National Aeronautics and Space Administration

Landsat's Critical Role in Managing Ecosystems and Biodiversity

Our world is made of complex networks of living things and physical elements that constantly interact and affect each other. Such networks are known as "ecosystems." Healthy and economically important ecosystems such as temperate forests, wetlands, grasslands, coastal zones, coral reefs, and rainforests all play roles in human life. For example, farm and rangeland ecosystems must be healthy to produce the grains and livestock on which we depend as a nation. Marine ecosystems depend on the health of land ecosystems, because coastal areas provide habitat needed to support the productivity and diversity of aquatic organisms.

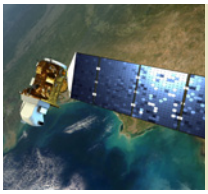
Landsat has brought valuable capabilities to ecosystem studies. Landsat instruments measure reflected light in visible and infrared wavelengths. Because plants reflect little visible light and a lot of infrared light when they are healthy, the measurement of both types of light simultaneously gives scientists a way to assess plant health and density over a landscape. Measurements are detailed enough while still covering a wide area that ecologists can expand their interpretations of local events and processes, such as an insect infestation in a specific forest, to a regional scale. This helps them to gauge the health of larger ecosystems. Because Landsat data are accurately mapped to reference points on the ground and adjusted for topographic relief, they can be integrated with other geographic data sets and models to explore more complex studies of ecosystems and biodiversity across space and time.

Designed, built, and launched by NASA, Landsat satellites have recorded global ecosystem conditions every year since the 1970s.The U.S. Geological Survey provides

this valuable data to the public at no cost. Landsat observations continue into the future with the Landsat Data Continuity Mission, the eighth in the series of Landsat missions.

Data for Decision Making

- Mapping ecosystems
- Quantifying the rate and extent of forest disturbance and re-growth
- Tracking species distributions
- Assessing the effectiveness of ecosystem restoration projects



ABOUT LANDSAT

Landsat satellites provide an unparalleled record of Earth's varying landscapes. Landsat's 30-meter resolution is ideal for measuring human impacts on the land. The consistency of Landsat's digital image data from sensor to sensor and year to year makes it possible to trace land cover changes from 1972 to the present.

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Landsat and Ecosystems

Mapping ecosystems

Coral reefs, coastal waters that host giant kelp, barrier islands, and thick mangrove forests provide critical shelter and food for innumerable species of marine life, many of which are economically important. Landsat data have made it possible to map all of these ecosystems accurately on a global scale. Because of Landsat, researchers identified 650 previously unrecognized barrier islands worldwide and made the first global inventory of coral reefs. Such maps help researchers to identify potential rehabilitation sites, set conservation priorities, and quantify ecosystems' contributions to fisheries and their roles in saving lives and property from natural disasters such as hurricanes and tsunami.

Quantifying the rate and extent of ecosystem disturbance and re-growth

Fire, insect outbreaks, and logging are among the processes that disturb forest growth, and they vary widely across the continent. They affect the amount of carbon in the atmosphere. Disturbance events tend to emit carbon to the atmosphere, and recovery from disturbance tends to sequester carbon from it. The Landsat Ecosystem Disturbance Adaptive Processing System project recently assembled a coast-to-coast record of forest disturbance for the United States and Canada for the period 1990–2000. Data analysis showed common disturbance rates of 2-3% per year, and this has reduced uncertainties associated with studies of the North American carbon cycle.

Tracking species distributions

When non-native species of plants and animals invade an ecosystem, they can marginalize native species and harm the ecosystem. Jeffrey Morisette, PhD, Assistant Center Director for Science at the U.S. Geological Survey Fort Collins Science Center, explains, "The threats caused by invasive species have become one of the greatest environmental challenges of the 21st century in economic, environmental, and human health expenditures, with an estimated cost in the United States of more than $120 billion per year." Landsat provides key data for mapping and assessing the ecological and biophysical impacts of tamarisk, kudzu, cheatgrass, purple loostrife, and other invasive species.

Assessing the effectiveness of ecosystem restoration projects

Mississippi River delta diversion projects were established in the early 1990s to help restore deteriorating wetlands. Dr. Michael Kearney of the University of Maryland employed Landsat data in an analysis of the effects of three such freshwater diversion restoration projects. He and his team found there was no significant marsh recovery in these diversion areas. In fact after Hurricanes Katrina and Rita, the diversion project areas were more severely damaged than non-restored areas. They have been slow to rebound, while in the non-restoration areas recovery has been swift. Landsat-based assessments can provide data that help to improve the effectiveness of restoring of many kinds of land and coastal ecosystems.

The lagoons and coral reefs of New Caledonia harbor impressively rich biodiversity. This Landsat 7 image acquired on May 10, 2001, shows coral reefs enclosing the waters near the islands in shallow lagoons. Those ecosystems harbor large numbers of predators and fish, turtles, and the world's third-largest dugong population.

Further Reading

Landsat Ecosystem Disturbance Adaptive Processing System
http://ledaps.nascom.nasa.gov/

Millenium Coral Reefs Landsat Archive
http://oceancolor.gsfc.nasa.gov/cgi/landsat.pl

NASA Landsat: http://www.nasa.gov/landsat

USGS Landsat: http://landsat.usgs.gov/

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