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## DIGITAL PHOTO SERIES (Natural Fuels Photo Series)

Clinton S. Wright

USDA Forest Service, [cwright@fs.fed.us](mailto:cwright@fs.fed.us)

Robert E. Vilnacek

USDA Forest Service, [bvihnanek@fs.fed.us](mailto:bvihnanek@fs.fed.us)

Roger D. Ottmar

USDA Forest Service, [rottmar@fs.fed.us](mailto:rottmar@fs.fed.us)

Paige C. Eagle

University of Washington, [pceagle@u.washington.edu](mailto:pceagle@u.washington.edu)

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## DIGITAL PHOTO SERIES

Final Report to the Joint Fire Science Program

Project Number: 04-4-1-02

August 31, 2007

### PRINCIPAL INVESTIGATORS:

*Clinton S. Wright, Robert E. Vihnanek and Roger D. Ottmar*  
USDA Forest Service, Pacific Northwest Research Station  
Fire and Environmental Research Applications (FERA) team\*

### WEB, SOFTWARE AND DATABASE PROGRAMMER:

*Paige C. Eagle*  
University of Washington, College of Forest Resources\*

\*Pacific Wildland Fire Sciences Laboratory  
400 North 34<sup>th</sup> Street, Suite 201, Seattle, WA 98103  
Telephone: (206) 732-7800 Facsimile: (206) 732-7801  
E-mail: [cwright@fs.fed.us](mailto:cwright@fs.fed.us), [bvihnanek@fs.fed.us](mailto:bvihnanek@fs.fed.us),  
[rottmar@fs.fed.us](mailto:rottmar@fs.fed.us), [pceagle@u.washington.edu](mailto:pceagle@u.washington.edu)

### WEBSITE:

<http://depts.washington.edu/nwfire/dps>

### COOPERATORS:

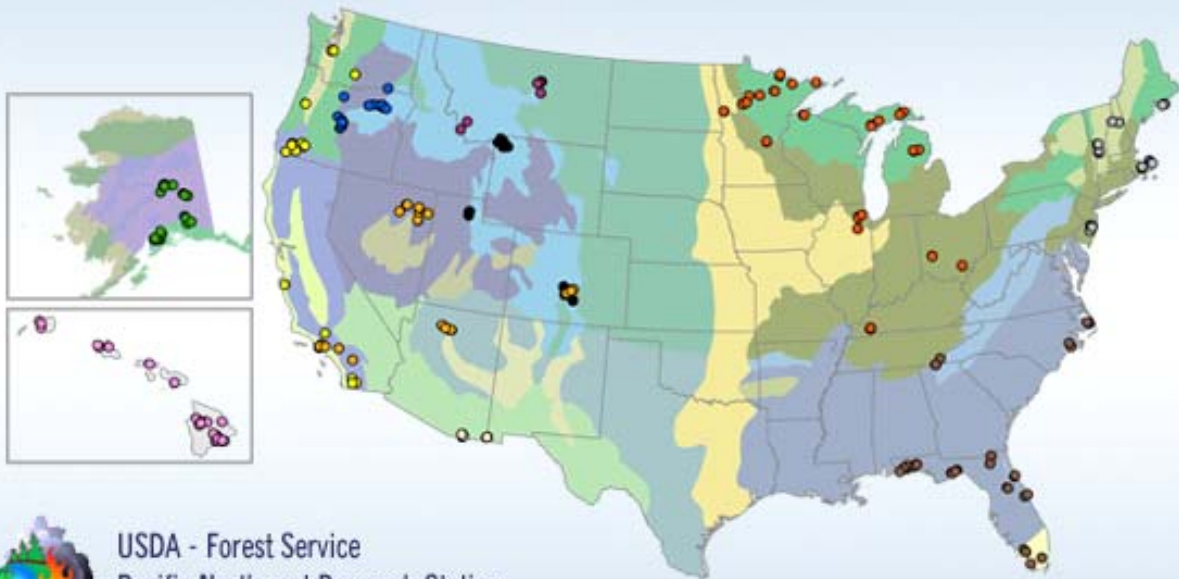
University of Washington

### PROJECT SUMMARY:

The Digital Photo Series (DPS) is a web-based application that provides access to the Natural Fuels Photo Series database and photographs. The DPS works through a user's internet browser, but has also been designed to work as a stand-alone application when the computer is disconnected from the internet. A user-friendly interface allows users to browse, query, and download photo series data and high-quality photographs. The Digital Photo Series is intended to complement, not replace, the printed photo series volumes.



# Digital Photo Series



USDA - Forest Service  
Pacific Northwest Research Station  
**FERA** Pacific Wildland Fire Sciences Laboratory  
Fire and Environmental Research Applications Team  
400 N 34th Street, Suite 201 • Seattle, WA 98103 • 206.732.7800



## BACKGROUND:

Photo series provide quick and easy ways for managers to quantify and describe existing fuel and vegetation properties, such as loading of dead and down woody material, tree density, or height of understory vegetation. This information is critical for making fuel management decisions and for predicting fire behavior and fire effects. The Digital Photo Series is a user-friendly, web-based project that provides the Natural Fuels Photo Series data and images in electronic form. It includes data from all 14 volumes published to date, with 37 photo series containing a total of 398 sites in database form. System architecture enables searching, downloading, customized site generation, and side-by-side comparisons. The DPS builds on the published volumes both in content and presentation. In many cases, more information has been added than was originally published (e.g., land owner and Bailey's ecoregion), in others, data have been rearranged and terminology (e.g., field names, table headings) altered to standardize among the sites. Photo series sites can be navigated using 1) the site search page, where a user can specify geographic and ecological criteria to locate sites of interest; 2) the site

browser page, where a user can browse the photo series using an expandable navigation tree with all 398 sites organized by volume; and 3) the custom site builder page, where a user can combine data tables to create their own sites. The DPS provides added functionality for fire and fuels planners and scientists by enabling querying, report generation, and output formatted for use with other fire management tools and software. The DPS enables easier and more effective use of the comprehensive fuels data sets available for numerous ecosystems (which in the future could potentially include older, more difficult-to-find, and out-of-print-photo series) for strategic planning and analysis, and for improved implementation of field projects. The DPS has the ability to grow to include new photo series, fuels data accompanied by photographic documentation, as well as older, more difficult-to-find, and out-of-print photo series, and to evolve as the priorities and needs of fire and fuels managers change.

### The Natural Fuels Photo Series

Accurate, complete fuels data are critical for all fire management planning and implementation. Fuels data are often lacking or difficult to obtain for many areas or ecosystems. With assistance from the Joint Fire Science Program (JFSP) and others, the Fire and Environmental Research Applications (FERA) team, located at the Pacific Wildland Fire Sciences Laboratory, in Seattle, Washington, developed the Natural Fuels Photo Series to address this critical need for high quality fuels information. Photo series are useful tools for quickly and inexpensively evaluating vegetation and fuel conditions in the field. The Natural Fuels Photo Series is a collection of geo-referenced data and photographs that collectively display a range of natural conditions and fuel loadings in a wide variety of forest-, shrub-, and grass-dominated ecosystem types.

The Natural Fuels Photo Series builds on a well-established tradition and methodology (e.g., Blank 1982; Blonski and Shramel 1981; Koski and Fisher 1979; Fisher 1981; Maxwell and Ward 1979, 1980a, 1980b; Ottmar and Hardy 1989a, 1989b; Reeves 1988, etc.). It is a popular and valuable tool with a large, diverse user base. Photo series are currently available for a wide range of ecosystem types nationwide. While primarily intended as a fuel inventory resource for fire managers and practitioners, the photo series can also be used to ecologically assess landscapes through appraisal of living and dead woody material and vegetation biomass and stand characteristics. Once an inventory has been completed, stand treatment options such as prescribed fire or harvesting can be planned and implemented to better achieve desired effects while minimizing negative impacts on other resources. The Natural Fuels Photo Series is useful in several branches of natural resource science and management: inventory data such as these can be used as inputs for evaluating animal and insect habitat, nutrient cycling, and microclimate. Fire managers can use these data for predicting fuel consumption, smoke production, fire behavior, and fire effects during wildfires and prescribed fires. Additionally, the photo series can be used to estimate carbon sequestration, an important factor in predictions of future climate, and to link remotely sensed imagery to live and dead fuels on the ground. The Natural Fuels Photo Series continues to evolve and grow as land managers, researchers, and policy-makers identify ecosystems for which vegetation and fuel inventory data are needed.

At present, 14 Natural Fuels Photo Series volumes have been published (Table 1); an additional volume to estimate post-hurricane fuels in southeastern US forest types is under development. Each volume documents a range of fuel conditions in 1-4 ecosystems, with detailed summary data and high-resolution photographs (stereo, wide-angle, and standard view). Each site includes inventory data summarizing vegetation composition, structure, and loading; woody material loading; density by size class, forest floor depth, and loading; and various site characteristics. The FERA team is the custodian of the raw and processed data, manuscript proofs, and photographic media that have been used to produce the Natural Fuels Photo Series books. Close familiarity allowed FERA to extract the maximum benefit from these data sets and materials during the development of the Digital Photo Series, the electronic complement to the Natural Fuels Photo Series books.

**Table 1.** Natural Fuels Photo Series developed by FERA (see References section for full citations).

<b>Volume</b>	<b>Region</b>	<b>Ecosystem Types</b>
I	Pacific Northwest	Mixed-conifer, western juniper, sagebrush, grass
II	Alaska	Black and white spruce
Ila	Alaska	Hardwoods with spruce
III	Rocky Mountains	Lodgepole pine, quaking aspen, Gambel oak
IV	Southwest	Pinyon-juniper, sagebrush, chaparral
V	Central & Lake States	Red & white pine, northern tallgrass prairie, mixed oak
Va	Lake States	Jack pine
VI	Southeast	Longleaf pine, pocosin, marshgrass
VIa	Southeast	Sand hill, sand pine scrub, hardwood with white pine
VII	West Coast	White oak, deciduous oak, mixed-conifer with shrubs
VIII	Northeast	Hardwoods, pitch pine, red spruce/balsam fir
IX	Southwest	Oak-juniper woodlands and savannahs
X	Montana	Sagebrush with grass, ponderosa pine-juniper
Hawaii	Hawaii	Grassland, shrubland, woodland, forest

### The Digital Photo Series

The Natural Fuels Photo Series was originally designed as a field-based inventory tool in book form. At the time of its inception (mid-1990's), conventional printing was the most effective way to present the images and data of the Natural Fuels Photo Series in a concise, economical, user-friendly package. Changes in software, hardware and network technology, and development of new fire- and natural resource-based software applications that require fuel and stand information as inputs, highlighted the need to enhance the data and utility of the Natural Fuels Photo Series by making it available in an electronic format. Furthermore, fire and fuels management require more and better fuel and vegetation data, like those included in the Natural Fuels Photo Series, to effectively plan treatments, including prescribed fire and mechanical fuels treatment.

The objective of the Digital Photo Series (DPS) project was to develop both an online and stand-alone software application that would access a geo-referenced database containing the images and data published in the Natural Fuels Photo Series, as well as additional data that were collected but not included in the space-constrained book versions. Making the Natural Fuels Photo Series data available in digital form provides added functionalities such as the ability to query and browse data and images across series and volumes, the ability to compare the fuels on sites side-by-side, and the ability to build and save custom fuelbeds. Data from the DPS also has the potential to interface with existing and future fire and fuel-management software packages (e.g., Fuel Characteristic Classification System, Behave, FOFEM, Consume 3.0, etc.). Additionally, providing the Natural Fuels Photo Series data through an online database allows the flexibility to update the database as new data become available (i.e., as new photo series are developed). Development of the DPS was intended to complement, not replace, the paper and ink versions available now and in the future; its primary goal was to be a tool to more easily and effectively use the comprehensive data sets available for numerous ecosystems for strategic planning and analysis, and for implementation of field projects.

#### **MATERIALS AND METHODS:**

Development of the DPS occurred in four overlapping phases. Phase 1 included system design and engineering. Phase 2 included data entry and compilation, as well as photo compilation and scanning. Phase 3 included software programming and initial testing. Phase 4 is still in progress, and includes application testing, distribution and technology transfer.

##### Phase 1 – system design and engineering

Users of the book-form Natural Fuels Photo Series were surveyed to determine what additional features they were interested in seeing in the DPS. Input from the wider user community was also solicited to insure that the interface design and output specifications met the preferences and technology requirements of fire and fuels managers and planners, particularly those employed by federal land management agencies. This process was carried out through the distribution of a questionnaire (see Appendices 1 and 2) and informal discussions with interested parties. Discussions with in-house, contract, and national-level Forest Service software programmers and web developers informed decisions regarding system architecture and application functionality.

##### Phase 2 – data entry and compilation

Natural Fuels Photo Series data were stored in various electronic formats in the FERA archive. Some of these data required re-coding and analysis to extract their full value for the DPS. Data collected from 398 sites were standardized and consolidated into a relational database. Film images (positive and negative transparencies) for the wide-angle photos were scanned into digital format. Small- and medium-sized thumbnails (15-30 KB each) and high resolution (250-500 KB each) digital images are available online; very high resolution (25-30 MB each) digital images are available upon request. Refinements of this database will continue, and additional data elements not included in print are being added. Several projects, including LANDFIRE, FFE-FVS, and FIRETEC, have requested and been supplied this database.

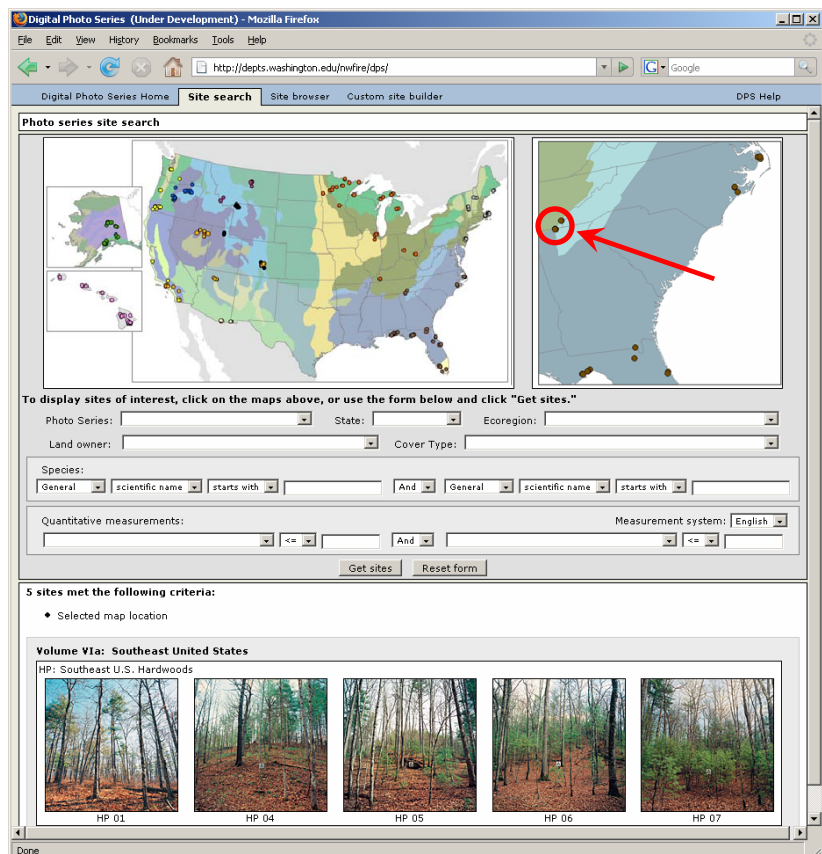
### Phase 3 – software programming and initial testing

The DPS application consists of a user-friendly web interface that can be accessed using a web browser (such as Internet Explorer or Mozilla Firefox), either through the internet (<http://depts.washington.edu/nwfire/dps/>) or from an individual computer's hard drive. A series of web pages provide access to the database, which is currently located on a University of Washington web server. The web pages were developed using a combination of HTML, JavaScript, CSS, and PHP with help from the Smarty® template engine and require a web browser connected to a server that can resolve PHP scripts. The DPS application was tested on both Windows and Macintosh computers and on both Mozilla® Firefox 1.0 and 2.0 and Microsoft® Internet Explorer 6.0 and 7.0.

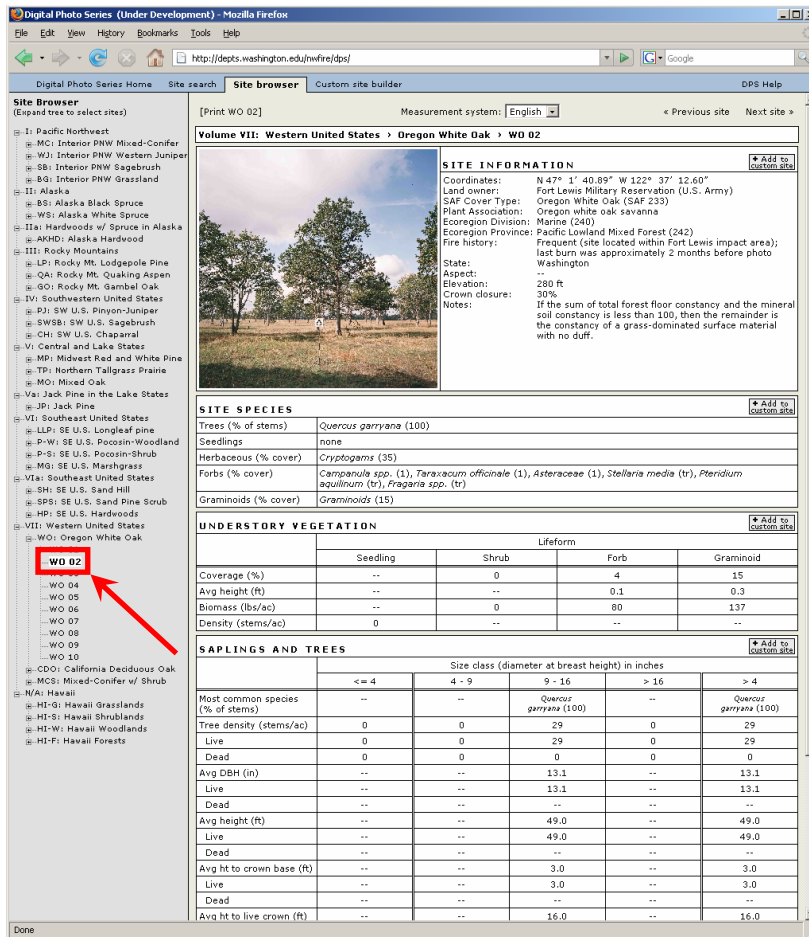
In the absence of a web connection, a stand-alone version of the DPS (utilizing the portable MicroWeb® web server) can be used to run the site from a local computer hard drive. At present, an approximately 300 MB self-executing zip file can be sent to users upon request, and soon the file will be downloadable from the FERA website. After installing the stand-alone version of the DPS, the user can start the application and open the DPS home page with their default web browser. The stand-alone version functions identically to the web-based version by utilizing the user's web browser and micro server software (MicroWeb®) to mimic an internet connection.

Creating an application that functions the same whether on or off-line eliminates the need for users to learn more than one program.

The DPS interface is organized into tabbed pages, allowing a user to navigate to photo series sites in a variety of ways. A user can navigate to a site using the "Site search" page (Figure 1) by selecting specific geographic criteria (e.g., clicking on a map, or selecting state, Bailey's ecoregion, and/or land owner) and/or ecological criteria (e.g., cover type, species, and structural attributes). Alternatively, a user can navigate the photo series using an expandable



**Figure 1.** Site search interface for the DPS. In this example, search results generated by clicking the circled cluster of points are shown below the search form. Users can also search by specific geographic (e.g., state, Bailey's ecoregion, and land owner) and/or ecological criteria (e.g., cover type, species, and structural attributes).



**Figure 2.** Site browser interface for the DPS. Selecting a site from the navigation tree, as indicated by the highlighted box, loads the data and photograph for a photo series site. All 398 sites are organized by volume in the navigation tree.

terminology (e.g., field names, table headings) altered to standardize among the sites. At present the DPS only offers wide-angle photos for each site; we are hopeful that technological advances in coming years will reach the mainstream and allow users to view stereoscopic images on a computer screen. The DPS also offers a choice of measurement system; it defaults to English units, however, users can toggle between English and metric units. The DPS provides added functionality for fire and fuels planners and scientists by providing downloadable data for each photo series and high resolution images for each site. Development activities are ongoing that will enable users to generate output formatted to interface with other fire management tools and software that require fuels data as inputs (e.g., FCCS, CONSUME, BehavePlus, etc.).

#### Phase 4 – testing, distribution and technology transfer

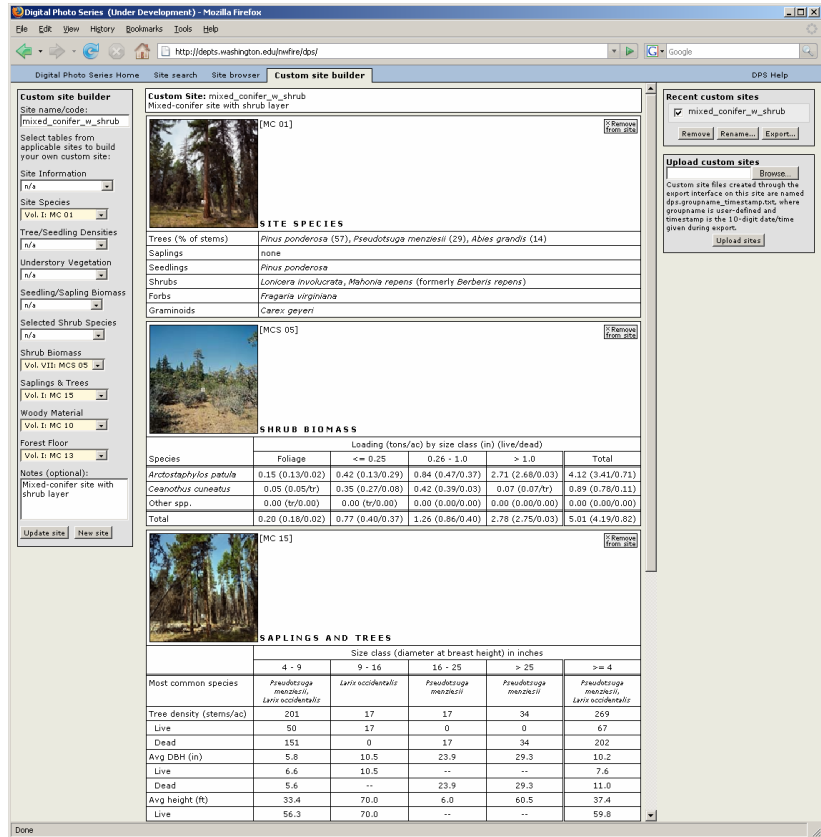
Testing was performed in-house by users with a range of experience both with the photo series and software development. Participants in the various workshops at which the DPS was demonstrated and taught also served as an informal testing community. Workshop

navigation tree that includes all 398 sites organized by volume using the “Site browser” page (Figure 2). Additionally, a user can create a custom site using the “Custom site builder” page (Figure 3). Data tables can be combined to create custom sites with data that are more representative of a specific land management unit, or a desired management state. Custom sites can be saved and shared between DPS users. Finally, a “DPS Help” page can be accessed by selecting the tab on the far right of the DPS screen.

The DPS diverges slightly from the published volumes both in content and presentation. In many cases more information was added than was originally published (e.g., land owner and Bailey's ecoregion), in others, data were rearranged and



participants provided feedback in terms of application content and functionality as well as supplying a wide variety of test platforms (i.e., different computer and operating system setups). All of the documentation included in the printed Natural Fuels Photo Series volumes is available in the DPS. In addition, documentation for the DPS application can be found on the "DPS Help" page. The "Digital Photo Series Home" page provides a brief description of the DPS. The "DPS Help" page includes a more detailed introduction and also a description of the differences between the DPS and published photo series volumes, computer system requirements, instructions for navigating the DPS (including the site search, site browser and custom site builder tabs) and using its functionality (e.g., download and interpret data files, view larger photographs, etc.), and an explanation of how to run the MicroWeb® edition of DPS.



**Figure 3.** Custom site builder interface for the DPS. Selecting sites from the drop down boxes loads the data and photograph for multiple photo series sites. Custom sites can be saved and shared with other users.

The primary technology transfer mechanisms for the DPS are the web-based application and the stand-alone application (see Tables 2 and 3). At present, the stand-alone application is available through the mail on CD-ROM for users that lack internet connectivity. It will be made available for download from the DPS and FERA websites; updates will be made available online. Discussions are ongoing with the Fire Research and Management Exchange (FRAMES) group at the University of Idaho to add the DPS to the FRAMES website. Other technology transfer activities include demonstrations of the DPS application at 13 workshops and 2 science delivery discussions, a posting and fact sheet on FIREHouse (June 2005), a JFSP highlight (September 2005), and distribution of the DPS database to the FIRETEC, LANDFIRE, and FFE-FVS projects. An online seminar will be offered during Fall 2007 (once the fire season has slowed); additional web seminars may be offered if interest is high. A short section addressing the DPS is already incorporated into the existing Natural Fuels Photo Series online tutorial (available for download

from: <http://www.fs.fed.us/pnw/fera/research/tutorials/photoseries.shtml>); additional content will be added to address the DPS in greater detail.

### **Benefits of the Digital Photo Series:**

The DPS leverages the very detailed and expansive data set developed during the course of the various phases of the Natural Fuels Photo Series (phases II and III were funded by the JFSP). As with the book version, data characterizing all of the vegetation and fuels (not just the down woody and surface fuels) in an ecosystem is viewable from the application interface, and available as printed or saved reports. In addition to the data published in the bound volumes, the DPS includes data that were collected but not printed due to publication limitations. The DPS also allows users the choice to view the data either in English or metric units (the book versions were published using English units). Users are able to draw on data and high quality images from all published volumes simultaneously. The DPS combines data from a large number of sites and ecosystems (i.e., individual photo series site data) in a single repository, allowing managers and planners to compare and query data from a variety ecosystems and locations to examine similarities and differences. The ability to query across locations and ecosystems allows users familiar with one fuel type to compare with other types with which they may be less familiar.

The DPS is intended to complement, not replace, the paper and ink versions available now and in the future. Published volumes are more appropriate for use in a field setting and can be used with a stereoscope for a three-dimensional view of photo series sites.

### **The Future of the Digital Photo Series:**

The DPS has been designed to accept new photo series as they are developed, allowing it to grow and evolve as more data become available. Future versions may incorporate data from other published photo series or fuels inventories that are accompanied by photographic documentation. The system design and interface are robust and can readily accept new data as appropriate. The current interface allows users to browse, query and download photo series data and photographs and to generate customized sites. Additional features will be developed with input and ideas from current and future users of the DPS, as well as current users of the Natural Fuels Photo Series books and fire and fuels planners, managers and scientists.

### **Science Delivery and Application:**

This project was funded specifically to develop a digital interface for the Natural Fuels Photo Series. The DPS web application and stand-alone software are the primary deliverable products for this project (Table 2). A short article suitable for *Fire Management Today* is also being drafted to make the existence of the DPS more widely known among the fire management community. The relational database containing the Natural Fuels Photo Series data is an intermediate product that has been shared with fire and fuel scientists. Digital Photo Series demonstrations and other science delivery activities are listed in Table 3.

**Table 2.** Proposed and actual project deliverables.

<b>Proposed</b>	<b>Delivered</b>	<b>Status</b>
DPS application	The DPS application can be accessed at the following website: <a href="http://depts.washington.edu/nwfire/dps">http://depts.washington.edu/nwfire/dps</a> . The DPS provides access to the Natural Fuels Photo Series data and images in electronic form and provides added functionality such as browsing, querying, report generation, and downloadable data. Access to the DPS is through a web browser and internet connection. If not in a network setting (e.g., in the field or at fire camp), a stand-alone version of the DPS is available.	Done
DPS database*	Microsoft® Access database including all data from the Natural Fuels Photo Series. Copies of the database have been distributed to: Los Alamos National Laboratory, Wildland Fire Prediction Model (FIRETEC; Dr. Rodman Linn), UDSA Forest Service, Rocky Mountain Research Station, Fire and Fuels Extension to the Forest Vegetation Simulator (FFE-FVS; Ms. Stephanie Rebain and Dr. Elizabeth Reinhardt) and LANDFIRE (Ms. Karen Short).	Done
User survey	Users of the book-form Natural Fuels Photo Series were surveyed to determine what additional features they would like to see in the DPS (Appendices 1 and 2). This process was carried out through the distribution of a questionnaire and informal discussions with interested parties.	Done
DPS tutorial and lesson plan	Additional material addressing the DPS will be incorporated into the existing online tutorial and lesson plan designed to teach students how to use the Natural Fuels Photo Series.	Partially implemented
DPS quick reference sheet*	A “quick reference” sheet providing basic instruction on DPS navigation and use.	Done
DPS online seminar	In an effort to reach a broad audience, a web seminar will be scheduled for Fall 2007 (once the fire season has slowed). This seminar will use the Verizon Advanced Net Conference Live Meeting service, and will include a quick lesson on how to navigate the DPS, as well as practical examples of how the DPS can be used for fire and fuels management.	To be offered Fall 2007
Technology transfer	Technology transfer activities include demonstrations of the DPS application at 13 workshops and 2 science delivery discussions, a posting on FIREHouse, and a JFSP highlight; these activities are described in more detail in Table 3.	Done
Publication	A draft manuscript announcing the release of the DPS, describing its functionality, and detailing its development will be submitted to <i>Fire Management Today</i> in September 2007.	To be submitted Sept. 2007
JFSP final report	WRIGHT, C.S., R.E. VIHNANEK AND R.D. OTTMAR. 2007. Digital Photo Series. JFSP final report.	Done

\*Deliverables in excess of proposed.

**Table 3.** Digital Photo Series technology transfer activity dates and descriptions.

<b>Date</b>	<b>Venue</b>	<b>Presentation Type</b>
June 2005	FIREHouse (the Northwest and Alaska Fire Research Clearinghouse) posting	DPS information and a link to the application
September 2005	JFSP Project Highlight	DPS highlighted in monthly JFSP highlight publication
November 2005	USDA Forest Service, Region 6, Integrated Vegetation Management Workshop, Hood River, OR	DPS demonstration
November 2005	Southern Regional Fuels Workshop*, Jones Center for Ecological Research, Ichauway, GA	DPS demonstration
February 2006	Hawaii Regional Fuels Workshop*, State of Hawaii, Department of Forestry, Hilo, HI	DPS demonstration
March 2006	1 <sup>st</sup> Fire Behavior and Fuels Conference, San Diego, CA	DPS demonstration
May 2006	Pacific Northwest Regional Fuels Workshop*, USDA Forest Service, Region 6, Sunriver, OR	DPS demonstration
August 2006	Alaska Regional Fuels Workshop*, Alaska Fire Service, Fairbanks, AK	DPS demonstration
November 2006	3 <sup>rd</sup> Fire Ecology and Management Conference, San Diego, CA	DPS demonstration
November 2006	Midwest Regional Fuels Workshop, Portsmouth, OH	DPS demonstration
March 2007	Southern California Regional Fuels Workshop*, Cal-Poly University, San Luis Obispo, CA	DPS demonstration
March 2007	2 <sup>nd</sup> Fire Behavior and Fuels Conference, San Destin, FL	DPS demonstration
April 2007	Western Regional Fuels Workshop, University of Idaho, Moscow, ID	DPS demonstration
May 2007	Southwest Regional Fuels Workshop*, Albuquerque, NM	DPS demonstration
July 2007	PNW Fire Research Science Delivery Discussion, Seattle, WA	DPS demonstration
September 2007	Southeast Regional Fuels Workshop, Jones Center for Ecological Research, Ichauway, GA	DPS demonstration
September 2007	Carnegie Mellon University, Software Engineering Institute Modeling Session (in Seattle, WA)	DPS demonstration

\*Regional Fuels Workshops funded with a grant to R.D. Ottmar by the JFSP. These 2-½ day workshops taught participants to use the Fuel Characteristic Classification System (FCCS), Consume 3.0, the Natural Fuels Photo Series, and the Digital Photo Series.

## **Acknowledgments:**

Numerous individuals contributed to the successful completion of the Digital Photo Series: Diana Olson, Alynne Bayard, Lara Kellogg, Mike Tjoelker, Jeff Kelly, Paul Campbell, Frank Archuleta, Ann McAuley, Noah Carlson, Felicia Mehl, Zhen Zhu, and Veronica Mendoza. John Szymoniak helped us distribute our survey questionnaire to federal fire and fuels professionals. Funding for the creation of the Digital Photo Series was provided by the Joint Fire Science Program. Development of the original Natural Fuels Photo Series was funded in part by the Department of Interior fuels working group, the National Fire Plan, the Joint Fire Science Program, the State of Hawaii, the Department of the Army, the United States Air Force, and others.

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**Appendices:**

Appendix 1: Digital Photo Series prospective user questionnaire.

Appendix 2: Digital Photo Series prospective user questionnaire results.



## Appendix 1:

### Digital Photo Series -- User Questionnaire

The Natural Fuels Photo Series is a collection of printed publications that contain high quality wide-angle and stereo-pair photographs and data describing the composition, amount and arrangement of aboveground biomass (fuels). To date there are several volumes, each representing a different geographic region. Series within volumes represent different ecosystem types, and sites within series show a range of conditions that can occur in a given ecosystem type. The Joint Fire Science Program has provided funding to turn the paper and ink photo series into an electronic version with added functionality for users. With this in mind, we are soliciting input and feedback to identify and prioritize features and functions that past, current and future users of the photo series would like to see incorporated into what we are calling the Digital Photo Series. Below are some general questions that will help us to design the data structure and interface in such a way as to add the greatest value and insure the most effective use and access to vital fuels information for a wide user community.

Name:

Title:

Affiliation:

Phone:

e-mail:

What computer operating system and web browser do you use most frequently?

Operating System:

Web Browser:

Does your computer have a:  CD-ROM drive?  DVD-ROM drive?

What is your monitor resolution or screen area in pixels?  640 x 480  1280 x 1024

(for Windows users, right click on the Windows  800 x 600  1600 x 1200

Desktop, select Properties, then the Settings tab)  1024 x 768  more than 1600 x 1200

Is your computer:  connected to a network (with Internet access)?  or remote?

If both, approximately how much of the time is it disconnected? %

How do you, or could you, use photo series data (i.e., information describing the composition, amount and arrangement of aboveground live and dead organic matter)?

as input for models (e.g., Consume, FOFEM, Behave, etc.)?

If yes, which models?

as input for smoke management/prescribed fire planning/permitting?

for planning and prioritizing fuel treatments?

other uses? Please specify:

If you were searching for an example of a particular condition, what variables would you find most useful for searching (e.g., region or location, species presence or composition, woody fuel loading in certain size classes, forest stands of a certain density or average size, plant association or other vegetation classification, etc.)?

Please specify:

Do you regularly use data from more than one:

ecosystem?  always  mostly  sometimes  rarely  never

geographic region?  always  mostly  sometimes  rarely  never

If yes, how much of the time (check one box in each column)?

How would/could you use the images included in the photo series?

for field evaluations of fuels?

for inclusion in presentations?

for inclusion in planning documents?

other uses? Please specify:

What format(s) would be most useful as output(s)?

- printed reports?
- electronic documents (Adobe PDF, MS Word, rich text format)?
- electronic data tables (MS Excel, MS Access)?
- ASCII-type files (.xml, .csv)?
- individual or multiple images (.jpg or MS PowerPoint slideshow)?
- other formats? Please specify:

For which ecosystem types do you still need data?

Comments, suggestions and other feedback:

These questions are simply meant to stimulate your thoughts, and are just a starting point... please feel free to elaborate and expound (at length if you wish). With your help we would like to identify novel and innovative ways to use the data and images contained within the Natural Fuels Photo Series. While it is not necessary to submit your name and contact information, we expect it will be a great help to us should we have questions about your responses. Thank you for your thoughts and input.

## Appendix 2:

Appendix 2 compiles and summarizes the results of the Natural Fuels Photo Series user survey to determine computer system requirements and desired additional features in the development of the Digital Photo Series.

In April 2005, the Digital Photo Series User Questionnaire was sent to fire and fuels managers and Natural Fuels Photo Series users, representing the USDA Forest Service (both management and research), Bureau of Land Management, National Park Service, US Fish and Wildlife Service, US Air Force, US Army, Minnesota Department of Natural Resources, Washington Department of Ecology, Hawaii Department of Fish and Wildlife, Washington Department of Fish and Wildlife, The Nature Conservancy, Systems for Environmental Management, and the Cnaan Valley Institute. Positions ranged from fuels technicians to fire management officers, forestry technicians to fire ecologists, smoke managers, GIS specialists, program managers, technology transfer specialists, and public participation and planning specialists. The questionnaire requested information regarding users' computer operating system, web browser usage, monitor resolution/screen area, internet access speed, how photo series data are used, whether photo series data are used at local or regional scales, how digital images might be used and what kind of output format would be preferred. Thirty-nine responses were received; the survey questions and tallies/answers are summarized below. In general the text of the user responses has been summarized to reflect the main point(s) yet still maintain the nature of the response, and sometimes a response was combined with other similar responses.

### Affiliation:

USDA Forest Service	21	US Military	2
National Park Service	8	Non-Governmental Organizations	2
Bureau of Land Management	3	US Fish and Wildlife Service	1
State Land Managers	2		

### What computer operating system and web browser do you use most frequently?

#### Operating System:

Windows 2000	20
Windows ME	1
Windows XP	14
unspecified Windows	4

(1 Windows XP user also used the Linux operating system)

#### Web Browser:

Internet Explorer	36
Firefox	2

### Does your computer have a:

CD-ROM drive?	31
DVD-ROM drive?	21

**What is your monitor resolution or screen area in pixels?**

640 x 480:	3	1280 x 1024	16
800 x 600	3	1600 x 1200	1
1024 x 768	19	> 1600 x 1200	1

**Is your computer:**

Connected to a network (with Internet access)? 39 or remote? 13 (some of the time)  
If both, approximately how much of the time is it disconnected? 33.5% (avg.)

**How do you, or could you, use photo series data (i.e., information describing the composition, amount and arrangement of aboveground live and dead organic matter)?**

As input for models (e.g., Consume, FOFEM, Behave, etc.)? 33

Which models?

Behave	23	VSmoke	1
FOFEM	16	ClearSky	1
Consume	11	BlueSky	1
FFE-FVS	9	Cruz	1
FARSITE	8	DDWoody	1
NEXUS	5	FORVIS	1
FMA Plus	5	FPA-HA	1
FlamMap	3	Canadian FBPS	1
SASEM	1		

As input for smoke management/prescribed fire planning/permitting? 32

For planning and prioritizing fuel treatments? 34

Other uses? Please specify:

- inventory
- monitoring (fire effects and fuels) and analysis
- use with programs like FIREMON/FEAT
- vegetation and fuel mapping/classification (e.g., FCCS/FRCC)
- determining condition class
- development of custom fuel models
- writing burn plans/burn plan development/prescription development
- Wildland Fire Situation Analysis
- model differences in alternatives for NEPA
- wildland fire use fire behavior prediction
- daily predictions for fire use/suppression actions
- FIREWISE grants
- visual representation for the public
- communication with other resource professionals

**If you were searching for an example of a particular condition, what variables would you find most useful for searching (e.g., region or location, species presence or composition, woody fuel loading in certain size classes, forest stands of a certain density or average size, plant association or other vegetation classification, etc.)? Please specify.**

Suggested search variables fell into 8 categories: composition [28], location [27], classification [25], structure [24], loading [15], topography [9], condition [2], and history [2].

**Composition** variables included:

species	20	overstory species	2
tree species	3	understory vegetation	3

**Location** variables included:

location (generic)	15	region	12
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**Classification** variables included:

plant association	9	forest type	1
vegetation	6	fuel type	1
habitat type	3	moisture regime	1
biophysical type	1	working group	1
FCCS crosswalk	1		

**Structure** variables included:

tree density	7	litter depth	1
tree size class	6	duff depth	1
basal area	1	forest stand	1
canopy bulk density	1	fuel continuity	1
stand density	1	fuel strata of the FCCS	1
overstory tree density	1	ladder fuels	1
midstory tree density	1		

**Loading** variables included:

woody by size class	8	herbaceous	1
fuel	3	litter	1
shrub	1	duff	1

**Topographic** variables included:

aspect	3	slope	3
elevation	3		

**Condition** variables included:

site index	1	stand/vegetation	1
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**Historical** variables included:

stand age	1	time since fire	1
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**Do you regularly use data from more than one (if yes, how much of the time):**

Ecosystem?

always	8
mostly	13
sometimes	11
rarely	5
never	1

Geographic region?

always	5
mostly	6
sometimes	12
rarely	11
never	1

**How would/could you use the images included in the photo series?**

for field evaluations of fuels?	37
for inclusion in presentations?	29
for inclusion in planning documents?	32
other uses? Please specify:	

- calibration of data and fire/fuels outputs
- communication with specialists
- communication with the public
- exhibit in contract solicitations and/or task orders
- FIREWISE grant applications
- developing crosswalks from vegetation maps to fuel maps
- analysis (specific mention of landscape level analysis)
- for communications in collaborative planning processes
- for identifying prescriptions
- training (specific mention of prescribed fire and fire behavior training)
- WUI education
  - integration of fuels management treatment alternatives utilizing timber, natural resource, and hazardous fuels point of views

**What format(s) would be most useful as output(s)?**

printed reports?	23
electronic documents?	35
electronic data tables?	27
ASCII-type files?	5
individual or multiple images?	30
other formats? Please specify:	

- graphs (like what FOFEM produces)
- formats required to import data to build custom fuel models in Behave or FARSITE
- a CD (in addition to a field guide)

## For which ecosystem types do you still need data?

### Pacific Northwest:

- interior ponderosa pine
- Klamath/Siskiyou mixed-conifer and true fir
- east Cascades mixed-conifer
- northeastern Washington forest cover types
- natural fuels with brush understory
- post wildfire time series
- Oregon oak woodlands
- northern Blue Mountains
- whitebark pine
- very dry pine sites

### Alaska:

- shrubs, tussock tundra
- white spruce with beetle kill

### Rocky Mountains:

- Colorado front range mixed-conifer
- mixed-conifer for intermountain region
- more variety in aspen/mixed-conifer aspen
- more variety in gambel oak/bigtooth maple
- ponderosa pine
- mountain mahogany
- nearly everything in central Montana
- lodgepole pine
- Douglas-fir
- spruce-fir
- whitebark pine

### Southwest:

- chaparral
- southern California shrub types
- various coastal sage scrub and chaparral types

### Central/Lake States:

- boreal mixed-woods in the northern Lake States
- tallgrass and mixed grass prairies in North and South Dakota

### Southeast:

- activity fuels in the southeastern US Piedmont
- central Appalachian hardwoods and hardwood/pine
- longleaf pine rocklands
- long and short hydroperiod prairies
- southern rough (pine with palmetto/gallberry that has not burned in 5-10-20 years)

## Comments, suggestions and other feedback:

### Comments:

- “A lot of what we do now forms the basis for communicating with others such as between specialists, informing decision makers, in discussions with stakeholders and cooperating agencies. Comparative illustrations of fuel conditions are helpful in this dialogue with individuals and groups.”
- “This is a great project. So glad that you are doing this.”
- “Keep up the good work. You are providing a valuable service to field managers.”
- “It will be challenging (and also very cool) to begin using the new expanded fuel models in fire spread simulation modeling. Your project will be a great resource to help with this work.”
- “This is a fantastic idea - good on ya.”

### Suggestions/Questions:

- Correlate canopy cover values to less subjectively and more easily measured values such as basal area and trees per acre. Look at light levels entering the forest floor and their corresponding effect on seedling regeneration, specifically pines (this suggestion was in reference to the Plumas, Lassen and Tahoe Forests).
- How does/will this program relate to the Photo Series Explorer Software?
- The ability for field going units to be able to submit plot data and Browns transect data with photos and physical plot characteristics into a database where data can become more localized (than the region) and shared electronically across agencies.
- Develop consistent data for fuel continuity across series. Sometimes in the printed series the variables differ based upon when the data were collected.
- Include fuelbed depth (Behave requires it and it is difficult to infer from the photos). Moisture of extinction would also be helpful (another Behave input).
- Incorporate post burn fuel loading into the series: a series of photos depicting different post burn conditions in each fuel type would be very useful and faster than doing Brown’s transects for quick estimates.
- I would like to see the data tables for below ground fuels for the tallgrass and mixed grass ecosystems (something similar to what FOFEM provides, i.e., graphs and reports); also consider multi-management issues such as haying, and grazing impacts within those ecosystems. Consider linking the photo series with the FEIS, FOFEM, and give it a GIS (possibly LandFire) capability.
- FMA+ is helpful in sorting and evaluating fuel loadings by various plant association groups. A post wildfire photo series with predictions of future fuel loading at 10, 20, 30+ year increments, based on fall/decay rates, would be helpful.
- Gear program toward fire management and include fields for fuel bed depth, live woody, live herbaceous, etc. Offer a choice for metric inputs/outputs. Allow for expansion into canopy fuels (more studies will be offering canopy fuel parameters: canopy bulk density, canopy fuel load, canopy base height, canopy ceiling height, crown ratio, etc.). Also allow for metadata to encompass what is included in the canopy fuels, e.g., foliage alone or foliage + some proportion of 1-hour fuels. Also the methodology for calculating canopy bulk density (volumetric or segmental). A routine for cross-walking NFDRS to the 13 standard fuel models



to the new fuel models would be handy. An option to output fuels information into Behave and NEXUS import formats would be exceptionally handy. Software written for palmtop computers would allow fire monitors to access the information in the field. Please allow for user input of future local fuel models and photo series.

- Use examples of FRCC along with the standard data.
- It is advantageous to provide text documents in PDF and MS Word so that a person may alter information if necessary for their own use.
- Some of the things we could/would do: (1) Assimilate 'most used' photos/loadings from different photo series and create a custom, small, local, field book. (2) Load the images/loadings on PDA's or pocket PCs for field inventory/data recording. (3) FFI (FIREMON x FEAT) will be PDA compatible, perhaps there could be a data entry crosswalk. Even in the office, data entry crosswalks could speed up the process and would reduce human entry errors. (4) Electronic photos are always useful. (5) Depending on how you set things up, it would be nice to query a fuel loading and look at picture(s). I think FMA does this, but of course it is private and expensive.