Department of Defense
Legacy Resource Management Program

PROJECT NUMBER 10-111

Development of a Management System and Geographic Interface for Biological Resource Data: Transfer Plan

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1 Introduction

A natural resource data viewer web application, built by the University of Southern California Spatial Sciences Institute (SSI, 2011) for the *Department of Defense Legacy Resource Management Program* (DoD, 2011), provides an innovative digital data archive with advanced geospatial search and data retrieval capabilities. The data viewer is currently hosted at: http://geoserv.usc.edu/flexviewer/index.html (accessed 12/21/2011). The data viewer includes an interactive map, metadata search tools and spatial data selection and download functionality. This document provides background and instructions for the transfer and use of this data viewer by the Department of Defense. The project is funded through Agreement No. W9132T-10-2-0041 between the Department of the Navy and the University of Southern California.

1.1 DFSP Project Context-Project Demonstration Site

The Defense Fuel Support Point (DFSP) installation in San Pedro, California, is operated by the Defense Logistics Agency (DLA, 2011). The Defense Logistics Agency is responsible for providing fuel to military installations throughout southern California. At the same time, this installation is home to many environmentally sensitive natural resources presently subject to various legal management and protective actions. These natural resources include the federally listed insectivorous bird species California Gnatcatcher, the Palos Verdes Blue Butterfly, and rare and sensitive plant communities including Coastal Sage Scrub, Perennial California Grassland, and the rare plant Peirson's Morning Glory (CNPS 4.2 listed plant). The habitats and therefore the spatial distribution of these resources are subject to change over time, in particular the Palos Verdes Blue Butterfly and its larval food plants. Thus the main aim of the DFSP is to find new and efficient ways to access their own data on these natural resources, to assist DFSP installation operation decisions.

1.2 Purpose of DFSP Web Map Viewer

The main purpose of the geographic data viewer is to provide easy-to-use tools for DFSP natural resource data archiving and visualization, and especially data search and retrieval operations. The interface design of the data viewer is geared toward both technical and non-technical users. The intent is to facilitate decision making processes related to natural resources planning at the DFSP installation by providing a user-friendly yet highly robust web-based data management system.

The first goal was to create data visualization tools that would allow users to be able understand the spatial distribution of environmentally sensitive biological resources on the installation property at a glance. Also, these digital maps were to be based on the most recent surveys of these resources. The second goal was for data viewer users to be able to easily share that information within decision making entities. The third goal was to build a digital data archive that supports easy searching of metadata associated with the DFSP natural resource data. In addition, ecologically meaningful search functionality was

implemented in the metadata search tools, accommodating both standard Extensible Markup Language (XML) and Ecological Metadata Language (EML; KNB, 2011). Lastly, the data viewer was designed to provide several general GIS tools including as draw, measure and print capabilities, as well as data download tools that allow users to access any natural resource data added to or updated within this digital archive.

1.3 Data Sources

Natural resource data archived and implemented in the DFSP data viewer were obtained from Tierra Data Systems, a consultant to the Department of the Navy currently developing a revised *Integrated Natural Resources Management Plan* for the DFSP installation. Biological data were also obtained from The Urban Wildlands Group, one of the biological service providers for the installation. Details on these datasets will be provided in the final report for this project.

2 DFSP Map Viewer Tools

The natural resources data viewer developed the DFSP installation is currently hosted by USC SSI at: http://geoserv.usc.edu/flexviewer/index.html (accessed 12/21/2011). Figure 1 provides an example map displaying some of they key user interface components of the data viewer.

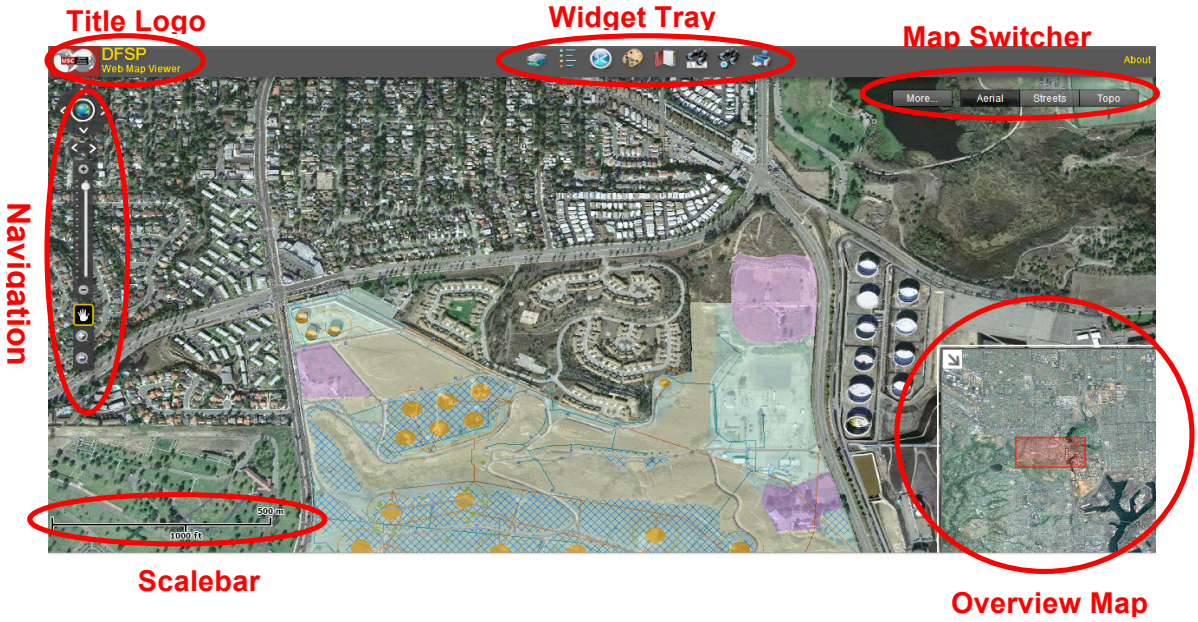

Figure 1. The main components of the DFSP data viewer user interface.

The *Title Logo* is the title of the project and the logo of "USC Spatial Sciences Institute" (Figure 1). The *Navigation* tool allows a user to control the map view by zooming in, zooming out, and panning the maps. The *Overview Map* dynamically displays the current extent of the main map view in the lower right corner of the map view, and can be toggled on and off. The latter allows a user to visualize exactly where the map view they are currently looking at is located, i.e. birds eye view.

The *Widget Tray* and the *Map Switcher* components contain the data visualization, search and download components of the DFSP viewer, described in detail in below.

2.1 Widget Tray

The DFSP data viewer includes eight widgets, each of which has a specific function. A data viewer widget is a basically a small software module installed within the map application which is accessed via an icon. A widget is executed whenever an end user clicks on a widget icon. Figure 2 displays the data viewer widget tray, while a detailed description of each widget is provided below, in sequence from left to the right.

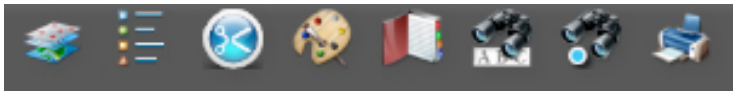

Figure 2. The Widget Tray contains all of the data viewer widgets.

-  The *Layer List* widget allows users to turn map data layers (also referred to as map services) on and off, or visible and invisible. For example in Figure 3, three main map data layers are displayed in the widget. Each main layer has a checkbox to the left that allows end users to easily turn their visibility on or off simply by checking the box. In addition, a clickable arrow to the immediate left of the visibility checkboxes indicates that users may expand that particular layer to view names of sub-layers within that main data layer.

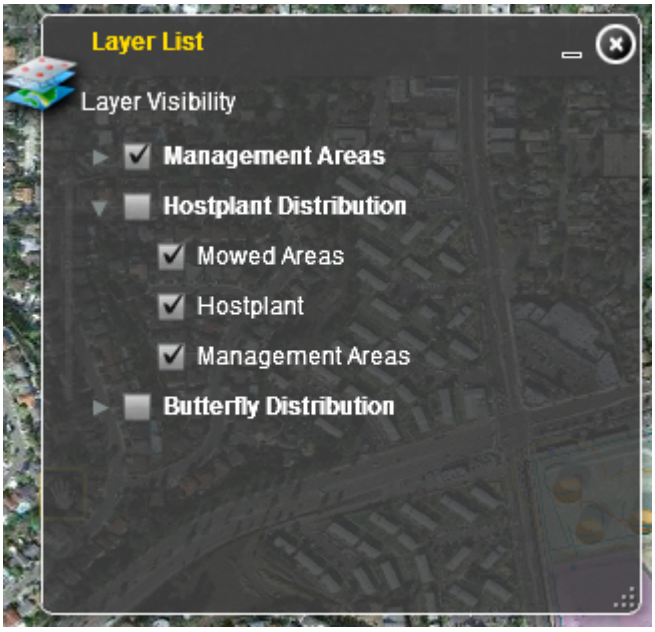

Figure 3. Example list of layers accessed using the *Layer List* widget, accessed by clicking the corresponding icon in the widget tray.

Tip: The *Layer List* widget functionality can also be accessed through the Map Switcher widget in the upper right corner of the map (Figure 1), by clicking on the "More..." button which also provides this visibility control of the data layers.

-  The *Legend* widget is accessed by clicking on the *Legend* icon in the widget tray. The *Legend* conveys the meaning of the symbols used to represent mapped features (points, lines and polygons representing data) visible on the map (Figure 4). Thus the *Legend* consists of example map symbols with labels containing explanatory text. The *Legend* is dynamically tied to the active map view, in other words the *Legend* only displays symbols for layers that are set as visible by the user using the *Layer List* widget in the current map view.

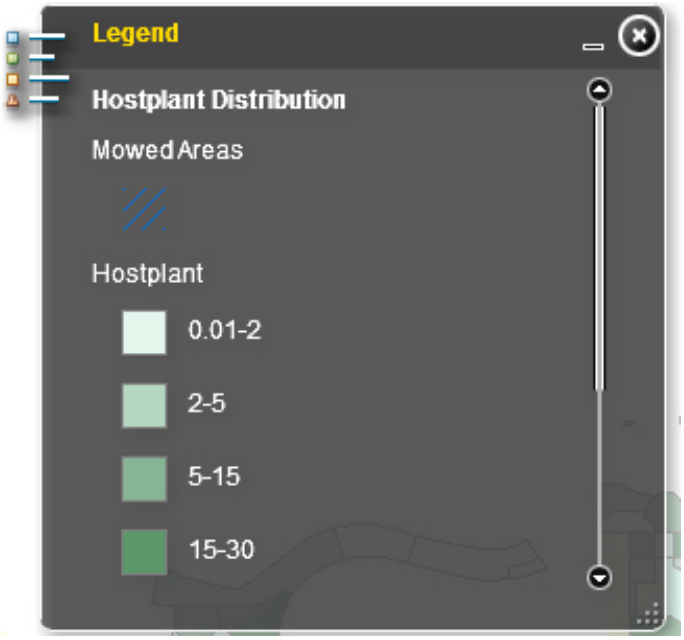

Figure 4. An example view of the in the *Legend* widget showing symbols which represent map features (dashed lines and solid fill) depicting data in the layers.

-  The *Clip and Ship* widget allows a user to interactively draw an area of interest on the web map and download the underlying set of data layers for that region (Figure 5). To begin, the user clicks on the Extract Data widget from in the widget tray, which opens the pop-up dialog shown in Figure 5. This dialog displays the options available for selecting and downloading data including (a) tools for drawing the selected region via polygon creation or freehand; (b) the layers that are available for download; and (c) the output file options.

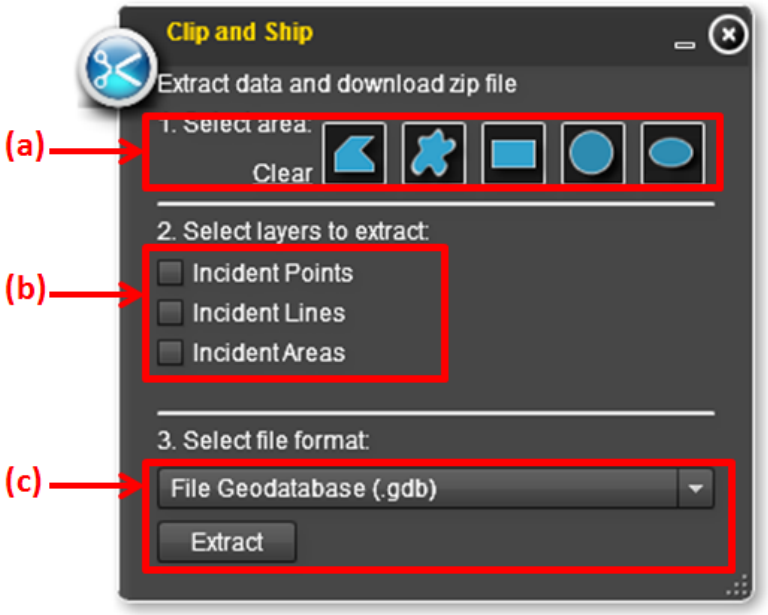

Figure 5. The three main functionalities of the *Clip and Ship* widget include map data selection, extraction and download.

From this *Clip and Ship* widget dialogue box, the user first draws an area on the map where they would like to download data, by clicking one of the drawing options shown in Figure 5 (a) and drawing directly on the map with the mouse (click and drag with the left button). Once the area to download has been identified, the user then selects the layers he/she would like download by clicking the checkbox to the left of the layer in the *Clip and Ship* widget (Figure 5 (b)), and then choosing the output format by clicking the Extract Data button (Figure 5 (c)). There are five different spatial data format options available, and user must select one from a drop-down menu: File Geodatabase (.gdb), Shapefile (.shp), Autodesk AutoCAD (.dxf and .dwg), and Bentley Microstation Design (V8, .dgn). This action calls a geo-processing service on the server which clips out only the requested data layers from the selected data layers using the area to download previously drawn by the user. This clipped data is then packaged into a zip file behind-the-scenes and automatically sent to the user as a download through the browser being used (no email is necessary). A given zip file will contain the DSP natural resource data for the selected layers covering only the region selected by the user in the first step, area to download. Next, a second Ship and Clip dialog box will appear prompting the user to confirm whether or not to save the zip file (Figure 6).

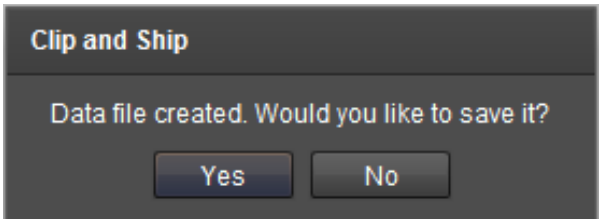

Figure 6. The Clip and Ship dialog dialog box requires a user to confirm that they wish to save their zip files to their own media.

The final dialogue box requests the user to Select Location for Download (Figure 7), allowing the user to specify a storage location for saving the zip file to their personal, local media. All downloaded zip files are named extractedData.zip, therefore if multiple zip files are generated and downloaded, the user should rename them during this final step.

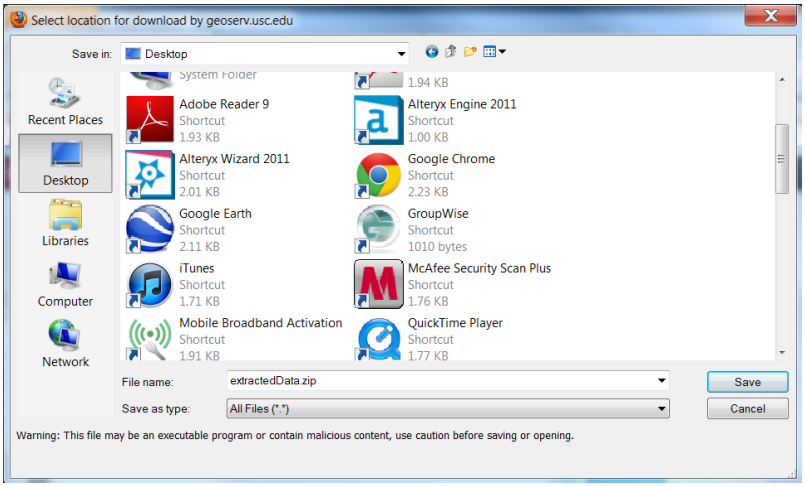

Figure 7. The user may select their desired media or location on their computer to save downloaded DFSP natural resource data zip files.

-  The *Draw and Measure* widget enables end users to draw simple graphics and text onto the map display. It provides nine feature creation tools: point, polyline, freehand line, rectangle, circle, ellipse, polygon, freehand polygon and text.

-  The *View Metadata* widget enables end users to view metadata files associated with DFSP natural resource data layers. For those of data layers for which metadata was created by the data provider, two different data standards, XML (Extensible Markup Language) and EML (Ecological Metadata Language) are provided as

alternative data viewing options. An example list of DFSP metadata files are provided in Figure 8.

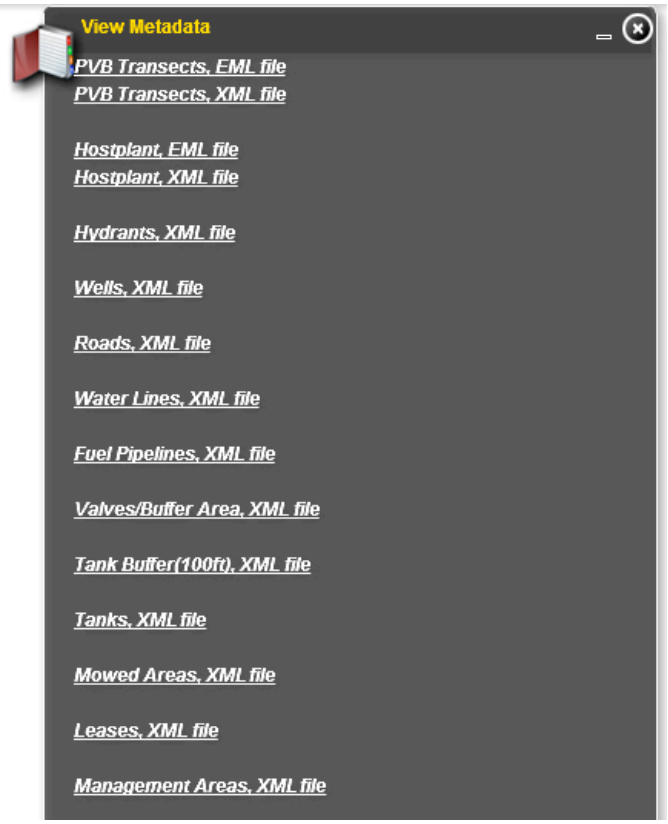

Figure 8. Example list of XML metadata files obtained using the *View Metadata* widget.

When a user clicks on a metadata link shown as a "layer name, XML File" in Figure 8, a new window will pop up displaying information contained within the selected data layer's metadata. For example, Figure 9 shows the *Fuel Pipelines* metadata in XML format, associated with that particular data layer.

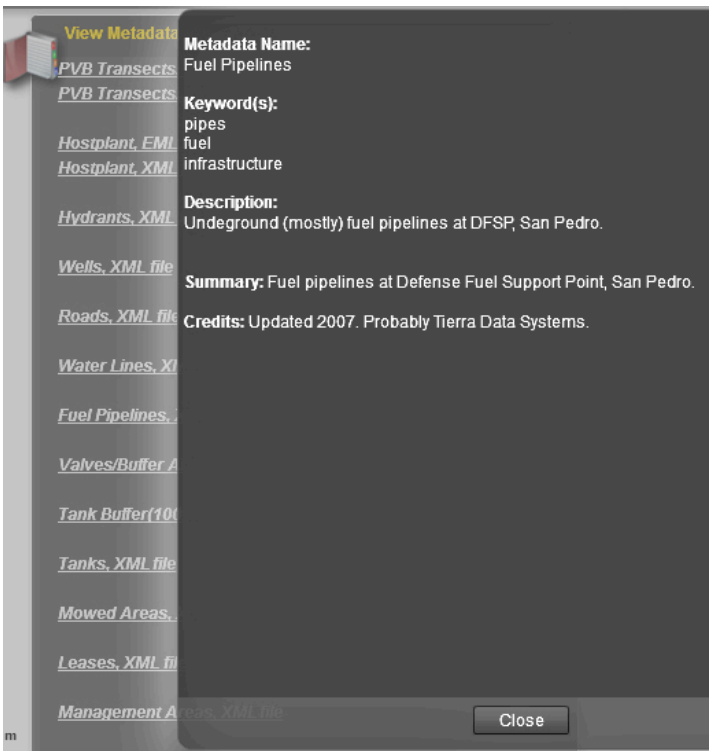

Figure 9. An example search result using the *View Metadata Widget*.

-  The *Search EML Metadata* widget allows users to search for a specific keyword in different attributes in a given metadata EML file (Figure 10). An attribute is any nonspatial information about a geographic feature stored in a table associated with the feature (point, line or polygon). This feature would become useful when searching for information about particular taxonomic groups (e.g., insects, birds). The EML data contain higher-level taxonomic information and make it searchable. The user can search on words in a layer title, abstract and more. When a search is successful, the widget then displays the content of the matched metadata as the search result.

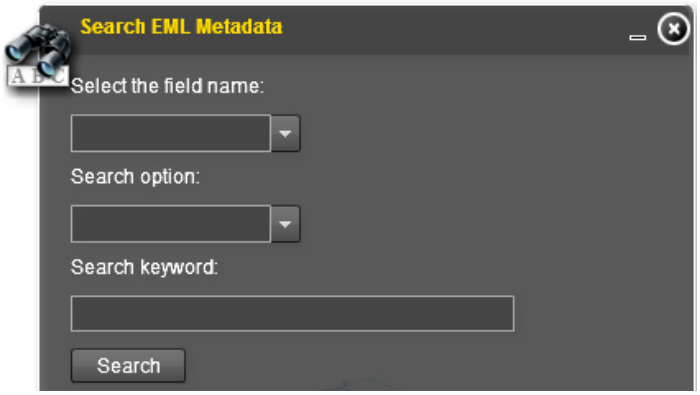

Figure 10. The *Search EML Metadata* widget.

The user first selects the field name to search for the search keyword (i.e., Title, Abstract, Keyword or Creator) from the drop-down list shown in Figure 11. Next the user selects a search option (Exactly, Contains or Starts with). After typing in a search keyword, the user clicks the Search button. These search options are designed assist users in identifying metadata whose given field contains search keywords of interest to them.

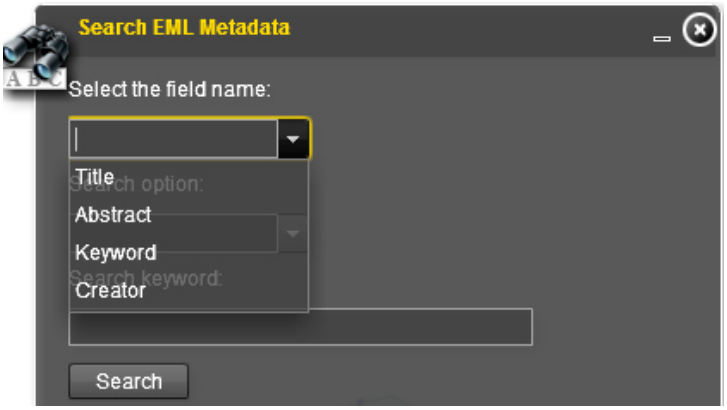

Figure 11. The *Search EML Metadata* dropdown list options for searching metadata based on a field (attribute) name.

For example, Figure 12 shows the result of selecting the field name "Title", search option "Contains", and searching on the keyword "San Pedro" in field of XML metadata files.

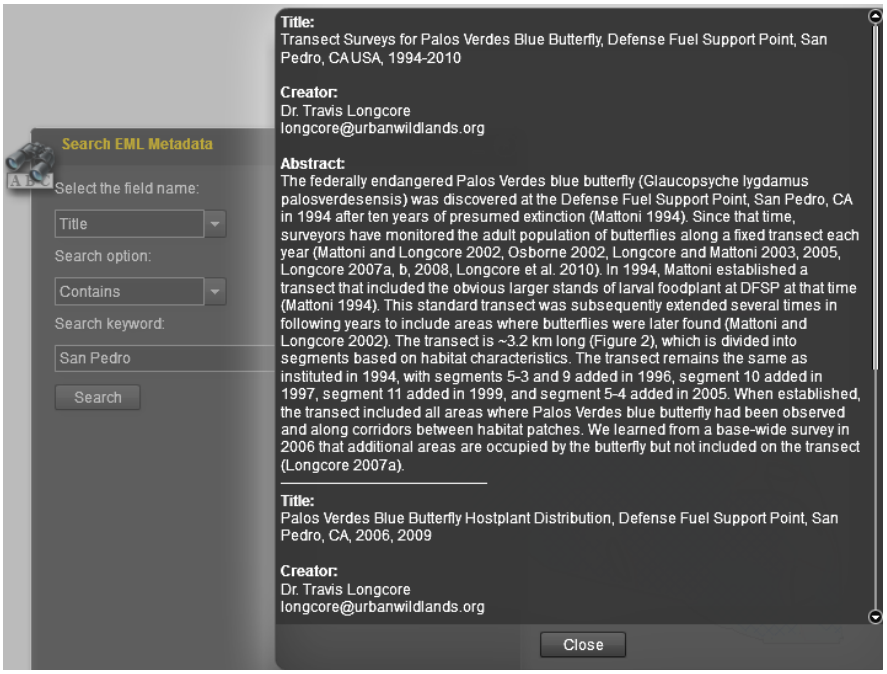

Figure 12. Example result using the *Search EML metadata* widget.

 The *Search XML Metadata* widget has a similar functionality as the *Search EML Metadata widget.* However, in this widget, the search is going through XML metadata files instead of EML metadata files.

The workflow for using the *Search XML Metadata* is very similar to that of the *Search EML Metadata* widget discussed above (select field name, search option and search keyword, respectively). Figure 13 shows and example of metadata retrieved by searching on the keyword "San Pedro" in "Description" field of the *Search XML Metadata* widget.

Figure 13. Example result using the *Search XML Metadata* widget.

-  The *Print* widget enables end-users to print their current map display to their own local printer, whatever data is being visualized at the time of printing (Figure 14). The *Print* widget also allows the user to specify any Title and Subtitle desired on their printed map. The print functionality operates using the "what you see is you get" (WYSIWYG) browser-based controls. All data layers visible to the user in the map display will be printed.

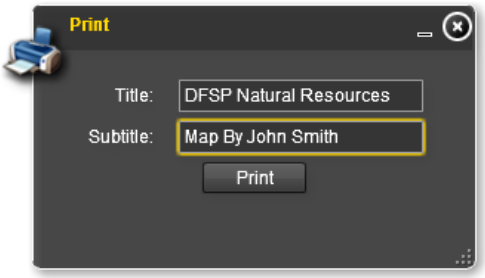

Figure 13. Example Title and Subtitle entered in the *Print* widget.

2.2 Map Switcher

The *Map Switcher* widget enables users to easily switch between "basemaps" in the DFSP data viewer (Figure 14). Typically such basemaps are utilized in the data viewer to display background imagery and street data beneath other spatial data of interest, providing highly accurate location context and landmarks. The *Map Switcher* widget has three button-controlled base map options: Aerial, Streets and Topo. Only one base map can be visible at a time. The user may click any one of the *Map Switcher* widget buttons to change the basemap displayed in the data viewer. The basemap layers are provided by Esri and consequently their availability is subject to their limitations on extent and resolution.

Figure 14. Map Switcher Widget

As mentioned above, the *Map Switcher* widget also has an option to provide users the ability to turn the visibility of DFSP data layers on or off on the map display, by clicking the More button (see The *Layer List* widget discussion and Figure 3).

3 Technical Specifications

The DFSP web mapping application was created and implemented using *ArcGIS Viewer for Flex* (ESRI, 2011a and b). The *ArcGIS Viewer for Flex* application and API (Application Programming Interface) allows software developers to create GIS-enabled web mapping applications with minimal programming, facilitating rapid development and deployment of Flex-based web mapping applications.

The DFSP data viewer currently includes four operational natural resources map layers: Management Areas, Hostplant Distribution, Butterfly Distribution, and Other Biological Data. These are considered "Operational Layers" in ArcGIS Server, when publishing map layers. The following section describes how to publish such operational map layer and incorporate them into the data viewer.

3.1 Publishing Operational Map Layers

Operational map layers are usually displayed on top of a basemap layer. If you are responsible for publishing GIS services, you will typically publish each operational map layer as a separate web map service. One of the types of map services that you can publish using ArcGIS Server is a dynamic map service. ArcGIS Server allows you to share your spatial data resources across an enterprise and across the Web (Esri, 2011c). You share these resources by hosting them on your ArcGIS Server system, which is a GIS (web map) server, and allowing client applications to use and interact with the resources. The main advantages of sharing your GIS resources on a GIS server are the same as sharing any data through any kind of server technology: the data is centrally managed, supports multiple users, and provides clients with the most up-to-date information.

ArcGIS Desktop applications (ArcCatalog, ArcMap, and ArcGlobe) provide direct access to the GIS resources on the GIS server (Esri, 2011c). Thus, your ArcGIS Desktop applications can serve as "clients", and they are also the tools you'll use to create the resources that you host on your GIS server. For instance, you'll author maps in ArcMap, then use ArcCatalog to publish them on your GIS server.

First, in ArcCatalog, connecting to your GIS server is similar to connecting to a local folder on your computer or to a database server. Once connected, you have access to all the resources available on the GIS server. You can use these resources just as you would use any resource, for example, by adding a map service as a layer in an ArcMap map. *Since you will need to have administrative access to the ArcGIS Server software and the server hosting it, you'll see additional tools that let you manage the server.* Administrative access is critical to successful implementation of any ArcGIS server-based application. You should be knowledgeable in configuring both your own server operating system as well as the software. This will enable you to freely add and remove ArcGIS Server resources, and monitor it to make sure it is working properly.

To create a dynamic map service that is served using ArcGIS Server, you first need to create an ArcMap document and publish it as a map service. *This can be done on the server, or on another machine and copied to the server, as long as the paths to the data files being served are exactly the same on both machines.* Once you finish creating a map document (.mxd), follow these steps to publish it as a map service:

- Open your map document in ArcMap.
- Display the Map Service Publishing toolbar by right-clicking any toolbar and clicking Map Service Publishing.
- Click the Analyze button.
- Examine the report that appears at the bottom of your map. You'll notice one URL for each capability you enabled. Click Finish.
- To publish a map service, you need to resolve any items marked *Error*. However, you'll get the best performance and appearance if you resolve all the *Warnings* too. The Preview button can give you an idea of how your map will look, as well as

the time you are gaining with each fix. *Tip*: If you cannot resolve all the *Errors*, you can still publish a map service in Manager or ArcCatalog by browsing to the .mxd file. However, performance will be slower if you publish the map service this way.

- Once you've fixed the errors and optionally any Warnings, click Publish. You'll see Publish to ArcGIS Server Wizard at this point.
- Choose the server you want to publish to, the service name, and the folder. Then click Next.
- Choose the optional capabilities you want to enable, then click Next.
- Examine the services that will be created. You'll notice one URL for each capability you enabled. Click Finish.

When you publish a map service using the Map Service Publishing toolbar in ArcMap, ArcGIS creates a map service definition (i.e. .msd) file that is placed in your server input directory. This is a URL that streams your data and map service, referred to as rest endpoints. If you want to author the map on one machine and publish from a different machine, you can use the Save button on the Map Service Publishing toolbar to save the .msd file in a location (meaning directory on your server, such as in /…inetpub…/) you choose. You can transfer and publish this .msd file to any machine running ArcGIS Server that has access to your source map data.

> *Note*: If you make further edits your source .mxd after the service is running, you must re-save an updated .msd file, then restart the ArcGIS Server map service for the changes to take effect.

Next, test the rest endpoints (URL's) you've created directly in a browser to make sure your map services are working correctly. Lastly, you can then replace the rest endpoints (entire URL's) streaming your own map services in the Flex viewer code configure files with comprise the DFSP data viewer, simply by copying and pasting these URL's into code – being sure to delete the old rest endpoints not longer needed.

> *Note*: It is important that the attributes (fields) in your new map service layers (spatial layers in your .mxd) match those the data viewer application was designed to work with – the attributes that are integrated into the widgets. If not, you'll need to manually modify (edit) the DFSP data viewer widget and/or source code to support the names of those attributes that differ.

Notepad++ as a free (open source) user-friendly web page editing program, which you can use to edit any of the uncompelled code and widgets contained in the installation packets (Notepad, 2001).

3.2 Software Requirements

This section covers the installation for the DFSP web mapping application. First, ensure the software requirements above are met, and then follow the instructions to copy the

DFSP data viewer application to your own local server, then implement and test the DSFP data viewer as per the instruction below:

- A web browser (e.g., Firefox 4, Internet Explorer 9, or higher).
- A web server running on the machine where the DFSP web mapping application will be installed (e.g., IIS or Apache). Ask your systems administrator to verify that your machine has a web server running, *and be sure to inform them that you will require administrative rights to the server as well as to ArcGIS Server software in you intend to create and publish ArcGIS server map services yourself*.

3.3 OSD Computers and Error Code 2032

This site is accessible on DoD and civilian computers. However, some attempting to access the site using an OSD computer may encounter error code 2032. Error 2032 is related to the computer's security and permissions, due to the map's Flash application. We recommend that you contact the OSD IT help desk to resolve this issue.

3.4 DFSP Data Viewer Installation Guide

Two DFSP data viewer application packages are available:

- Compiled package - This download package does not include source code, but is already compiled and ready to use.
- Uncompiled package - This download package includes the DFSP data viewer application's source code. You will need to compile this before using it.

Only one download package is needed to install and use the ArcGIS Viewer for Flex. The compiled package is targeted at users who intend to use the DFSP web mapping application with no modification. The uncompiled package is targeted at developers who intend to create custom widgets and/or extend the core DFSP data viewer application. Decide which package meets your needs, then follow the relevant instructions below.

- Copy the zipped package from the CD and save the ZIP file anywhere on your machine.
- Unzip the download package file; it will create a new folder called flexviewer.
- Place the flexviewer folder into your machine's web server folder. The actual folder location may be different depending on your web server configuration, but when using IIS, the default is: "C:\inetpub\wwwroot" (Figure 14).

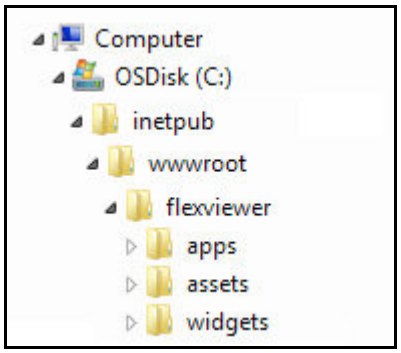

Figure 14. Example showing important root directories on the ArcGIS Server.

Important Note: You will need write permissions for this folder, and perhaps for the entire C: drive on the server.

- Open a web browser and test the DFSP Web mapping application by entering the following URL: http://<machinename>/flexviewer/index.html. Substitute <machinename> with the name of your machine (e.g., http://mymachinename/flexviewer/index.html).

For example, the DFSP installed on a server "geoserv.usc.edu" is reachable through http://geoserv.usc.edu/flexviewer/index.html. You should see the same application.

Congratulations, you have installed and implemented the data viewer!

4 References

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