

Spectroscopic Remote Sensing of Invasive Plants

VSWIR/TIR Detection of Biochemical Signatures and Evaluation of Ecosystem Impacts

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Invasive Species

A Top Environmental Issue of the 21st Century ...

■ Economic Costs:

- **\$137+ Billion / Yr**

(Pimentel, et al. 1999; NISRC Management Plan, 2001)

■ Environmental Costs:


- **Decreased biodiversity, ecological services, etc.**

■ Human-Health Costs:

- **West Nile Virus, Malaria, etc.**

■ Agricultural Costs:

- **Crop pathogens, hoof-and-mouth, mad cow disease**


PEST ALERT 

Emerald Ash Borer (EAB)

Exotic insect pests like EAB are a major threat to Michigan's 19 million acres of forestland and 700 million ash trees. EAB aggressively attacks and kills ash trees. This unwanted pest can become established when infested firewood is transported to a new area. Because the insect is under the bark, you usually cannot tell that you are giving this unwanted "hitchhiker" a ride. So, you are asked to:

- Make sure you are not transporting wood from an EAB quarantined area. Doing so is illegal. (Visit www.michigan.gov/mda and click on "Emerald Ash Borer" in the Spotlight section to view current quarantined locations).
- Use local sources of firewood.
- Do not bring firewood from home.
- If you have already brought firewood from home or another source, do not dump it, leave it, or take it back. BURN IT IMMEDIATELY.

Also, as you camp, hunt, fish, visit, or simply enjoy Michigan, please be on the lookout for this unwanted pest. In ash trees only, if you see the following signs:



Die Back Shoots/Suckers Larvae S-shaped galleries D-shaped exit hole


Report immediately via
Michigan Emerald Ash Borer Hotline: (866) 325-0023

DON'T MOVE FIREWOOD


Working together we can help stop this invader and protect and preserve Michigan's natural resources.

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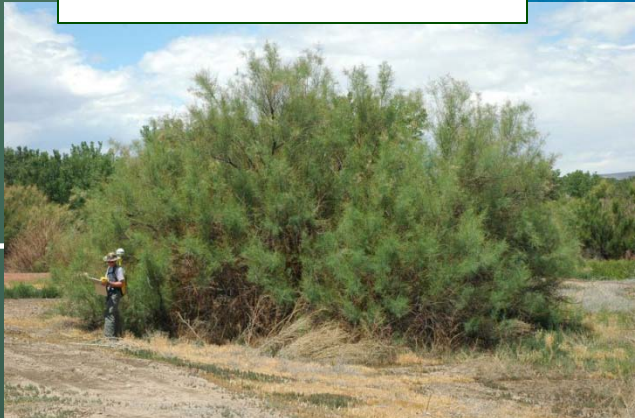


WARNING
Remove all plants from:
Boats, trailers, props, anchors, anchor lines, live wells, and fishing equipment.



It's the Law



For more information
800-452-1942



Invasive species

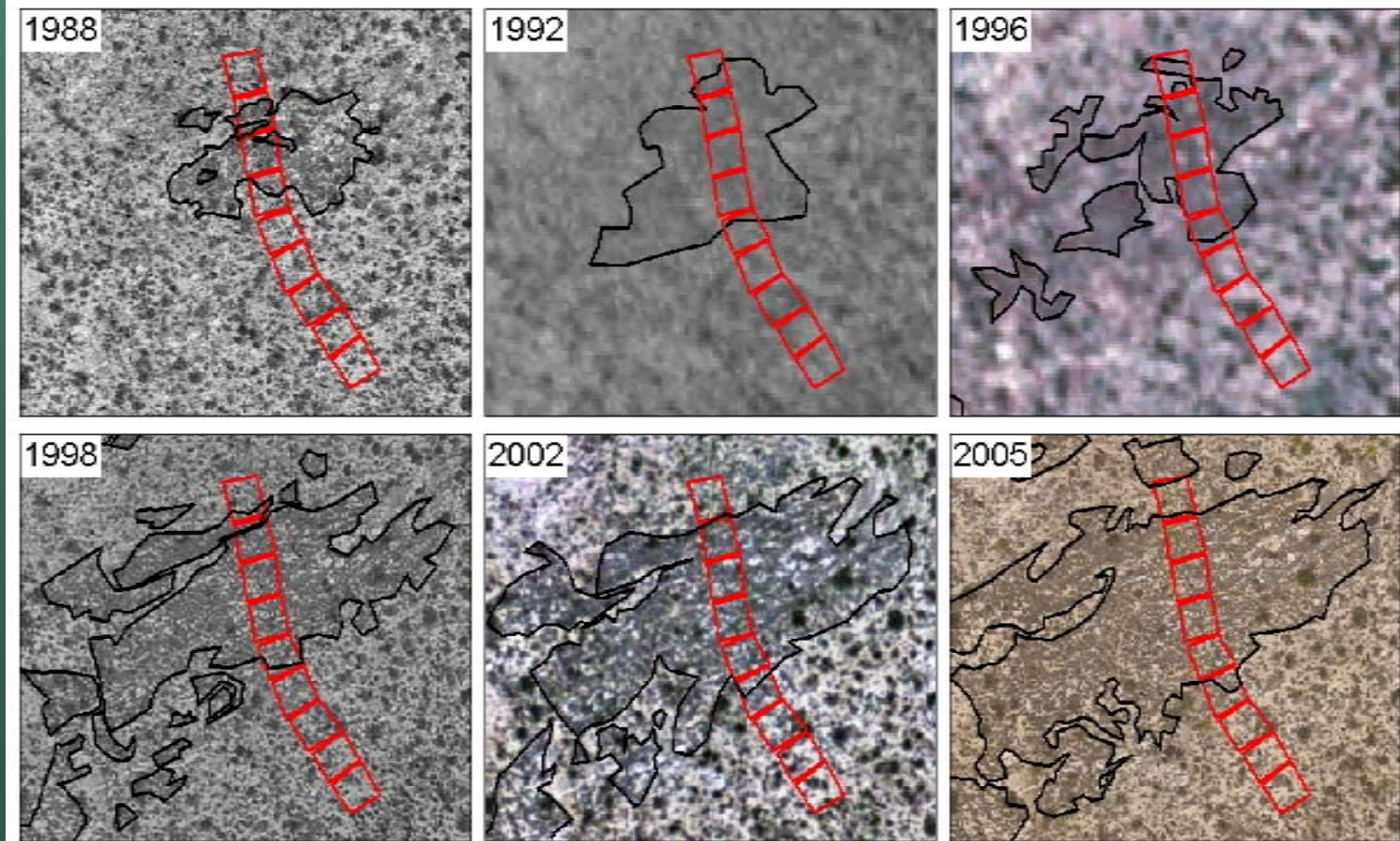


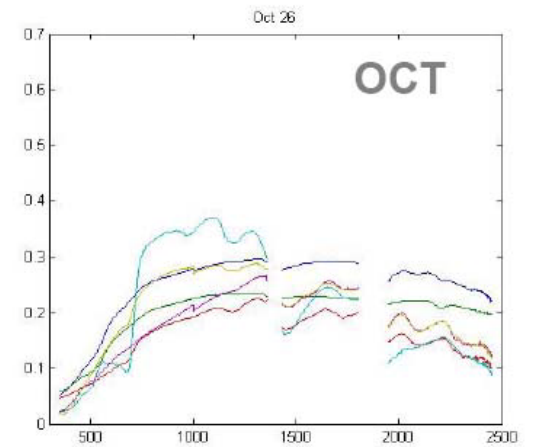
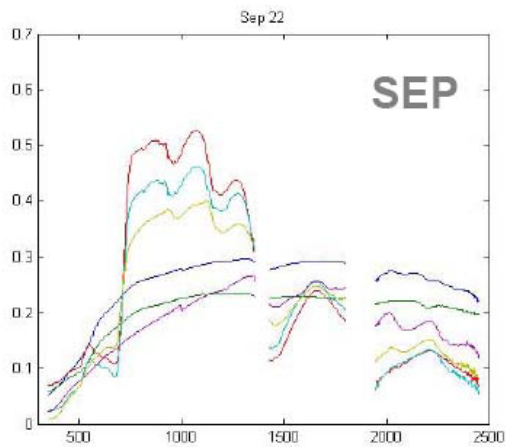
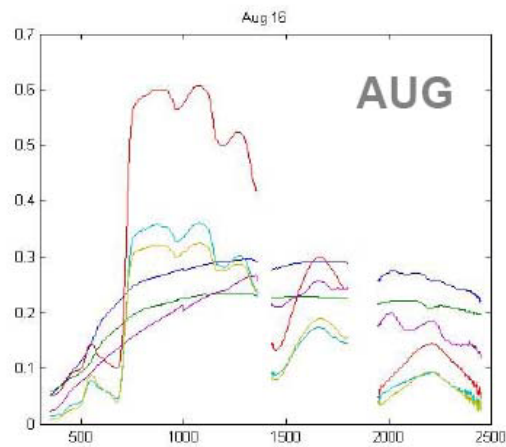
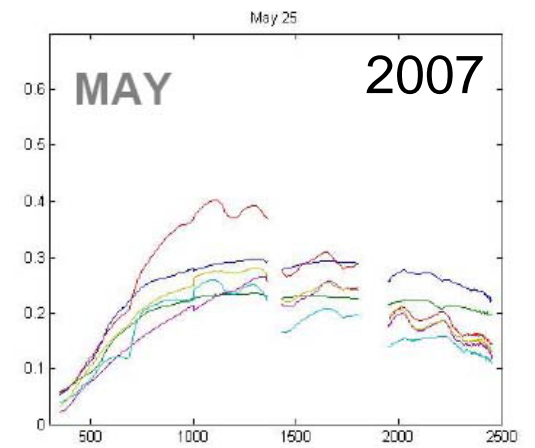
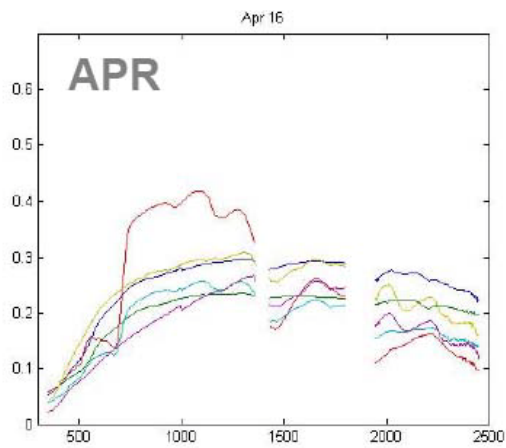
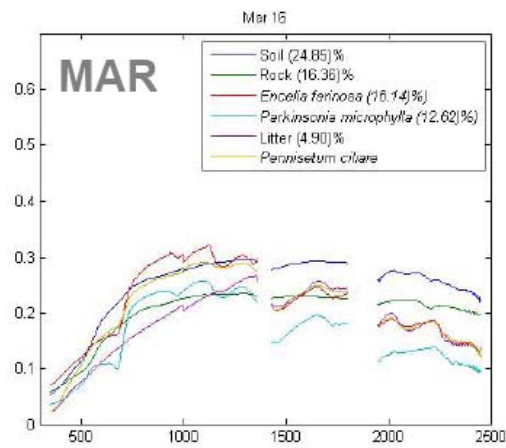
- Where is it now?
(locating)
- Where can it survive?
(habitat modeling)
- What are the ecological and economic impacts?
(impacts)
- How does it spread?
(dispersal/vectors)
- How can we control it?
(efficacy)

Buffelgrass (*Pennisetum ciliare*)



Field Spectroscopy at plots near Tucson, AZ





Earlier senescence of buffelgrass (SEPT) compared to dominant natives

Spectroscopic Remote Sensing

- **VSWIR: Detect patterns of pigment, water and cellulose/lignin content consistent with invasive plant and divergent from native plants**
- **TIR: Calculate land surface temperature, model evapotranspiration, compare to air temperature to reveal temporal patterns divergent from native plants**

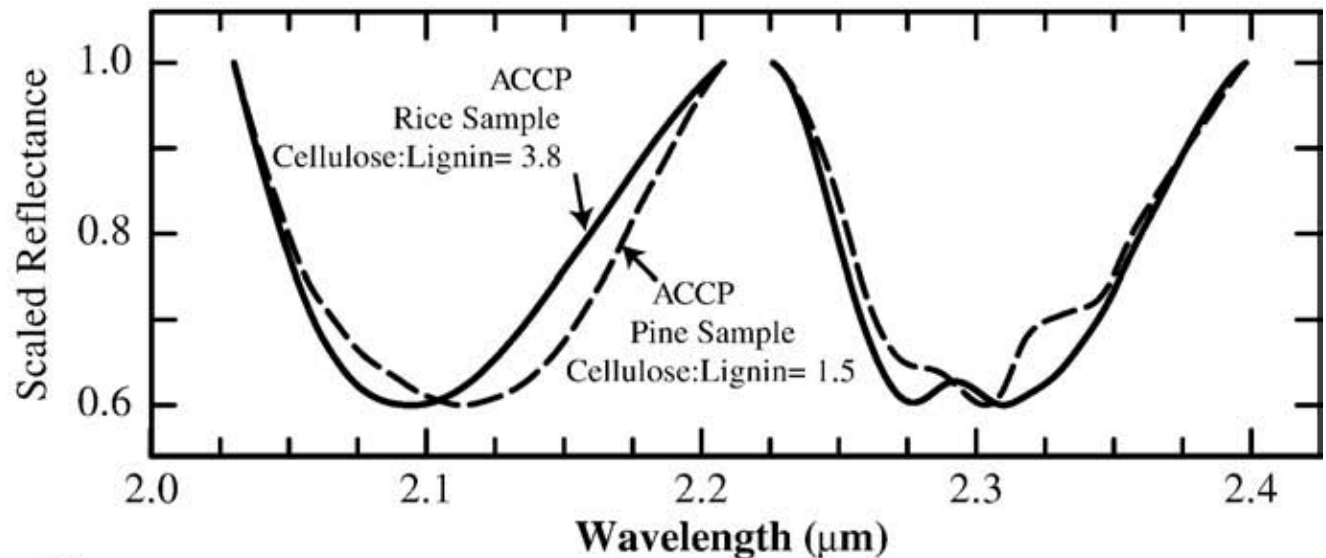
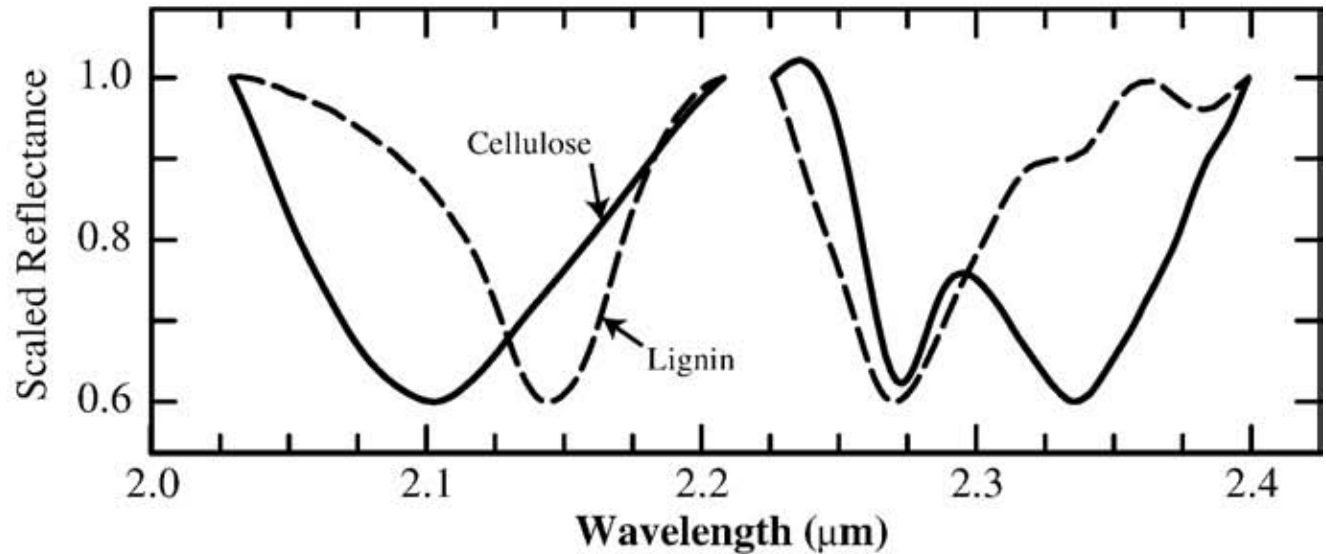
Thermal Infrared

Thermal-band detection of land surface temperatures (LST) minus the air temperature (T_a), will aid in distinguishing BG invasions in the summer monsoon period (August) versus the rest of the year

	Uninvaded Desert	Invaded Desert
Most of Year	Low CAI Low NDVI Bare soil w/high LST - T_a	High CAI Low NDVI Dormant BG w/ low LST - T_a
Summer Monsoons	Low CAI High NDVI Bare soil w/high LST - T_a	Low CAI Highest NDVI Green BG w/very low LST - T_a

VSWIR

A change in plant composition to grass dominated system leads to cellulose dominated absorption features in reflectance spectrum



Application of Results

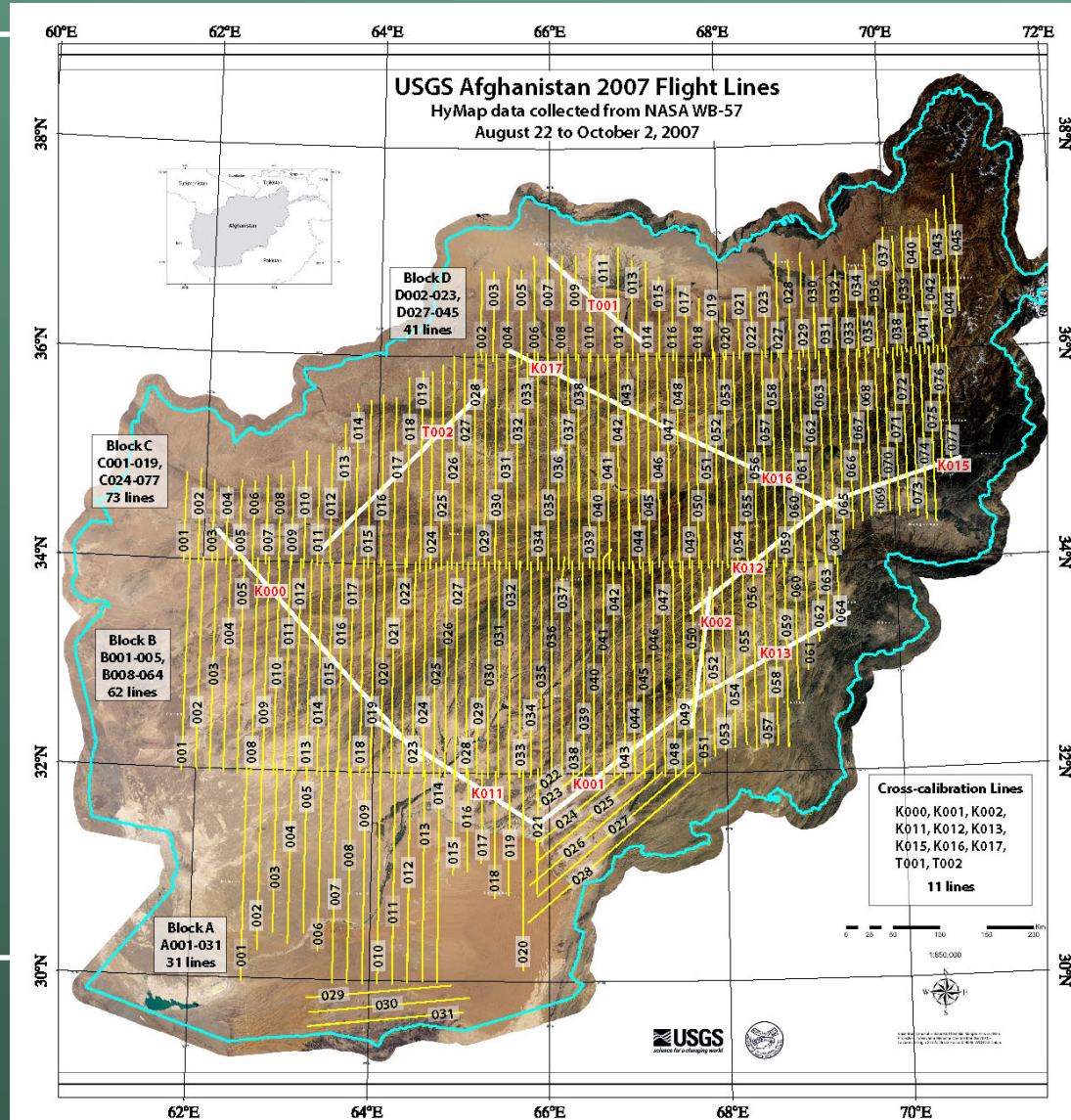
- Land management (treatment and evaluation)
- Shifts in plant composition (to non-woody)
- Soil composition (formation of caliche)
- Fire promotion (post-fire soil impact)
- Predictive modeling of expansion
- Climate change
- Identification of areas at risk for invasion

National-level detection, monitoring and early warning system for invasive plant species

Large Area Coverage

Large area coverage by VSWIR + TIR

- needed for current land management
- significant for HypsIRI calibration, product development
- largest, continuous imaging spectrometer data coverage was done in 2007 in Afghanistan, no TIR



Opportunities and Challenges

- **Arid and semi-arid ecosystems**
 - Low percent cover by plants
 - Effects of soil and hydrologic changes
 - Soil mineral composition detectable
- **Invasive plant species**
 - Detection of small infestations
 - Broad areas need to be covered
 - Temporal trends in expansion

National-level detection, monitoring and early warning system for invasive plant species
