1. Introduction

This document is a conservation assessment for the northern goshawk, blacked-backed woodpecker, flammulated owl, and pileated woodpecker in the Northern Region of the USDA Forest Service completed between March 15 and July 20, 2005, with subsequent modifications.

The Forest Service is required by the National Forest Management Act (NFMA) to "provide for diversity of plant and animal communities based on the suitability and capability of the specific land area in order to meet overall multiple-use objectives." 16 U.S.C. 1604(g)(3)(B). To implement the NFMA, the Forest Service's regulations, implemented on January 5, 2005, state "The overall goal of the ecological element of sustainability is to provide a framework to contribute to sustaining native ecological systems by providing ecological conditions to support diversity of native plant an animal species in the plan area. This will satisfy the statutory requirement to provide for diversity of plant an animal communities based on suitability and capability of the specific land area to in order to meet overall multiple-use objectives." 36 C.F.R.219.10(b). Prior Forest Service regulations, implemented in 1982, provided that "Fish and wildlife habitat shall be managed to maintain viable populations of existing native and desired non-native vertebrate species in the planning area" 36 C.F.R. 219.19 (2000). The Forest Service's focus for meeting the requirement of NFMA and its implementing regulations is on assessing habitat to provide for diversity of species.

For each species, this conservation assessment consists of:

1) a brief overview of ecology, behavior, and habitat use;

2) a brief overview of the habitat use in the Northern Region;

3) estimates of well distributed habitat and habitat amount by National Forest;

4) evaluation of short-term (today's landscape) viability; and

5) evaluation of long-term viability (historic landscape) and ecosystem sustainability.

2. Summary - Methods and Background

This conservation assessment includes consideration of the peer-reviewed literature, non-peer-reviewed publications, particularly unpublished master's theses and PhD dissertations, research reports, and data accumulated by the Forest Service. Where possible, the peer-reviewed professional society literature is emphasized in that it is the accepted standard in science.

Major search engines in the literature review included use of three online line search engines:

> Cambridge Scientific Abstracts [i.e., Agricola (3,651,000 citations as of October 2001), Biology Sciences (38,350 citations as of September 2003), and Environmental Sciences

and Pollution Management (1,607,700 citations as of July 2004)];

WorldCat (52,000,000 records as of November 2004), a compilation of catalogs from libraries worldwide; and

Wildlife and Ecology Studies Worldwide, a compilation of references dating to 1935.

Literature published since 2000 was emphasized in that such recent publications review the previous literature and provide the best available and most recent science. Unpublished literature with a strong focus on unpublished master's theses and PhD dissertations provided information reflecting two to three year investigations into ecology, behavior, and or habitat requirements of the four species. Such unpublished university-based information was important to provide detailed information on species given the possible lack of studies published in the professional peer-reviewed literature. WorldCat served as the search engine to locate unpublished theses and dissertations.

Summary

This conservation assessment for the northern goshawk, black-backed woodpecker, flammulated owl and pileated woodpecker is based on a principle-based approach to population viability analysis (PVA). The methods and background for this principle-based approach using point observation data and vegetation inventory information based on Forest Inventory and Analysis (FIA) data was to build wildlife habitat relationship models to analyze short-term viability is discussed below. Also discussed below is the use of dispersal distance to assess the distribution of habitat and the consideration of long-term viability using the principles of Representation, Redundancy and Resiliency. The principle-based approach, using existing hard data, to develop this conservation assessment was utilized due to the limitations of population viability analysis in estimating minimum viable population numbers through either models or real numbers (Appendix 1). As explained, literature (Beissinger 2002) supports of a principle based approach due to the lack of long-term demographic and environmental data. The focus should be away from a quantitative approach to PVA to an approach based on ecological principles widely agreed to in the peer reviewed professional society scientific literature. As background PVA models, as well as, the use of real data is discussed below prior to a discussion of the Region 1 principle-based approach to PVA.

Population Viability Analysis (PVA) Models

Beissinger (2002) in *Population Viability Analysis: Past, Present, and Future,* a book that summarized the results of an international symposium to address population viability analysis (PVA), described the history of the PVA field in four steps.

First, in 1981, Shaffer (1981) established a new direction for the field of PVA. Shaffer (1981) built on the earlier work by McCullough (1978), which predicted the future of the grizzly bear in the Greater Yellowstone Ecosystem. Shaffer's (1981) approach incorporated chance events, both demographic (largely variation in birth rates and death rates) and environmental stochasticity (effects of weather or other chance event), which led to estimating the minimum viable population (MVP) size that would persist with a given probability over a particularly length of time (Shaffer and Samson 1985).

Second, early application of the MVP concept (Samson 1983, Salwasser et al. 1984) explored the use of the concept as criteria to determine whether species should be listed under the Endangered Species Act (1973) and the converse, whether delisting was warranted (Beissinger 2002). The concept of risk (Salwasser et al. 1984, Samson et al. 1985) also was introduced to permit the relative evaluation of management actions as well as to begin to prioritize species for conservation.

Third, in 1981, Frankel and Soule's (1981) book *Conservation and Evolution* suggested a genetic-based approach to the MVP. From this book emerged the 50/500 (50 individual in the short-term/500 individuals in the long-term) rule which has become etched into the fabric of PVA (Beissinger 2002). Gilpin and Soule (1986) expanded the PVA concept using genetic and related information drawn from captive populations in zoological parks. Concurrent to Gilpin and Soule (1986) was the emergence of numerous and readily available software packages (VORTEX, RAMAS, ALEX and others) that greatly expanded the use of basic concepts (largely stochasticity and genetics) into PVA's.

Fourth, the ready availability of PVA software packages also illustrated the Achilles heel of PVA—the lack of long-term data to populate quantitative PVA models. Boyce (1992), Ralls and Taylor (1997), Beissinger and Westphal (1998), Groom and Pascal (1998), Reed et al. (1998) and others document the lack of long-term data and inability to accurately predict population trends without long-term demographic data. The lack or poor quality of data have lead to difficulties in parameter estimation, weak ability to validate any model, little understanding of the effects of alternative model structures in predicting population trends, and a need to shift to principle-based (Beissinger and Westphal 1998) rather than a quantitative approach to PVA.

Long-term demographic data is defined by the variance in death, birth, or other rates that do not tend to stabilize without 8 to 20 years of data collection (Beissinger and Westphal 1998, Morris et al. 1999) if at all (Pimm 1991). Rare environmental events—e.g., the 100-year drought or flood, fires, storms, unusually severe winters, and so on—also have large effects on variance estimates required in the use of PVA models (Ludwig 1996, 1999).

Shaffer et al. (2002) could find no example where a PVA model had been used to forecast the extinction of a wild population that occurred within the confidence limits of the model. Shaffer et al. (2002) further found no experimental tests of the commonly available models other than Belovski et al. (2002). Belovski et al. (2002) found the available models were inaccurate in terms of expected lifetimes (based on his laboratory populations of brine shrimp), but the underlying assumption that population lifetimes do depend on available habitat was, in essence, correct.

The lack of long-term demographic and environmental data had raised the question as to whether PVA was valuable to the field of species conservation (Beissinger 2002). The general conclusion was "yes" but change in focus and approach was required—away from "quantitative" or model-based approach to PVA to an approach based on ecological principles widely agreed to in the peer reviewed professional society scientific literature.

Real Studies to Determine Minimum Viable Populations:

Estimating the population density let alone population trend for most any vertebrate species is at best problematic (Bart et al. 2004). For example, four sources of bias in estimating bird density are 1) coverage, 2) closure, 3) surplus birds, and 4) detection rates.

Coverage refers to whether the population of interest is sampled in a way such that density estimates are possible. Often, the bias in such estimates is the difference in the trend in the area sampled and in the region-wide survey required to estimate trend (Bart et al. 2004). "The best approach for reducing bias due to incomplete coverage is probably to develop habitat-based models to extrapolate from surveyed to the nonsurveyed areas" (page 1244).

Double sampling is an approach to deal with closure or incomplete coverage. Double sampling is to conduct a broad-scale survey followed by smaller, more specific surveys to insure the accuracy of large-scale surveys but further the "application of double-sampling needs further investigation" (Bart et al. 2004:1245). Bart et al. (2004) "know of no cases in which these assumptions (i.e., all birds are recorded and no surplus birds are present) are necessarily true, and urge these assumptions be tested."

Detectability is the requirement in a survey approach to estimate the numbers of birds (or other taxa under consideration) that each observer failed to detect. This is a significant issue. Failure to detect 10% of the birds in an area by an observer yields a very different density estimate than if the observer failed to detect 90% of the birds. Bart et al. (2004:1245) pointed out many surveys are conducted along roads, dikes, trails or other nonrandom locations and therefore are often "not representative of the study region." Training of observers may help but is no substitute to the consideration of environmental characteristics which can vary substantially across the landscape.

Complicating the detectability of birds is the fact that males of many species cease to sing during the nesting season (Gibbs and Faaborg 1991). From an evolutionary viewpoint, it is advantageous to the paired male to feed its progeny and avoid attracting a predator to the nest area. Habitat based on singing males (versus that of a nest site) is just that, it may or may not be representative of habitat required to successfully nest and raise young.

Region 1 Principle-Based Approach to PVA Using Hard Data:

Point Observation Data Utilized

In November 2004 (McAllister 2004), a letter from the Regional Forester requested each Forest/Grassland to update their respective Point Observation Data (POD) so that it can be entered into FAUNA, the Forest Service's corporate database for wildlife information. This letter served as a follow-up to a Regional request for POD for the goshawk in the summer of 2004.

Where available, POD were emphasized as the basis to build wildlife habitat relationship models, particularly to estimate the amount and distribution of habitat for each of the four species. Three of the four remaining criteria to evaluate the four species in this conservation assessment—human disturbance, biotic interactions, and managing for ecological processes—are primarily based on the recent peer-reviewed scientific literature.

In addition, for each Northern Region wildlife habitat relationship model developed for this conservation assessment, a bootstrap approach (Appendix 2) was used to provide an estimate of the standard error (SE). The SE is a relative measure of variability around the mean. A 90% confidence interval was selected and estimates of confidence limits and SE's for the estimates of each model are provided in Appendix 3.

FAUNA provides an up-to-date source of species information both to locate and describe high quality habitat to bridge the gap between single species management and ecosystem conservation. Currently, agreements are being developed to insure annual exchange of POD with the Montana Natural Heritage Program, The Nature Conservancy, Helena; Idaho Conservation Data Center, Idaho Department of Fish and Game, Boise; US Fish and Wildlife Service; Bureau of Land Management; and others from universities and elsewhere that collect POD.

POD is regularly used to build wildlife habitat relationship models (Peterson et al. 2002). Sergio and Newton (2003: 857) describe how 1) "Occupancy (POD) may be a reliable method of (habitat) quality assessment, especially for populations in which not all territories are occupied, or for species in which checking occupancy is easier than finding nests;" 2) "successful conservation should maintain or improve high quality (occupied) sites rather than focusing on poor (unoccupied) sites" (page 863); 3) occupancy data are often available, either by specific or amateur monitoring schemes; and 4) occupancy through space and or time is a reliable measure of territory quality, thus can provide key information for the development of conservation strategies.

Peterson et al. (2002: 619) suggest two additional advantages to use of POD in the development of models and conservation strategies, i.e., when updated from time to time, POD provide "for a continuously updated, never-out-of-date, growing database that builds in real time, thus taking advantage of a maximum of information for every result," and use of POD avoids the element of subjectivity when an expert (s) provides a range map, species account, or an ecological summary as the basis for a wildlife habitat relationship model.

Vegetation Inventory Information Used – FIA Data

Vegetation inventory information used to build the wildlife habitat relationship models and describe today's landscape is based on Forest Inventory and Analysis (FIA) data. FIA is the only congressionally mandated, comprehensive, field-based forest inventory for each of the 50 States, Puerto Rico, and Trust Territories. The McSweeney-McNary Forest Research Act (1928) defines the FIA mission: "Make and keep current a comprehensive inventory and analysis of the present and prospective conditions of and requirements for the renewable resources of the forest and rangelands of the United States."

FIA produces statistical reports and analytical information on status and trends in forest area and location; species, size, and health of trees; total tree growth, mortality, and removals by harvest; wood production and utilization rates for various products; and forest land ownership. As an example of its scientific stature, FIA maintains a bibliographic database of over 1,400 reports and scholarly papers dealing with FIA field surveys for the United States and its territories for the period 1975 through July 2001. These citations include integrated assessments and multi-disciplinary surveys, representative citations associated with timber resource assessments, and all known theses and dissertations associated with FIA data since 1975, regardless of topic.

In addition to FIA, estimates of forested habitat for each National Forest in the USDA Northern Region were developed. These estimates were developed using remote sensing (Appendix 4) and served only to provide estimates of forest (versus non-forest) habitat in that providing more detailed information (tree size, tree diameter, number of canopy layers and so on) is not obtainable through most forms of remote sensing.

Distribution of Habitat

Dispersal ability of young is the measure of well-distributed habitat (Thomas et al. 1992, Appendix P). In the President's Plan to conserve the oldgrowth forests of the Pacific Northwest, Thomas et al. (1992: 367) concluded for the spotted owl that "the distances between Habitat Conservation Areas should be within the known dispersal distances of at least two-thirds (67%) of all juveniles" in order to satisfy the 219.19 requirement for well distributed habitat. Subsequent modifications of the original Habitat Conservation Area network by the spotted owl recovery team also meet this criterion. The 9th Circuit Court has upheld the President's Plan.

Dispersal of young is an important component of population viability, yet is difficult to measure (Koenig et al. 2003). Researchers rarely look beyond their respective study areas to relocate banded birds or to recover dead birds. No broad-scale surveys exist to relocate banded birds and few telemetry-based studies are adequate in scope to address dispersal distances.

In an overall review of dispersal distance in birds, Bowman (2003: 198) found a relationship between median dispersal distance and the square root of territory size for a species that can be described as follows.

Median dispersal distance (in km) = 12 times the square root of the territory size (in ha).

The approach to dispersal distance in birds developed by Bowman (2003) is used in this conservation assessment for each of the four species.

Long-Term Viability

Shaffer et al. (2002), given the lack of progress in the demographic-based approaches to PVA, suggested a new direction to maintain MVP's over the long-term, one based on habitat and three ecological principles: 1) Representation, 2) Redundancy, and 3) Resiliency (the three R's). Representation is to provide representative examples of the natural landscape. Redundancy is to provide more than one example of the elements/natural landscape. Resiliency is to take into account environmental variation due to ecological processes. Employing these three principles "would acknowledge both what we do know about the determinants of long-term persistence and the limits of our forecasting ability" (Shaffer et al. 2002) whether in the short- or long-term.

Conservation of Ecosystem Diversity (full distribution of ecosystem characteristics) along with a comparison of the current condition of ecological processes to their pre-European settlement frequency and extent in the 2005 Draft Directives to implement the 2005 Forest Service Planning Rule is based on the three R's. The three R's form along with a comparison to the pre-European settlement character of an ecosystem form the basis to evaluate long-term viability and ecosystem sustainability in this conservation assessment.

An understanding of the pre-European landscape is essential to understand the requirements for the long-term conservation of species (Haufler et al. 2002) and ecosystem sustainability (Holling 1992, Allen and Holling 2002).

Historic inventories are one of several sources of information that can be used to reconstruct a landscape (Foster et al. 1996). Between 1937 and 1948, detailed surveys of forested lands were conducted in Idaho and western Montana (Berglund 2005). Such historic forest surveys provide information of forest composition and structure and provide a basis to compare those forests to the composition and structure of forests today as sampled by FIA.

Assumptions and limitations of this Conservation Assessment include the following.

1) Methods to estimate canopy closure, forest structure, and dominant forest type may differ among the studies referred to in this assessment and from those used by the Forest Service to estimate these habitat characteristics.

2) This conservation assessment focuses on forested habitat and may underestimate habitat for a species such as the northern goshawk known to use open shrub lands.

3) FIA sample points affected within the prior 10 years by either timber harvest or fire are excluded in the estimates of habitat for the four species.

4) FIA does not adequately sample rare habitats.
Scientific names are provided in Appendix 5.

Summary of Results

This short-term viability assessment reflects those eological factors which now impact a species persistence (Appendix 1). This conservation assessment shows that short-term viability is not an issue in Region 1 for the northern goshawk, black-backed woodpecker, flammulated owl or pileated woodpecker. Viable populations in the short-term for these species will be maintained as there is no scientific evidence that the species are decreasing in number, there have been substantial increases in the extent and connectivity of forested habitat since European settlement, the level of timber harvest of the forested landscape in the Northern Region has been insignificant, and well-distributed and abundant habitat exists on today's landscape for these species.

In regard to long-term viability, this conservation assessment has found that long-term habitat conditions in terms of Representativeness, Redundancy, and Resiliency is "low" for all species. The assessment of long-term viability relates to the sustainability of habitat conditions in which the species have persisted for an extended period of time (>100 years). The reason for the "low" habitat assessment in the long-term is that habitat (landscape) changes have occurred and are occurring that are moving habitat away from historic habitats. Included in these landscape changes are loss of grasslands and the increases in intermediate-aged forests and the increased connectivity of the landscape. These increases in intermediate-aged forests and connectivity threaten key remaining elements of biodiversity, such as areas of old growth, as these areas no longer persist in fire-protected refugia but are embedded in a well-connected matrix of intermediate-aged forest that permits the rapid spread of fire and insect outbreaks with a spatial-temporal pattern unlike the historic landscape. The result is a low rating for habitat Representativeness, Redundancy and Resiliency in the long-term.