The Integrated Landscape Assessment Project

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Abstract

The Integrated Landscape Assessment Project (ILAP) is a three-year effort that produces information, models, data, and tools to help land managers, policymakers, and others examine mid- to broad-scale (e.g., watersheds to states and larger areas) prioritization of land management actions, perform landscape assessments, and estimate potential effects of management actions for planning and other purposes. ILAP provides wall-to-wall, cross-ownership geospatial data and maps on existing, potential and future vegetation conditions, land ownership and management allocation classes, and other landscape attributes. State and transition models integrate vegetation development, management actions, natural disturbances, and climate change to allow users to examine the mid- and long-term effects of alternative management, disturbance, and climate scenarios. State-and-transition model (STM) outputs are used to produce information on many landscape characteristics, including vegetation conditions, disturbance regimes, fuel conditions, wildlife habitats, and economic values of natural resource-related products in Arizona, New Mexico, Oregon, and Washington. The project consists of science delivery (e.g., state and transition models, spatial data) and knowledge discovery (e.g., new linkages to wildlife habitat relations, fuel treatment economics, aboveground carbon pools, biomass, water supplies, and trends in wildfire and fuel conditions) that are integrated through decision support systems. The spatial data, state and transition models, model outputs, and interpretations cover all major upland vegetation types, including forests, woodlands, shrublands, grasslands, and deserts. To date, more than 50 GIS layers and 250 unique state and transition models have been produced across the 4-state area (over 117 million hectares). ILAP data, models, and tools will be accessible through a Western Landscapes Explorer portal to be publicly launched in 2012 (INR and OSU Libraries 2012). Products from ILAP can be used by land managers, program managers, analysts, planners, and policymakers to evaluate management strategies that reduce wildfire risk, improve habitat, generate revenues, benefit rural communities, and inform restoration investment decisions. Because it allows for integration of many natural resource management objectives, ILAP facilitates collaborative landscape planning over very large areas. ILAP methods should be widely applicable for all lands.

Keywords: landscape assessment, science delivery, knowledge discovery, vegetation models, decision support.

Introduction

Fire suppression, vegetation management activities, grazing, climate change, and other factors produce constantly changing vegetation, fuel, and habitat conditions across millions of hectares in the western United States. In recent years, the size and number of large wildfires has grown, threatening lives, property, and ecosystem integrity. At the same time, habitat for species of concern is often becoming less suitable, the economic vitality of many natural resource-dependent human communities is declining, and resources available for natural resource management are tight. Techniques are needed to prioritize where natural resource management activities, such as fuel treatments, could be most effective and most likely to result in desirable conditions. Solutions driven by single resource concerns have proven problematic in most cases, since ecological and human systems are necessarily intertwined. More than $5.5 million of funding from the American Recovery and Reinvestment Act in 2009 provided the opportunity to hire a team of more than 50 technical experts to provide an integrated approach to assess landscape conditions and forecast potential future effects of alternative natural resource management strategies in Arizona, New Mexico, Oregon, and Washington. This paper summarizes the approach and methods used in the ILAP. Examples of applications can be found elsewhere (Creutzburg et al. 2012, Morzillo et al. 2012, Shlisky et al. 2012, Zhou and Hemstrom 2012).

The Integrated Landscape Assessment Project (ILAP) produces databases, reports, maps, analyses, and other information showing mid- to broad-scale (thousands to millions of hectares) vegetation conditions and trends, key wildlife habitat conditions and trends, potential economic value of products that might be generated during vegetation management, and other critical information for all lands and all major upland vegetation types in Arizona, New Mexico, Oregon, and Washington (fig. 1).

ILAP integrates these landscape attributes into databases, reports, and maps that show a continuum of integrated priority areas (from high to low priority) considering a combination of vegetation trends, treatment costs, and likely effects of treatments and climate change impacts on key wildlife habitat, fuel conditions, and other landscape characteristics. ILAP gathers and consolidates key information and filled in data gaps across the 4-state area. The project packages and delivers knowledge in usable ways and allows for the development of new knowledge. In addition, ILAP is modular and allows updates or exchange of vegetation data sets, including incorporation of new plot data, resource interpretations, and other elements as knowledge improves.

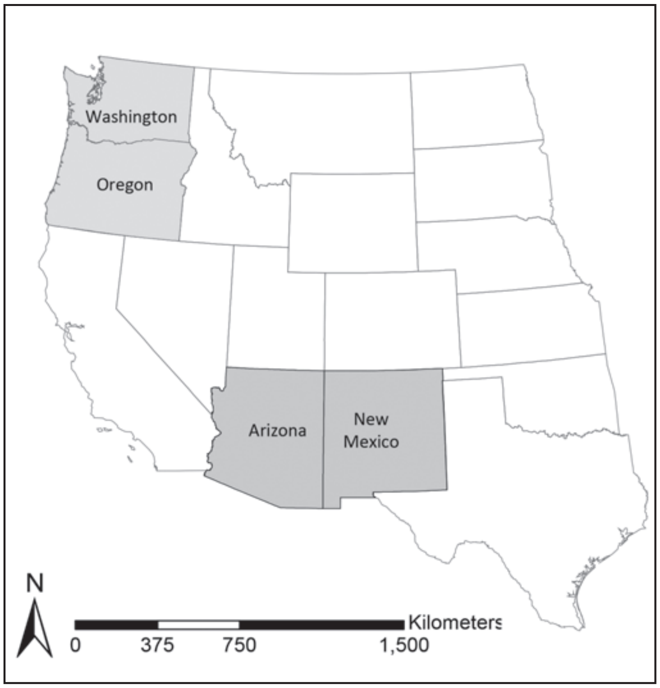

Figure 1—Integrated Landscape Assessment study area.

ILAP relies on regional advisory groups—with representation from state and federal land management agencies, conservation organizations, and industry groups—for definition of goals and priorities. With their input, a set of resource management questions have been defined relating to all major upland ecological systems in the 4-state area:

1. What are the existing vegetation conditions across forests, woodlands, shrublands, grasslands, deserts, and other ecological systems?
2. What are the implications of vegetation and natural disturbance trends on key wildlife habitats, wildland fuel conditions, nonnative invasive plant species, and other landscape characteristics?
3. How might those trends play out in the future under alternative land management approaches and in the face of climate change?

While ILAP models and data cover all major upland vegetation types in the 4-state area, the project also works with collaborative groups involved with restoration decisionmaking in focus landscape areas to demonstrate utility and refine the landscape analysis process. At present, focus areas include the Tapash Sustainable Forest Collaborative in

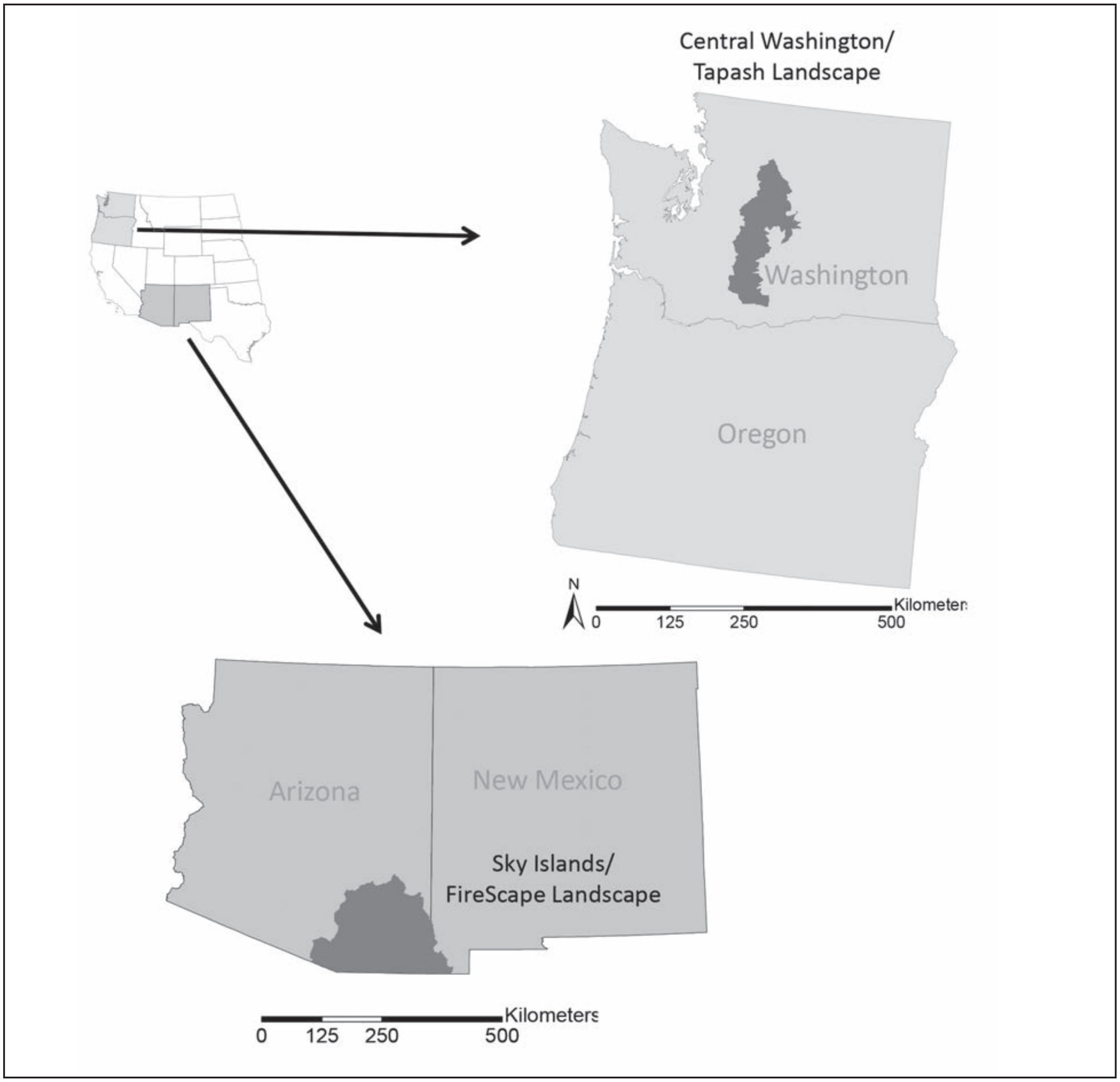

Figure 2—The central Washington and Sky Islands landscape focus areas within the Integrated Landscape Assessment Project.

central Washington and the Sky Islands/FireScape group in southeastern Arizona (fig. 2). While management questions are specific to each focus area, example questions include:

1. What general kinds of treatments might produce the desirable combinations of fuel reductions and wildlife habitat conditions? Is it possible to slow or stop the upward spiral of fire suppression costs through fuel treatments? What are the economic costs of such an approach?
2. How likely are fuel treatments to generate valuable economic products? Can the treatments pay for themselves?
3. What areas and management regimes might be most likely to produce high combined potential to reduce critical fuels, improve or not degrade key wildlife habitat, and generate positive economic value?

4. How will projected climate scenarios affect future vegetation, habitat, and fuel conditions over the long term (100 years)?

Because ILAP is funded by the American Recovery and Reinvestment Act, the project will be completed in a relatively short time (about 3 years). Both the project timeframe and the size of the four state project area (>117 million hectares) necessitate reliance on existing information (vegetation data, state and transition models, etc.) rather than development of extensive new information. The 4-state project area was selected because of the state and transition models and collaborations that were already in place between Region 3 of the USDA Forest Service (based in Albuquerque, New Mexico), Region 6 of the Forest Service, and the Forest Service PNW Research Station (based in Portland, Oregon). Because ILAP aims to be an "all-lands" approach, new data sets and models are developed to fill data gaps or where models do exist, as is the case for much of the arid land. Existing data and models are refined as new insights into ecological interactions, natural resource conditions and trends, potential climate change effects, economic and social interactions, and other topics become apparent.

Organization

The project is a collaborative effort and incorporates expertise from several institutions and disciplines (fig. 3). An oversight team, composed of representatives from the funding agency and major collaborators (Institute for Natural Resources, Oregon State University College of Forestry, USDA-FS PNW Research Station, and USDA-FS Region 3) provides overall direction at monthly meetings. Two groups of project advisors, one from Oregon and Washington and one from Arizona and New Mexico, connect the project goals, objectives, and products to state agencies, federal

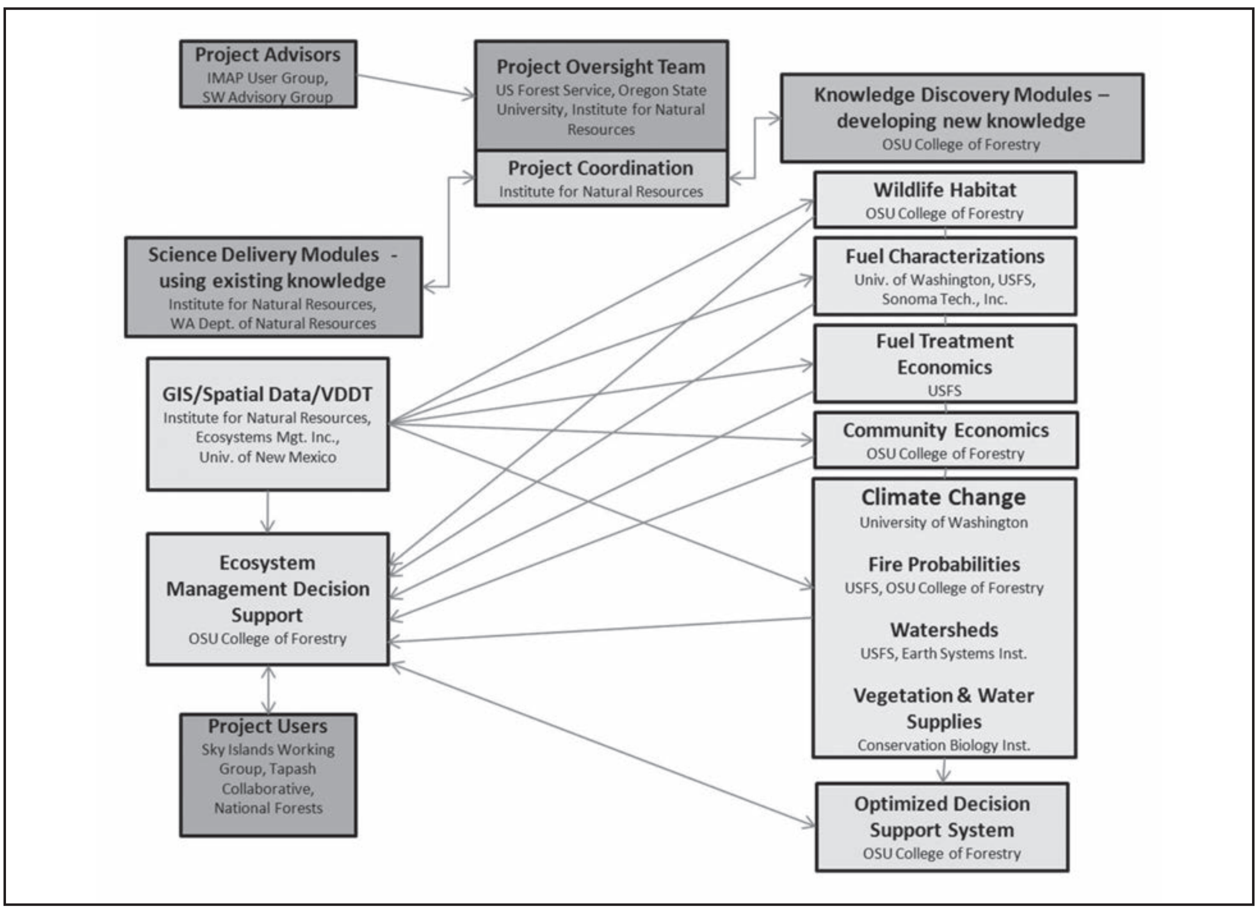

Figure 3—Organization of science delivery and knowledge discovery partners in the Integrated Landscape Assessment Project.

agencies, non-profit organizations, private contractors and industries, universities, and the interested public by providing comment, feedback, and review at twice-yearly working sessions. The project lead scientist and project coordinator oversee the technical and outreach aspects of project work. Science delivery, as a whole, is jointly led by scientists from the Institute for Natural Resources and the Washington Department of Natural Resources. Each science delivery module has a lead investigator and production team, as necessary. Knowledge discovery modules are led by several universities and nonprofit organizations and each module has a lead scientist and, as appropriate, a production team. User involvement is critical to establishing project priorities and developing useful products.

Science Delivery and Knowledge Discovery

The project is separated into two major components: science delivery and knowledge discovery. Science delivery teams generally work with *existing* methodologies to develop landscape-level information (primarily relating to vegetation conditions) while the knowledge discovery teams develop and apply *new* methodologies to develop, project, and integrate associated landscape-level information on wildlife habitat, fuel conditions, treatment economics, community impacts, and climate change impacts using STM simulation outputs. From a timing perspective, the science delivery teams produce the foundational data and model outputs that are then used by the knowledge discovery teams as inputs to their models and tools to enable a multidimensional approach to assess landscapes and inform management priorities for restoration over very large areas. The ILAP team is organized into 12 module teams: GIS, vegetation modeling, wildlife habitat, fire and fuels, fuel treatment economics, community economics, climate change and vegetation, climate change and watersheds, climate change and fire, EMDS decision support, optimized decision support, and data portal.

Science Delivery Modules

ILAP's science delivery modules include the Geographic Information System (GIS), State and Transition Modeling (STM), and Ecosystem Management Decision Support (EMDS) modules.

Geographic Information System Module

The GIS module provides spatial data to the other ILAP modules. These data include current and potential vegetation conditions, watershed boundaries, ownership categories, management activities, and others. The GIS team gathers data from various public and private sources, merges and appends it into seamless datasets, combines attribute data into consistent formats, creates detailed documentation, and provides data to the broader ILAP team and partners. Much effort focuses on standardizing datasets across administrative units and between modeling regions. Data is delivered in raster/grid and polygon formats. The GIS team uses a long-term data management process to facilitate the incorporation of any data updates or use of new and improved datasets, as well as maintenance of original datasets. GIS data on current and potential natural vegetation are developed by using imputation methods and geo-referenced plot data from various sources. Much of the plot data, especially for forested vegetation types, are from permanent inventory plots on federal lands, such as the Forest Inventory and Analysis (FIA) program (USDA FS 2012a). A significant plot gathering and database compilation effort in the Southwest is under sub-contract with Ecosystem Management, Inc. (EMI) and Natural Heritage New Mexico at the University of New Mexico. Local field offices of many federal agencies (USFS, NRCS, BLM, etc.) are visited to collect plot data. Often times, these plot data are not in a digital form or georeferenced, so efforts are made to select the highest priority data to digitize and compile. Existing or current vegetation and potential vegetation types (PVTs) are mapped using gradient nearest neighbor imputation (GNN; Ohmann and Gregory 2002) for forested vegetation and a combination of GNN and random forest nearest neighbor imputation (RFNN; Breiman et al. 2006) for arid lands, both of which rely on a combination of remotely sensed information and other geographic data. The resulting spatial data are 30 m grids that contain information on key attributes of existing vegetation and an assignment of potential vegetation types (PVT) in Oregon and Washington and potential natural vegetation types (PNVT; PVT for simplicity) in Arizona and New Mexico. The vegetation data cover all major vegetation types across all wildlands (forests, woodlands, shrublands, grasslands, and desert). Riparian areas, minor upland types, urban, agricultural and other developed areas are excluded.

State and Transition Modeling Module

The state and transition modeling (STM) module collects, assembles, and builds models for forest and arid land vegetation types. Using input datasets from the GIS module (existing vegetation cover and structure, potential vegetation, ownership and management data layers, and watershed boundaries), the STM module projects future landscape conditions for all major upland vegetation types using a "no management" scenario (no management other than continued wildfire suppression on all lands and continued grazing in arid lands) and for the landscape focus areas according to a few example alternative management scenarios.

ILAP builds on STMs currently used by various organizations for federal land management planning, restoration planning, and ecoregional assessments in the 4 state area and elsewhere (e.g., Forbis et al. 2006, Hann et al. 1997, Hemstrom et al. 2007, Holsinger et al. 2006, Merzenich and Frid 2005, Weisz et al. 2009). The STM approach treats vegetation as states, with each state defined as a combination of cover type and structural stage within potential vegetation types. Transitions among states represent natural disturbances, management actions, and vegetation growth and development. At present, STMs are implemented in the Vegetation Development Dynamics Tool (VDDT) (ESSA Technologies Ltd. 2012) and run using the Path Landscape Modeling Framework (Apex Resource Management Solutions Ltd. 2012). STMs are adapted from existing models available from the USDA Forest Service, Pacific Northwest and Southwest Regions, The Nature Conservancy, and LANDFIRE (LANDFIRE 2012). In some cases, STMs consistent with project methods are not available and new models are constructed using similar existing models as templates. STMs are developed for each PVT within each modeling region (fig. 4), resulting in 124 STMs for Oregon and Washington and 90 STMs for Arizona and New Mexico. Transitions are developed from a combination of expert opinion, available literature, and empirical data analysis (e.g., the Monitoring Trends in Burn Severity data—for wildfire probabilities; MTBS 2011). Transitions include all major natural disturbances, including wildfire (low, mixed, and high severity), insect outbreaks, wind disturbance, drought mortality, and others as appropriate to the ecological system being modeled, as well as a variety of management activities.

The 4-state area is stratified by combinations of land ownership, land allocation classes, and potential vegetation types within modeling regions. Fifth-code (Hydrologic Unit Code; HUC; USGS 2012) watersheds were used to further stratify results to improve spatial resolution. HUC boundaries within a modeling region do not affect ecological relationships in the models but allow modelers to better target management treatments to relatively small areas (e.g. 1000s of hectares). STM are run on each modeling region, PVT, land ownership/allocation, and HUC stratum. Alternative land management scenarios are generated by changing assumptions about vegetation management treatments and rates by modeling region, PVT, land ownership, land use allocation and HUC. Resulting forecasts of vegetation conditions, management activities, and natural disturbances are linked to wildlife habitat characteristics, economic values, and other important conditions (Barbour et al. 2007, Hemstrom et al. 2007, Reeves et al. 2006, Wales et al. 2007). In this fashion, model simulation results forecast potential future amounts and distributions of important landscape characteristics at the scale of modeled strata without implying pixel or stand-level accuracy.

Ecosystem Management Decision Support (EMDS) Module

The Ecosystem Management Decisions Support (EMDS) module integrates the separate factors of vegetation, fuels, wildlife habitat, and economic conditions into a combined, flexible assessment and prioritization process. Likely future trends are included in the prioritization process along with important ancillary data (e.g. wildland-urban interface boundaries, roads, key watershed delineation, etc.). The EMDS tool helps managers and others explore and set

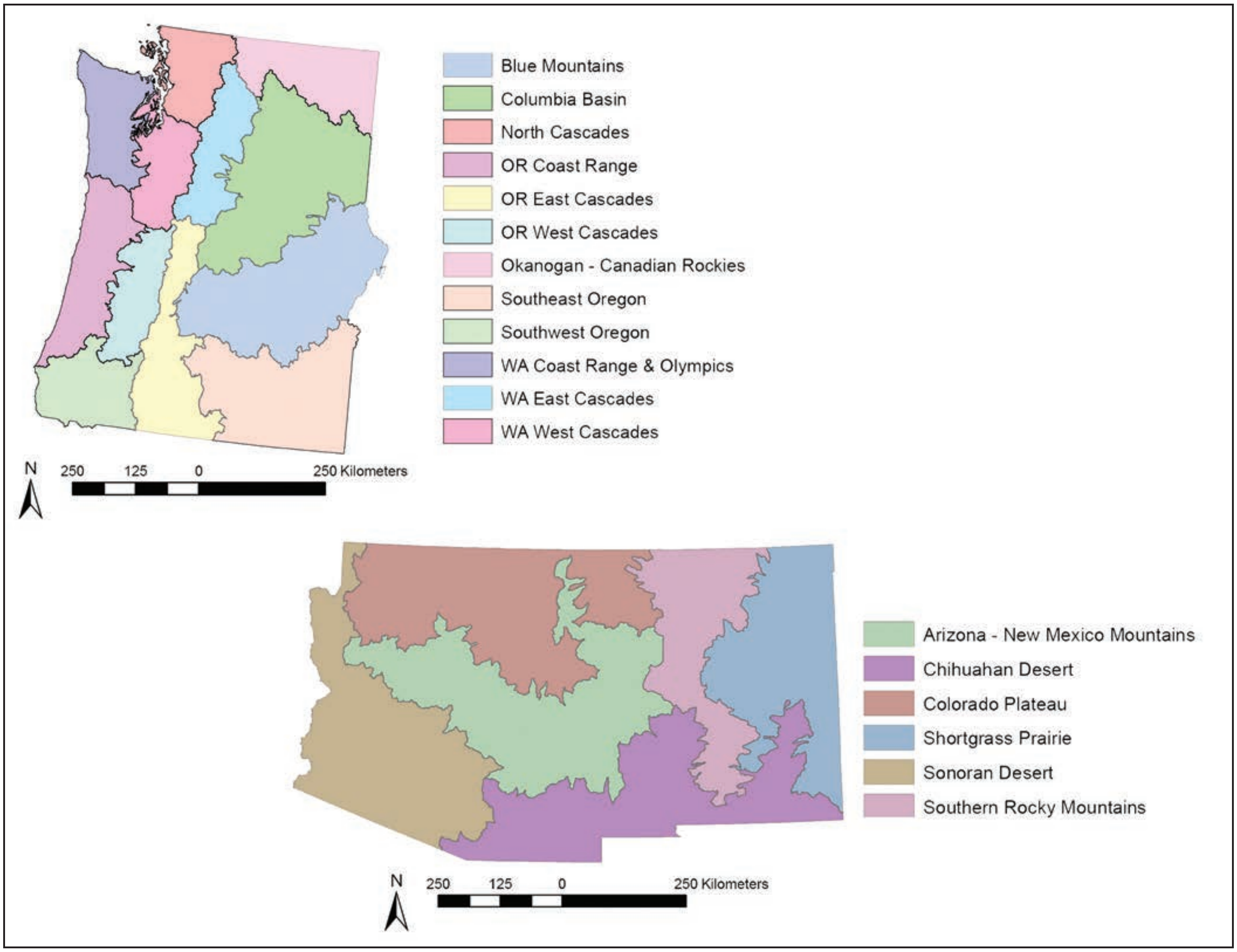

Figure 4—Modeling regions used in the Integrated Landscape Assessment Project.

priorities using maps, tables, and reports based on different combinations of characteristics that best reflect their values.

Knowledge Discovery Modules

ILAP's knowledge discovery modules include fire and fuel characterization, wildlife habitat, fuel treatment economics, community economics, climate change, and an optimized decision support system.

Fire and Fuel Characterization Module

The fire and fuel characterization module evaluates potential future fire hazard, focusing on how land management and natural disturbances might affect fuels and answering question such as: How do fuel characteristics vary across the four states? How might different forest management scenarios affect fuel conditions and fire hazard across landscapes? To what extent can fuel treatment programs reduce fire hazards over the long term? Fuel beds (descriptions of burnable biomass extending from the forest floor to the canopy) have been built for each vegetation state in forested STM using inventory and other plots classified into each state class. Resulting fuel beds allow users to assess current conditions and trends in fuels and potential fire behavior. Deliverable module products include: (1) characterized fuel properties from inventory plots, describing a range of conditions in each STM state class and (2) characterization of fire hazard for each land ownership and PVT stratum by watershed, including both qualitative characterization (fire potential on a scale of 0 to 9) and quantitative characterization (output such as simulated fire flame length, rate of spread, and crown fire potential). One application of this module's outputs is to assess the likelihood of crown fire given different management approaches.

Fuel Treatment Economics Module

The fuel treatment economics module assesses the financial feasibility of proposed forest vegetation management treatments. This module estimates potential supplies of timber and biomass (by diameter classes and tree species groups) and aboveground, tree-based carbon pools by STM state class for forested lands in Oregon and Washington. In addition, methods and data from this module allow users to conduct financial analyses that compare alternative vegetation treatment scenarios. Methods are tested by comparing a base "no management" scenario to a hypothetical restoration scenario in the central Washington landscape area. This example uses STM simulation outputs of removed products from proposed treatments over time to develop cost-benefit analyses. It considers harvesting cost associated with each treatment using a fuel reduction cost simulator (FRCS) (USDA FS 2012b), transportation cost to the desired mills, products prices, and other economic factors. Deliverable products include: (1) data and methods for examining available biomass and timber across all forested lands in Oregon and Washington, (2) methods and data for examining potential timber and biomass removals associated with a wide variety of alternative management scenarios for forested lands in Oregon and Washington, and (3) an example analysis of economic attribute trends and variability for a no management and an alternative restoration management scenario in the central Washington landscape area, and (4) documentation of modeling methods and results. The outputs of this module can help land managers and others evaluate prospective areas for timber and forest product extraction and assess watersheds where forest management treatments may have the largest economic potential in terms of revenue and jobs for communities or where those products may help offset the costs of management treatments.

Wildlife Habitats Module

The wildlife habitat module generates look-up tables for STM state classes to estimate potential habitat area for more than 50 species and habitats in Arizona, New Mexico, Oregon, and Washington. The module develops databases that allow users to derive aggregate area of vegetation composition for each modeling region, PVT, ownership-land allocation, and watershed stratum and match this information to species-habitat relationships to determine potential aggregate habitat area within each stratum. Deliverable products include: (1) a list of focal species-habitat relationships (Oregon and Washington) or habitats of interest (Arizona and New Mexico), (2) example generation of wildlife habitat analyses based on STM outputs for a no-management scenario and a restoration management scenario in the central Washington landscape area, and (3) written documentation of methods, results, and findings. The outputs of this module provide land managers and planners with an ability to evaluate how specific habitats may be impacted by various land management decisions and proposed policies across modeled lands in the 4-state area.

Community Economics Module

The community economics module addresses the question of to what degree can large-scale forest vegetation treatment programs support economic activity and contribute to well-being in communities that have been negatively impacted by recent federal forest policy changes. Essentially, this module asks: How would priorities for fuel treatment areas be affected by including community well-being as a criterion for treatment prioritization, along with fire hazard reduction and wildlife habitat quality? Communities are assigned an "Impact Score" based on their level of socio-economic distress, their ability to utilize harvested forest materials, and whether they have been impacted by changes in federal forest policy, such as the Northwest Forest Plan. One application of this module's output is to help describe the potential for fuel treatments to produce economic benefits to nearby communities for the forested landscapes in Arizona, New Mexico, Oregon, and Washington.

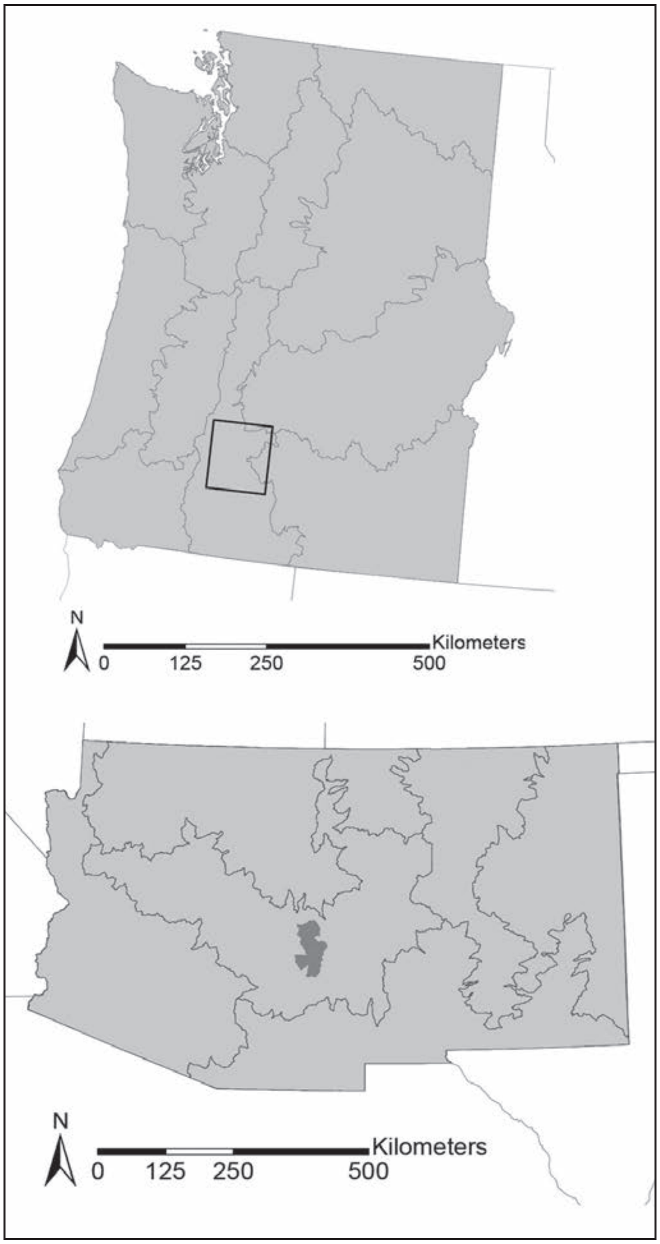

Figure 5—The central Oregon and eastern Arizona climate change prototype area within the Integrated Landscape Assessment Project.

Climate Change

The three ILAP climate change modules address potential climate change impacts on vegetation, watershed conditions, and fire probabilities. Together, these modules evaluate potential future effects that climate change might have on: (1) mid- to broad-scale vegetation conditions and wildfire regimes, (2) hydrology at the watershed scale, and (3) local, stand-scale vegetation and wildfire interactions.

Climate change and vegetation module—
The climate change and vegetation module provides estimates of potential future climate change on major vegetation types and wildfire conditions in study areas in central Oregon and eastern Arizona (fig. 5). In normal usage, the areal extent of potential vegetation types and associated STM remain constant over time (Kerns et al. 2012). In the future, however, climate change is expected to alter the mix and distribution of PVTs. This module builds "mega-models" in which many individual STMs are combined. Landscape area can move among PVTs over time as a function of changes in climatic conditions and wildfire. The module gathers vegetation change and wildfire trend data from simulations of three global climate model and emissions scenarios (MIROC-A2, CSIRO-A2, and Hadley-A2) run with the MC1 dynamic vegetation model (Bachelet et al. 2001). That information is used to build new transitions that cross PVT boundaries in response to vegetation and wildfire trends from MC1 (fig. 6). Potential future wildfire trends under different climate change scenarios are also included under the assumption that wildfire will be a major contributor to climate change effects. The resulting models will allow users to answer questions such as: How might the forests and arid lands in the study areas change in the future given the three different climate scenarios? What kinds of management activities might exacerbate climate change effects on vegetation conditions, natural disturbances, and associated resource values? Conversely, are there suites of management activities that might foster relatively resilient vegetation communities? Module products will include a set of "climatized" STMs for the two study areas, simulations of the three climate scenarios at 4 km grid scale for all of the modeling regions in the four state area, GIS tools to extract hydrography and other data from dynamic global vegetation model output, and methods that can be used to construct similar models in other areas.

Climate change and watersheds module—
The climate change and watersheds module applies and enhances the NetMap system (Earth Systems Institute

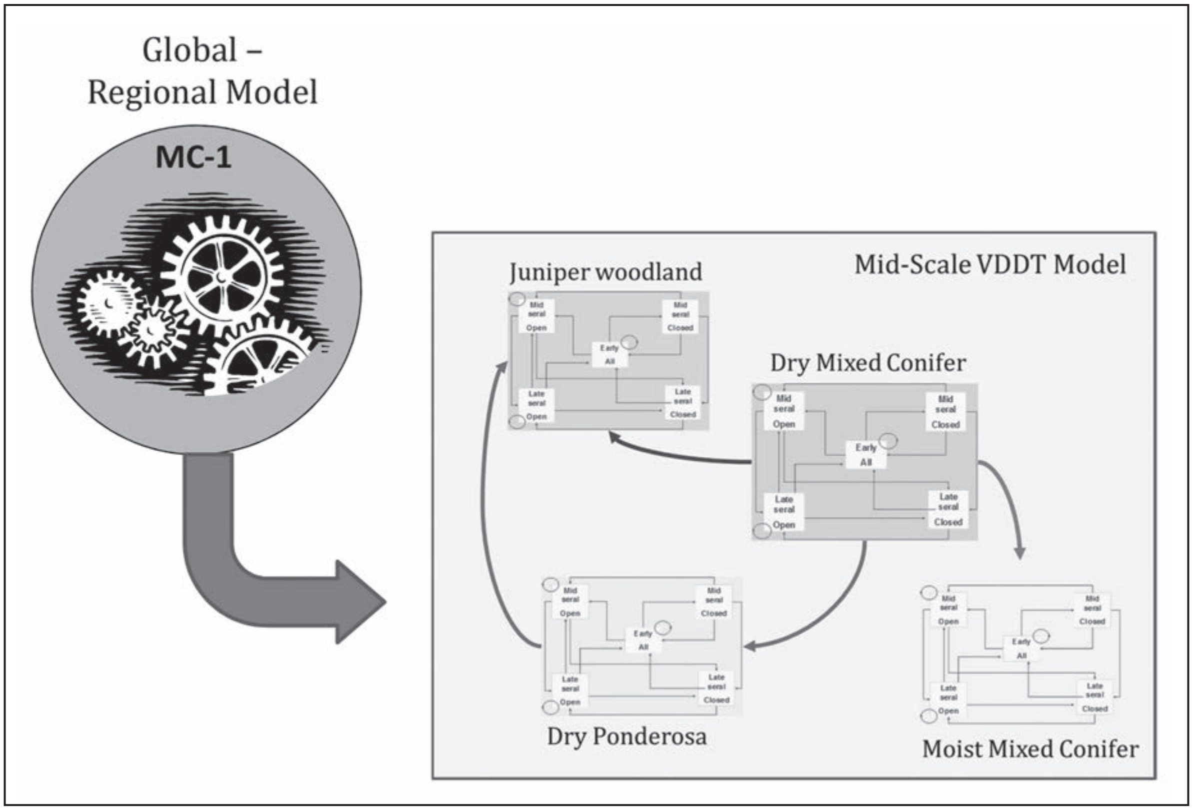

Figure 6—Conceptual process for connecting a Dynamic Global Vegetation Model (MC1) to STM.

2012) to generate estimates of erosion hazards, in-channel habitat conditions, and other important watershed characteristics for all 5th code hydrologic unit (U.S. Geological Survey 2012) watersheds that contain national forest lands in Oregon and Washington. Based on a computer model of stream systems, different inputs such as bank slope and sediment erosion potential are used to create maps of priority restoration areas. It also provides estimates of potential future changes in watershed condition under climate change by analyzing the likely effects of changes in precipitation amount and seasonality along with changes to wildfire and vegetation conditions that might result from alternative climate change scenarios. NetMap is free downloadable software that can be overlaid on Google Earth to help managers identify areas where changes are most likely, and where restoration activities may be most effective.

Climate change and fire probabilities module— The climate change and fire probabilities module provides refined insight at the stand scale into the variation of wildfire probabilities and vegetation dynamics with climate change in a prototype area of the upper Deschutes sub-basin in Oregon. This module uses the FireBGCv2 computer model (USDA FS 2012c) to generate data and maps of fire ignition, spread, frequency and severity and the resulting shifts in vegetation arrangement and distribution. In the future, results from the FireBGCv2 and similar models will help to inform STMs by characterizing vegetation change and altered fire regimes under a range of potential climate change conditions.

Optimized Decision Support Module

The optimized decision support module integrates fuels, wildlife habitat, and economic conditions into a spatially-based analytical decision support process. Input criteria, such as preserving habitat for a particular wildlife species, generating revenue from forest products, or encouraging desirable future forest conditions will be variously weighted in the optimization process. The analysis procedure is

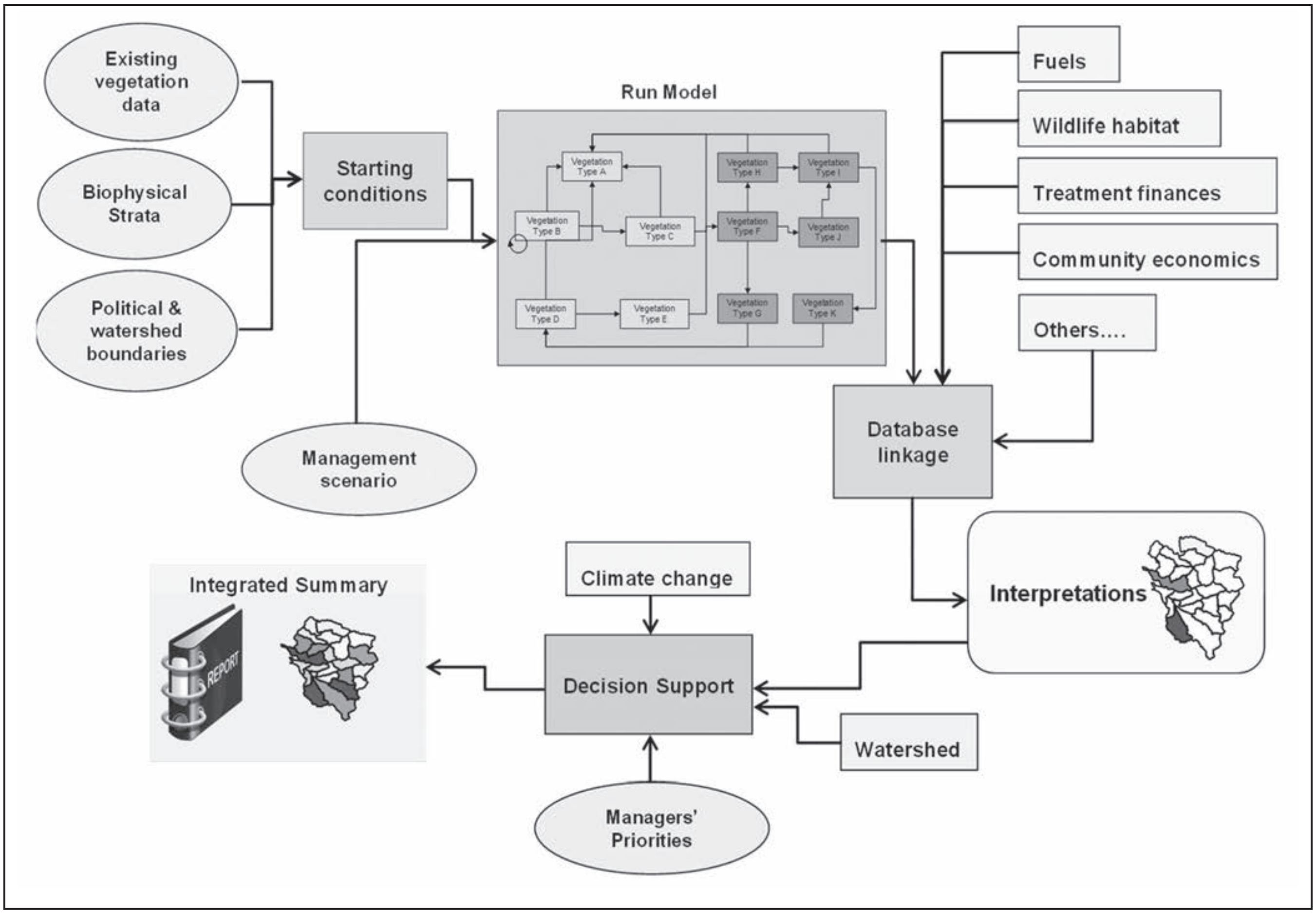

Figure 7—Process flow for landscape analysis and prioritization in the Integrated Landscape Assessment Project.

computationally intensive and often limits the size of the landscapes that can be analyzed using optimization methods. This module will explore the geographic limits of optimization methods and provide a spatial representation of the integrated landscape components.

Forecasting Future Conditions Process

While many users are satisfied w ith information on current landscape conditions contained in various ILAP data sets, ILAP STM can be used for examining likely future outcomes of alternative management strategies. For example, land management planners may use STM to see if a proposed set of management activities are likely to produce desired conditions. Alternatively, resource managers can use a gaming approach to generate management approaches that provide an acceptable mix of natural resource conditions and values. This scenario forecasting process requires several steps (fig. 7).

- Assemble base data needed to run state and transition models. This involves aggregating and cross-walking existing vegetation, potential vegetation types, watershed boundary, and land ownership/allocation data into the strata used for modeling. Cross-walking and aggregation are not trivial tasks given the potential variety of data that may be useful. Aggregation of finer-scale grid or polygon data to coarser modeling strata reduces spatial detail, but often improves data compatibility. Spatial detail is critically dependent on the scale and accuracy of input data. It is important to understand the limitations of input data.

- Generate management scenarios. Users are consulted about the issues with which they are most concerned. Most often, this process results in a series of natural resource management and socioeconomic questions that relate to one another. These questions must be translated into assumptions about vegetation management treatment types and rates, differences among the vegetation and management objectives of different land owners and on different land allocations, and the kinds of resulting landscape conditions of interest. The combination of assumptions and desired products is a management scenario. Developing a management scenario is not a trivial step and often takes several in-depth discussions with users to clarify their intent and interests.
- Run STM simulations for many decades or longer with management scenarios of interest. ILAP typically runs models for 50 to 100 years or more. Simulations usually include 30 Monte Carlo sequences of randomly drawn wildfire years and insect outbreaks as well as the prescribed management activities.
- Analyze model output and link to interpretations of fuel conditions, wildlife habitat, economic values, and other forecast landscape characteristics. The modeling process generates output by year, state class, and transition. In essence, every state class and every transition is output for every year. Output data are linked by look-up tables to the combinations of state classes (area by year by model stratum) and transitions (area by year by model stratum) that are interpretations of key wildlife habitats, fuel conditions, economic values, and other landscape characteristics.
- Integrate and prioritize. Separate analyses of fuels, wildlife habitats, and economics provide useful information for examining mid- and broad-scale trends, but the real power of the project comes through integrating these separate factors into a combined, flexible prioritization process. ILAP uses decisions support systems to help managers and others interact with combinations of characteristics that best answer their particular questions. Outputs are maps, tables, databases, and reports.
- Product delivery. ILAP products range from relatively simple geographic and other data sets to integrated landscape analyses, to white papers and science journal articles. ILAP products are accessible from the Western Landscapes Explorer portal (INR and OSU Libraries 2012). Most basic geographic data and many landscape analysis reports will be freely available. Some data sets and analyses may be available for only limited distribution if they contain data that users deem sensitive.

Conclusion

ILAP creates a variety of analytical and graphical tools that will help land managers and planners integrate and prioritize management activities. The project's publications, models, maps, data, and tools will be available online and archived so that scientists and managers in years to come will be able to use and build on the project's products. The project will also create a web-enabled decision support system if time and resources permit. Land managers, planners, analysts, scientists, policymakers, and large-area landowners can use the project's tools and information for many applications including, but not limited to:

- Watershed restoration strategies
- Land management planning
- Statewide assessments and bioregional plans
- National forest plan revisions

ILAP data and models are currently in use by the Okanogan-Wenatchee and Colville National Forests to support current forest plan revisions. Forest planning analysts are running the ILAP models with help from the ILAP team and the Forest Service regional planning analyst. Other national forests in the Pacific Northwest (Deschutes, Ochoco, and Fremont-Winema) are using the ILAP data and models to support wildlife species viability analyses. National forests in the southwest are using local versions of ILAP models for forest plan revisions. Several other USDA Forest Service regions use STMs for land management planning and assessments and those regions could be easily included in ILAP. Remaining Forest Service regions may not have STMs except for LANDFIRE models, but more detailed STMs suitable for planning and assessments could be developed rather quickly. In addition, the USDA Natural Resources Conservation Service and USDI Bureau of Land Management often use STMs in ecological site descriptions. The ILAP process could be applied to natural resource management issues in any ecological system as long as that system can be described in state and transition terms.

As the first phase of ILAP concludes, a strong foundation of landscape-level data, STMs, tools and expertise has been built that can be efficiently applied to other landscapes in the West. The goal is to have complete Western coverage of ILAP data and STMs to support regional and statewide issues of importance by groups such as the Western Governors' Association, Western Forestry Leadership Coalition, and Landscape Conservation Cooperatives.

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