

# Digital Aerial SketchMapping (DASM) for Invasive Weeds

## Disadvantages of Imagery-Based Weed Mapping

- It is often difficult to distinguish the weeds from their surroundings on imagery.
- The spectral response (i.e., color) of a particular weed may vary from location to location.
- Imagery must generally be collected within a narrow time frame when distinguishing phenological characteristics, such as flowering, are present.
- Imagery may need to be acquired on multiple dates (a very expensive proposition) to account for site-to-site variations in phenology.



**High-winged monoplaner**—A typical plane used for aerial sketchmapping

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## Introduction

Aerial sketchmapping consists of identifying features on the ground, from the vantage point of an aircraft, and recording them on maps or photographs. Aerial sketchmappers typically fly in monoplanes such as a Cessna 206 at elevations of 1,000 - 3,000 feet above ground. The sketchmapper tracks the plane's location on hardcopy maps or aerial photographs and sketches areas of interest on these maps or photographs (figure 1).

Sketchmapping remains the preferred way to detect and monitor forest pest outbreaks because of its reliability and relatively low cost. Trained observers can accurately distinguish between a feature of interest and its surroundings, even when the colors of both are similar. No artificial sensor has yet been developed that can collect the amount and kind of information that a trained observer can. For these reasons, sketchmapping can be a good method for mapping weeds.

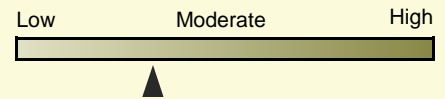
Advances in GPS technology and computer hardware and software led to the development of a digital aerial data collection system. This system addresses one of the problems with sketchmapping—making sure you know your current position on the map. A digital aerial sketchmapping (DASM) system was developed by the US Forest Service (USFS) Remote Sensing Applications Center (RSAC) and USFS Forest Health Technology Enterprise Team in cooperation with State Forestry personnel across the nation.

## QUICK LOOK

### Objective:

This document presents an overview of the digital aerial sketchmapping system developed for forest health monitoring. This technology has many other applications including mapping invasive weeds.

### Cost:



### Expertise:

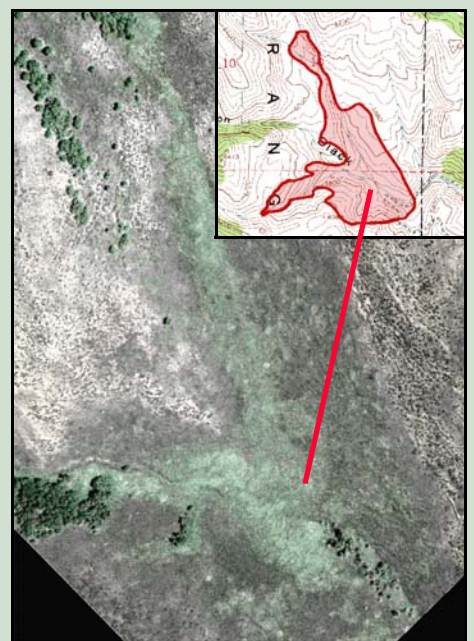
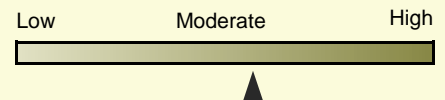


Figure 1—Weed patches, such as this leafy spurge infestation (light green), are observed from an aircraft and sketched on a base map (inset).





**Digital aerial sketchmapping—**  
*The DASM system continually updates the plane's location over the base map or imagery while the sketchmapper draws points, lines, or polygons on the screen to document weed patches.*

### The Digital Aerial SketchMapping System

The DASM system consists of a portable PC with a pen-based screen that is linked to a GPS receiver in the aircraft. Mapping software on the PC allows input of digital background maps, such as standard USGS quadrangles, ortho-photos, and maps based on satellite imagery. An icon shows the current position of the aircraft over the base map. The base map background automatically pans (shifts) as the plane icon approaches the edge of the display. The user can draw points, lines and polygons anywhere on the map and assign attributes to them using the pen stylus (figure 2). After the survey, the digital files of collected data can be downloaded directly into a GIS.



Figure 2—The majority of forest health aerial surveyors use this laptop PC-based system. The Dell 8000 PC, Garmin 12XL GPS Receiver, and KDS touchscreen are shown above.

### Software

The DASM development team investigated a number of different software applications. GeoLink, produced by Michael Baker Jr Inc (<http://www.mbakercorp.com/services/gis/products/geolink.html>) was selected for use with the DASM system. GeoLink has been extensively customized to meet the needs of aerial surveyors. ArcPad, produced by ESRI, is also used by some aerial surveyors. This software package allows editing of GIS data layers using the editing interface of ESRI's flagship GIS software, ArcGIS (<http://www.esri.com/software/arcgis/arcpad/>).

### Hardware

The typical hardware configuration of the DASM system consists of a laptop PC, Garmin GPS, and external pen touchscreen (figure 2). When the laptop is



running, the user can interface with the software using the touchscreen pen. Access to the laptop keyboard is not required. Recently, many surveyors have begun using pen-based computing tablets, such as the Hammerhead XRT from WalkAbout computers (figure 3). These pen tablets have a much simpler hardware setup with fewer cables and connections.

Aerial detection and mapping of invasive plants is currently being conducted by The Nature Conservancy (TNC) of Idaho in the Hells Canyon area of the Snake River and by the National Park Service in the Everglades, using a rotary wing platform (figure 4). Helicopters are advantageous because of their ability to fly slowly and hover when mapping; the disadvantage is a marked increase in operational cost over fixed wing aircraft.



Figure 3—Pen tablet PCs have a simpler hardware profile compared to the laptop-based system.

### **i** COSTS & EQUIPMENT

Hardware: \$8,000 - 10,000

- Laptop PC
- Touchscreen or
- Pen tablet PC
- GPS
- Cables

Software: \$600 - 1,400

- GeoLink or
- ArcPad

Operational costs: Variable

- Ferry time
- Flight time
- Processing time

### Costs

Hardware (laptop PC, touchscreen, or pen tablet PC, GPS, various cables) costs can run from \$8,000 - \$10,000, depending on what configuration is chosen and what is already available. GeoLink software costs approximately \$1,400 and ArcPad costs around \$600. Also, the purchase and processing of digital map data to display as a base map should be included in the budget; costs can vary widely depending on what the surveyor desires and what is currently available. Operational costs per acre can vary depending on aircraft ferry time (flight time from the airport to the survey area), the ability of the surveyor, target species, and survey pattern. Jason Karl (TNC- Idaho) reports \$0.20 - \$0.70 per acre for weed survey work in the Hells Canyon area of Idaho/Oregon using a helicopter.



Figure 4—Helicopter flying a mission to sketchmap invasive weeds in Idaho.

### Advantages and Disadvantages of Aerial SketchMapping

#### Advantages

There is a distinct cost advantage for using aerial sketchmapping over imagery-based mapping methods for most target species. For imagery-based mapping, it may be necessary to acquire imagery at multiple times during the growing season to account for variations in the time of appearance of phenological characteristics. For example, acquired imagery may show weeds in bloom on south facing slopes, but not on north facing slopes. Later in the season, weeds on the north facing slopes may be in bloom while those on the south slopes may already have gone to seed and would not be discernable. Multiple aerial survey flights during the growing season can be flown for less than the cost of acquiring the multiple sets of high-resolution imagery necessary to map invasive weeds.

Another advantage of aerial sketchmapping for invasive weeds is the quick turnaround of the data. Rather than waiting months for imagery to be collected, delivered, and processed, managers can have GIS-ready map data when the aircraft lands.

#### Disadvantages

An aerial sketchmap is the observer's interpretation of what is seen on the ground, and there can be differences between observers mapping the same area. Some surveyors tend to be "lumpers," combining many small areas of infestation into one large area, while others can be "splitters," preserving the many small areas. These differences in consistency can be a disadvantage, especially if more than one surveyor is involved in surveying the same area at different times of the year. To address this issue, forest health surveyors conduct calibration and conformity meetings yearly in the spring as a warm-up for the upcoming survey season.

#### **i** ASSISTANCE?

For more information or assistance, please contact

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