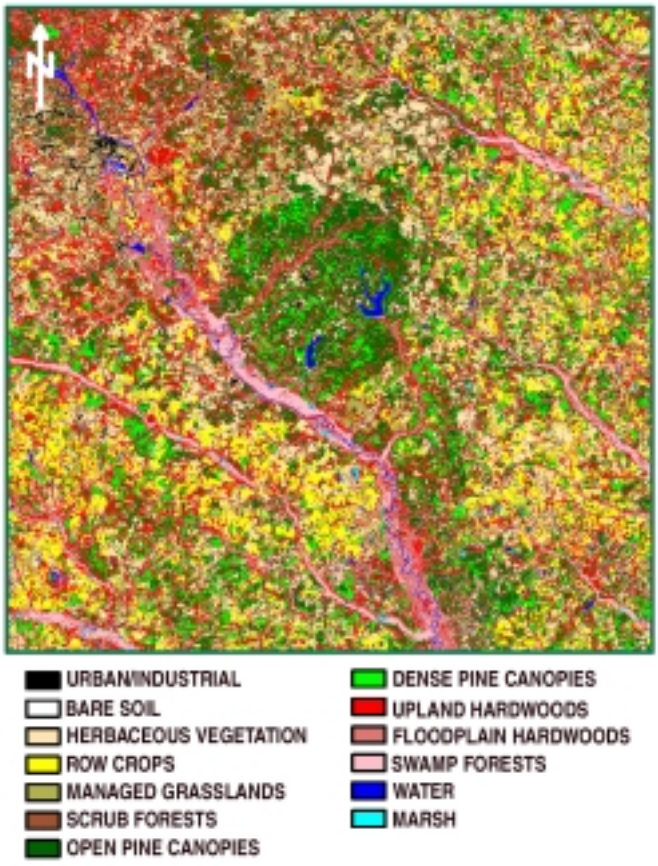
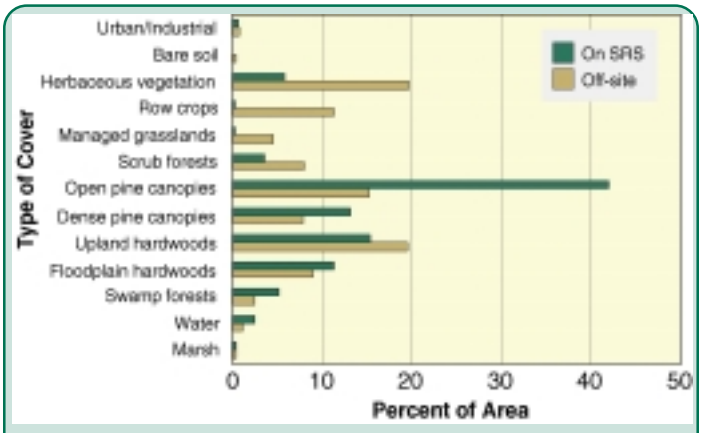
Habitat Analyses using Remote Sensing Technologies

Much of the sun's energy that reaches the earth's surface is reflected back into space. This includes not only the red through blue colors of visible light but also nonvisible parts of the spectrum of electromagnetic radiation such as ultraviolet and infrared energy. Since the 1970s, satellites have been monitoring this reflected energy, forming images of the earth's surface, and returning the images to earth-based receiving stations. The scientific discipline of remote sensing involves the processing and analysis of these images to map, detect, and quantify changes in the earth's surface.

Satellite images, such as the one shown below, clearly show the contrast between the forested Savannah River Site (SRS) and the surrounding, largely agricultural area. The predominance of forests on the SRS appears as broad areas in shades of bright green. Bare soils, fallow fields, crops, and abandoned farmland in the surrounding area are relatively small patches of white, faint blue, lime green and maroon, respectively. Although the image provides a qualitative comparison of habitats and land uses between areas on and off the SRS, it is not as informative as the quantitative comparisons that can result from remote sensing technologies. Such a quantitative comparison may indicate less obvious but potentially important differences that can affect decisions on management and stewardship of SRS lands.

To obtain a quantitative comparison of on-site and off-site areas, the staff of the Savannah River Ecology Laboratory (SREL) used remote sensing technologies to analyze a series of four Landsat Thematic Mapper (TM) images from 1997 and 1998. These images contain measures of reflected electromagnetic radiation in visible and infrared bands for 30-m by 30-m units of ground surface, called pixels. The four images were selected from different seasons to ensure accurate mapping of pines, deciduous hardwood forests, abandoned farmland, pastures, and both early-season and late-season row crops. A 100-km by 100-km area centered on the SRS (below) was mapped into the following habitat and land use classes: urban/industrial; bare soil; herbaceous vegetation such as that on abandoned farmland or recently cleared forests; row crops; managed grasslands such as pastures, lawns, and golf courses; short-stature scrub forests; open canopy pine forests which are indicative of older pine forests; dense canopy pines which are indicative of young, more recently established pine plantations;





Relative distributions of habitats and land uses on the SRS and in surrounding off-site areas.

upland forests of deciduous hardwoods; floodplain hardwoods; swamp forests; water; and marshes such as those in Carolina bays. Comparisons of the distributions of these habitats and land uses between the SRS and surrounding areas indicated differences that could be attributed to (1) initial constraints on the placement of the SRS, (2) past management of the SRS, and (3) recent management of pine forests on surrounding lands.

Forested Wetlands and Water are More Abundant on the SRS

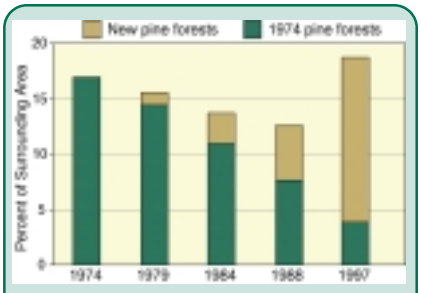
Floodplain hardwoods are 20% more prevalent and swamp forests are 100% more prevalent on the SRS than off-site. This results from the region's geomorphology and the initial constraints placed on locating the SRS. Because of the need to use and discharge large volumes of water for reactor cooling, the SRS was placed adjacent to the Savannah River, on land dissected by relatively large creeks that were used to return water to the river. The abundance of floodplain forests was further enhanced by the inclusion of the floodplain of Lower Three Runs Creek in a narrow corridor of the SRS. Water is twice as abundant on the SRS because of the construction of reactor-cooling reservoirs such as Par Pond and L-Lake. Most of the off-site water bodies are small farm ponds, Carolina bays, and the Savannah River. The large SRS reservoirs provide important winter habitat for migrating waterfowl.

The SRS has More Abundant, Older Pine Forests than the Surrounding off-site Area

Pine forests are more than twice as abundant on the SRS, which is the most obvious difference between the SRS and surrounding areas. This difference occurs because land management on the SRS included planting of pines in the early 1950s on areas that had been row crops, managed grasslands, and old fields of herbaceous vegetation before the site was established. Some managed grasslands still occur on the SRS as lawns around facilities and as vegetation covers for waste burial sites, and herbaceous vegetation still occurs along power lines, water lines, and on recently cut forest stands.

Although this difference is obvious, recent changes in forest management in the surrounding area have resulted in subtle changes in the relationships between SRS forests and those on private lands.

Since the mid 1970s, the off-site pine forests that had established on farmland abandoned in the 1920s and 1930s have been extensively cut. By 1997, more than 75% of the off-site pine forests that existed in 1974 had been cut. The establishment of pine plantations on off-site areas also increased in the 1980s.



Cutting of 1974 pine forests in areas surrounding the SRS and their replacement with newly established pine plantations.

In 1974, the SRS was mostly young, recently planted pine forests, while the surrounding area was mostly older pine forests established in the 1920s and 1930s. Now the SRS has mostly older pine forests, while many of the surrounding off-site pine forests are younger, recently planted stands. This marked difference between the SRS and the surrounding region highlights the importance of this 310-square mile site to the biodiversity of the southeastern U.S. Because less than 10% of the SRS is developed or used by the Department of Energy (DOE) for industrial sites, waste containment, and infrastructure such as roads and power lines, the remainder of the site is managed for timber, forest products, and wildlife, or set aside in "control" areas that remain relatively undisturbed. This has resulted in this site becoming a center of biodiversity in the Southeast.

SRS industrial development surrounded by pine forest.

Off-site farm land.

The SRS preserves not just plant and animal species, but also large tracts containing important habitats that have become increasingly rare off-site as lands are farmed, harvested, or developed. Furthermore, the SRS provides for relatively long-term, predictable preservation of these habitats. This contrasts with the surrounding area where lands are broken up into relatively small, privately owned parcels whose fates are often affected by unpredictable changes in demands for agricultural products, forest products, and space for urban expansion. As plant and animal species and their respective habitats become increasingly threatened across the Southeast, remote sensing technologies will continue to be important in assessing the SRS's role in the regional management of biodiversity and natural resources.