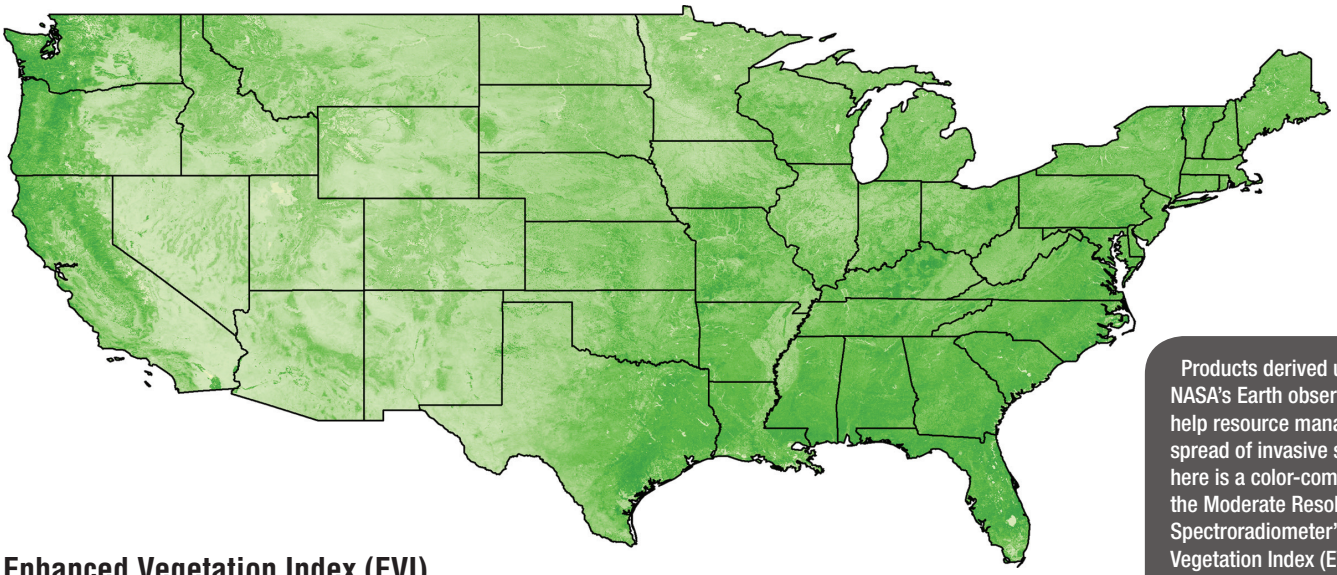
National Aeronautics and Space Administration

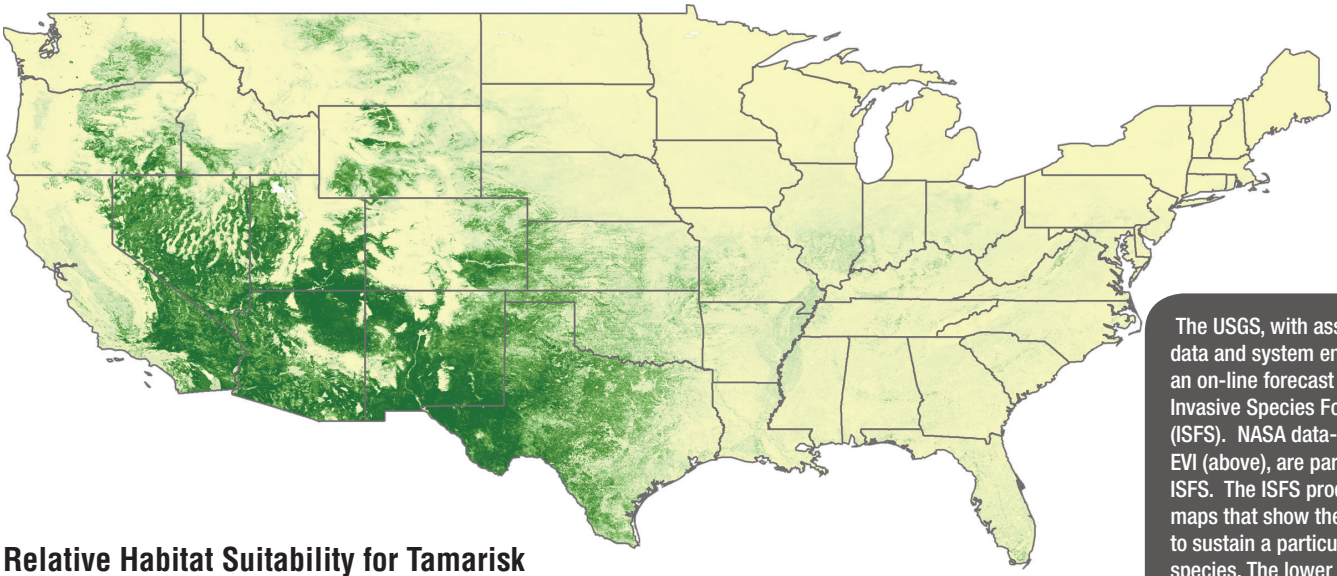
SCIENCE SERVING SOCIETY: INVASIVE SPECIES



Enhanced Vegetation Index (EVI)

-3 10

Products derived using data from NASA's Earth observing satellites help resource managers control the spread of invasive species. Shown here is a color-composite map of the Moderate Resolution Imaging Spectroradiometer's (MODIS) Enhanced Vegetation Index (EVI) data product (top). EVI is an indicator of the vigor of vegetation. The greener the area is on this map of the United States, the more vigorous the vegetation.



Relative Habitat Suitability for Tamarisk

Less Suitable Highly Suitable

The USGS, with assistance from NASA data and system engineering, created an on-line forecast tool called the Invasive Species Forecasting System (ISFS). NASA data-products, such as EVI (above), are part of the input to the ISFS. The ISFS produces predictive maps that show the relative suitability to sustain a particular invasive plant species. The lower map shows habitat suitability for tamarisk, an invasive plant with major economic impact in the Western United States.

The ISFS provides more accurate and extensive information to land managers than previously available and improves the efficiency of efforts to control invasive species, such as tamarisk, hogweed and garlic mustard, whose spread can have significant negative economic impacts.

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Overview of the Program

At present, an array of Earth observing satellites are in orbit, and additional launches both by NASA and others will continue throughout the next decade. Our ability to observe our home planet from space has never been greater. Increasingly, studies of the Earth focus on understanding the Earth's land, atmosphere, oceans, and life as a whole integrated system rather than as individual independent elements. NASA is an important contributor in this systems approach to Earth science studies.

In addition to providing Earth observing capabilities, NASA forms strategic partnerships with other government, academic, private, and international organizations. Through these partnerships, NASA's Earth science observations and measurements are linked to practical applications. NASA data, information, and predictive models help NASA's partners, and nontraditional users of Earth science, make timely and accurate decisions regarding management of resources and development of policy. The agency's goal is to maximize the benefit of science and technology to stakeholders by smoothly flowing Earth science data and information from NASA satellites to society.

Invasive Species

Invasive species may be defined as a non-native plant, animal, or microbe whose introduction causes, or is likely to cause, harm to the economy, the environment, or human health. Increasing globalization—the rapid transportation of people and goods throughout the Earth—provides the opportunity and the mechanism for such species to enter the United States and thrive in new habitats. Each year, the U.S. incurs direct losses of approximately $120 billion due to these invasive species—an annual cost greater than most natural disasters combined.

Once a particular invasive species becomes established in a region, it is difficult to remove. The cost to control and eradicate invasive species that are already entrenched is prohibitive, therefore, response programs are aimed at trying to prevent invasive species from becoming established in new areas. Efforts are aimed at predicting where invasive species are likely to appear next so that control measures can be applied when the cost is low and success is more likely.

Until recently, most attempts to monitor and track the spread of invasive species have relied almost completely on field monitoring. For the most part, these studies have been too slow, costly, and inefficient to be effective because of the rapid rate at which these species spread and the manpower required for field studies. Earth observing satellites offer a much more efficient means of monitoring the spread of invasive species. The unique vantage point of space offers a perspective that field observations cannot match. NASA has substantial expertise at collecting and analyzing Earth science information and makes this information available to assist in the study of invasive species.

NASA works with a variety of federal, state, local, and tribal agencies to respond to the threat of invasive species. Earth observation data from NASA satellites and model outputs for monitoring land cover and climate are combined with ground data supplied by the agencies responsible for invasive species control to identify the corridors where invasive plants are likely to spread. NASA's computational capabilities are utilized to develop systems to generate predictive maps for invasive species.

For example, the U.S. Geological Survey (USGS) enhanced its ability to generate predictive maps of invasive species through the Invasive Species Forecasting System (ISFS) by using NASA Earth observations and systems engineering. The ISFS is an interactive, flexible, on-line tool that helps public and private users respond to the threat of invasive species. The ISFS will be fully operational by 2008.

One of the first species mapped using the preliminary ISFS is tamarisk, a prolific, non-native shrub that has spread across much of the southwestern United States in the past 150 years. Tamarisk thrives along stream and river reaches, where it competes with native vegetation and transforms the habitat by increasing soil salinity and consuming vast amounts of water. USGS is using the ISFS and the partnership with NASA to deliver up-to-date information to land managers on tamarisk location and potential spread. Recently, the team developed a National Habitat Suitability Map for tamarisk using time-series data from the Moderate Resolution Imaging Spectroradiometer (MODIS) on Aqua and Terra (see front page). The model combines ecological and biological field data with remotely sensed data to produce a map of habitat suitability for tamarisk (i.e., where tamarisk can be found) and a confidence map for the prediction. Multispectral and hyperspectral data from the Advanced Spaceborne Thermal Emission and Reflection Radiometer (ASTER) on Terra and the Hyperion instrument on the Earth Observing-1 (EO-1) satellite have been instrumental in enhancing the model for tracking the spread of tamarisk and guiding ground data collection strategies. Research continues on improving the model by adding elevation, soil composition, carbon storage, and other data.

The Earth Science Division in NASA's Science Mission Directorate is the primary source of Earth observation data for the ISFS. In the next decade, additional data from NASA satellites will be incorporated into the ISFS as they become available, which will further enhance our ability to plan cost-effective responses to invasive plant species.

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