DecAID: A Decaying Wood Advisory Model for Oregon and Washington[1]

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Abstract

DecAID is a knowledge-based advisory model that provides guidance to managers in determining the size, amount, and distribution of dead and decaying wood (dead and partially dead trees and down wood) necessary to maintain wildlife habitat and ecosystem functions. The intent of the model is to update and replace existing snag-wildlife models in Washington and Oregon. Whereas the relationship of dead and decaying wood to wildlife habitat is a major component of the model, DecAID will also provide expert advice on prescribing and interpreting conditions of dead wood for wildland and prescribed fire and fuels, pest and non-pest insects, pathogens and non-pathogenic fungi, and use of inventory data to describe current managed and natural levels of dead wood. The model also produces a list of ecosystem functions performed by species associated with dead and decaying wood. Advice on the distribution of dead wood at the stand and landscape scale is provided in the model.

Introduction

Models have been developed in the past to provide managers with tools by which they can determine snag sizes (diameter at breast height or dbh) and densities (number of snags per unit area) needed to maintain snag-dependent wildlife. These models focus on needs of primary cavity excavating species of birds (woodpeckers, nuthatches, and chickadees) (Neitro and others 1985, Thomas and others 1979). No similar models have been developed for down wood, largely because until recently there have been no empirical data relating wildlife species and population densities to

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down wood conditions and amounts in Oregon and Washington. Our new model, DecAID (Decayed Wood Advisory Model), is intended to replace the currently used models for determining snag numbers. DecAID will help resource specialists determine how to manage for the amount, type, and distribution of all types of dead wood within forest stands and across landscapes.

DecAID is being developed as part of an update to the existing wildlife habitat relationships books for Washington and Oregon (Brown 1985, Maser and others 1984, Thomas 1979) in a new book entitled *Wildlife-Habitat Relationships in Oregon and Washington,* hereafter referred to as the Species-Habitat Project (SHP). The Oregon Department of Fish and Wildlife and Washington Department of Fish and Wildlife are leading this effort. The USDA Forest Service is a major partner. DecAID is a work in progress; this paper is a report on the current status of the model (Marcot and others 2002, Ohmann and Waddell 2002).

Existing Models

Existing models of the relationships between wildlife species and snags in the Pacific Northwest typically are based on calculating potential densities of bird species and expected number of snags used per pair. This approach was first used by Thomas and others (1979). Marcot expanded this approach in Neitro and others (1985) and in the subsequent Snag Recruitment Simulator (Marcot 1992) by using published estimates of bird population densities instead of calculating population densities from pair home range sizes.

Recently there has been criticism of the existing modeling approach, in part because the numbers of snags suggested by the models seem far lower than are now being observed in field studies (Bull and others 1997, Lundquist and Mariani 1991). The existing models have also focused just on snags and have provided only deterministic point values of snag sizes or densities and of population response ("population potential") instead of probabilistic estimates more amenable to a risk analysis and risk management framework.

The existing models have focused on terrestrial vertebrate species that are primary cavity excavators. The assumption made by Thomas and others (1979) and Marcot (1992) is that secondary snag-using species would be fully provided for if needs of primary snag-excavating species were met. McComb and others (1992) and Schreiber (1987) indicate that secondary cavity nesting birds may be more sensitive to snag density than primary cavity excavators. The existing models also do not account for species that use different types of snags and partially dead trees, such as hollow live and dead trees used by bats (Betts 1998, Campbell and others 1996, Ormsbee and McComb 1998) and Vaux's swift (Bull and Cooper 1990, Bull and Hohmann 1993). These new findings are important to improving dead wood models for wildlife.

A New Model: DecAID

Our goal for developing the DecAID model was to advise managers on the numbers, sizes, species, and decay classes of dead wood needed to help maintain wildlife habitat and ecosystem functions in forests. We intend for the model to provide such advice by wildlife habitat and management objective. In addition to

snags and down logs, the advisory model will address diseased, partially dead, or decaying live trees, including hollow trees, as important wildlife habitat components. Whereas providing advice on maintaining wildlife habitat will be a main objective of the model, the model will be ecosystem-based and also provide information on ecosystem functions performed by wildlife associated with dead wood, maintenance of ecological function (e.g., soil productivity), roles of insects and diseases in the creation and dynamics of dead wood, and management of fire *(fig. 1)*. The modeling process will also help identify gaps in knowledge of dead wood as wildlife habitat and its role in ecosystem processes.

User Inputs

Three pieces of information will be required as user inputs: wildlife habitat type, structure stage, and management objective *(fig. 1)*. The first input, wildlife habitat type, is defined by the SHP (Johnson and O'Neil 2001). Examples include major vegetation alliances such as eastside mixed-conifer forest, southwest Oregon mixed-conifer/hardwood forest, and westside lowlands conifer/hardwood forest (Marcot and others 2002). The SHP describes 26 structural stages, which are combined into three successional stages for analysis of inventory data (Johnson and O'Neil 2001). The successional stages are early, mid-, and late-successional forests (Ohmann and Waddell 2002). For species use data we combined the mid- and late-successional stages into one class due to the way most data were reported in the literature. The management objective is based on the landowner's expectations for managing for ecosystem function and diversity. Management objectives relate to statistical tolerance levels for managing for species and functions based on empirical data on species-dead wood relations. High, moderate, and low statistical levels have been developed (Marcot and others 2002). High confidence level might be applicable where maintaining or restoring ecosystem functions is the objective: for example, late-successional reserves from the Northwest Forest Plan. Low confidence levels might apply where maintaining some wildlife habitat and some level of ecosystem function such as site productivity are desired, but timber harvest is the main objective.

Species-Dead Wood Relations

The wildlife or species component of DecAID focuses on species needs for sizes, amounts, and distribution of dead wood, primarily snags and down wood. We extensively reviewed the literature, contacted researchers, and summarized quantitative data on dead and decaying wood relationships of fungi, amphibians, birds, and mammals. We found many data gaps for some habitats and species groups. To make the model as complete as possible, we used unpublished data to fill in some of the gaps. We arranged the species use data into three cumulative species curves representing high, moderate, and low statistical levels for each combination of wildlife habitat type and structure stage for which data were available (Marcot and others 2002). Expert opinion was used to help interpret the data and species curves.

The DecAID output produces a list of wildlife species associated with dead wood and a list of ecological functions performed by those species *(fig. 1)*. We queried data matrices developed by the SHP to develop the lists. One query links to a Habitat Features database that lists species associations with different types and

amounts of dead and decaying wood, including snags, remnant trees (that possibly have some dead parts), mistletoe and witch's brooms, dead parts of live trees, hollow trees, tree cavities, bark crevices, down wood, litter, and duff. Lists of species associated with these elements can be linked to a Key Ecological Functions database to produce a list of functions the dead-wood-associated species perform in the ecosystem.

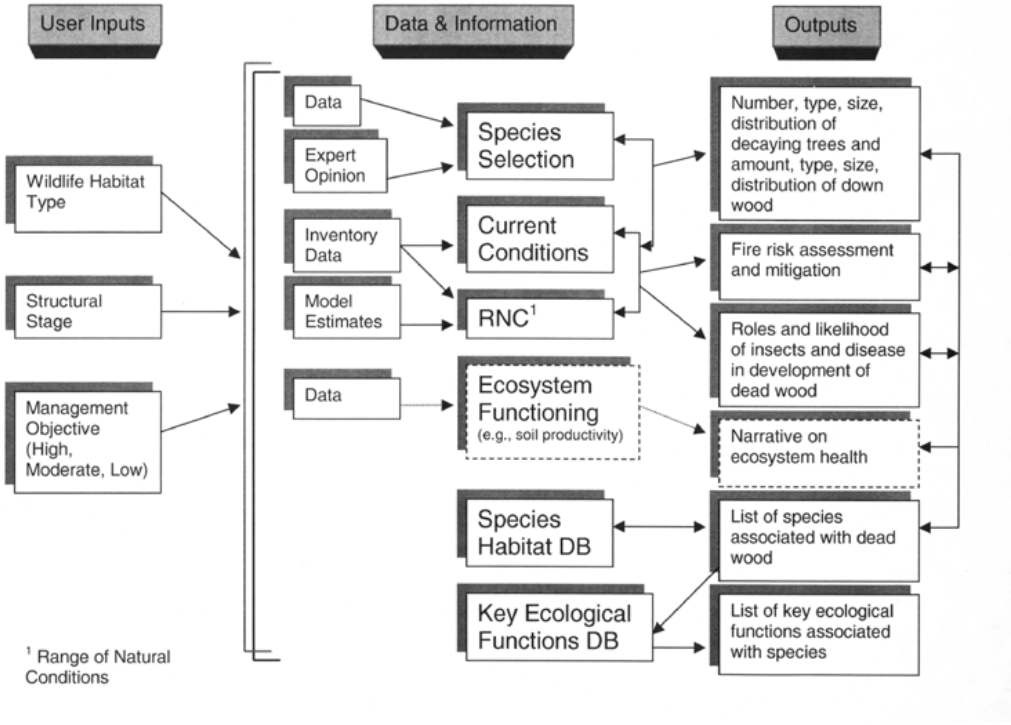

Figure 1—Flowchart of the DecAID model.

Inventory Data

We are using inventory data from nearly 17,000 Forest Service Continuous Vegetation Survey (CVS) and Forest Inventory and Analysis (FIA) plots, and USDI Bureau of Land Management Natural Resource Inventory (NRI) plots to estimate current amounts and condition of dead wood across private and public lands in Oregon and Washington (Ohmann and Waddell 2002). The data are stratified by wildlife habitat type and structure stage. Data from plots in reserved areas, which we assume to represent unharvested conditions, are used to estimate range of natural conditions (RNC) or historic levels of dead wood. This approach works better for wetter areas west of the Cascade crest where fire suppression has had less influence on dead wood resources than in drier habitats. In some Wildlife Habitat Types, especially east of the Cascade crest, a combination of fire suppression, insect outbreaks, salvage, and firewood cutting might limit our ability to determine natural levels of dead wood based on existing conditions. In these areas, models such as that of Harrod and others (1998) may provide more realistic benchmarks for natural levels of dead wood.

In DecAID, the information based on species' use of dead wood is compared to sizes and amounts of dead wood in unharvested stands. This comparison assists in determining if species are using dead wood at different levels than commonly occur in natural stands, and the potential of a stand to produce dead wood. The inventory data can also give us some ideas about distribution of dead wood in natural systems. We should also be able to show how well current conditions are meeting species needs and how closely current conditions reflect RNC.

Natural Processes

Insects and Diseases

The influence of insects and diseases (used here to include pathogenic and decay-causing fungi and dwarf mistletoes) on recruitment of dead wood through time is assessed in the model. We obtained occurrence and severity frequencies of plots or trees affected by selected insect and/or disease species from the inventory data for each wildlife habitat type and structure stage. This portion of the model provides a list of the insects and diseases that are most likely to generate dead or decaying wood in each habitat. DecAID will then provide generalized predictions about the future amounts and types of dead and decaying wood that may occur naturally in stands. Each type of insect or disease produces a different type of dead wood or decay that subsequently may provide a different function for dead-wood-associated species. This portion of the model also will provide advice on how to mitigate or intensify the activity of these agents to decrease or increase dead wood recruitment.

Fire

The fire portion of DecAID has not yet been developed. Our plan is to assess the fire likelihoods associated with the amount and distribution of dead wood indicated by species use data. Information will be provided to help the land manager balance the needs of species with the risk of catastrophic fire.

Ecosystem Function

Our intent for this portion of the model is to provide qualitative and, where available, quantitative information on ecosystem functions affected by decadent wood, such as soil productivity, moisture retention, and slope stability. At this point, the time and funding necessary to complete a thorough literature review for these data are not available. We plan to use the qualitative information to provide a narrative review of the importance of dead and decaying wood to ecosystem functions *(fig. 1)*.

Summary

DecAID is a new decayed wood advisory model currently being developed. Displaying the relationship of dead and decaying wood to wildlife habitat and species is a major component of the model. DecAID also provides advice on dead and decaying wood as an important component of ecosystems and the relationship of dead and decaying wood to natural processes. Inventory data are used to compare species needs to current amounts of dead wood in managed and unharvested forests.

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