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A bird's-eye view of the environmental health of the Great Bay Estuary

On a clear day this August, a small airplane will fly over the Piscataqua River, Little Bay, and Great Bay to take pictures of the large, beautiful estuary system. But it is not a sightseeing tour. The project is part of a $70,000, multi-agency effort to understand the effect of increasing nutrients on the complex Seacoast system. The overall goal of the effort, which is being led by the New Hampshire Estuaries Project, is to create a conceptual model to help determine the sustainable amount of nutrients that can be released into the state's largest estuary. Based on this work, the NHEP will make recommendations to the NH Department of Environmental Services (NHDES), which is ultimately responsible for developing nutrient criteria to protect water quality and ecosystems of the Great Bay Estuary.

This intense effort is being driven by concerns over rising levels of nitrogen entering Great Bay. According the NHEP State of the Estuaries Report, the amount of nitrogen in Great Bay has increased 59% in the past 25 years. This trend is troubling because too much nitrogen in an estuary will cause algal blooms that cloud the water and disrupt the ecology of the bay. One species especially affected by high nitrogen levels and the resulting cloudy water is eelgrass. Eelgrass is a vital habitat for aquatic creatures and waterfowl, however, data indicate that eelgrass beds have diminished by 17 % from 1996 to 2004 in Great Bay. A major factor that limits eelgrass growth is the amount of sunlight penetrating the water. Water clarity is reduced when nutrients feed phytoplankton and when suspended inorganic particulates or dissolved organic matter in the water increases.

A Maryland company has been contracted to take the hyperspectral aerial images that will record 64 wavelengths across the visible and near-infrared spectrum. The resulting imagery will show colorful swirls of a variety of

suspended and dissolved materials in the water over the 17-square-mile region. To check the reliability of the image data, teams of researchers from the University of New Hampshire and NHDES will be taking water samples in a variety of locations during the flight. Additionally, a state-of-the-art buoy deployed in Great Bay by the UNH Coastal Observing Center will make continuous measurements of the hyperspectral water clarity as well as other physicochemical parameters, including turbidity, chlorophyll-a, colored dissolved organic mater, and nitrate. The buoy is a prototype deployed as part of the national Integrated Ocean Observing System (IOOS) with funds from NOAA Coastal Services Center and was designed to answer management issues like water clarity. Information from the buoy, together with flow-through surveys coinciding with the flight, will be invaluable in piecing all the information together.

Phil Trowbridge, NHEP Coastal Scientist, believes this project is the best way to enhance understanding of how the Great Bay Estuary system responds to nutrient loading. "The Great Bay Estuary is unique because of its geography and the degree of development throughout its watershed. Existing models for nutrient loading don't quite make sense for this system. We need real data and observations from several sources to determine what is happening."

Ru Morrison, a bio-optical oceanographer of the UNH Coastal Observing Center within the UNH Institute for the Study of Earth, Oceans, and Space (EOS), concurs and explains the value of multiple data collection approaches. "To fully understand water clarity in the Great Bay Estuary we need information from multiple sources. The buoy in Great Bay is great at collecting long-term information at one spot but how does that compare to the rest of the estuary? We need the aerial information corroborated or 'ground truthed' with the spatial surveys to expand results from the buoy. Synthesis of data from all these sources will provide valuable insight into light penetration in the waters of the Great Bay Estuary."

Trowbridge notes that there is need for further research and monitoring. "This project captures the conditions at one point in time. To understand how the estuary reacts to changing environmental conditions, including climate change and increased upland development, we must monitor these parameters over the next 10 to 15 years so we have reliable data on which to base decisions."

The New Hampshire Estuaries Project, in cooperation with the UNH Coastal Observing Center, secured the funding for this project from the US EPA Regional Dedicated Water Quality Program.

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