, Battaglia 2000, Huff et al. 2000).

In 1998, the Oregon-Washington Chapter of PIF undertook the development of a comprehensive Landbird Monitoring and Assessment Program in cooperation with the Avian Research and Monitoring Support program of the U.S. Geological Survey in Boise, Idaho. A conceptual framework for the program was developed (Bart and Battaglia 2000) including a vision statement and goals, objectives, and strategies consistent with the vision. The vision for the program is:

> *A practical, statistically rigorous program of data collection on the abundance, productivity, and survival rates of birds throughout Oregon and Washington, covering all seasons and habitats and designed to meet the needs of managers at local and State levels as well as to contribute to meeting national and international goals.*

Two goals were established for the Program:

1. *Identify undesirable existing and/or impending trends in landbird abundance or distribution.*
2. *Identify causes of the undesirable trends and ways of reversing them.*

The objectives for achieving these goals are:

1. *Monitor distribution and abundance of landbirds at the regional, and selected sub-regional levels.*
2. *Estimate habitat-specific abundance for species, populations, and habitats of special importance to managers.*
3. *Investigate demographic rates in populations of special importance to better understand determinants of habitat quality and improve ability to predict the*

consequences of management actions.

The strategies for achieving the objectives are:

1. *Describe current monitoring and assessment programs*
    a. *Update Altman's (1995b) Directory of Monitoring Projects*
    b. *Summarize knowledge about habitat relationships*
2. *Design the program to monitor regionwide abundance*
    a. *Assess the accuracy of existing long-term, regionwide programs*
    b. *Decide whether other programs can contribute to long-term monitoring*
    c. *Decide whether an expanded regionwide program is needed*
3. *Design the initial short-term projects*
    a. *Identify species in need of study*
    b. *Identify management issues in need of study*
    c. *Select species, issues, and methods for the initial short-term projects.*

Strategy 1a, 1b, and 2a have been completed (Battaglia 2000, Johnson and O'Neill 2001, and Bart and Battaglia 2000, respectively). This document focuses on Strategy 2b and 2c, monitoring species outside existing long-term regional programs. Strategy 3, the development of projects to support the program, is the implementation component of this document.

Need and Purpose

Nearly all the recent emphasis on landbird monitoring has focused on using standardized approaches for broad-scale landscape- or habitat-based monitoring. The primary example of the former is the continental Breeding Bird Survey (BBS) (Robbins et al. 1986). Two examples of habitat-based monitoring specific to Oregon and Washington include the U.S. Forest Service Region 6 Landbird Monitoring Program and the Point Reyes Bird Observatory Shrub-Steppe Monitoring Program. For all these programs, the emphasis is bird community monitoring using point count methodology. However, there is a significant suite of species that are not captured by these "broad brush" approaches to population monitoring. These species usually fall into one or more of the following categories:

· their habitats not well monitored,
· they are too rare or erratic to be sampled effectively, or
· their ecology is not conducive to standard methodologies (e.g., inconspicuous, colonial, nocturnal, low densities).

Information on the population status of most of these "Special Species" is lacking. Some of the species are considered species of management concern because of their rarity or vulnerability, and these species and their habitats are afforded varying levels of interest and/or regulatory protection. Other species perhaps should receive consideration for protection, but current knowledge is insufficient to assess their population status. Some species may be in decline and could benefit from conservation actions, but without knowledge of their population status to elicit conservation actions, these species may be on the road to listed status.

For a few Special Species, some population monitoring has occurred (e.g., northern goshawk, great gray owl, white-headed woodpecker), although several factors limit the utility of those data. First, available data often are locally representative and may not be reflective of the species as a whole. Second, protocols have not been standardized for many of the species, thus it is difficult to compare results from monitoring efforts. Finally, there has not been a statistically based framework established for most of the monitoring that has been conducted.

This document has been prepared to address the data gap for populations of the aforementioned Special Species. The primary purpose of the document is to:

> *Provide guidance for conducting population monitoring and status assessment for landbird species in Oregon and Washington that are not adequately monitored by the Breeding Bird Survey.*

We present a conceptual framework with protocols and recommended responsibilities that emphasizes the most appropriate and efficient way to monitor landbird species not adequately monitored by the BBS. We refer to this as the Special Species Landbird Monitoring and Assessment Program (SSLMAP). The approach is primarily habitat-based, but includes spatial and temporal parameters, and also includes species-specific parameters where appropriate.

The document is intended to assist government agencies mandated with responsibilities for maintaining viable populations of landbirds, and non-governmental organizations and private landowners that are otherwise responsible for management of habitats used by landbirds. Monitoring the Special Species addressed in this document will be essential for as complete and accurate representation of their population status as possible, and to determine whether management and conservation is appropriate.

Monitoring and Assessment

Within this document, and in the course of data analysis and interpretation when monitoring is conducted, it will be important to distinguish between population monitoring and status assessment (or “tracking”). We define population monitoring as the systematic collection of occurrence data that can be evaluated analytically to determine whether a population change has occurred over a period of time. Population status assessments also use systematically-collected data but the analyses are more descriptive and lack the statistical rigor of population monitoring data because of limited sample sizes due to a number of ecological or logistical factors (e.g., rare or secretive species). In the most extreme case, status assessment might entail the mere recognition of occurrence of a particular species at various sampling locations, and a basic understanding that this occurrence changed over time. Such data are obviously less reliable than population monitoring data. For some species, status assessment may only be short-term until the level of the sampling required for effective population monitoring is determined. For some species, the level of sampling required for population monitoring may be enormous or the population may be too small to ever be effectively monitored, in which case status assessment is the only means of monitoring. We believe that the greatest value of status assessment information is as a first indication that a species is or may be undergoing population changes. In that case, it may be necessary to overcome the factors that impeded effective population monitoring, and the species at that point should be monitored to a higher standard unless management can be implemented to address an obvious factor impacting the species population. General references to "monitoring" in this document include "status assessment" unless specified otherwise.

Scope of the Program

There are four important sideboards to the scope of this document. First, as stated before, this report only addresses species not adequately monitored by the BBS. Our assumption is that the BBS provides adequate population monitoring for many landbird species, and the purpose of the SSLMAP is to complement the BBS. We recognize that the roadside bias inherent to the BBS results in population parameters that are not habitat-specific. Additionally, some species may meet sample size criteria for BBS trend analysis, but there are other monitoring methods that likely provide more reliable estimates of population size and trends (e.g., colony counts). Thus, reliance on BBS trends has been questioned, and habitat- or species-specific surveys for all species are being promoted elsewhere in the west to supplement the BBS (Leukering et al. 2000). However, we believe that the power of the BBS data set (30+ years with over 200 routes in OR and WA) can compensate for some concerns about habitat-specificity, and that the BBS is providing reasonably accurate population information for most species, especially for the many species that are relatively common and not habitat specialists. Rather than attempt to replace or supplement the BBS, we decided there is a greater need to focus limited resources on monitoring species with little to no population information.

Furthermore, recent work (Bart et al., unpublished) suggests that the combination of substantially increasing the number of BBS routes and intensive studies to reduce potential bias in trend estimates based on the BBS may permit adequate coverage of some of the widely distributed species not adequately covered at present. If increased BBS coverage was implemented in Oregon and Washington, some of the species addressed in this document would likely be adequately covered. Many species, however, will still not be well-covered by the BBS, and the SSLMAP is intended for this suite of species.

Secondly, this report only addresses landbird species. We recognize that an all-taxa monitoring strategy is desirable, but felt it was most important at this time to develop and implement the landbird component with the ultimate goal of including other species as well. Additionally, populations of waterfowl and some other water-associated birds are often monitored by state and federal agencies, and other regional and national bird monitoring programs are being developed (e.g., shorebirds). Within the category of landbirds, we do not address introduced species or listed species which are the focus of regulatory agencies.

Thirdly, this report only addresses monitoring of breeding-season populations of birds. This is not to imply that monitoring outside the breeding season is not important, but our highest priority and greatest need is for data on breeding season populations. From a conservation standpoint, there is an underlying assumption that maintaining quality habitat to support viable populations of breeding landbirds will also support wintering and migrant birds of the same and other species.

Finally, this report only addresses systematic monitoring to estimate population status (e.g., abundance, density, distribution) and population trends. The SSLMAP as described in this document is not intended for landbird inventories or other short-term evaluations of presence/absence. Additionally, the measure of population status we discuss is detections of individual birds during censusing, not other potential population parameters such as number of active or successful nests, number of fledged young, etc. This document also does not address monitoring of population demography, which is critical to understanding the causes of population trends and for developing conservation and management strategies (see Goal 3, above). It is well recognized that population trend data do not assess the viability or fitness of a population, and can potentially be misleading in terms of population health (Van Horne 1983). Demographic types of monitoring are highly desirable and are not meant to be trivialized by the authors. However, for most of the species addressed in this report, there is little if any information on population status, let alone the demographic parameters that affect population status. This document is intended to stimulate action to address the unknown population status of these species which will be important for government agencies to determine levels of concern for the species. By the very nature of stimulating interest in the population status of these species, it is likely that demographic types of monitoring also will be initiated. We encourage efforts to monitor population demography of Special Species, but an emphasis on demographic monitoring is outside the scope of this document. Information on demographic types of avian monitoring can be found in Ralph and Scott (1981), Martin and Geupel (1993), Ralph et al. (1993), and Nur et al. (1999).

“Special Species” Determination

The process of developing a list of Special Species for the SSLMAP involved several steps that included data analysis and interpretation and the use of professional knowledge as appropriate. Bart and Battaglia (2000) presented the initial analysis of the suitability of BBS data to monitor population trends for the 162 breeding landbird species in Oregon and Washington. Landbirds were defined as all birds except loons, grebes, seabirds, waterfowl, long-legged waders, shorebirds, gulls, terns, alcids, cranes, and rails. A few exceptions (e.g., long-billed curlew and upland sandpiper) were deemed appropriate for practical reasons. The criteria established for a species to be “adequately covered” by the BBS was that it was recorded on at least 14 routes and that the 95% confidence interval for the trend was less than 0.08. These criteria were applied separately in Washington and Oregon. The results were that 77 and 58 species are adequately covered by the BBS in Oregon and Washington, respectively (Bart and Battaglia 2000).

Based on work in progress to set quantitative goals for avian monitoring programs at the National level (Bart and Francis 2001), slightly different criteria were used in this project to assess which species were adequately monitored by the BBS. The new criteria were applied to an analysis of the U.S. Fish and Wildlife Service (FWS) Region 1 (Oregon, Washington, California) BBS data, but included an estimate of potential bias in the BBS estimates. The rationale for using a larger region than just one State is that larger patterns - for example a shift in range - will often be of great interest to the manager and that the estimation of regionwide trends can include parameters describing spatial variation in the trend. This approach probably provides the flexibility needed by State-level managers while permitting use of the larger data set. The FWS Region 1 was used as a surrogate for such a region of interest because estimates for this area were readily available. Ideally, different regions would be used for different species. For example, the Great Basin might be used for shrubsteppe species while the North Pacific region might be used for forest species.

The rationale for including potential effects of bias was that bias undoubtedly occurs and can seriously mislead analysts if its potential effects are not considered. The most important possible biases in BBS trend estimates appear to result from restricting the survey to roadsides, changes in average observer skill over time, and making false assumptions in the analytic methods. The combined effect of these biases, in the estimated annual rate of change in population size, was estimated to be <1%, and this upper limit was used in determining which species are adequately covered at present.

The analysis used a 15% significance level on the basis that 85% certainty (e.g., in hypothesis tests) is probably more appropriate for many management decisions given that use of a higher level (e.g., .05) will likely result in real declines being missed in the analysis. Using a larger region and higher significance level tends to portray the BBS as providing adequate coverage for more species, whereas including potential effects of bias has the opposite effect. It turned out that these changes just about canceled each other so the list obtained for this project was not much different from the list in the initial analysis of Bart and Battaglia (2000). As a result of the FWS Region 1 analysis, 57 species were deemed to be inadequately monitored by the BBS (Appendix A).

Once the list of species not well-monitored by BBS was generated, we removed from the list a number of species we decided were not appropriate for special monitoring in Oregon and Washington. This included four introduced species; chukar, gray partridge, wild turkey, and northern bobwhite: and two listed species, spotted owl and greater sage grouse. We also removed two species, cordilleran flycatcher and northwestern crow, due to taxonomic uncertainties, and four species, red-breasted sapsucker, say’s phoebe, bank swallow, and ruby-crowned kinglet, that likely are adequately monitored by the BBS in Oregon and Washington, although not in the larger FWS Region 1 data base. This reduced the Special Species list to 45.

We then added species that we felt should be included for two important reasons. First, we added species generally not detected well by the BBS due to their ecology (e.g., owls) or rarity (e.g., upland sandpiper, yellow-billed cuckoo, white-tailed ptarmigan). Additionally, we added species that although well sampled by the BBS in the FWS Region 1 data set, their occurrence and/or abundance on BBS routes is low in Oregon and/or Washington. The latter species were evaluated subjectively by determining the number of BBS routes they occurred on in Oregon and Washington (generally < 40), and the average number of detections in Oregon and Washington per year (generally < 30). This added 30 species to the list and brought the total number of landbird species that we believe warrant special monitoring efforts to 75.

The Special Species list in Table 1 and Appendix A reflects a bi-state perspective on the need to conduct population monitoring for those species. There are a number of other species that are

Table 1. Habitat Groups and Monitoring Parameters for the Special Species Landbird Monitoring and Assessment Program (SSLMAP) in Oregon and Washington.

	Monitoring Parameters			
High Elevation	Monitoring Type	Timing [1]	Geographic/Ecoregional	Habitat
American pipit	point counts or point transects	mid-June to mid-July	Cascades and Olympics, WA; Cascades, n. Rockies, Steens, OR	alpine
Boreal chickadee	point counts or point transects	mid-June to mid-July	n. Cascades, n. Rocky Mtns. WA	subalpine forest
Boreal owl	broadcast recorded vocalizations at road stations	mid-April to late-March	n. Cascades, WA	subalpine forest
Clark's nutcracker	point counts or point transects	mid-June to mid-July	all high elevation forest, OR and WA	subalpine forest
Fox sparrow	point counts or point transects	June	n. Rocky Mtns., WA and Cascades of OR and WA	shrubby subalpine forest
Gray-crowned rosy finch	point counts or point transects	mid-June to mid-July	Cascades and Olympics, WA; Cascades, n. Rocky Mtns., Steens, OR	alpine
Lincoln's sparrow	point counts or point transects	June	n. Rocky Mtns., and Cascades of OR and WA	high elevation wet meadows
Pine grosbeak	point counts or point transects	mid-June to mid-July	all high elevation forest, WA; n. Rocky Mtns., OR	subalpine forest, montane mixed conifer
Spruce grouse	broadcast recorded vocalizations at stations	mid-June to mid-July	all high elevation forest WA except Olympics; n. Rocky Mtns., OR	subalpine forest, lodgepole pine
Three-toed woodpecker	broadcast recorded vocalizations at stations	early-May to mid-June	n. Rocky Mtns and east-slope Cascades, OR and WA	subalpine forest, burns
White-tailed ptarmigan	broadcast recorded vocalizations at stations	mid-June to mid-July	Cascades, WA	alpine
Eastside Forest Riparian				
American redstart	point counts or point transects	June	n. Rocky Mtns. OR and WA; rare east-slope Cascades, westside	hardwood riparian forest
Calliope hummingbird	point counts or point transects	late-May to late-June	all forest zones of e. OR and WA; Steens, Hart, Siskiyous, OR	open forest, meadows, riparian
Gray catbird	point counts or point transects	mid-June to early July	n. Rocky Mtns., OR and WA; east-slope Cascades, WA	riparian shrub
Northern waterthrush	point counts or point transects	June	n. Rocky Mtns., WA and Klamath Co., OR	riparian forest along montane streams
Eastside Upland Non-Forest				
Black-throated sparrow	point counts or point transects	late May through June	Great Basin of se Oregon; small population Columbia Basin, WA	sagebrush, desert scrub
Bobolink	point transects or colony counts	June	Great Basin, small population Columbia Basin, WA	grassland, herbaceous wetlands
Burrowing owl	auto driving routes, point counts or point transects	April through early May	Columbia Basin, Great Basin, High Lava Plains	open shrub-steppe, grassland
Canyon wren	point counts or point transects	May	Columbia Basin, Great Basin, High Lava Plains	canyons
Ferruginous hawk	auto driving routes or point counts	mid-April to mid-May	Columbia Basin, Great Basin, High Lava Plains	grassland, shrub-steppe
Loggerhead shrike	auto driving routes, point counts, or point transects	early-April to mid-May	Columbia Basin, Great Basin, High Lava Plains	shrub-steppe, open juniper
Long-eared owl	broadcast recorded vocalizations at stations	April	Columbia Basin, Great Basin	wooded riparian, open forest
Prairie falcon	auto driving routes, point counts, or point transects	April	Columbia Basin, Great Basin	grassland, shrub-steppe
Short-eared owl	auto driving routes	late-April to late-May	Columbia Basin, Great Basin	grassland, wetland
Swainson's hawk	auto driving routes or point counts	late-April to late-May	Columbia Basin, Great Basin	grassland, shrub-steppe
White-throated swift	point transects or colony counts	May	Columbia Basin, Great Basin	canyonland cliffs
Eastside Open Forest				
Black-backed woodpecker	broadcast recorded vocalizations at stations	mid-April to late-May	n. Rocky Mtns and east-slope Cascades, OR and WA	lodgepole, burns
Black-chinned hummingbird	point counts or point transects	late-May to late-June	n. Rocky Mtns and east-slope Cascades, OR and WA	open woodlands, riparian, towns
Common poorwill	broadcast recorded vocalizations at road stations	mid-May to mid-June	e. WA and OR except Columbia Basin, sw OR	shrub-steppe, canyons, open forest
Flammulated owl	broadcast recorded vocalizations at road stations	mid-May to mid-June	n. Rocky Mtns. and East-slope Cascades, OR and WA	ponderosa, mixed conifer
Gray flycatcher	point counts or point transects	mid-May to mid-June	Columbia Basin; Great Basin; low-mid elevation forests	juniper, lodgepole, ponderosa
Lewis' woodpecker	broadcast recorded vocalizations at stations	mid-April to mid-May	n. Rocky Mtns., eastslope Cascades OR and WA; sw valleys, OR	burns, oaks, ponderosa, cottonwood
Pinyon jay	point counts or point transects	May	c. OR Cascades	juniper
Pygmy nuthatch	point counts or point transects	mid-May to mid-June	n. Rocky Mtns and east-slope Cascades, OR and WA	ponderosa
Red-naped sapsucker	broadcast recorded vocalizations at stations	April to mid-May	n. Rocky Mtns and east-slope Cascades, OR and WA	all conifer forests; riparian forest
White-headed woodpecker	broadcast recorded vocalizations at stations	April to mid-May	n. Rocky Mtns and east-slope Cascades, OR and WA	ponderosa
Williamson's sapsucker	broadcast recorded vocalizations at stations	May	n. Rocky Mtns and east-slope Cascades, OR and WA	ponderosa, grand fir, larch, Doug-fir

Southwest Oregon				
Acorn woodpecker	broadcast recorded vocalizations at stations	April to mid-May	Klickitat Co., WA; w. Interior Valleys, OR	oak woodlands, ponderosa
Black phoebe	roadside point counts or walking point transects	mid-May to mid-June	valleys and coastal of sw. OR	riparian
Blue-gray gnatcatcher	roadside point counts or walking point transects	mid-May to mid-June	Jackson and Josephine Cos. OR; scattered se. OR	chaparral
California towhee	roadside point counts or walking point transects	May	Umpqua and Rogue valleys and Klamath Canyon, OR	chaparral, parks
Lesser goldfinch	roadside point counts or walking point transects	May	Rogue, Umpqua, and Willamette Valleys, OR	chaparral, oak chaparral
Oak titmouse	roadside point counts or walking point transects	May	valleys and hills of Jackson and Josephine Cos. OR	oak woodlands
Wrentit	roadside point counts or walking point transects	May	OR coast and sw. OR	shrub-dominated, brushy
Westside Lowlands				
Allen's hummingbird	roadside point counts or walking point transects	mid-April to late May	coastal Curry and Coos Counties, OR	shrubby veg in rural and riparian
Anna's hummingbird	roadside point counts or walking point transects	mid-April to late May	lowlands and foothills of w. OrR and WA	shrubby veg in residential and rural
Barn owl	broadcast recorded vocalizations at road stations	April	Columbia Basin; Great Basin; all w. Interior valleys	open, non-forest; edges and man-made
Marsh wren	roadside point counts or walking point transects	May	w. Interior Valleys (local e. OR and WA wetlands)	herbaceous wetlands
Purple martin	colony counts at known/suspected colonies	June	w. OR and WA	open water snags/nest boxes; upland large snags
Low-Mid Elevation Closed Conifer Forest				
American dipper	point counts or point transects	mid-April to mid-May	e. and w. conifer forest zones, OR and WA	fast-flowing montane rivers and streams
Band-tailed pigeon	broadcast recorded vocalizations at stations	June through mid-July	w. OR and WA conifer forest zones	conifer forests; mosaic of closed with openings
Barred owl	broadcast recorded vocalizations at road stations	mid-March to end April	e. and w. conifer and mixed forest except high elevation, sw and se OR	conifer and mixed forests
Cooper's hawk	broadcast recorded vocalizations at stations	mid-April to late-May	e. and w. all forest and woodlands	conifer, mixed, and decid forest; riparian
Great gray owl	broadcast recorded vocalizations at road stations	early March to late April	Okanagon Highlands, WA; n. Rocky Mtns. and Cascades, OR	conifer forest near openings
Great-horned owl	broadcast recorded vocalizations at road stations	mid-Feb to end March	throughout OR and WA except high elevation	all forest types, agriculture, urban
Mountain quail	roadside point counts or walking point transects	May to mid-June	conifer forest and foothills of OR; introduced populations in WA	shrubby vegetation in early seral forest
Northern goshawk	broadcast recorded vocalizations at stations	April to mid-May	e. and w. forested habitats except rare in coastal	conifer forests; aspen in desert
Northern pygmy owl	broadcast recorded vocalizations at road stations	April to mid-May	e. and w. conifer forest zones except high elevation	mixed and conifer forests and woodlands
Northern saw-whet owl	broadcast recorded vocalizations at road stations	April to mid-May	e. and w. conifer forest zones except high elevation	all forest types including riparian
Ruffed grouse	broadcast recorded vocalizations at stations	mid-March to late-April	e. and w. forested habitats except se OR	decid and mixed forests; riparian and regenerating
Sharp-shinned hawk	broadcast recorded vocalizations at stations	mid-April to late May	e. and w. conifer forest zones except high elevation and coastal	conifer, mixed and deciduous forest
Western screech owl	broadcast recorded vocalizations at road stations	April to mid-May	e. and w. forested and woodland habitats at low-mid elevations	hardwood or mixed forests
Rare and Unique				
Black rosy finch	inventory known/suspected sites; count individuals	mid-June to mid-July	Steens, OR	alpine
Black swift	inventory known/suspected sites; count individuals	mid-July to end August	Cascades of OR and WA	waterfalls
Clay-colored sparrow	inventory known/suspected sites; count individuals	mid-May to mid-June	ne WA near Spokane	grassland
Juniper titmouse	inventory known/suspected sites; count individuals	May	Lake Co, OR	juniper
Least flycatcher	inventory known/suspected sites; count individuals	mid-May to mid-June	e. WA and OR except Columbia Basin, rare westside and coastal	hardwood riparian
Merlin	follow-up reports with inventory; active pairs	May	coastal, Olympics, San Juans, and Puget Sound, WA	mid-late seral mixed and conifer forest
Northern mockingbird	follow-up reports with inventory; count individuals	mid-May to mid-June	Columbia Basin, WA; sw. Oregon; scattered east and west	residential, rural farmland
Red-shouldered hawk	follow-up reports with inventory; active pairs	May	s. coastal and sw. OR; rare elsewhere w. OR valleys and coast	riparian forest along montane streams
Tri-colored blackbird	inventory known/suspected sites; count individuals	May and early June	s. OR; scattered elsewhere in OR	herbaceous and shrub wetlands
Upland sandpiper	inventory known/suspected colonies; transect counts	early May to early June	n. Rocky Mtns., OR; ne Washington	grassland
White-tailed kite	follow-up reports with inventory; active pairs	mid-April to mid-May	w. OR lowland valleys and coast	grassland, riparian edge
White-winged crossbill	follow-up reports with inventory; count individuals	whenever nesting	n. Cascades, Okanagon Highlands, WA	subalpine forest
Yellow-billed cuckoo	inventory known/suspected sites; count individuals	mid-June to late July	large areas of cottonwood gallery forest in e. OR and WA	hardwod riparian gallery forest

[1] Timing: These dates represent the best 4-6 week time frame for monitoring (i.e., the height of the breeding season when birds are most detectable). Dates may vary by elevation and latitude.

adequately monitored by the BBS across the two states, but may warrant Special Species monitoring in some regions of the two states because of local or regional declining populations or other factors. We did not attempt any analysis to determine these species, but used professional knowledge to develop a list of Regional Special Species (Appendix B). The Regional Special Species fall into several categories including subspecies with distinct breeding ranges and habitat affinities, species negatively impacted by population growth and associated habitat loss in the valleys of western Oregon and Washington, and disjunct "local" populations of species otherwise adequately monitored by the BBS. We are not recommending special monitoring programs for Regional Special Species, but suggest that these species should be considered for monitoring when developing Special Species monitoring programs in the areas where they occur.

Monitoring Framework: "Habitat Groups"

Our first step in the development of the SSLMAP was to pool species with similar broad-scale habitat relationships and/or distribution to facilitate a habitat-based design for monitoring. The final list of 75 Special Species were broadly categorized into seven "Habitat Groups" (Table 2). An eighth category, rare and unique species, was included to capture regular breeding species with a small breeding population, or species with unique, specialized habitat requirements.

Table 2. Special Species Categorization by Habitat Groups.

Habitat Group	Habitats	Special Species	Monitoring Responsibility [1]
High Elevation	englemann spruce, subalpine fir, whitebark pine, lodgepole pine, wet meadow, alpine grassland and shrubland, talus and avalanche chutes	11	NPS, USFS
Eastside Forest Riparian	riparian woodland, riparian shrub, wetland shrub	4	USFS, USFWS, SWA
Eastside Upland Non-Forest	canyonlands, steppe, shrub-steppe, woodland patches	11	BLM, SWA, USFWS
Eastside Open Forest	ponderosa pine, juniper, lodgepole pine, pine-oak, riparian	11	USFS, BLM, FPC
Southwest Oregon	chaparral grassland, chaparral shrub, oak chaparral, oak woodland, riparian	7	SWA, BLM
Westside Lowlands	natural cavities/nest boxes, wetland, residential shrub, open foothills, rural farmland	5	SWA, USFWS, BLM
Low-Mid Elevation Closed Conifer Forest	riparian, early successional, mid successional, late successional	13	USFS, BLM, FPC
Rare and Unique Species	many	13	SWA, TNC

[1] This refers to the logical agencies or organizations that should cooperatively assume primary responsibility for conducting and/or coordinating monitoring based on land ownership, agency mandates, or other directives (see Implementation); NPS = National Park Service, USFS = U.S. Forest Service, USFWS = U.S. Fish and Wildlife Service, SWA = State Wildlife Agencies, BLM = Bureau of Land Management, FPC = Forest Products Companies, TNC = The Nature Conservancy.
NOTE: Monitoring on private lands (e.g., agricultural lands) may be a component of any habitat group, but especially Eastside Forest Riparian, Eastside Upland Non-Forest, and Westside Lowlands. This should be considered by the responsible agency or organization when coordinating and implementing the program.

Within each Habitat Group there are multiple habitats, and Special Species should be targeted for monitoring in the habitats they are associated with (see Tables in Appendices C-K). Most species are specific enough in their habitat relationships or distribution that they only need to be monitored in one Habitat Group. However, the distribution and habitat relationships of a few Special Species overlap among two or more Habitat Groups. These species are indicated as footnotes in the monitoring methods table in each appendix, and should be considered when conducting monitoring for species in that Habitat Group.

Within each Habitat Group, monitoring recommendations are driven by commonalities among species and habitats including methodological, geographic, and temporal parameters. Monitoring methods are suggested to efficiently capture the monitoring needs of these species within the context of these parameters (see Selection of Field Methods below). Species with specialized and distinctive habitat associations (e.g., black swift) or highly specialized monitoring needs (e.g., owls) are addressed individually.

A summary of the general monitoring parameters for each Special Species is presented in Table 1. For each Habitat Group, there is an appendix with pertinent information for each species on the habitats and geographic priorities for monitoring, recommended monitoring methods, and selected literature (primarily from Oregon and Washington) on each species (Appendices C-K). A description of the monitoring protocols is presented in Appendix L.

Delineation and Selection of Monitoring Plots

Unlike the stratified random placement of BBS road-routes or other systematic landscape designs for monitoring, our recommended approach for the SSLMAP is habitat-based with a series of plots as sampling units. Plots are distributed throughout the coverage of each habitat in that Habitat Group in such a way that inferences can be made to the entire habitat. Within the plots, monitoring routes/stations etc. either sample or completely cover the habitat depending on the size of the area and the monitoring technique.

The high reliance on assuming that habitats within the Habitat Group includes all or nearly all the suitable habitat for each Special Species means that care must be taken in delineating habitat coverage. A start can be made by delineating the general area covered by the Habitat Group using existing vegetation maps for Oregon and Washington (Fig. 1). The next step is to delineate the specific habitats (i.e., stratum) for Special Species being targeted (see Appendices C-K). Field work will be needed to make final decisions about boundaries because our knowledge of the habitat associations for many Special Species is limited, and vegetation maps may be inaccurate. At this stage, the boundaries are placed to include more rather than less habitat so that we include most individuals of the Special Species for the Habitat Group. The coverage of the targeted stratum are then partitioned into "sampling units" of approximately equal size (Fig. 1).

It would be inefficient (and impractical) to monitor the full extent of each Habitat Group, so the next stage of plot selection is randomly selecting and mapping "primary sampling units". The mapping may simply distinguish accessible, potentially suitable areas from areas that we are confident do not contain any appreciable number of individuals of the Special Species for the Habitat Group. The remaining, potentially suitable, areas might be sub-divided into additional strata based on anticipated density, appropriate survey methods, or ease of access. Any issues of practical concern can potentially form the basis for delineating strata. In most cases, however, only a few strata other than the excluded one will be delineated within a primary sampling unit.

Potential survey plots (secondary sampling units) are then delineated and a sample is selected (Fig. 1). If some areas cannot be surveyed in a stratum, due, for example, to access problems or safety, then these areas are first identified. The remaining area in each stratum is sub-divided into plots. The plots must be non-overlapping, fully cover the stratum, and be as homogeneous as possible. As a result, they will generally be irregularly-shaped and of varying sizes. Finally, a sample of the plots is selected for monitoring.

Once the plots are selected, they can be monitored annually (the most efficient approach for trend estimation) or during multi-year periods (see "How often to Monitor" below). An alternative to obtain better information about spatial variation in distribution and abundance would be to select new plots annually or less often.

It was noted above that our recommended approach works best if most individuals of each Special Species occur in the Habitat Group to which the species has been assigned. If a Special Species occurs in more than one Habitat Group, then the sampling design procedures described above still apply, but data from the different Habitat Groups are combined.

Selection of Field Methods

There are numerous challenges inherent in attempting to monitor populations of a group of species that by definition are "outside the box" for a standard, broad-scale monitoring program like the BBS. A primary emphasis of our approach in the SSLMAP was to recommend monitoring methods that ensure the greatest likelihood of detectability for each Special Species. Because of the high degree of ecological variability among Special Species, we suggest a variety of monitoring methods to determine population status and trend information.

The ornithological literature on monitoring methods is extensive; however, what is clear is that no single method is ideal. The choice depends on a number of factors such as objectives, cost, personnel, precision of the data, etc., and these factors often must be balanced against one another. What is most important from a population monitoring standpoint is that regardless of

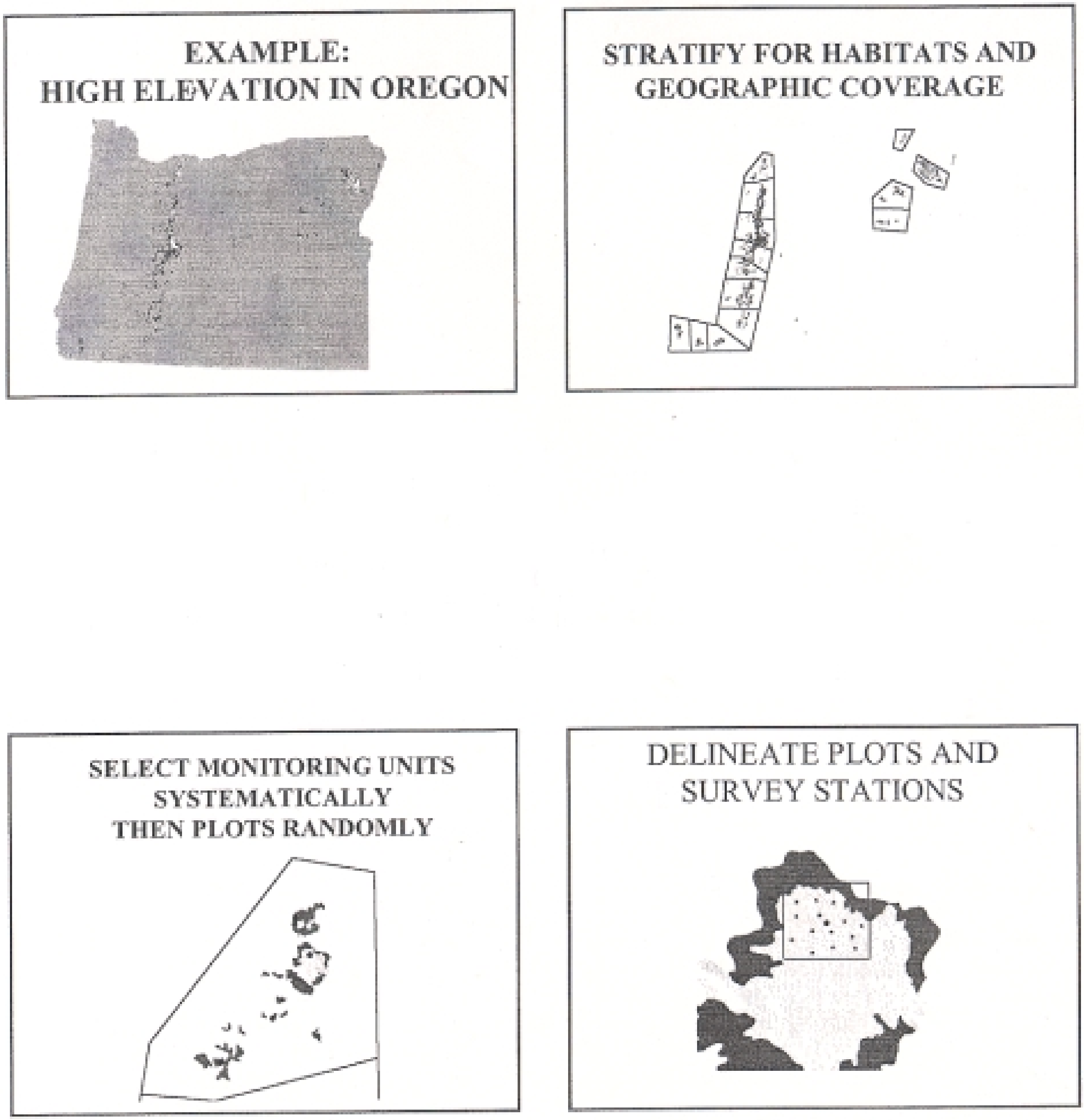

Figure 1. Example of plot selection for High Elevation Habitats.

methodology and the specific parameters used, consistency must be maintained through time. Consistency must include survey timing and frequency, location, weather conditions, observer skills, etc. Comprehensive reviews of landbird monitoring methods can be found in a number of sources including Ralph and Scott (1981), Verner (1985), Koskimies and Vaisanen (1991), Bibby et al. (1992), and Ralph et al. (1993). Additionally, there are methodologies that have been promulgated by various sources for species or taxonomic groups (e.g., raptors, owls).

There is an extensive literature on the use of point counts and transect counts in bird population monitoring, including a number of direct comparison studies (e.g., Anderson and Ohmart 1981, Edwards et al. 1981, Verner and Ritter 1985, DeSante 1986, Tarvin et al. 1998, Jones et al. 2000, Wilson et al. 2000). From a population monitoring standpoint, both methods provide an index to abundance, but the value of each method to estimate bird populations can be confounded by numerous factors. Methodological options (e.g., variable versus fixed radius plots), differences in habitat types, the species of interest, and the duration of the detection period can all influence the outcome of a survey effort. From a practical standpoint, point counts are recommended where the terrain is difficult to traverse and the vegetation is dense (Reynolds et al. 1980), and transects are most effective in open habitats where walking is relatively easy (Anderson and Ohmart 1981, Bibby et al. 1992). From a statistical standpoint, point counts are often recommended, if it can be assumed that each count represents an independent data point, because this can generate a large sample size and a robust data set. In contrast, an entire transect represents only one data point.

All the literature comparing point counts and transects is within the context of sampling a large number of regularly detected species within the avian community. For Special Species monitoring, the uncommon or rare status of many of the species becomes an important consideration when selecting an appropriate methodology. <u>Our first concern for Special Species monitoring is to be efficient in detecting the species</u>. Thus, emphasis is placed on monitoring where the species is known or suspected to occur, but also on using a methodology that ensures the greatest likelihood of detecting the species. Conducting random or systematically-placed point counts across the landscape (e.g., BBS and some regional monitoring programs) is not likely to detect many of our Special Species unless the stratum is habitat-based and specific to our habitats and geographic regions.

To address the concern of maximizing opportunities for detection of Special Species, a method frequently recommended in this document is a combination of point counts and transects called a point transect (Leukering et al. 2000) (Appendix L). Data on Special Species are collected at systematically placed point count stations (e.g., every 250 m) along an off-road walking transect route, and supplemental data are collected for Special Species while walking the transect between point count stations. Some individual birds may be included in both data sets if detected during both survey methods. Data analysis for Special Species can be conducted separately for the point counts if desired for comparison with other point count studies, and data analysis can be conducted separately for the walking transect. One advantage of this method is that data are collected continuously while in the field, and not intermittently as would occur if just conducting point counts. This potentially increases the number of detections, especially for species that are not frequently detected, like most of our Special Species. This approach also maintains the option of using one of the primary advantages of point count sampling which is a large sample size of independent data points (if assumptions of independence are considered valid based on design).

Several other habitat-based methods are recommended for particular situations (Appendix L). Walking or auto-driving transects are recommended for several open-country birds (e.g., ferruginous hawk, Swainson’s hawk, loggerhead shrike). Area searches are recommended for small areas (e.g., <20 ac [8 ha]) that can be completely covered, and for species that occur in low abundance (e.g., rare species) or species that are not readily detected on transects or point counts. Roadside point count stations are suggested for large habitat areas where there are roads within the habitat. Off-road point counts are suggested where the area is too small for a point transect (e.g., <0.5 mile [0.3 km]) or where the vegetation or topography precludes monitoring while walking between points. When any of the monitoring methods are being conducted for a species that is rare or vocalizes infrequently, we recommend playback methods if the species responds positively to this method (e.g., owls, woodpeckers, some passerines). These increase the likelihood of detection.

In a few species, count-based methods are recommended (Appendix L). These species typically have small populations (e.g., Rare and Unique Habitat Group) or are colonial with discrete populations (e.g., purple martin, bobolink). In contrast to habitat-based monitoring, these surveys focus on known or suspected locations for the species.

For many raptors and some colonial passerines, monitoring detection rates of individuals may evolve to monitoring the presence of active nests. This may include random sampling of sites for species that are widely dispersed or have relatively large populations, or monitoring all nests for species with a restricted range or a small population. An examples of the former would be flammulated owl, and examples of the latter would be ferruginous hawk and burrowing owl.

When evaluating and selecting methods, it will be necessary to coordinate with others who share responsibility for the habitat group. Coordination will ensure that methods are compatible and data sets can be combined to increase sample sizes. This will be essential for some species because sample sizes generated in one area or by a single entity may be too small for formal analysis, whereas combined samples from across a region may allow for effective population monitoring.

What to Measure: Indices to Abundance or Density?

There has been extensive discussion in the ornithological literature regarding the ability of different types of point counts and transects to measure bird populations (e.g., many papers in Ralph and Scott 1981, Verner 1985, Raphael 1987, etc.). It is not our purpose or desire to further this discussion, but to recommend that distance sampling techniques (Buckland et al. 1993) are used during point transect and point count Special Species monitoring. Distance estimation to each detection provides a means of measuring detectability of species (Buckland et al. 1993), and

provides the data to use density, using the program DISTANCE (Thomas et al. 1998), as the population measure for our Special Species.
We suggest that for many of our Special Species a little extra effort to derive density estimates provides a significant improvement in the quality of the data over simple unadjusted point counts that provide indices of abundance. Monitoring indices of density rather than abundance also is important since one of the objectives of most studies is to compare species which requires some assessment of the differences/similarities of detectability of each species. There are inherent differences in the detectability of different species which are not accounted for with fixed or unlimited radius unadjusted point counts. Even if distance sampling data do not prove to be useful (e.g., too few detections), the data can still be analyzed using more traditional methods (i.e., fixed radius with indices to abundance).

We recognize that distance estimation requires additional training and has the potential to add bias in comparing and pooling data. However, we feel any potential bias is reduced in our SSLMAP because distance estimation would not be done for all species, but only for a few of the Special Species being monitored at any time. This provides more time to make careful distance estimates (and to verify estimates when possible) for each detection than would be available if distance estimates were being done for all species. Additionally, distance estimation would not be appropriate for count-based monitoring of colonial species, tracking a population by counting individuals in the Rare and Unique Habitat Group, or whenever area searches are being conducted. There are a number of sources that provide information on training observers to record distance estimates that should be reviewed and implemented prior to conducting field work (e.g., Kepler and Scott 1981, Fancy, S.G. www1.nature.nps.gov/im/monitor/vcpform.doc).

Although not a priority in our SSLMAP, double-counting (Cochran 1977), a more intensive effort alternative for a reliable estimate of actual density (rather than an index), is described in Appendix M.

How Often to Monitor: Annual or other Alternatives?

It would be ideal if monitoring could be conducted annually for a long period to estimate population trends for Special Species. Realistically, a funded program to do this for Special Species, many of which will require individual monitoring efforts, may significantly impact limited agency or organization funds available for bird conservation. This may leave little financial resources for many other aspects of bird conservation such as education and outreach, habitat restoration and protection, etc. It is noteworthy in this regard that the only long-term national avian monitoring program, the BBS, is not funded for implementation, but is volunteer-based. Even for regional or state monitoring programs with a large number of species it is difficult to secure commitment of agency funds for long-term bird monitoring. Although we encourage annual monitoring in concept, we suggest that it is probably only realistic when the monitoring is to be conducted primarily or exclusively by volunteers. Where there is a potentially strong volunteer base for Special Species bird monitoring, we encourage annual monitoring because of the advantage of an annual data set in estimating population trends.

As an alternative to annual monitoring for Special Species, we considered both alternate-year surveys and alternating periods of several years with and without surveys (e.g., 5 years with surveys, 10 years without surveys, 5 years with surveys, etc.). For the SSLMAP, we suggest alternating periods of three years of surveys and three years without surveys if annual monitoring is not occurring. This schedule allows for a reasonable assessment of a species population status in three years, a means of evaluating population change over time, and yet also a period of time to use funding for other aspects of bird conservation or for other monitoring projects.

Although we stress the need for bird monitoring in any bird conservation program, we recognize that other aspects of bird conservation such as restoration and habitat protection efforts are just as important if not more so than monitoring, and also warrant funding resources. Additionally, these types of projects often generate more widespread public interest in bird conservation than monitoring does, which ultimately will result in greater public support and potential funding for bird conservation projects which may also provide additional funding for bird monitoring.

What to Record: All Detections or only Special Species?

Although the SSLMAP emphasizes monitoring populations of Special Species, implementing the SSLMAP also provides the opportunity for data collection on other species. If the monitoring is projected to be annual or long-term with alternating periods of several years, data collection for other species may be particularly valuable as a habitat-specific supplement to the roadside abundance indices and trend estimates provided by the BBS. Although we encourage all species data collection in concept, we suggest that it only be done under the conditions described below.

The decision to record detections of all species should be determined by the skill level of the observers and the level of bird activity in the habitat. The highest priority should always be detecting Special Species and accurate and complete data collection on those species. Any data collection beyond that should not compromise the quality of Special Species data. Thus, it is probably only prudent to attempt all-species data collection when observer skills are very high, there is likely to be consistency of observers over time, and the degree of bird activity in that habitat does not result in reduced quality of the data on Special Species. Even among the most skilled observers, when data collection is occurring in bird-rich habitats such as riparian areas, the observer's ability to accurately record species identification, number of detections, and the distance to each detection becomes a significant issue.

For many of the short-term (e.g., 3 years) intermittently implemented projects, it is likely that volunteers or seasonal employees may be solicited to conduct the monitoring. In most cases, their skill levels in bird identification and in conducting bird monitoring may not be high enough to attempt all species monitoring. However, one of the potentially attractive components of the SSLMAP which is suitable for volunteers or seasonal employees is that the list of Special Species to be monitored is relatively short, and the SSLMAP is conducive to intensive training of volunteers or seasonals on learning just a few species. Additionally, potential observer biases are reduced when only a few species are targeted.

Data Analysis

Analytic methods will depend on the sampling plan used to select plots. If permanent plots are used, then route regression trend estimate methods used for Breeding Bird Survey data will be applicable, though preliminary analysis may be needed. For example, when distance estimates are used in data collection, then a program such as DISTANCE (Thomas et al. 1998) would first be used to compute estimated densities and these would then be used as the input data. If index methods are used (as in the BBS), then the simple counts would be used as the input data. Stratification could be employed without necessitating much, if any, change in the BBS methods, because the BBS itself is a stratified sample.

If plot locations change between years (e.g., because habitat moves around or the design incorporates changing plots), then the situation may become more complex. One simple case would occur if a completely new (i.e., spatially independent) sample of plots was selected each year. In this case, standard regression (rather than route regression) methods would be applicable. More realistically, if some plots are permanent and some move around, then a mixed approach of some sort would need to be developed. This task will require work by a statistician but is tractable.

As with any trend monitoring, long-term data sets are needed to detect population trends (e.g., 5-10 years minimum, Nur et al. 1999). For some species, population trend monitoring may not be possible because sample sizes are likely to be to low for inferential statistics or because the variance associated with their abundance is high. This would include most species in the Rare and Unique Habitat Group and species from other Habitat Groups that have small populations or are widespread with low densities. The occurrence and abundance of these species should be "tracked" (Leukering et al. 2000) by counting individuals at known or suspected locations where they occur, and conducting descriptive statistical analyses (e.g., means) to evaluate population status and track the pattern of population change. Monitoring of these species should be done in coordination with state agencies and/or Natural Heritage Programs, and the data should be maintained in a state database.

Implementation

Implementation of the SSLMAP will require a substantial, coordinated effort by the various agencies and organizations with responsibility for wildlife and wildlife habitat in Oregon and Washington. Clearly, no one agency/organization could or should be expected to implement all or even most of the monitoring described herein. Our approach, pioneered by the Rocky Mountain Bird Observatory (Leukering et al. 2000), is dependent on sharing resources and responsibilities to achieve monitoring goals.

To facilitate implementation, we have made suggestions as to the monitoring responsibility for each Habitat Group (Table 2). Monitoring responsibility refers to the logical agencies or organizations that should assume primary responsibility for conducting or coordinating the monitoring based on land ownership, agency mandates, or other directives. It is anticipated that these groups will become cooperating partners in the SSLMAP to coordinate monitoring and share data which will result in a greater benefit to each partner than their own contribution. It is also anticipated that these groups will solicit assistance from and work with other agencies and organizations with land management or species responsibilities within the area or habitats covered by that Habitat Group. Responsibility for a Habitat Group includes all aspects of the SSLMAP from design through data collection and analysis. The manner in which these tasks are accomplished is likely to vary among partners and may include in-house or contracted work for any or all of the components.

This approach (i.e., partnerships in which resources and responsibilities are shared) provides a simple but defensible rationale for partner commitments to participate in the program, and we think provides a reasonable starting point for launching the SSLMAP. Development and implementation of the SSLMAP under the umbrella of Partners in Flight also offers a degree of protection to the partners from outside criticism since Partners in Flight is the recognized leader in all aspects of landbird conservation.

Acknowledgments

This project was funded by the Bureau of Land Management, Oregon State Office; U.S. Fish and Wildlife Service, Migratory Birds and Habitat Division, Region 1; U.S. Forest Service, Region 6 Landbird Program; U.S. Geological Survey, Forest and Rangeland Ecosystem Science Center; and the U.S. Navy, Whidbey Island. The document greatly benefitted from several discussions among participants in the Oregon-Washington Chapter of Partners in Flight. Joe Buchanan provided comments on an earlier draft.

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Appendix A. Working List for the Special Species Landbird Monitoring and Assessment Program (SSLMAP) in Oregon and Washington.

Species	N [a]	CI [b]	WA	OR	Comments
White-tailed kite			0	0	
Sharp-shinned hawk	23	15	0	0	
Cooper's hawk	56	15	0	0	
Red-shouldered hawk	58	12	0	0	
Swainson's hawk	77	9	13	5	
Merlin	2	35	0	0	
Chukar	50	17			deleted; introduced species
Gray partridge	16	13			deleted; introduced species
Ruffed grouse	36	15			
Sage grouse	17	19			deleted; listed species
Spruce grouse	1		0	0	
Wild turkey	27				deleted; introduced species
Northern bobwhite	0				deleted; introduced species
Mountain quail			0	11	
Flammulated owl	0		0	0	
Western screech-owl	13	24	0	0	
Burrowing owl	65	10	1	3	
Spotted owl	0				deleted; listed species
Barred owl	0		0	0	
Long-eared owl	0		0	0	
Northern saw-whet owl	0		0	0	
Common poorwill	55	25	0	0	
White-throated swift			10	0	
Black-chinned hummingbird	49	9	0	0	
Anna's hummingbird			0	0	
Acorn woodpecker			0	10	
White-headed woodpecker			0	2	
Red-naped sapsucker			0	0	
Red-breasted sapsucker					deleted; adequate BBS monitoring (???)
Three-toed woodpecker	0		0	0	
Black-backed woodpecker			0	3	
Gray flycatcher	61	10	12	35	
Cordilleran flycatcher					deleted; taxonomic/identification
Black phoebe			0	0	
Say's phoebe	133	10			deleted; adequate BBS monitoring (???)
Pinyon jay	33	16	0	0	
Clark's nutcracker	83	11	2	32	
Northwestern crow	6	26			deleted; taxonomic uncertainties
Purple martin	26	23	0	2	
Bank swallow	82	12	333	36	deleted; high number of detections
Boreal chickadee	0		0	0	
Oak titmouse			0	2	
Juniper titmouse	12	100	0	0	
Canyon wren	68	14	1	0	
Ruby-crowned kinglet	105	27			deleted; adequate BBS monitoring (???)
Blue-gray gnatcatcher			0	0	
Wrentit			0	31	
Northern mockingbird			0	0	

American pipit	0		0	0	
American redstart	11	10	2	0	
California towhee			0	1	
Black-throated sparrow			0	22	
Tri-colored blackbird	49	16	0	14	
Gray-crowned rosy finch	0		0	0	
Black rosy finch	0		0	0	
Pine grosbeak	4	17	0	0	
White-winged crossbill	0		0	0	
Northern goshawk			0	0	added to list
Ferruginous hawk			0	2	added to list
Prairie falcon			0	5	added to list
Upland sandpiper		0	0	added to list	
White-tailed ptarmigan			0	0	added to list
Band-tailed pigeon					added to list
Yellow-billed cuckoo			0	0	added to list
Northern pygmy-owl			0	1	added to list
Short-eared owl			5	1	added to list
Boreal owl			0	0	added to list
Great gray owl			0	0	added to list
Great-horned owl			1	4	added to list
Barn owl					added to list
Black swift			24	0	added to list
Calliope hummingbird			8	1	added to list
Allen’s hummingbird			0	0	added to list
Lewis’ woodpecker			4	2	added to list
Williamson’s sapsucker			1	25	added to list
Least flycatcher					added to list
Loggerhead shrike			7	19	added to list
Pygmy nuthatch			1	12	added to list
Marsh wren			10	28	added to list
American dipper			1	1	added to list
Gray catbird			14	0	added to list
Northern waterthrush			1	0	added to list
Fox sparrow			8	22	added to list
Lincoln’s sparrow			2	6	added to list
Bobolink			1	2	added to list
Lesser goldfinch			0	26	added to list
Clay-colored sparrow			0	0	added to list

[a] N = Number of BBS routes on which the species was recorded (null means number not reported by the BBS program) in U.S. Fish and Wildlife Service Region 1.

[b] CI = half-width of the 85% confidence interval for the trend estimate

WA = mean number of detections per year on BBS routes in Washington

OR = mean number of detections per year on BBS routes in Oregon

Appendix B. Regional Special Species in Oregon and Washington.

Species	Region	Habitat
white-breasted nuthatch	western Washington	oak woodlands
pallid horned lark	Cascades and Olympics, WA; Cascades, OR	alpine
streaked horned lark	lowland western Oregon and Washington	grassland
Oregon vesper sparrow	western Washington and Willamette Valley	grassland
western meadowlark	western Washington and Willamette Valley	grassland
grasshopper sparrow	western Oregon valleys	grassland
common nighthawk	western Washington and Willamette Valley	grassland, urban
chipping sparrow	western Washington	oak woodland, open forest
red-eyed vireo	lower Columbia River	riparian forest
purple finch	east-slope Cascades, Washington	riparian forest, forest edge
yellow-breasted chat	Willamette Valley	riparian and upland shrub
yellow-headed blackbird	western Oregon and Washington	marsh
Bewick’s wren	Columbia Basin	riparian
sage sparrow	Columbia Basin, Washington	sagebrush
green-tailed towhee	Blue Mountains	riparian shrub

Appendix C. High Elevation Habitat Group

Target Habitats: Englemann spruce (ENSP), Subalpine Fir (SAFI), Whitebark pine (WBPI), Lodgepole pine (LOPI), Wet meadow (WEME), Alpine grassland and shrubland (ALGS), Talus and avalanche chutes (TAAC)

Bird Conservation Plans: Westside Coniferous Forests, Northern Rocky Mountains, East-Slope Cascades

Primary Monitoring Responsibility: National Park Service, U.S. Forest Service

Monitoring Methods: Species breeding in High Elevation Habitats tend to be highly characteristic (often obligate) to these habitats which are relatively limited in distribution with few roads to conduct BBS routes. High Elevation Habitats present several challenges for monitoring bird populations. First, these habitats include a range of cover types including closed forest, open forest, and shrub and herbaceous-dominated non-forest. Secondly, there are diurnal species (e.g., boreal chickadee, Clark's nutcracker) and nocturnal species (e.g., boreal owl), relatively common species (e.g., American pipit) and somewhat rare species (e.g., pine grosbeak), and species that are wide-ranging (e.g., spruce grouse). Thirdly, road access is limited, and weather can be unpredictable, especially during the early part of the monitoring time frame. Because of these and other species-specific factors, multiple monitoring methods are presented with suggestions as to the conditions under which they are most appropriate. Protocols for all of these methods are presented in Appendix L.

Table C1. Recommended monitoring methods for Special Species associated with High Elevation Habitats in Oregon and Washington. [1]

SPECIAL SPECIES	MONITORING METHODS [2]			
	Off-Road Point Transects [3,6]	Off-Road Point Counts [4,6]	Roadside Point Counts [5,7]	Comments and Monitoring References
American pipit	x	x		area search if small habitat fragments
Boreal chickadee	x	x	x	
Boreal owl		x	x	playback recording (nocturnal); Takats et al. (2001); potentially active nest monitoring
Clark's nutcracker	x	x	x	
Fox sparrow	x	x	x	
Gray-crowned rosy finch	x	x		area search if small habitat fragments
Lincoln's sparrow	x	x		point transect if traversable trail; if not, place

				point count station(s) at edge of habitat or do an area search from the edge
Pine grosbeak	x	x	x	
Spruce grouse	x	x	x	playback recording (drumming?)
Three-toed woodpecker	x		x	playback recording (diurnal); Goggans et al. (1997)
White-tailed ptarmigan	x			playback recording (diurnal): Martin and Commons (1997)

[1] Review Appendices B, J, and K for other Special Species that also may be appropriate for monitoring in High Elevation Habitats (e.g., Coopers' hawk, sharp-shinned hawk, white-winged crossbill).
[2] See Appendix L for description of monitoring methods.
[3] Use if traversable (i.e., walking not difficult) and there are relatively large patches of suitable habitat (e.g., >0.5 mile [0.3 km] in length) to accommodate transects.
[4] Use in fragmented habitats where patches of suitable habitat are <0.5 mile (0.3 km) in length (i.e., too small for a point transect) or patch of suitable habitat >0.5 mile (0.3 km) in length but not traversable (i.e., vegetation and/or topography preclude walking between points).
[5] Use if road within patch of suitable habitat.
[6] May need to access sites by skis or snowmobiles where roads still snow-covered, but breeding habitat is open (e.g., south-facing slopes).
[7] Likely limited applicability of this technique due to lack of roads in most of these habitats, and potential for roads to be impassable due to snow.

Table C2. Habitat relationships and geographic distribution of Special Species associated with High Elevation Habitats in Oregon and Washington.

SPECIES	**HABITATS** [1,3]							**ECOREGIONS** [2,3]									
	ES	SF	WP	LP	WM	AL	TA	OP	NC	SC	OH	BM	OU	OC	CR	KS
American pipit						1		1	1	1		1	1			
Boreal chickadee	1	2							1		1					
Boreal owl	1	1		1					1	1	2	1		2		
Clark's nutcracker	1	1	1	2				2	1	1	1	1		1	2	
Fox sparrow	1	1							1	1	1	1	2	1		1
Gray-crowned rosy finch						1	1	2	1	1		1	1	1		
Lincoln's sparrow					1				1	1	1	1		1		2

Pine grosbeak	1	1	1	1					1	1	2	1				
Spruce grouse	1	1		1					1	2	1	2				
Three-toed woodpecker	1	1		2					1	1	1	1		1		2
White-tailed ptarmigan						1			1	1		2				

[1] ENSP = Englemann spruce, SAFI = Subalpine Fir, WBPI = Whitebark pine, LOPI = Lodgepole pine, WEME = Wet meadow, ALGS = Alpine grasslands and shrublands, TAAC = Talus and avalanche chutes (WA).
[2] Species known to regularly occur as a breeding species in the following ecoregions: OP = Olympic Peninsula (WA), NC = North Cascades (WA), SC = Southern Cascades (WA), OH = Okanogan Highlands (WA), BM = Blue Mountains (WA and OR), OU = Owyhee Uplands (OR), OC = Oregon Cascades, CR = Coast Range (OR), KS = Klamath/Siskyous (OR).
[3] 1 = highest priority for monitoring based on high degree of association with that habitat or relatively high abundance in that ecoregion; 2 = lower priority for monitoring based on moderate or low degree of association with that habitat or relatively low abundance in that ecoregion. NOTE: These are bi-state ecoregional priorities to provide decision-makers with a perspective on their responsibility for the species within the context of its range in Oregon and Washington. These priorities do not necessarily reflect local concern or interest.

Selected Literature (High Elevation Habitat Group):

General:
Booth, E.S. 1952. Ecological distribution of the birds of the Blue Mountain region of southeastern Washington and northeastern Oregon. Walla Walla College Publications of the Department of Biological Sciences and the Biological Station 7:65-107.

Jewett, S.J. 1924. Additional records of alpine birds in Oregon. Condor 26:78.

Manuwal, D.A., M.H. Huff, M.R. Bauer, C.B. Chappell, and K. Hegstad. 1987. Summer birds of the Upper Subalpine Zone of Mount Adams, Mount Rainier, and Mount St. Helens, Washington. Northwest Sci. 61(2):82-92.

Yocum, C.F. 1958. Records of bird observed in the Okanogan Highlands and the Selkirk Mountains of northeastern Washington. Murrelet 39(2):15-18.

Boreal chickadee:
LaFave, L.D. 1958. Hudsonian chickadee for northeastern Washington. Murrelet 39(1):14.

LaFave, L.D. 1965. Additional records of the Hudsonian chickadee for northeastern Washington. Murrelet 46(2):27.

Boreal owl:
Eckert, K.R., and T.L. Savaloja. 1979. First documented nesting of the boreal owl south of Canada. Am. Birds 33:135-137.

Hayward, G.D., R.K. Steinhorst, and P.H. Hayward. 1992. Monitoring boreal owl populations with nest boxes: sample size and cost. J. Wildl. Manage. 56(4):777-785.

Hayward, G.D., P.H. Hayward, E.O. Garton, and R.Escano. 1987. Revised breeding distribution of the boreal owl in the northern Rocky Mountains. Condor 89:431-432.

Hayward, G. D., and J. Verner, tech. editors. 1994. Flammulated, boreal, and great gray owls in the United

States: A technical conservation assessment. Gen. Tech. Rep. RM-253. USDA For. Serv., Fort Collins, Colo. 214p.

Stepniewski, A.M. 1996. Boreal owls found nesting in Washington in 1992. Wash. Birds 5:55-60.

Takats, D.L., C.M. Francis, G.L.Holroyd, J.M. Duncan, K.M. Mazur, R.J. Cannings, W.Harris, and D. Holt. 2001. Guidelines for nocturnal owl monitoring in North America. Beaverhill Bird Observatory and Bird Studies Canada. http://www.bsc-eoc.org/regional/owlguide.html

Whelton, B.D. 1989. Distribution of the boreal owl in eastern Washington and Oregon. Condor 91:712-716.

Clark's nutcracker:
LaFave, L.D. 1954. Clark's Nutcracker nesting near Spokane. Murrelet 35(1):12.

LaFave, L.D. 1958. Another nesting record of the Clark's Nutcracker in the Spokane area. Murrelet 39(2):27.

Pine grosbeak
Pederson, R.J.A., W. Adams, and L.D. Bryant. 1973. Observations on birds in the Blue Mountains. Murrelet 56(1):7-10.

Spruce grouse:
Ratti, J.T., D.L. Mackey, and J.R. Alldredge. 1984. Analysis of spruce grouse habitat in northcentral WA. J. Wildl. Manage. 48:1188-1196.

Three-toed woodpecker:
Bull, E.L., S.R. Peterson, and J.W. Thomas. 1986. Resource partitioning among woodpeckers in northeastern Oregon. USDA For. Serv. Res. Note PNW-444. 19 pp.

Ministry of Environment. 1998. Inventory methods for woodpeckers. Standards for components of British Columbia's biodiversity No. 19. Version 2.0. http:www.for.gov.bc.ca/RIC/Pubs/teBioDiv/woodpeckers/index.htm

Goggans, R, R.D. Dixon, and L.C. Seminara. 1987. Habitat use by three-toed and black-backed woodpeckers, Deschutes National Forest, Oregon. Oreg. Dept. Fish and Wildl. Tech. Rep. No. 87-3-02. 43 pp.

White-tailed ptarmigan:
Braun, C.E. 1993. White-tailed ptarmigan habitat investigations in northeast Oregon. Oreg. Birds 19:72-73.

Martin, K. and M.L. Commons. 1997. Vancouver Island white-tailed ptarmigan inventory project: progress report, 1997 summer surveys. Centre for Alpine Studies, Forest Sciences, Univ. of British Columbia. Report WTPVI-3. www.forestry.ubc.ca/alpine/docs/wtpvi-3.pdf

Appendix D. Eastside Forest Riparian Habitat Group

Target Habitats: Riparian Woodland (RIWO), Riparian Shrub (RISH), Wetland Shrub (WESH)

Bird Conservation Plans: Columbia Plateau, Northern Rocky Mountains, East-Slope Cascades

Primary Monitoring Responsibility: U.S. Forest Service, U.S. Fish and Wildlife Service, State Wildlife Agencies

Monitoring Methods: Special Species breeding in Eastside Forest Riparian Habitats generally have restricted distributions in addition to the fact that the habitats they occur in (i.e., riparian, wetland) are not monitored well by the BBS. Eastside Forest Riparian Habitats present several challenges for monitoring. First, they can be impenetrable to traverse on foot due to water depth and/or dense vegetation. Secondly, riparian habitats are linear in shape and often very narrow which is problematic when estimating densities. Thirdly, the noise of running water in some riparian habitats can make auditory detection of birds difficult. Because of these and other factors, multiple monitoring methods are suggested for each species depending on the circumstances. Protocols for all of these methods are presented in Appendix L.

Table D1. Recommended monitoring methods for Special Species associated with Eastside Forest Riparian Habitats in Oregon and Washington. [1]

SPECIAL SPECIES	MONITORING METHODS [2]			
	Off-Road Point Transects [3]	Off-Road Point Counts [4]	Roadside Point Counts [5]	Comments and Monitoring References
American redstart	x	x	x	consider stream noise in design; area search if small habitat fragments
Calliope hummingbird	x	x	x	focus on known or suspected use areas, particularly areas with foraging plants
Gray catbird	x	x	x	consider stream noise in design; area search if small habitat fragments
Northern waterthrush	x	x	x	consider stream noise in design; area search if small habitat fragments

[1] Review Appendices B, F, H, and K for other Special Species that also may be appropriate for monitoring in Eastside Forest Riparian Habitats (e.g., marsh wren, least flycatcher).
[2] See Appendix L for description of monitoring methods.
[3] Use if traversable (i.e., walking not difficult) and there are relatively large patches of suitable habitat (e.g., >0.5 mile [0.3 km] in length) to accommodate transects.
[4] Use in fragmented habitats where patches of suitable habitat are <0.5 mile (0.3 km) in length (i.e., too small for a point transect) or patch of suitable habitat >0.5 mile (0.3 km) in length but not traversable (i.e., vegetation and/or

topography preclude walking between points).
[5] Use if road within or alongside patch of suitable habitat.

Table D2. Habitat relationships and geographic distribution of Special Species associated with Eastside Forest Riparian Habitats in Oregon and Washington.

SPECIAL SPECIES	HABITATS [1,3]			ECOREGIONS [2,3]				
	RIWO	RISH	WESH	NC	SC	OH	BM	CO
American redstart	1	2	2			1	1	
Calliope hummingbird	2	1	1	1	1	1	1	1
Gray catbird	2	1	1	2	2	1	1	
Northern waterthrush	2	1	1			1		2 [4]

[1] RIWO = Riparian woodland, RISH = Riparian shrub, WESH = Wetland Shrub.
[2] species known to regularly occur as a breeding species in this region, NC = North Cascades (WA), SC = Southern Cascades (WA), OH = Okanogan Highlands (WA), BM = Blue Mountains (WA and OR), CO = Central Oregon (OR).
[3] 1 = highest priority for monitoring based on high degree of association with that habitat or relatively high abundance in that ecoregion; 2 = lower priority for monitoring based on moderate or low degree of association with that habitat or relatively low abundance in that ecoregion. NOTE: These are bi-state ecoregional priorities to provide decision-makers with a perspective on their responsibility for the species within the context of its range in Oregon and Washington. These priorities do not necessarily reflect local concern or interest.
[4] Local population in northern Klamath County only.

Selected Literature (Eastside Forest Riparian Habitat Group):

Northern waterthrush:
LaFave, L.D., and W.A. Hall. 1963. A Washington State breeding population of the northern waterthrush. Murrelet 44(1):16.

Appendix E. Eastside Upland Non-Forest Habitat Group

Habitats: Canyonlands (CANY), Steppe (STEP), Shrub-Steppe (SHST), Woodland Patches (WOPA)

Bird Conservation Plans: Columbia Plateau

Primary Monitoring Responsibility: Bureau of Land Management, State Wildlife Agencies, U.S. Fish and Wildlife Service

Monitoring Methods: Monitoring Special Species in Eastside Upland Non-Forest Habitats is challenging because of the ecological diversity and uniqueness that characterizes this group. Additionally, there are limited roads to conduct BBS routes in some habitats such as canyonlands. The group includes both raptors and passerines, colonial and semi-colonial nesters, and habitat specialists. For example, the raptors are wide-ranging and occur in low densities and other species occur in very specialized habitats or are colonial nesters. Because of these and other factors, several monitoring methods are suggested. Protocols for all of these methods are presented in Appendix L.

Table E1. Recommended monitoring methods for Special Species associated with Eastside Upland Non-Forest Habitats. [1]

SPECIAL SPECIES	**MONITORING METHODS** [2]					
	Off-Road Point Transects [3]	Off-Road Point Counts [4]	Roadside Point Counts [5]	Colony Count	Roadside Driving Transects	Comments and Monitoring References
Black-throated sparrow	x	x	x			off-road point counts (Liverman 1983)
Bobolink	x			x		transects (Wittenberger 1978); area search if small habitat fragments
Burrowing owl	x		x		x	potentially active nest monitoring
Common poorwill			x			playback recording (dusk); roadside point counts (Kalcounis 1992)
Canyon wren	x	x	x			
Ferruginous hawk			x		x	playback recording (diurnal); potentially active nest

						monitoring
Loggerhead shrike	x		x		x	automobile transects (McConnaughey and Dobler 1994)
Long-eared owl			x			playback recordings (nocturnal); Takats et al. (2001)
Prairie falcon	x		x		x	playback recordings (diurnal); potentially active nest monitoring
Short-eared owl			x		x	playback recordings (nocturnal); Takats et al. (2001)
Swainson's hawk			x		x	playback recordings (diurnal); potentially active nest monitoring
White-throated swift	x			x		

[1] Review Appendix B, F, H, and K for other Special Species that also may be appropriate for monitoring in Eastside Upland Non-Forest Habitats (e.g., gray flycatcher, black-chinned hummingbird, barn owl, upland sandpiper).
[2] See Appendix L for description of monitoring methods.
[3] Use if traversable (i.e., walking not difficult) and there are relatively large patches of suitable habitat (e.g., >0.5 mile [0.3 km] in length) to accommodate transects.
[4] Use in fragmented habitats where patches of suitable habitat are <0.5 mile (0.3 km) in length (i.e., too small for a point transect) or patch of suitable habitat >0.5 mile (0.3 km) in length but not traversable (i.e., vegetation and/or topography preclude walking between points).
[5] Use if road within patch of suitable habitat.

Table E2. Habitat relationships and geographic distribution of Special Species associated with Eastside Upland Non-Forest Habitats.

SPECIAL SPECIES	HABITATS [1,3]				ECOREGIONS [2,3]			
	CANY	STEP	SHST	WOPA	GB	OU	HP	CB
Black-throated sparrow		2	1		1	1		2
Bobolink		1			1	1		
Burrowing owl		1	2		1	1	2	1
Canyon wren	1				1	1	1	1
Common poorwill	1		2		1	1	2	2
Ferruginous hawk		2	1		1	1	2	1

Loggerhead shrike		2	1		1	1	1	1
Long-eared owl	2			1	1	1	1	1
Prairie falcon	1				1	1	1	1
Short-eared owl		1			1	1	2	1
Swainson's hawk		2	1		1	1	2	1
White-throated swift	1				1	1	1	1

[1] CANY = Canyonlands, STEP = Steppe, SHST = Shrub-Steppe, WOPA = Woodland Patches.
[2] Species known to regularly occur as a breeding species in this region, GB = Great Basin (OR), OU = Owyhee Uplands (OR), HP = High Lava Plains (OR), CB = Columbia Basin (OR and WA).
[3] 1 = highest priority for monitoring based on high degree of association with that habitat or relatively high abundance in that ecoregion; 2 = lower priority for monitoring based on moderate or low degree of association with that habitat or relatively low abundance in that ecoregion. NOTE: These are bi-state ecoregional priorities to provide decision-makers with a perspective on their responsibility for the species within the context of its range in Oregon and Washington. These priorities do not necessarily reflect local concern or interest.

Selected Literature (Eastside Upland Non-Forest Habitat Group):

<u>General</u>:
Holmes, A.L. and G.R. Geupel. 1998. Avian population studies at Naval Weapons System Training Facility Boardman, Oregon. Unpubl. rept. submitted to the Dept. of Navy and Oreg. Dept. Fish and Wildl. Point Reyes Bird Observatory, Stinson Beach, CA.

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Keister, G. and G. Ivey. 1994. Analysis of raptor surveys in northern Harney County. Oreg. Dept. Fish and Wildl., Nongame Wildl. Prog. Tech. Rept. 94-5-02. 11 pp plus app.

<u>General: Raptors</u>:
Ministry of Environment. 1997. Inventory methods for raptors. Standards for components of British Columbia's biodiversity. http://www.for.gov.bc.ca/RIC/Pubs/teBioDiv/raptors/index.htm

<u>General: Owls</u>:
Takats et asl. (2001) http://www.bsc-eoc.org/regional/bcowls.html

<u>Black-throated sparrow</u>:
Brown, R. 1960. Black-throated sparrows in south-central Oregon. Condor 62:220-221.

DuBois, H.M. 1960. Black-throated sparrows in northwestern Oregon. Condor 61:435.

Liverman, M.C. 1983. Status of the black-throated sparrow (*Amphispiza bilineata deserticola*) in the Harney County Basin, Harney County, Oregon. Oreg. Dept. Fish and Wildl., Nongame Wildl. Prog. Tech. Rep. 82-5-02.

Marks, J.S., J.H. Doremus, and A.R. Bammann. 1980. Black-throated sparrow breeding in Idaho. Murrelet 61:112-113.

<u>Bobolink</u>:

Hunn, E.S. 1989. First verified nesting of the bobolink in WA. Washington Birds 1:45-47.
Whittenberger, J.F. 1978. The breeding biology of an isolated bobolink population in Oregon. The Condor 80:355-371.

Burrowing owl:
Brown, B.A., J.O. Whitaker, T.W French and C Maser. 1986. Note on food habits of the screech owl and the burrowing owl of southeastern Oregon. Great Basin Naturalist 46:421-426.

Green, G.A., and R.G. Anthony. 1989. Nesting success and habitat relationships of burrowing owls in the Columbia Basin, Oregon. Condor 91(2):347-354.

Maser, C., E.W. Hammer, and S.H. Anderson. 1971. Food habitats of the burrowing owl in central Oregon. Northwest Sci. 45:19-25.

Canyon wren:
Cannings, R.J. 1992. Status report on the Canyon Wren (*Catherpes mexicanus*) in Canada. Committee on the Status of Endangered Wildlife in Canada (COSEWIC). Available from Canadian Nature Federation, Ottawa. 9 pp.

Common poorwill:
Kalcounis, M.C., R.D. Csada, and R.M. Brigham. 1992. The status and distribution of the common poorwill in the Cypress Hills, Saskatchewan. Blue Jay 50(1):38-44.

Ministry of Environment. 1998. Inventory methods for nightjars. Standards for components of British Columbia's biodiversity No. 9. Version 2.0. http:www.for.gov.bc.ca/RIC/Pubs/teBioDiv/poorw/index.htm

Ferruginous hawk:
Cottrell, M.J. 1981. Resource partioning and reproductive success of three species of hawks in an Oregon prairie. MS Thesis. Oreg. State Univ., Corvallis. 72 pp.

Fitzner, R.E., D. Berry, L.L. Boyd, and C.A. Rieck. 1977. Nesting of ferruginous hawks in Washington, 1974-75. Condor 79:245-249.

Olendorff, R.R. 1993. Status, biology, and management of ferruginous hawks: a review. Raptor Research and Tech. Assist. Center Spec. Rep., USDI Bureau of Land Manage., Boise, ID. 84 pp.

Loggerhead shrike:
Leu, M. 1995. The feeding ecology and the selection of nest shrubs and fledgling roost sites by loggerhead shrikes (*Lanius ludovicianus*) in the shrub-steppe habitat. M.S. Thesis, Univ. Wash., Seattle.

McConnaughey, J. and F.C. Dobler. 1994. Project shrike: abundance and perch use of loggerhead shrike in eastern Washington, 1994. Unpubl. rept., Wash. Dept. Fish and Wildl., Ephrata. 59 pp.

Poole, L.D. 1992. Reproductive success and nesting habitat of Loggerhead Shrike in shrubsteppe communities. M.S. Thesis, Oreg. State Univ. 69 pp.

Prairie falcon:
Holthuijzen, A.M.A., W.G. Eastland, A.R. Ansell, M.N. Kochert, R.D. Williams, and L.S. Young. 1990. Effects of blasting on behavior and productivity of nesting prairie falcons. Wildl. Soc. Bull. 18:270-281.

Swainson's hawk:

Bechard, M.J., R.L. Knight, D.G. Smith, and R.E. Fitzner. 1990. Nest sites and habitats of sympatric hawks in Washington. J. Field Ornithol. 61:159-170.

Cottrell, M.J. 1981. Resource partioning and reproductive success of three species of hawks in an Oregon prairie. MS Thesis. Oreg. State Univ., Corvallis. 72 pp.

Henjum, M. 1987. Inventory of nesting raptors in Union and Baker Counties, Oregon. Oreg. Birds 13:151-156.

Janes, S.W. 1987. Status and decline of Swainson's hawks in Oregon: the role of habitat and interspecific competition. Oreg. Birds 13:165-179.

Littlefield, C.D., S.P. Thompson, and B.D. Ehlers. 1984. History and present status of Swainson's hawks in southeast Oregon. Raptor Res. 18:1-5.

Sharp, B. 1986. Management guidelines for the Swainson's hawk. Region 1, U.S. Fish and Wildl. Serv., Portland. 28 pp.

Appendix F. Eastside Open Forest Habitat Group

Habitats: Juniper (JUNI), Ponderosa Pine (POPI), Lodgepole Pine (LOPI), Pine-Oak (PIOA), Riparian (RIPA)

Bird Conservation Plans: East-Slope Cascades, Northern Rockies

Primary Monitoring Responsibility: U.S. Forest Service, Bureau of Land Management, Private Forest Companies

Monitoring Methods: Special Species breeding in Eastside Open Forest habitats generally occur in very specialized habitats, have a small distribution (e.g., pinyon jay), or are generally not conducive to detection by the BBS methodology (e.g., woodpeckers, hummingbirds). Because of these and other species-specific factors, multiple monitoring methods are presented with suggestions as to the conditions under which they are most appropriate. Protocols for all of these methods are presented in Appendix L.

Table F1. Recommended monitoring methods of Special Species associated with Eastside Open Forest Habitats in Oregon and Washington. [1]

SPECIAL SPECIES	MONITORING METHODS [2]			
	Off-Road Point Transects [3]	Off-Road Point Counts [4]	Roadside Point Counts [5]	Comments and Monitoring References
Black-backed woodpecker	x		x	playback recordings (diurnal); Goggans et al. (1987)
Black-chinned hummingbird	x	x	x	focus on known or suspected use areas, particularly areas with foraging plants
Flammulated owl			x	playback recordings (nocturnal); Takats et al. (2001); potentially active nest monitoring
Gray flycatcher	x	x	x	
Lewis' woodpecker	x		x	playback recordings (diurnal); transects (Galen 1989)
Pinyon jay	x		x	
Pygmy nuthatch	x	x	x	
Red-naped sapsucker	x		x	playback recordings (diurnal)

White-headed woodpecker	x		x	playback recordings (diurnal)
Williamson's sapsucker	x		x	playback recordings (diurnal)

[1] Review Appendix B, D, E, J, and K for other Special Species that also may be appropriate for monitoring in Eastside Open Forest Habitats (e.g., bobolink, calliope hummingbird, canyon wren, western screech owl, northern pygmy owl, Coopers' hawk, sharp-shinned hawk, northern goshawk, juniper titmouse).
[2] See Appendix L for description of monitoring methods.
[3] Use if traversable (i.e., walking not difficult) and there are relatively large patches of suitable habitat (e.g., >0.5 mile [0.3 km] in length) to accommodate transects.
[4] Use in fragmented habitats where patches of suitable habitat are <0.5 mile (0.3 km) in length (i.e., too small for a point transect) or patch of suitable habitat >0.5 mile (0.3 km) in length but not traversable (i.e., vegetation and/or topography preclude walking between points).
[5] Use if road within patch of suitable habitat.

Table F2. Habitat relationships and geographic distribution of Special Species associated with Eastside Open Forest Habitats in Oregon and Washington.

SPECIAL SPECIES	**HABITATS** [1,3]					**ECOREGIONS** [2,3]						
	JUNI	POPI	LOPI	PIOA	RIPA	GM	BM	NC	YP	CF	CO	KB
Black-backed woodpecker			1			1	1	1	1	2	1	1
Black-chinned hummingbird		1			1	1	1	2	2			
Flammulated owl		1				2	1	2	1	2	1	1
Gray flycatcher	1	2	1	2		1	2	2	1	1	1	1
Lewis' woodpecker		2		1		2	1	1	1	1	2	2
Pinyon jay	1										1	2
Pygmy nuthatch		1				1	1	1	1		1	1
Red-naped sapsucker		2			1	1	1	1	1	1	1	1
White-headed woodpecker		1				2	1	2	1	2	1	1
Williamson's sapsucker		1	2			2	1	1	1	1	1	1

[1] JUNI = Juniper, POPI = Ponderosa Pine, LOPI = Lodgepole Pine, PIOA = Pine Oak, RIPA = Riparian.
[2] Species known to regularly occur as a breeding species in this region, GM = Northern Glaciated Mountains (WA), BM = Blue Mountains (OR and WA), NC = North Cascades (WA), YP = Yakima Plateau (WA), CF = Columbia Foothills (OR and WA), CO = Central Oregon (OR), KB = Klamath Basin (OR).
[3] 1 = highest priority for monitoring based on high degree of association with that habitat or relatively high abundance in that ecoregion; 2 = lower priority for monitoring based on moderate or low degree of association with that habitat or relatively low abundance in that ecoregion. NOTE: These are bi-state ecoregional priorities to provide decision-

makers with a perspective on their responsibility for the species within the context of its range in Oregon and Washington. These priorities do not necessarily reflect local concern or interest.

Selected Literature (Eastside Open Forest Habitat Group):

General:

Bate, L.J. 1995. Monitoring woodpecker abundance and habitat in the central Oregon Cascades. M.S. Thesis, Univ. Idaho, Moscow. 115 pp.

Ministry of Environment. 1998. Inventory methods for woodpeckers. Standards for components of British Columbia's biodiversity No. 19. Version 2.0. http:www.for.gov.bc.ca/RIC/Pubs/teBioDiv/woodpeckers/index.htm

Black-backed woodpecker:

Bull, E.L., S.R. Peterson, and J.W. Thomas. 1986. Resource partitioning among woodpeckers in northeastern Oregon. USDA For. Serv. Res. Note PNW-444. 19 pp.

Goggans, R., R.D. Dixon, and C.S. Seminara. 1987. Habitat use by three-toed and black-backed woodpeckers. USDA, Deschutes National Forest, Oreg. Dept. Fish and Wildl., Tech. Rept. 87-3-02.

Flammulated owl:

Bull, E. and R.G. Anderson. 1978. Notes on flammulated owl in northeastern Oregon. Murrelet 59:26-28.

Bull, E.L., Wright, A.L. and M.G. Henjum. 1990. Nesting habitat of flammulated owls in Oregon. J. Raptor Res. 24(3)52-55.

Goggans, R. 1985. Habitat use by flammulated owls in northeastern Oregon. M.S. Thesis, Oreg. State Univ., Corvallis.

Hayward, G. D., and J. Verner (tech. eds). 1994. Flammulated, boreal, and great gray owls in the United States: A technical conservation assessment. Gen. Tech. Rep. RM-253. USDA For. Serv., Fort Collins, Colo. 214p.

Howle, R.R. and R. Ritcey. 1987. Distribution, habitat selection, and densities of flammulated owls in British Columbia. Pp. 249-254 *in* USDA For. Serv. Gen. Tech. Rep. RM-142.

Takats, D.L., C.M. Francis, G.L.Holroyd, J.M. Duncan, K.M. Mazur, R.J. Cannings, W.Harris, and D. Holt. 2001. Guidelines for nocturnal owl monitoring in North America. Beaverhill Bird Observatory and Bird Studies Canada. http://www.bsc-eoc.org/regional/owlguide.html

Lewis' woodpecker:

Bock, C.E. 1970. The ecology and behavior of the Lewis' woodpecker (*Asyndesmus lewis*). Univ. Calif. Publ. Zool. 91. 100 pp.

Galen, C. 1989. A preliminary assessment of the status of the Lewis' woodpecker in Wasco County, Oregon. Oreg. Dept. Fish and Wildl., Nongame Wildl. Prog. Tech. Rep. 88-3-01. 23 pp.

Jackman, S. M. 1975. Woodpeckers of the Pacific Northwest: their characteristics and their role in the forests. M.S. Thesis, Oreg. State Univ., Corvallis. 147 pp.

Saab, V.A. and J. Dudley. 1995. Nest usurpation and cavity use by Lewis' woodpecker. Unpubl. rept., USDA For.

Ser., Intermountain Res. Stat., Boise, Idaho. 9 pp.

White-headed woodpecker:
Dixon, R.D. 1995a. Density, nest-site and roost-site characteristics, home-range, habitat-use, and behavior of white-headed woodpeckers: Deschutes and Winema National Forests, Oregon. Oreg. Dept. Fish and Wildl. Nongame Rept. No. 93-3-01.

Dixon, R.D. 1995b. Ecology of the white-headed woodpecker in the central Oregon Cascades. M.S. Thesis. Univ. Idaho, Moscow.

Frederick, G.P. and T.L. Moore. 1991. Distribution and habitat of white-headed woodpeckers (*Picoides albolarvatus*) in west-central Idaho. Cons. Data Center, Idaho Dept. Fish and Game, Boise.

Frenzel, R.W. 2000. Nest-sites, nesting success, and turnover-rates of white-headed woodpeckers on the Deschutes and Winema National Forests, Oregon in 2000. Unpubl. rept. submitted to Oreg. Nat. Heritage Prog,, The Nature Conserv. Of Oregon, Portland. 31 pp. plus tables and figures.

Frenzel, R.W. and K.J. Popper. 1998. Densities of white-headed woodpeckers and other woodpeckers in study areas on the Winema and Deschutes National Forests, Oregon in 1997. Unpubl. rept. submitted to Oreg. Nat. Heritage Prog,, The Nature Conserv. Of Oregon, Portland. 25 pp.

Williamson’s sapsucker:
Bull, E.L., S.R. Peterson, and J.W. Thomas. 1986. Resource partitioning among woodpeckers in northeastern Oregon. USDA For. Serv. Res. Note PNW-444. 19 pp.

Conway, C.J. and T.E. Martin. 1993. Habitat suitability for Williamson's sapsuckers in mixed- conifer forests. J. Wildl. Manage. 57(2):322-328.

Appendix G. Southwest Oregon Habitat Group

Target Habitats: Chaparral-Grassland, (CHGR), Chaparral-Shrub (CHSH), Oak-Chaparral (OACH), Oak Woodland (OAWO), Riparian (RIPA)

Bird Conservation Plans: Westside Lowlands and Valleys, Westside Coniferous Forests

Primary Monitoring Responsibility: State Wildlife Agencies, U.S. Bureau of Land Management

Monitoring Methods: Special Species in Southwest Oregon habitats are not adequately monitored by the BBS in Oregon because of their limited distribution and/or abundance. These species are at the northern limit of their range. Monitoring Special Species unique to Southwest Oregon is challenging because of the range of chaparral habitats used by these species, and some of the species are local with small populations (e.g., blue-gray gnatcatcher). Additionally, one species, black phoebe, is associated with riparian habitats which present monitoring concerns. Because of these and other factors, multiple monitoring methods are suggested for each species. Protocols for all of these methods are presented in Appendix L.

Table G1. Recommended monitoring methods for Special Species associated with Southwest Oregon Habitats. [1]

SPECIAL SPECIES	MONITORING METHODS [2]			
	Off-Road Point Transect [3]	Off-Road Point Counts [4]	Roadside Point Counts [5]	Comments and Monitoring References
Acorn woodpecker	x	x	x	playback recordings (diurnal)
Black phoebe	x	x	x	consider stream noise in design
Blue-gray gnatcatcher	x	x	x	area search if small habitat fragments
California towhee	x	x	x	
Lesser goldfinch	x	x	x	
Oak titmouse	x	x	x	
Wrentit	x	x	x	

[1] Review Appendices B, H, J, and K for other Special Species that also may be appropriate for monitoring in Southwest Oregon Habitats (western screech owl, mountain quail, grasshopper sparrow, red-shouldered hawk, white-tailed kite).

[2] See Appendix L for description of monitoring methods.
[3] Use if traversable (i.e., walking not difficult) and there are relatively large patches of suitable habitat (e.g., >0.5 mile [0.3 km] in length) to accommodate transects.
[4] Use in fragmented habitats where patches of suitable habitat are <0.5 mile (0.3 km) in length (i.e., too small for a point transect) or patch of suitable habitat >0.5 mile (0.3 km) in length but not traversable (i.e., vegetation and/or topography preclude walking between points).
[5] Use if road within patch of suitable habitat.

Table G2. Habitat relationships and geographic distribution of Special Species associated with Southwest Oregon Habitats.

SPECIAL SPECIES	**HABITATS** [1,3]					**REGIONS** [2,3]	
	CHGR	CHSH	OACH	OAWO	RIPA	UV	RV
Acorn woodpecker			2	1		1	1
Black phoebe					1		1
Blue-gray gnatcatcher		1	1				1
California towhee	1	2	2			2	1
Lesser goldfinch	1	1	2	2		1	1
Oak titmouse			1	1			1
Wrentit	2	1	1		1	1	1

[1] CHGR = Chaparral-Grassland, CHSH = Chaparral-Shrub, OACH = Oak-Chaparral, OAWO = Oak Woodland, RIPA = Riparian.
[2] species known to regularly occur as a breeding species in this region, UV = Umpqua Valley (OR), RV = Rogue Valley (OR).
[3] 1 = highest priority for monitoring based on high degree of association with that habitat or relatively high abundance in that ecoregion; 2 = lower priority for monitoring based on moderate or low degree of association with that habitat or relatively low abundance in that ecoregion. NOTE: These are bi-state ecoregional priorities to provide decision-makers with a perspective on their responsibility for the species within the context of its range in Oregon and Washington. These priorities do not necessarily reflect local concern or interest.

Selected Literature (Southwest Oregon Habitat Group):

General:
Browning, M.R. 1975. The distribution and occurrence of the birds of Jackson County, Oregon, and surrounding areas. N. Amer. Fauna No. 70. 79 pp.

Cross, S.P. and J.K. Simmons. 1983. Bird populations of the mixed-hardwood forests near Roseburg, Oregon. Oreg. Dept. Fish and Wildl. Tech. Rep. 82-2-05.

Acorn woodpecker:

Ministry of Environment. 1998. Inventory methods for woodpeckers. Standards for components of British Columbia's biodiversity No. 19. Version 2.0. http:www.for.gov.bc.ca/RIC/Pubs/teBioDiv/woodpeckers/index.htm
Walker, K.M. 1952. Northward extension of the range of the acorn woodpecker in Oregon. Condor 54:315.

Blue-gray gnatcatcher:

Speer, F. and J. Felker. 1991. Blue-gray gnatcatcher (*Polioptila caerulea*) study: Lower Table Rock Preserve. Unpubl. rept. submitted to The Nature Conservancy, Medford, OR.

Appendix H. Westside Lowland Habitat Group

Target Habitats: Natural Cavities/Nest Boxes (NCNB), Wetlands (WETL), Rural Farmland (RUFA), Residential Shrub (RESH), Open Foothills (OPFO)

Bird Conservation Plans: Westside Lowlands and Valleys

Primary Monitoring Responsibility: State Wildlife Agencies, U.S. Fish and Wildlife Service

Monitoring Methods: Special Species breeding in Westside Lowland habitats that are not adequately monitored by the BBS are unique for several reasons including habitat specialists (marsh wren), geographically restricted (Allen's hummingbird), have special nesting requirements (purple martin, barn owl), or are generally not conducive to BBS monitoring (Anna's hummingbird). Because of the uniqueness of these species, multiple monitoring methods are presented with suggestions as to the conditions under which they are most appropriate. Protocols for all of these methods are presented in Appendix L.

Table H1. Recommended monitoring methods for Special Species associated with Westside Lowland Habitats in Oregon and Washington. [1]

SPECIAL SPECIES	MONITORING METHODS [2]				
	Off-Road Point Transects [3]	Off-Road Point Counts [4]	Roadside Point Counts [5]	Colony Counts	Comments and Monitoring References
Allen's hummingbird	x	x	x		focus on known or suspected use areas, particularly areas with foraging plants
Anna's hummingbird	x	x	x		focus on known or suspected use areas, particularly areas with foraging plants
Barn owl		x			playback recordings (nocturnal); "points" can be at barns; potentially active nest monitoring
Marsh wren	x	x	x		point transect if traversable trail; if not, place point count station(s) at edge of habitat or do area search around edge
Purple martin				x	"look see" area search or point count (Bibby et al. 1992); Bettinger (2001); Williams (1999)

[1] Review Appendix G, J, and K for other Special Species that also may be appropriate for monitoring in Westside Lowland Habitats (e.g., short-eared owl, grasshopper sparrow, band-tailed pigeon, great-horned owl, western screech owl, acorn woodpecker, black phoebe, lesser goldfinch).
[2] See Appendix L for description of monitoring methods.
[3] Use if traversable (i.e., walking not difficult) and there are relatively large patches of suitable habitat (e.g., >0.5 mile [0.3 km] in length) to accommodate transects.
[4] Use in fragmented habitats where patches of suitable habitat are <0.5 mile (0.3 km) in length (i.e., too small for a point transect) or patch of suitable habitat >0.5 mile (0.3 km) in length but not traversable (i.e., vegetation and/or topography preclude walking between points).
[5] Use if road within patch of suitable habitat.

Table H2. Habitat relationships and geographic distribution of Special Species associated with Westside Lowland Habitats in Oregon and Washington.

SPECIAL SPECIES	**HABITATS** [1,3]					**REGIONS** [2,3]					
	NCNB	WETL	RUFA	RESH	OPFO	PL	WV	UV	RV	CO	CW
Allen's hummingbird				1	1				2	1 [4]	
Anna's hummingbird				1	1	2	1	1	1	1	
Barn owl			1			1	1	1	1	1	1
Marsh wren		1				1	1	2	2	1	1
Purple martin	1					1	1	2	2	1	2

[1] NCNB = Natural Cavities/Nest Boxes, WETL = Wetland, RUFA = Rural Farmland, RESH = Residential Shrub, OPFO = Open Foothills.
[2] species known to regularly occur as a breeding species in this region, PL = Puget Lowlands (WA), WV = Willamette Valley (OR and WA), UV = Umpqua Valley (OR), RV = Rogue Valley (WA), CO = Coastal Oregon (OR), CW = Coastal Washington (WA).
[3] 1 = highest priority for monitoring based on high degree of association with that habitat or relatively high abundance in that ecoregion; 2 = lower priority for monitoring based on moderate or low degree of association with that habitat or relatively low abundance in that ecoregion. NOTE: These are bi-state ecoregional priorities to provide decision-makers with a perspective on their responsibility for the species within the context of its range in Oregon and Washington. These priorities do not necessarily reflect local concern or interest.
[4] Southern Oregon coast only.

Selected Literature (Westside Lowland Habitat Group):

Purple martin:
Bettinger, K. 2001. Proposal for surveying purple martins in upland habitats of western Oregon. Unpubl. Northwest Habitat Institute.

Horvath, E. 1999. Distribution, abundance, and nest-site characteristics of purple martins in Oregon. Oreg. Dept. Fish and Wildl. Wildl. Diversity Prog. Tech. Rept. 99-1-01.

Lund, T. 1977. Purple martins in western Oregon. Part I: status and conservation. Oreg. Birds 3:5-10.
Milner, R.L. 1987. Status of the purple martin in southwestern Washington: results of the 1987 survey. Unpubl. report submitted to the Washington Dept. of Wildlife, November 1987.

Richmond, S.M. 1953. The attraction of purple martins to an urban location in western Oregon. Condor 55:225-249.

Sharp, B. 1986. Guidelines for management of the purple martin, Pacific coast population. Sialia 8(1):9-14.

Williams, B.D.C. 1999. Distribution, habitat associations, and conservation of purple martins breeding in California. Draft rep. Calif. Dept. Fish and Game, Bird and Mammal Conserv. Prog., Sacramento.

Appendix J. Low-Mid Elevation Closed Conifer Forest Habitat Group

Target Habitats: Riparian Instream (RI), Early Successional (ES), Mid Successional (MS), Late Successional (LS)

Bird Conservation Plans: Westside Coniferous Forests, East-Slope Cascades, Northern Rocky Mountains

Primary Monitoring Responsibility: U.S. Forest Service , Bureau of Land Management, Private Forest Companies

Monitoring Methods: Most Special Species monitoring in the Low-Mid Elevation Closed Conifer Forest Habitat Group is challenging because the species and habitats are broadly distributed in both states and species often occur in low densities. Because of these and other species-specific factors, multiple monitoring methods are presented with suggestions as to the conditions under which they are most appropriate. Protocols for all of these methods are presented in Appendix L.

Table J1. Recommended monitoring methods for Special Species associated with Low-Mid Elevation Closed Conifer Forest Habitats in Oregon and Washington. [1]

SPECIAL SPECIES	MONITORING METHODS [2]			
	Off-Road Point Transects [3]	Off-Road Point Counts [4]	Roadside Point Counts [5]	Comments and Monitoring References
American dipper	x	x		consider stream noise in design; Loegering (1997)
Band-tailed pigeon				see State Wildlife Agencies protocols; Sanders (1999)
Barred owl			x	playback recordings (nocturnal); Takats et al. (2001); potentially active nest monitoring
Cooper's hawk		x	x	playback recordings (diurnal); potentially active nest monitoring
Great gray owl			x	see regional protocol; playback recordings (nocturnal); Takats et al. (2001); potentially active nest monitoring
Great horned owl			x	playback recordings (nocturnal); Takats et al. (2001); potentially active nest monitoring

Mountain quail		x	x	
Northern goshawk		x	x	see regional protocol; playback recordings (diurnal); broadcast calls (Kennedy and Stahlecker 1993); potentially active nest monitoring
Northern pygmy owl			x	playback recordings (nocturnal); Takats et al. (2001); potentially active nest monitoring
Northern saw-whet owl			x	playback recordings (nocturnal); Takats et al. (2001); potentially active nest monitoring
Ruffed grouse			x	
Sharp-shinned hawk		x	x	playback recordings (diurnal);potentially active nest monitoring
Western screech owl			x	playback recordings (nocturnal); Takats et al. (2001); potentially active nest monitoring

[1] Review Appendices C, G, H, and K for other Special Species that also may be appropriate for monitoring in Low-Mid Elevation Closed Conifer Forest Habitats (e.g., merlin, fox sparrow, purple martin, wrentit).
[2] See Appendix L for description of monitoring methods.
[3] Use if traversable (i.e., walking not difficult) and there are relatively large patches of suitable habitat (e.g., >0.5 mile [0.3 km] in length) to accommodate transects.
[4] Use in fragmented habitats where patches of suitable habitat are <0.5 mile (0.3 km) in length (i.e., too small for a point transect) or patch of suitable habitat >0.5 mile (0.3 km) in length but not traversable (i.e., vegetation and/or topography preclude walking between points).
[5] Use if road within patch of suitable habitat.

Table J2. Habitat relationships and geographic distribution of Special Species associated with Low-Mid Elevation Closed Conifer Forest Habitats in Oregon and Washington.

SPECIAL SPECIES	**HABITATS** [1,3]				**REGIONS** [2,3]								
	RI	ES	MS	LS	OP	NC	SC	OH	BM	OU	OC	CR	KS
American dipper	1				1	1	1	1	1	2	1	1	1
Band-tailed pigeon		2	2	1	1	1	1				1	1	1
Barred owl				1	1	1	1	1	2		1	1	2
Cooper’s hawk	2		2	1	1	1	1	2	2	2	1	1	1
Great gray owl				1				1	1		1		2

Great horned owl				1	1	1	1	1	1	1	1	1	1
Mountain quail	1	1							1	2	1	1	1
Northern goshawk				1	1	1	1	1	1	2	1	2	1
Northern pygmy owl		2		1	1	1	1	1	1	2	1	1	1
Northern saw-whet owl				1	1	1	1	1	1	2	1	1	1
Ruffed grouse	1	1		2	1	1	1	1	1	1	1	1	1
Sharp-shinned hawk	2		1	2	2	1	1	1	1	2	1	1	1
Western screech owl			2	1	1	1	1	2	2	2	1	1	1

[1] RI = riparian (includes instream), ES = early successional, MS = mid successional. LS = late successional
[2] species known to regularly occur as a breeding species in the following ecoregions: OP = Olympic Peninsula (WA), NC = North Cascades (WA), SC = Southern Cascades (WA), OH = Okanogan Highlands (WA), BM = Blue Mountains (WA and OR), OU = Owyhee Uplands (OR), OC = Oregon Cascades, CR = Coast Range (OR), KS = Klamath/Siskyous (OR).
[3] 1 = highest priority for monitoring based on high degree of association with that habitat or relatively high abundance in that ecoregion; 2 = lower priority for monitoring based on moderate or low degree of association with that habitat or relatively low abundance in that ecoregion. NOTE: These are bi-state ecoregional priorities to provide decision-makers with a perspective on their responsibility for the species within the context of its range in Oregon and Washington. These priorities do not necessarily reflect local concern or interest.

Selected Literature (Low-Mid Elevation Closed Conifer Forest Habitat Group):

General: Raptors:
Ministry of Environment. 1997. Inventory methods for raptors. Standards for components of British Columbia's biodiversity. http://www.for.gov.bc.ca/RIC/Pubs/teBioDiv/raptors/index.htm

General: Owls:
Takats, D.L., C.M. Francis, G.L.Holroyd, J.M. Duncan, K.M. Mazur, R.J. Cannings, W.Harris, and D. Holt. 2001. Guidelines for nocturnal owl monitoring in North America. Beaverhill Bird Observatory and Bird Studies Canada. http://www.bsc-eoc.org/regional/owlguide.html

American dipper:
Ministry of Environment. 1998. Inventory methods for riverine birds: harlequin duck, belted kingfisher, and American dipper. Standards for components of British Columbia's biodiversity No. 12. Version 2.0. http:www.for.gov.bc.ca/RIC/Pubs/teBioDiv/rbirds/index.htm

Loegering, J. P. 1997. Abundance, habitat association, and foraging ecology of American dippers and other riparian-associated wildlife in the Oregon Coast Range. Ph. D. Thesis, Oreg. State Univ., Corvallis.

Parsons, D.R. 1975. Time and energy budgets of a population of dippers (Cinclus mexicanus) during winter in the Cascade Range of Oregon. M.S. Thesis, Oreg. State Univ., Corvallis. 29 pp.

Price, F.E. and C.E. Bock. 1983. Population ecology of the dipper (Cinclus mexicanus) in the front range of

Colorado. Studies in Avian Biol. No. 7. Allen Press Inc., Lawrence, Kansas. 84 pp.

Band-tailed pigeon:
Jarvis, R.L. and M.F. Passmore. 1992. Ecology of the band-tailed pigeon in Oregon. USFWS, Biol. Rep. 6.

Jeffrey, R.G. 1989. The band-tailed pigeon: distribution, effects of harvest regulations, mortality rates, and habits 1968-79. Unpubl. rep. to Wash. Dept. Wildl., Olympia.

Leonard

Sanders, T.A. 1999. Habitat availability, dietary mineral supplement, and measuring abundance of band-tailed pigeon in western Oregon. Ph.D. Diss., Oreg. State Univ., Corvallis.

Sisson, L.H. 1968. Calling behavior of band-tailed pigeon in reference to a census technique. M.S. Thesis. Oreg. State Univ., Corvallis. 57 pp.

Cooper's hawk:
Reynolds, R.T., E.C. Meslow, and H.M. Wight. 1982. Nesting habitat of coexisting accipiter in Oregon. J. Wildl. Manage. 46:124-138.

Reynolds, R.T. and H. M. Wight. 1978. Distribution, density, and productivity of accipiter hawks in Oregon. Wilson Bull. 90:182-196.

Great-gray owl:
Anderson, G. 1960. The status of the great gray owl in southern Oregon. Murrelet 41:28.

Bryan, T. and E.D. Forsman. 1987. Distribution, abundance, and habitat of great gray owls in southcentral Oregon. Murrelet 68:45-49.

Bull, E.L., M.G. Henjum, and R.S. Rohweder. 1988. Home range and dispersal of great gray owls in northeastern Oregon. J. Raptor Res. 22:101-106.

Hayward, G. D., and J. Verner, tech. editors. 1994. Flammulated, boreal, and great gray owls in the United States: A technical conservation assessment. Gen. Tech. Rep. RM-253. USDA For. Serv., Fort Collins, Colo. 214p.

Mountain quail:
Brennan, L.A. and W.M. Block. 1986. Line-transect estimates of mountain quail density. J. Wildl. Manage. 50:373-377.

Northern goshawk:
Austin, K. 1993. Habitat use and home range size of breeding northern goshawks in the southern Cascades. M.S. Thesis, Oreg. State Univ., Corvallis. 56p.

Bull, E., and J. Hohmann. 1994. Breeding biology of northern goshawks in northeastern Oregon. Studies in Avian Biology 16:103-105.

Daw, S. K. 1996. Northern goshawk nest site selection and habitat associations at the post-fledging family area scale in Oregon. M.S. Thesis, Oreg. State Univ., Corvallis.

Fleming, T.L. 1987. Northern Goshawk Status and Habitat Associations in Western Washington with Special Emphasis on the Olympic Peninsula. Unpubl. rep. U.S. Dept. of Agric., Forest Serv., PNW Res. Stn., Olympia.

Joy, S.M., R.T. Reynolds, and D.G. Leslie. 1994. Northern goshawk broadcast surveys: hawk response variables and survey costs. Stud. Avian Biol. 16:24-31.

Kennedy, P.L. and D.W. Stahlecker. 1993. Responsiveness of nesting northern goshawks to taped broadcasts of three conspecific calls. J. Wildl. Manage. 57:249-257.

Reynolds, R.T., E.C. Meslow, and H.M. Wight. 1982. Nesting habitat of coexisting accipter in Oregon. J. Wildl. Manage. 46:124-138.

Reynolds, R.T. and H. M. Wight. 1978. Distribution, density, and productivity of accipiter hawks in Oregon. Wilson Bull. 90:182-196.

Northern pygmy owl:
Bull, E.L., G.E. Hohmann, and M.G. Henjum. 1987. Northern pygmy owl nests in northeastern Oregon. J. Raptor Res. 21:77-78.

Sater, D.M. 1999. Habitat associations of the northern pygmy owl in Oregon. M.S. Thesis. Oreg. State Univ., Corvallis.

Ruffed grouse:
Brewer, L.W. 1980. The ruffed grouse in western Washington. Wash. State Game Dept. Biol. Bull. No. 16. 101 pp.

Ammann, G.A. and L.A. Ryel. 1963. Extensive methods of inventorying ruffed grouse in Michigan. J. Wildl. Manage. 27:617-633.

Sharp-shinned hawk:
Reynolds, R.T., E.C. Meslow, and H.M. Wight. 1982. Nesting habitat of coexisting accipter in Oregon. J. Wildl. Manage. 46:124-138.

Reynolds, R.T. and H. M. Wight. 1978. Distribution, density, and productivity of accipiter hawks in Oregon. Wilson Bull. 90:182-196.

Western screech owl:
Brown, B.A., J.O. Whitaker, T.W French and C Maser. 1986. Note on food habits of the screech owl and the burrowing owl of southeastern Oregon. Great Basin Naturalist 46:421-426.

Cannings, R.J. 1997. A survey of the Western Screech-owl (*Otus kennicottii macfarlanei*) in the interior of B.C. Prep. for BC Environment. 27 pp.

Appendix K. Rare and Unique Species

Habitats: Many

Bird Conservation Plans: All

Primary Monitoring Responsibility: State Wildlife Agencies, Natural Heritage Programs

Monitoring Methods: These species will never be adequately monitored by the BBS because of low population size or unique, restricted distribution. The priority is to confirm reports and conduct habitat-specific inventories in areas of similar habitat in proximity to confirmed reports. The results should be tracked in a state database. The list includes species that are known or highly suspected to have breed in Oregon or Washington in recent years, and species extirpated as breeders (e.g., yellow-billed cuckoo).

Special Species:

Black rosy-finch
Black swift
Clay-colored sparrow
Juniper titmouse
Least flycatcher
Merlin
Northern mockingbird
Red-shouldered hawk
Tri-colored blackbird
Upland sandpiper
White-tailed kite
White-winged crossbill
Yellow-billed cuckoo

NOTE: All Special Species from other Habitat Groups should be recorded when monitoring for this group.

Selected Literature (Rare and Unique Species):

Black swift:
Foerster, K.S. and C.T. Collins. 1990. Breeding distribution of the black swift in southern California. Western Birds 21:1-9.

Schultz, C. Proposed black swift survey protocol. Unpubl. rep., San Juan Nat. For., CO. www.community.gorge.net/natres/pif.html

Tri-colored blackbird:
Hamilton, W.J., L. Cook, and R. Grey. 1994. Tricolored blackbird project 1994. Unpubl. rept. submitted to the USFWS, Region 1, Portland.

Upland sandpiper:
Akenson, H. and Schommer, T. 1992. Upland sandpiper survey protocol for the Blue Mountains of Oregon and Washington. Unpubl. report prepared for the Wallowa-Whitman National Forest, November 1992. 25 pp. plus appendices.

Herman, S.G., J.W. Scoville, and S.G. Waltcher. 1985. The upland sandpiper in Bear Valley and Logan Valley, Grant County, Oregon. Unpubl. rep. To Oreg. Dept. Fish and Wildl., Portland. 24 pp.

Stern, M.A. and G.A. Rosenberg. 1985. Occurrence of a breeding upland sandpiper at Sycan Marsh, Oregon. Murrelet 66:34-35.

Yellow-billed cuckoo:
Littlefield, C.D. 1988. Status of the California yellow-billed cuckoo in Klamath county and eastern Oregon. Oreg. Dept. of Fish and Wildl., Tech. Rept. 89-5-01. 34 pp.

Halterman, M.D. 1991. Distribution and habitat use of the Yellow-billed Cuckoo (*Coccyzus americanus occidentalis*) on the Sacramento River, California, 1987-1990. Masters Thesis, California State University, Chico.

Laymon, S.A. and M.D. Halterman. 1989. A proposed habitat management plan for Yellow-billed Cuckoos in California. USDA Forest Service Gen. Tech. Rep. PSW-110 p 272-277.

Appendix L. Monitoring Protocols

The uniqueness of the species we are addressing in the SSLMAP and the high variability of landscape conditions across Oregon and Washington make it problematic to establish rigid protocols for the program. Herein, we present suggestions for design and field protocols to maintain as much consistency as possible in the SSLMAP. It is anticipated that final establishment of monitoring protocols will result from collaboration among partners using this information as a starting point along with information provided in Appendices C-K.

General Protocols:

These apply to all the monitoring techniques recommended in this document. For a more thorough treatment of general bird monitoring protocols see Ralph et al. (1993).

· Data Collection:
  - · conduct monitoring only under favorable weather conditions
  - · when conducting multiple visits to point count stations or point transects, alternate starting points (starting ends for transects) to minimize time-of-morning bias at any particular location
  - · conduct 5-minute counts at all point count stations (but see woodpeckers and owls below)
  - · record all detections of Special Species and detections of other species only when observers skill level is sufficient enough not to detract from the quality of the data on Special Species
  - · estimate distances to detections of Special Species when conducting point counts or point transects (not colony counts or nocturnal surveys): distance from the plot center for point count station detections (Reynolds et al. 1980), and the perpendicular distance from the line for line transect detections (Burnham and Anderson 1976)
  - · use range finders and tapes to establish distances of predefined landmarks or use flagging at different intervals (e.g., 25m, 50m, 75m) to assist in distance estimates
  - · record distance estimates to nearest 5m
  - · when sampling area includes habitats other than target habitats, or detection of Special Species occur outside the target habitat, detections should be separated on the data sheet by habitat

· Timing:
  - · Daily: Sunrise to no later than 10:00 am unless otherwise indicated (e.g., owls, poorwill)
  - · Seasonal: Monitoring should be conducted within a 4-6 week window at the height of the breeding season when species are most vocal (active), and the number of transient individuals is likely to be minimal. Species-specific timing (see Table 1) is dependent on many factors including accessibility, elevation, latitude, aspect, etc. It can also vary slightly from year to year based on weather and climatic factors.

· Frequency:

- · 1 annual visit per point/transect etc. if objective is solely a long-term trend estimate (e.g., similar to BBS)
- · ≥2 annual visits if objective is a population estimate (abundance or density)
- · multiple visits during one season should be >7 days apart and evenly spaced throughout the breeding season for that species or group of species

<u>Off-Road Point Transects</u>

· Primary Use:

- · all habitats that are traversable and size of area is sufficient to establish transect with at least several points within the target habitat (e.g., >0.5 mile [0.3 km])
- · use where entire area may not be traversable, but linear corridor is (e.g., trail, dike)

· Design:

- · locate point count stations at systematic intervals (e.g., ≥250 m apart in open habitats, ≥200 m in forested or riparian habitats) along transects
- · if the area is large enough to sample the habitat, routes can be selected randomly and placed at least 100 m from the roads and edges of adjacent habitat
- · in large areas, point transect routes should placed parallel and far enough apart (based on Special Species detectability) to provide complete coverage of the area
- · in small or linear areas, place route and or stations in center of habitat or wherever you can maximize the amount of target habitat within the sampling area
- · point sampling in open grassland or wet meadow habitats should seek a station point that is slightly elevated to increase visibility

· Data Collection:

- · conduct walking (amble) transects with Special Species data collection between point count stations
- · if collecting data on all species, at point count stations use a 100 m fixed radius count in open habitats (Savard and Hooper 1995) and 50 m in forests; record detections within and outside fixed radii
- · data collection and analyses is separate for transects and point counts; thus detections recorded on the transect while walking to the point may also be recorded as part of the point count if they are detected during that 5-minute period also

<u>Roadside Point Counts</u>

· Primary Use:

- · when Special Species are not rare and can be expected to be detected at multiple point count stations along a road route
- · habitats where roads are sufficient to establish routes with at least several points within the habitat
- · riparian habitats where roads occur alongside the habitat in sufficient length to establish at least several points

· Design:

· routes should be on secondary or tertiary roads; i.e., traffic should be minimal during the survey period

· routes (i.e., roads) can be selected randomly if the area is large with sufficient roads that you want to sample the roaded habitat

· routes (i.e., roads) are not selected randomly when the area is relatively small or there are too few roads for sampling; you simply conduct the survey on the existing roads within the target habitat

· systematically place points (i.e., every ½ mile) along existing roads that occur within the target habitats

· if collecting data on all species; 100 m fixed radius count in open habitats (Savard and Hooper 1995); and 50 m in forests; record detections within and outside fixed radii

Area Searches

This method is a variation of point counts and transects in which the count duration is fixed (20 minutes), and the observer moves freely throughout a defined area. Area searches provide standardized quantitative data that can be used for abundance and trend analysis, while mimicking the method of birding; thus, they have great appeal to volunteers (Ralph et al. 1993). Area searches are most effective in well defined habitat fragments or small areas (approximately 5-20 acres depending upon terrain, vegetation density, topography, visibility etc.) of a single habitat type. For temporal and spatial comparisons, it is critical to establish the exact boundaries of the site (if necessary flag or mark the boundaries). Slater (1994) discusses some factors affecting the efficiency of the area search method.

An area search can facilitate the detection of uncommon/rare species due to additional censusing time and the freedom of movement. Thus, area searches may be particularly effective for species-specific inventory/monitoring of uncommon or rare species such as many of our Special Species. An area search is also not as time-of-day sensitive as point counts; area searches can be done later in the morning because of the additional time allocated to seek out and identify birds, and there is less reliance on territorial vocalizations. For this reason, area searches are preferred over point counts in the non-breeding season when vocalizations are reduced.

· Primary Use:

· when habitat is traversable, but too small for a point transect or more than 1-2 point counts

· when species is not readily detectable by vocalization or visually, or for ground-foraging species where flushing will increase detectability

· Design:

· survey area should include only the target habitat

· survey area should be a size that can reasonably covered in 20 minutes

· Data Collection:

· duration of area search is 20 minutes

· while conducting the survey, detections of Special Species outside the survey area should be recorded separately from those within the survey area

Roadside or Off-Road Playback Surveys

This method is used to enhance detectability of many Special Species based on individuals responding to taped (or imitated) vocalizations or drumming (woodpeckers) of conspecifics. It is most appropriate for monitoring species that are difficult to detect during censusing and readily respond to their vocalizations. It has been particularly effective for locating and monitoring (with standardization of technique) population abundance of woodpeckers (Goggans et al. 1987) and owls (Takats et al. 2001). The effectiveness and response rate to playback vocalizations is variable and depends upon numerous factors including time of day/year, weather, order and type of calls presented, and home range size of the species. Additionally, the window of responsiveness may be small and must be ascertained for each species.

This type of broadcast recorded calls monitoring has been used for several species/programs including southwestern willow flycatcher (Tibbits et al. 1994), Project Tanager (Cornell Lab of Ornithology), and pileated woodpecker (Bull et. al. 1990). Broadcasting recorded calls also is frequently used to locate rare or secretive species such as the yellow-billed cuckoo (Littlefield 1988). Where the use of recorded calls for monitoring a species has not been validated, some level of research on specific methodologies and standardization most appropriate for that species should be conducted as a part of monitoring.

Use of this method for monitoring in the SSLMAP should be in conjunction with a censusing method (point count or point transect) design where recorded calls are broadcast at point count stations.

· Primary Use:

  · when goal is to document population status of woodpeckers, owls, nightjars, and some rare or secretive species that respond to their vocalizations

· Design:

  · conducted at point count stations or point transects

Modifications: Woodpeckers:

This is derived from several sources including Bate (1995), Dixon (1995a and b) , Frenzel and Popper (1998), Galen (1989), Goggans et al. (1987), and unknown author

  · establish point transects in suitable habitat with stations 1/4 mile apart

  · walk transect at a relatively slow pace and record all detections (i.e., calling, drumming, foraging pecks) of Special Species

  · at each point count station along the point transect, conduct a 3-minute listening period followed by a 5-minute playback (species-specific) and listening period with the recoding presented for 10-15 seconds followed by a listening period of 30 seconds

  · if a bird is detected or responds at any point, record the pertinent information, stop the

play back, and move to the next station
· seasonal timing for woodpecker playback surveys is generally April and May but see Table 1 for species-specific information
· daily timing for woodpecker playback surveys is ½ hour after sunrise to 4 hours after sunrise

Modifications: Owls
For a comprehensive summary of owl monitoring see Takats et al. (2000). The following are salient components taken directly from that document.

Survey Methods
The basic survey method being proposed is to listen for calling owls along a predetermined route consisting of a minimum number of evenly spaced stations (Bibby et al. 1992). In most cases, the routes will be along secondary roads, with relatively little traffic, although off-road routes could be developed in some areas. This basic sampling method is used by the Breeding Bird Survey, and lends itself to large-scale surveys where the intention is to obtain data that can be analysed at a regional or larger scale. It is less suitable for intensive sampling of small areas. As well, it has the drawback that results may only be extrapolated to habitats along roads, where population trends may or may not be the same as those away from roads.

Route Selection
Routes need to be selected so that they are representative of the region being surveyed, in order to make valid statistical inferences about owl populations in the region.
· The only way to ensure that routes are representative is to select routes randomly from within the survey area using some sort of stratified sampling scheme.
· Although some routes could be selected away from roads, for access by snowmobile or horse or even possibly on foot (though few routes could safely be done on foot at night), most routes will necessarily be along roads. Suitable roads must be accessible in late winter/early spring, should not have excessive traffic or heavy logging trucks (for safety reasons and so that owls can be heard) and should go through potentially suitable habitat.
· Each route should be separated by at least 5 km from any other route, to minimize the risk that the same owls will be heard on more than one route (Anderson et al. 1979).
· The objective of random route selection is to ensure that all suitable roads are equally likely to be selected. One possible approach to selecting random routes is outlined in Appendix 6.
· Unfortunately, there are a number of difficulties in selecting random routes. For example, information on which roads are suitable, especially with respect to winter accessibility and habitat, may not be available centrally. Also, volunteers may not always be willing to survey selected random routes. Furthermore, even if roads are selected randomly, habitats or owl populations near roads may differ from those away from roads.
· In many cases if may not be possible to select routes in a fully random fashion. Provided

that routes are selected without prior knowledge of the distribution of owls, we believe that data from such surveys are still valuable, especially in the absence of any alternative information. Nevertheless, the greater the element of randomization, the greater the statistical credibility of the survey.

· Existing programs, with non-random routes, should continue to run existing routes, because there is considerable value to maintaining continuity, but should try to adopt a suitable randomization procedure for selecting new routes. In analyses, random and existing routes should be treated separately, and if average densities or trends prove to differ on the two types of routes, it may be appropriate to phase out the non-random routes and replace them with random routes (e.g., by attrition, through replacing non-random routes with random routes when volunteers drop out and new ones join).

· If any off-road routes are developed, they should be clearly identified as such, as they may require separate analysis, due at least in part to differences in selection procedures.

· In reporting on the results of the survey, it is important to clarify the area that has been sampled, and the procedures used to select routes, as this needs to be taken account in the analysis (e.g. for developing weighting factors for routes) as well as in the interpretation of results.

· Because routes without owls do not contribute to trend analysis (and are unlikely to interest volunteers) and routes without owls for two years in a row, could be discontinued, but efforts should be made to run them again every five years or so, in case owls have returned to the route (this procedure has been used by the Mourning Dove call survey in the United States).

· Selected routes should usually be ground-checked during the day, prior to starting the survey, to ensure that they are, in fact, safe and usable, and go through suitable habitat.

Route Design

Each route should have 10 stations, distributed along the route at equal intervals of 1.6 km.

· If the listening/playback protocol is short [see below], and the length of suitable road is adequate, then it is recommended that another route be run (continued from the first route, or in another area).

· The spacing of 1.6 km is intended to reduce the chances of detecting the same owl at multiple stations, while not requiring surveyors to spend too much time driving between stations. Depending upon the topography, some of the louder owls, such as Barred Owl, can be heard at distances of 2 km or more (Takats 1998, Mazur pers. comm., Duncan pers. comm.), but other owls cannot be heard as far or as clearly. In practice, we have found that most small owls are not heard at neighbouring stations along the route, if stations are spaced at 1.6 km.

Number and Timing of Surveys

Each route should be surveyed once per year at the time of year when vocal activity of the majority of species is greatest. The survey window should be relatively broad (e.g., 4 weeks) to maximize the number of surveys that can be conducted, and to include any annual variation in phenology.

· A single survey per year would encourage more surveyors to participate by reducing the amount of time spent surveying. Highly motivated volunteers could be encouraged to survey multiple routes per year thus allowing for a higher number of routes to be surveyed.

· Surveying a route two (or more) times per year would provide information on annual variation in the peak time of owl calling, and would more accurately monitor owl species with peak calling at different times of the year. However, for this general survey, we do not believe these advantages justify the 2-fold (or more) increase in the survey effort required. For a more intensive survey or limited areas, more than one repeat survey may be preferred.

· The optimal timing for surveys is likely to vary among regions. In Canada this may range from mid-February through May depending upon the location. Also, there is some variation in peak calling among species (for example, in Ontario and Alberta, peak calling of Great Horned Owls is earlier than for Barred Owls). In most areas the calling period for each species is broad enough that there are time periods when all species are potentially calling. If possible, survey timing should be selected to minimize the number of migrating owls recorded. The survey window should be clearly defined by the survey coordinators.

· Each route should be surveyed close to the same date every subsequent year.

Silent Listening

All protocols should start with a two-minute silent listening period at each survey stop.

· This will allow data to be compared across the continent, regardless of what playback protocols (if any) may be adopted. Two minutes appears to be adequate for most spontaneously calling owls to be detected, at least during the period of peak calling activity. In Alberta, relatively few additional owls were detected during a third minute of listening (Takats, pers. comm.). In Ontario, more than 70% of 5 species of owls that were detected over a 5 minute period (included playback) were detected in the first two minutes (Francis pers. comm.).

· A relatively short silent listening period allows for the possibility of incorporating playback, if desired, or for increasing the numbers of stations to be surveyed, both of which are likely to be more efficient than a protracted silent listening period.

Playback (optional)

It is well known that broadcasting recordings of owl vocalizations can increase calling rates or invoke approach from many species (Fuller and Mosher 1981, McGarigal and Fraser 1985, Duncan and Duncan 1991, Lepage et al. 1999), although this has not been the case in all studies.

· Regionally specific playback protocols, or additional silent listening periods could be added, provided that owls heard during these periods are recorded separately from those heard during the first two minutes, and the playback protocol is standardized at each station.

· Playback protocols, however, cannot be standardized across the continent, because of variation in target species and the differences and changes in recording quality, broadcast species, or broadcast equipment which could affect response rates and hence lead to long-term bias in trend estimates.
· Carrying and working with playback units on a cold winter night can be a significant hassle. Playback can also potentially be disruptive to owls (may increase risk of predation, disrupt foraging and courtship, and/or draw females off nests). In addition, playing calls can pull owls off their territories giving inaccurate information on their habitat use (Holroyd and Takats 1997).
· The benefits of broadcasts vary considerably among species, and need to be balanced against the problems. For example, in Ontario, a 12-minute period of alternating broadcasts and silent listening increased 3- to 6-fold the number of Barred Owls detected relative to the initial 2-minute silent listening period (Francis, unpublished). But for Northern Saw-whet and Boreal Owls, the relative increase in calling rates was much lower (because most of them were calling spontaneously); for Great Gray Owls there was no noticeable effect of playback on calling rates.
· We recommend against the use of imitated calls (voice or whistling), as they cannot be standardized, either across observers or over time.
· Playback recordings, if used, should be as clear and loud as possible without distortion. Digital technology is recommended (CD-ROM, solid state, or digital tape) as the sound quality can be better controlled and is less likely to deteriorate over time. If cassette tapes are used, they should be replaced periodically to avoid deterioration of the tape. The audio equipment should be of sufficient quality that it will not distort the sound at loud volumes. We suggest the volume be such that the recording can be heard at 400m, but not at 800m (to minimize bias at the next survey station due to owls hearing the recording from the previous station). If possible, the volume should be measured at a standard distance (e.g., 1m from the speakers) using a decibel meter.
· If playback is used, a recording should be used that includes all of the playback sequences and the silent listening periods. A soft 'beep' or other sound can be used to indicate the start of the first silent listening period, and another beep to indicate the end of the final listening period. This will ensure that the time is fully standardized at each station, and reduce the need for participants to keep checking their watches. If a cassette tape is used, the tape length should match the recording length, and the same recording put on both sides, so the tape can be flipped instead of rewound.

Time of Night

Surveys should be conducted between a half hour after sunset and midnight. An attempt should be made to conduct the survey at the same time of night each year.

· Owl call rates can change significantly during the night (Palmer 1987, Takats and Holroyd 1997). Call rates of at least some species tend to be lowest in the middle of the night (midnight to 04:00) and resume again early in the morning (Takats 1998). However, few volunteers are prepared to complete a survey before dawn. As such, we recommend surveying routes in the evening.

Site-Specific Colony Counts

These can take on different forms depending on what is counted (e.g., individuals, burrows, nests) and how it is counted (e.g., area search, point count, transect). This usually depends upon the species and the size, type, and configuration of the colony, accessibility within the colony, and whether the count is an estimation from sampling or a total count.

For estimation of breeding populations, active nests/burrows should be counted because a count of the number of individuals may include non-breeding birds. However, for species with nests not easily visible, counts of individuals are necessary to estimate the population. In small colonies, a total count can be made of individuals. In large colonies, censusing will likely be a sampling and extrapolation to estimate the population. Hamilton et al. (1994) provides an example of methodologies used to estimate populations in large colonies of tricolored blackbirds in California. This included transects during the breeding season to census individuals and after the breeding season for counts of nests. Another means of estimating the population of large colonies is to visually divide the flock into manageable groups (e.g. 10, 50, or 100 birds depending on the number of birds in the group and the size of the birds) and count the number of groups. For all colony counts, the position of the observer relative to visibility of the colony is important.

Colony counts may be more accurate for abundance and trend analyses than BBS for some species because of the high variation in BBS data for these species. This is especially true for colonially nesting swallows and swifts (e.g., cliff swallow, bank swallow, rough-winged swallow, black swift, purple martin). For these species, colony counts can also be used as complementary or as a cross-check with BBS data. As part of a monitoring program for a colonial nesting landbird, the design should incorporate protocol for searching for new colonies and revisiting abandoned sites. This is particularly appropriate for species where colony use may change regularly such as bank swallow and rough-winged swallow. Colony counts may be integrated with nest box monitoring for some species (e.g., purple martin).

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Appendix M. Measuring Density: An Alternative to Indices

A developing view in the literature on ornithological surveys is that actual density, rather than an index to it, should be estimated whenever possible (e.g., Nichols et al. 2000). Obtaining actual density has numerous advantages. Given a well-designed sampling plan to select survey areas, total population size can be estimated in each year the survey is conducted. This means that field methods, sample size, and other design factors like the number and placement of strata can be varied as goals or preferences change or new methods appear. Domains of interest (e.g., low-elevation vs. high-elevation forest) can also be compared. Index methods, on the other hand, have numerous short comings. The methods must be highly standardized which is often difficult and inefficient. Furthermore, to use index data, one must be able to exclude the hypothesis that observed trends are due to extraneous factors such as change in habitat or observer ability. Doing so is often difficult as numerous controversies in the avian literature demonstrate (e.g., see O'Connor et al. 2000). Domains of interest cannot be compared unless it can be assumed that detection rates are the same in the domains. This largely precludes comparison of abundance in habitats that differ in structure or other factors (e.g., noise) that affect detection rates.

One general approach for estimating actual density that has been used successfully in several past studies (e.g., Handel and Gill 1992) is to use a rapid method of the user's choice and then to determine actual density using intensive methods on a small sample of the plots. The detection rate is estimated from the intensively surveyed plots and is used to adjust the counts surveyed using the rapid. This approach is known in the survey sampling literature as double-sampling (Cochran 1977). It has been used for years in the waterfowl breeding pair survey, in aerial surveys of large mammals, and in various specialized studies (e.g., Anthony et al. 1999). Distance sampling has also often been recommended as a method for estimating density (e.g., Fancy 1997, Thomas et al. 1998), but it is uncertain how often the assumptions required in this approach are met in the field. Double sampling can be used to evaluate this issue. If the intensive plots show that actual density is well-estimated using the distance method, then on future surveys the intensive plots would not be needed.

The biggest potential problem with using double-sampling to estimate actual density is that carrying out the intensive surveys may be too time-consuming or may be completely impractical. This issue is being investigated in several studies around the country and needs further work. In this report, we suggest that intensive surveys be investigated for most if not all surveys. If intensive surveys are not practical, then index methods will probably have to be used, despite their many short comings. On the other hand, if intensive surveys on a small sub set of the plots turn out to be feasible, then we recommend that they be incorporated into the program on a permanent basis.

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