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# “Phrag” is a Drag: a Bird's Eye View of a Pesky Invasive Plant

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## a Bird's Eye View of a Pesky Invasive Plant

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Have you ever wondered what that really tall plant is? –the one that’s often found growing along highways, next to construction sites and in many tidal marshes; the one that’s 10 feet, 12 feet high, or taller? It may very well be *Phragmites australis*, also called common reed. Its name (pronounced “frag-my’-tees”) comes from the Greek word, phragma, which means fence or hedge. If you’ve ever seen *Phragmites* growing along the edge of streams or mosquito ditches in tidal marshes, you’ll agree that its height, abrupt edge and high density form a natural nearly impenetrable “fence.”

*Phragmites* is an invasive plant, although it’s not new to this area. Based on peat core samples, researchers have determined that it has grown in New England marshes for centuries but that until recently it was a relatively minor component of the landscape. Now it seems to be growing everywhere. Its sudden and explosive growth is believed to be the result of a non-native strain that was introduced to North America around 100 years ago.

The non-native strain is an aggressive invasive plant that has significantly altered many of the state’s tidal marsh communities. It forms very dense monocultures that stop sunlight from reaching the marsh surface, thereby preventing other indigenous plants from growing. This reduces the marsh plant biodiversity and reduces habitat for many waterfowl and other animal species.

“Within the lower Connecticut River, invasive *Phragmites* is eclipsing the biological integrity of many unique and exemplary tidal marsh communities, displacing several rare and endangered plant species not found elsewhere in other habitats,” notes Dr. Nels Barrett of the USDA Natural Resources Conservation Service.

A study done by the author and Dr. Nels Barrett used 1968 and 1994 stereo black and white aerial photography to document changes in the geographic extent of *Phragmites* in tidal marshes of the lower Connecticut River. Over this 26 year period there were dramatic increases in many areas and some marshes became totally dominated by *Phragmites*. One such example is Goose Island, located approximately 4.5 miles north of the river’s mouth. In 1968, *Phragmites* covered less than two of the island’s 96 acres. By 1994 it had expanded to cover more than 61 acres, or about 64% of the island’s area. Today, the island is almost completely covered with *Phragmites*.

James Hurd, a UConn remote sensing specialist, stands in front of a patch of *Phragmites australis* at the Ragged Rock tidal marsh, near the mouth of the Connecticut River. *Spartina patens*, a low-growing marsh grass, is in the foreground.

The Nature Conservancy, the Connecticut Department of Environmental Protection, the Natural Resources Conservation Service of USDA, and several other public and private organizations recently have begun work to remove *Phragmites* from a number of sites in the state, especially from marshes in the tidelands region of the lower Connecticut River. This work, which is still somewhat experimental, (there is not yet an agreed upon best way to eliminate *Phragmites* and we don’t know the long-term efficacy of different methods) uses herbicides to kill the plants, which are then mechanically mulched to allow sunlight to again reach the marsh surface. This permits seeds that have been dormant for years to germinate in the spring and to repopulate the site with a variety of native vegetation.

One of the problems in working in the tidal marshes is that they are relatively inaccessible and it’s very difficult to accurately map vegetation communities

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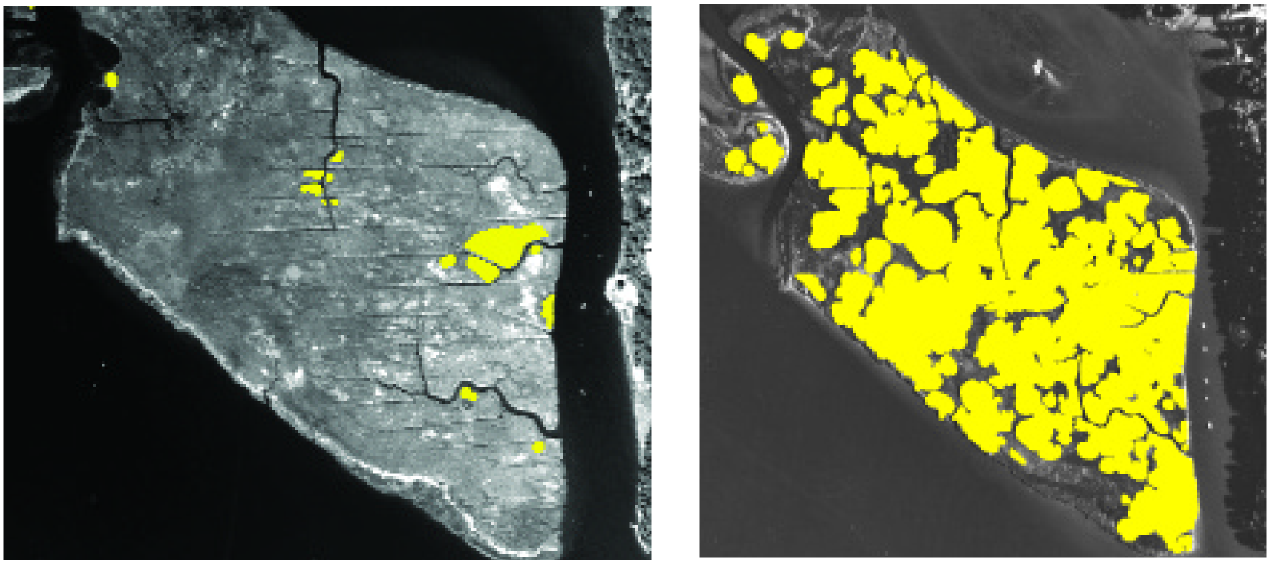

Goose Island in 1968 (left) and 1994 (right). Areas of *Phragmites* are shown in yellow.

using field-based methods. A team of researchers from the University of Connecticut, Wesleyan University, and the University of New Haven has been investigating the use of remote sensing using digital imagery acquired from satellite and airborne sensors to help address these problems. The team is developing methods to classify high-resolution images to identify existing stands of *Phragmites* and other vegetation types, to map and quantify treated areas and to monitor long-term vegetation changes.

Digital images that are being classified are comprised of hundreds of thousands of small squares called pixels. Each pixel corresponds to an area on the ground and stores the reflected energy values for that area. The size of each pixel determines the resolution or what can be "seen" in an image. Smaller pixels provide more spatial detail while larger pixels give us a more generalized "picture" of what's on the ground.

Dr. Marty Gilmore using a portable ASD spectrometer to collect spectra of a year-old cattail flower.

Although these digital images look like photographs, they actually contain data that measure the amount of reflected energy within specific portions of the electro-magnetic spectrum. For example, some sensors record blue, green, and red wavelengths that we can see, as well as near-infrared wavelengths that are invisible to our eyes. These sensors extend our ability to "see" into other portions of the spectrum and to gather information that can help identify different types of plant communities. This is possible because different types of plants reflect sunlight differently.

Through support from the EPA, the NOAA Coastal Services Center and the Institute for the Application of Geospatial Technology, the research team is assembling a multi-temporal collection of high-resolution multi-spectral Quickbird satellite imagery (pixel resolution = 2.6 meters) for four locations in Connecticut (Wheeler Marsh, Chapman Pond, Barn Island, and the lower Connecticut River) and for Flax Pond on the north shore of Long Island. The team also has acquired a single date set of very high-resolution airborne ADS40 imagery (pixel resolution = 0.5 meters) for all of Connecticut's coastal communities. These image datasets contain spectral values in the blue, green, red, and near-infrared portions of the spectrum and are being used to identify *Phragmites* and other common vegetation communities such as cattails (*Typha* spp.) and smooth cordgrass (*Spartina patens*).

To help classify the multi-spectral images, Dr. Marty Gilmore, Assistant Professor of Earth & Environmental Sciences at Wesleyan University and the UConn team have been collecting plant spectra throughout the 2004 and 2005 growing seasons at several tidal marsh sites.

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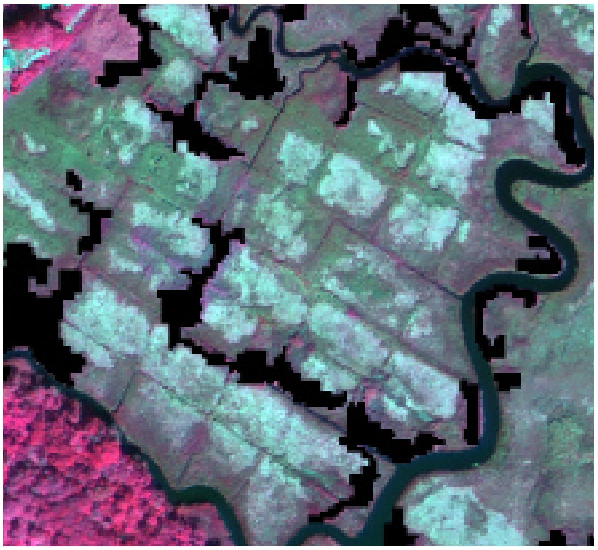
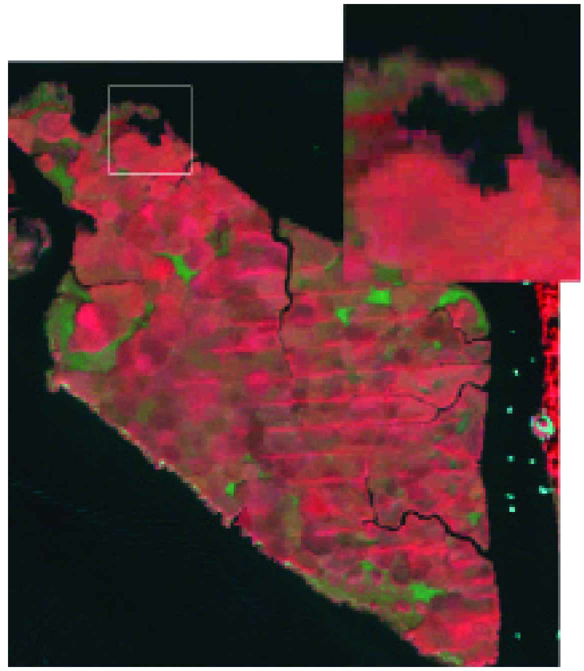


In this image of the Ragged Rock marsh, areas shown in black are stands of *Phragmites* that were identified using spectral properties of the image. These map data can be used to identify locations of *Phragmites* and to calculate the acres to be treated.



September 2004 Quickbird satellite image of Goose Island, taken from an altitude of 270 miles, displayed as a false-color infrared image in which growing vegetation appears red and water is dark. The enlargement shows individual pixels each of which has a ground resolution of 2.6 meters on a side.

"The spectral response curves reflect the biophysical and biochemical properties of the plants at a specific time and will help us document changes in each plant species over the growing season. We are looking at these spectra to determine at what time of year species are most distinct. We hope that we can recognize marsh species in past and future satellite imagery to monitor changes in plant diversity through time," says Dr. Gilmore.

Using specialized image processing software, Emily Wilson and James Hurd, remote sensing experts at UConn, will use the data on plant spectra to help classify the digital imagery. Image classification is a process in which spectral data in the image are used to create maps of that depict the locations of various plant communities. In very simple terms, this involves grouping pixels with similar spectral properties together into "objects" and then assigning similar objects to the same plant community class. While in concept this sounds simple, in practice it's very difficult. There are all kinds of physical and biological conditions that complicate the process (for example, shadows, mosquito ditches, tide stage, standing water on the marsh surface, clouds, mixed plant communities).

Like most research, this project represents an ongoing effort to integrate state-of-the-art technology to better map and understand resources of special concern. Preliminary results from the team's work are very encouraging. Based on collection and analysis of field spectra, it's been determined that the best dates to acquire imagery to classify and map *Phragmites*, the time that it appears spectrally most different from other plant communities, is late summer/early fall.

This information will result in better and more accurate maps that ultimately will help wetland managers and restoration specialists do a better job. Still to be investigated are methods to monitor future changes, especially to detect and map at an early stage, areas that are being reinvaded by *Phragmites*. Such information will help identify, and more easily treat, problem areas before they become too well-established and costly to eradicate.

Sandy Prisloe is an educator with the Department of Cooperative Extension in the College of Agriculture and Natural Resources. He manages the Geospatial Technology Program which is part of the Center for Land Use Education and Research. Other team members working on this project include Dr. Martha Gilmore, Wesleyan University; Dr. Nels Barrett, USDA Natural Resources Conservation Service; Emily Wilson, James Hurd and Dr. Dan Civco, University of Connecticut; Dr. Roman Zajac, University of New Haven and Cary Chadwick, a graduate student at the University of New Haven.