What Weeds Can Be Remotely Sensed?

Introduction

For some weeds, remote sensing may provide a cheaper, more efficient method of mapping infestations than ground surveys. However, many weeds are not good targets for remote sensing because they are indistinguishable from other native plants, particularly during vegetative growth. Therefore, it is critical to assess the likelihood of adequate detection before initiating a remote sensing-based mapping project. To guide this assessment, this document discusses and provides examples of:

- Biological traits that distinguish weeds from the surrounding vegetation
- The relative amount of weed cover compared to other vegetation as it relates to successful detection

QUICK LOOK

Objective:
This document will help you determine whether your weed is a good candidate for mapping using remote sensing. Important considerations include:

- Biological traits that help distinguish weeds from their surroundings
- Relative amount of weed cover compared to other vegetation

CAUTION

Determine the likelihood of detecting your weed before initiating a remote sensing-based mapping/monitoring project.

IMPORTANT

Imagery may need to be acquired more than once during the season because the time of appearance of distinguishing characteristics may vary with:

- *Elevation*
- *Weather*
- *Soil moisture*
- *Aspect*
- *Sun angle*

Distinguishing Biological Traits

Some invasive weeds have biological traits that distinguish them from their surroundings, making them good candidates for mapping using remote sensing. In some cases, these traits will allow them to be detected in nearly any environment. However, in other cases, the ability to detect the weeds will depend on the composition of the surrounding community. Some characteristics to consider include:

- Flowers and/or bracts
- Early green-up/senescence or late senescence
- Plant pubescence
- Canopy architecture
- Dicot weeds in grasslands
- Vegetation inhibiting root exudates
- Shadowing from tall weeds
- Growth form(s)
- Fall coloration

Flowers & Bracts

During peak flowering, weeds that would otherwise be indistinguishable from the surrounding vegetation may be easily identified. The bright yellow flowers and bracts of leafy spurge, for example, make the plants stand out from their surroundings (figure 1). Timing imagery acquisition to coincide with peak flowering is critical to success. Perennial pepperweed and hoary cress are other weeds that can be identified during peak flowering.

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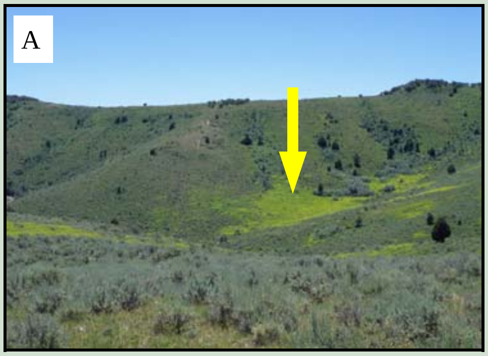

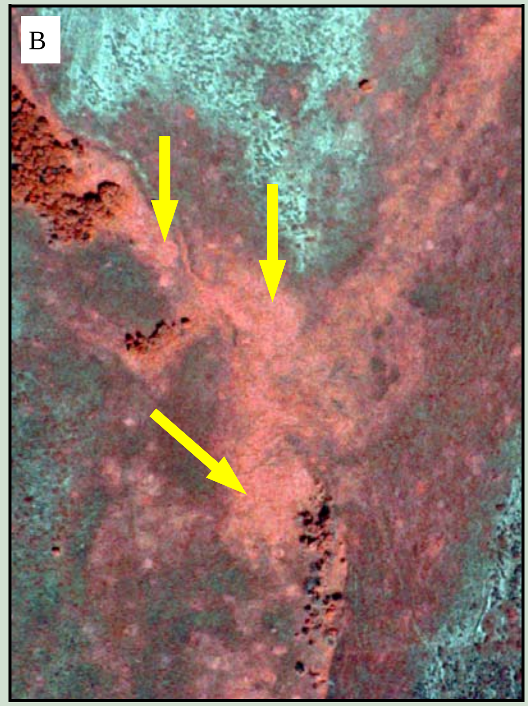

Figure 1—During peak flowering, leafy spurge is easily distinguished from surrounding vegetation. *(A)* The yellow flowers and bracts of leafy spurge can be seen from a distance. *(B)* Leafy spurge appears as a distinct light pink color in aerial color-infrared digital camera imagery (see arrows).

IMPORTANT

Distinguishing traits may only be present within a narrow window of time. Ensure that imagery is collected during the optimal window!

Early Green-up/Senescence or Late Senescence

Weeds that (1) green-up in the spring before green-up of the surrounding vegetation; (2) senesce before the surrounding vegetation does, or (3) senesce after the surrounding vegetation has senesced can be good targets for remote sensing. Cheatgrass *(Bromus tectorum)* (or downy brome), for example, greens-up early in the spring and then senesces before other grasses (figure 2).

To succeed in mapping these types of weeds, imagery acquisition must be timed at green-up, senescence, or both. Two acquisitions of imagery can often produce superior results compared to a single acquisition.

Figure 2—Cheatgrass senesces before other grasses, making it a good target for remote sensing at such times.

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***Silverleaf Sunflower**—In dense stands, silverleaf sunflower is a good target for mapping using remote sensing. Silvery pubescence allows this weed to be mapped using remote sensing.*

Plant Pubescence

Some highly pubescent (hairy) plants reflect incoming light much differently than the surrounding vegetation, allowing these plants to be detected using remotely sensed imagery. The pubescence of silverleaf sunflowers makes them a good target for mapping using remote sensing (figure 3).

Figure 3—Heavy pubescence on the leaves of silverleaf sunflower *(Helianthus argophyllus) (A)* reflects more visible and infrared light than surrounding vegetation. In sufficiently dense stands, this weed can be identified from color infrared aerial photography *(B).* Silverleaf sunflower appears as a pinkish color at the arrow.

***Rush Skeletonweed**—The architectural structures of rush skeletonweed, such as its erect stems and small, sparse leaves, make this weed difficult to map using remote sensing.*

Canopy Architecture

Some weed species can be distinguished because of their canopy architecture. Broom snakeweed, for example, has an erect-leaf canopy structure that gives it a dark image response (figure 4).

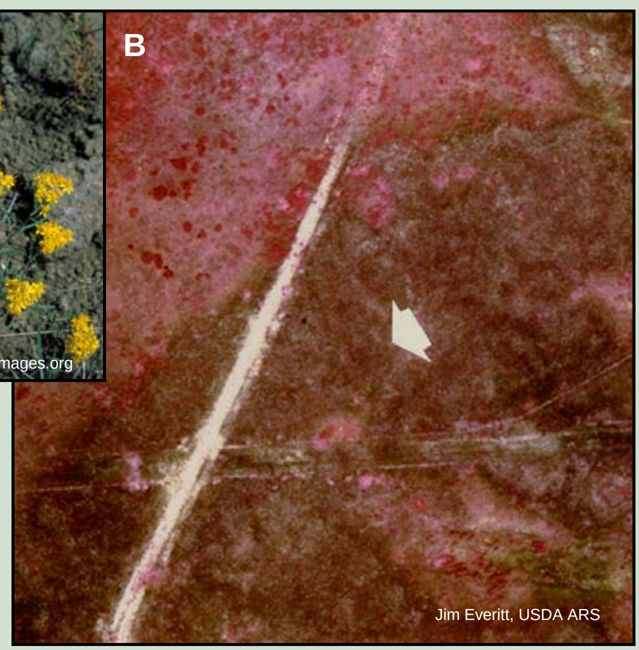

Figure 4—The erect-leaf canopy architecture of broom snakeweed *(Gutierrezia sarothrae) (A)* results in a dark brown color (see arrow) on color infrared imagery *(B).*

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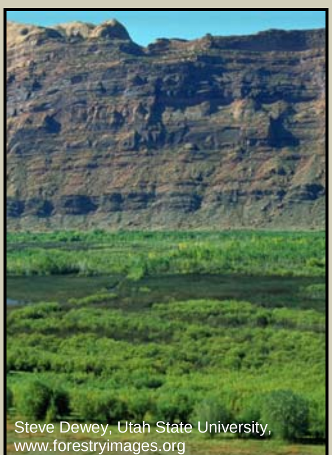
Spotted knapweed—*Root exudates from spotted knapweed inhibit the growth of the surrounding vegetation. Increased visible bare soil around spotted knapweed plants may make them visible in remotely sensed imagery.*



Saltcedar—*During the spring and summer, saltcedar has leafy salt glands that may make it a potential target for detection using remote sensing. However, additional work is needed in this area.*

Dicot Weeds in Grassland

Some dicot weeds can be detected in grasslands using remote sensing because of higher reflectances in the near infrared. The erect canopy structure of grasses results in lower near-infrared reflectance, thus creating a detectable contrast between the weeds and the grasses.

Vegetation Inhibiting Root Exudates

Root exudates from species such as spotted knapweed inhibit the growth of other vegetation, thus increasing the amount of visible bare soil. In some cases, the bright reflectance from the bare soil allows this weed to be mapped with remote sensing.

Shadowing from Tall Weeds

Some weeds are much taller than the surrounding vegetation and will cast distinct shadows when the sun is low in the sky. If imagery is collected when the sun is low in the sky, shadows can be identified to determine the locations of infestations.

Fall Coloration

During the fall of the year, the foilage of some weeds change to a color that is distinct from the surrounding vegetation, allowing mapping of these species using remote sensing. The leaves of Chinese tamarisk (*Tamarix chinensis* Lour.) (or saltcedar), for example, turn yellow-orange to orange-brown in the fall, just before leaf drop (figure 5).

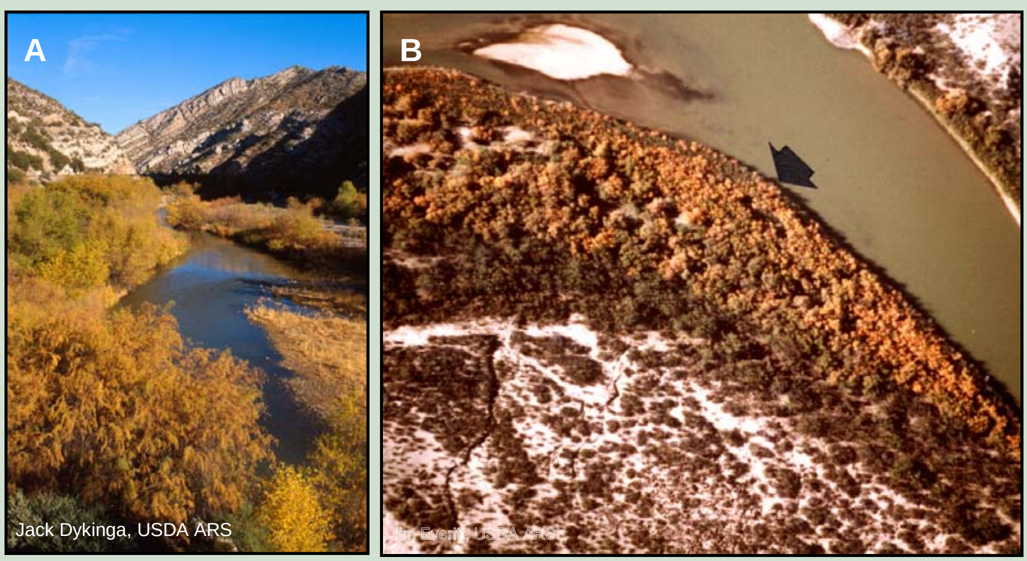


Figure 5—In the fall of the year, the leaves of Chinese tamarisk (saltcedar) turn yellow-orange to orange-brown in color *(A)*. On natural color aerial imagery, *(B)* the fall coloration of the tamarisk (arrow points to orange colored tamarisk plants) distinguishes it from the surrounding vegetation.


Vince Belleci, www.forestryimages.org

Scotch thistle*—Weeds such as Scotch thistle, which are much taller than the surrounding vegetation, may be discernable in remotely sensed imagery collected late in the day because of shadowing.*

Relative Weed Cover

An important factor to consider for remote sensing of invasive weeds is the relative amount of cover compared to other vegetation. Studies have shown that there is some threshold level of cover below which a weed species cannot be detected by remote sensing. Therefore, invasive weeds that are naturally clumped (e.g., plants that spread through underground rhizomes) may be more easily detected than plants that have a uniform distribution. For example, studies have shown that for flowering leafy spurge, the minimum detection threshold may be about 10 to 20 percent cover.

As you decide whether your weed is a good candidate for mapping using remote sensing, be sure to consider the likely density of the weed across the survey area. You may also want to find out if others have mapped the weed using remote sensing and, if so, what was their minimum threshold for weed cover.

ASSISTANCE?

For more information or assistance, please contact

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