Chesapeake Bay Land Margin Ecosystem Research (LMER): Trophic Interactions in Estuarine Systems (TIES)

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This project was completed in 2001

Overview

Estuaries are the link between terrestrial and coastal ecosystems. Relatively high nutrient loads, shallow depths, effective tidal mixing, and resulting high primary productivity lead to high fishery yields. Despite the small aggregate area of estuaries, more than 50% of U.S. fishery yields historically have been derived from estuaries or estuarine-dependent. There is evidence that the efficiency of fish production relative to primary production is higher in estuaries than in shelf, upwelling or oceanic systems. Estuaries, which occupy only 0.5% of global marine areas, are responsible for 2.6% of marine primary production, support 5.2% of global marine fish production and potentially can contribute 5.9% to the world fisheries harvest. The trophic linkages and mechanisms that promote efficient secondary production and trophic transfers in estuaries are poorly known and are the subject of this LMER program.

This project investigates factors regulating secondary production in distinctive regions of the land-sea interface using Chesapeake Bay as a study site. In major land margin ecosystems such as Chesapeake Bay, regional and inter-annual variations in primary and secondary production are strongly influenced by the pulsing nature of inputs. These inputs come from the adjacent watershed, atmosphere and coastal ocean, and by the associated temporal variabilities in circulation and fine-scale (1-10,000 m) physical structures, which act as sites of intense ecological activity.

In this program temporal scales include: (1) inter-annual periods focusing on variations in the magnitude and timing of freshwater, organic matter and nutrient loads from terrestrial, oceanic and atmospheric sources; (2) seasonal and shorter (hours-week) periods focusing most effort during the most productive seasons. Spatial scales include: (1) the whole bay; (2) distinctive regions of the bay (oligohaline, mesohaline and polyhaline zones) and; (3) zones characterized by physically driven processes (hydraulic control points, lateral fronts, river fronts, vertical structure); and (4) biologically dominated patches.

2001 Accomplishments

In FY2001 we collaborated with other TIES researchers to compile and analyze data, focus on common questions, and prepare manuscripts for publication. We also used preliminary results to write proposals and secure funding for data analysis through the Sloan Foundation’s Census of Marine Life program. The TIES program was completed at the end of 2001.

2000 Accomplishments

Acoustic data were collected and processed for April, July, and October sampling periods to finish the six year field survey of fish spatial distribution and abundance in the Chesapeake Bay.

Data were collected along a north-south axial transect spanning the length of the bay, along several east-west lateral transects, and in association with mid-water trawls and a hydraulic control bottom feature. We are moving into a collaboration and analysis phase of the project, so communications among investigators have intensified and linkages are being made among the various data sets.

1999 Accomplishments

Acoustic data were collected and processed for April, July, and October to investigate the spatial distribution and abundance of fish throughout the bay, and associated with hydraulic control points, biopatches, the RAZ (Raleigh Accumulation Zone), and mid-water trawls.

Acoustic data from the hydraulic control point in April and July were processed to show relative densities of fish. (Figure 1). Hydraulic control points are areas where underlying topographies exert control over density currents. As a density current flows over a ridge, that current shoals downstream but deepens upstream, rendering the upstream flow more subcritical. In the presence of bottom topographies, there is a downstream entrainment of the flow upstream of the feature and a consequent modulation of the estuarine circulation. The hydraulic control point investigated as part of the TIES project is at Rappahannock Spit, starting where the depth is 35-40 feet and ending where the depth is > 100 feet.

Little is known about organism distributions and ecological processes associated with the hydraulic control point in Chesapeake Bay; however, elevated concentrations of surface chlorophyll are often observed there. Abundance of gelatinous grazers declined precipitously south of this region during summer, while abundance of anchovy eggs and larvae were relatively high. This is also a region noted for its rich benthic macrofaunal community, with relatively high abundance and diversity. We have collected acoustic data on fish distributions along the hydraulic control point and have observed aggregations along the slope of the bottom feature.

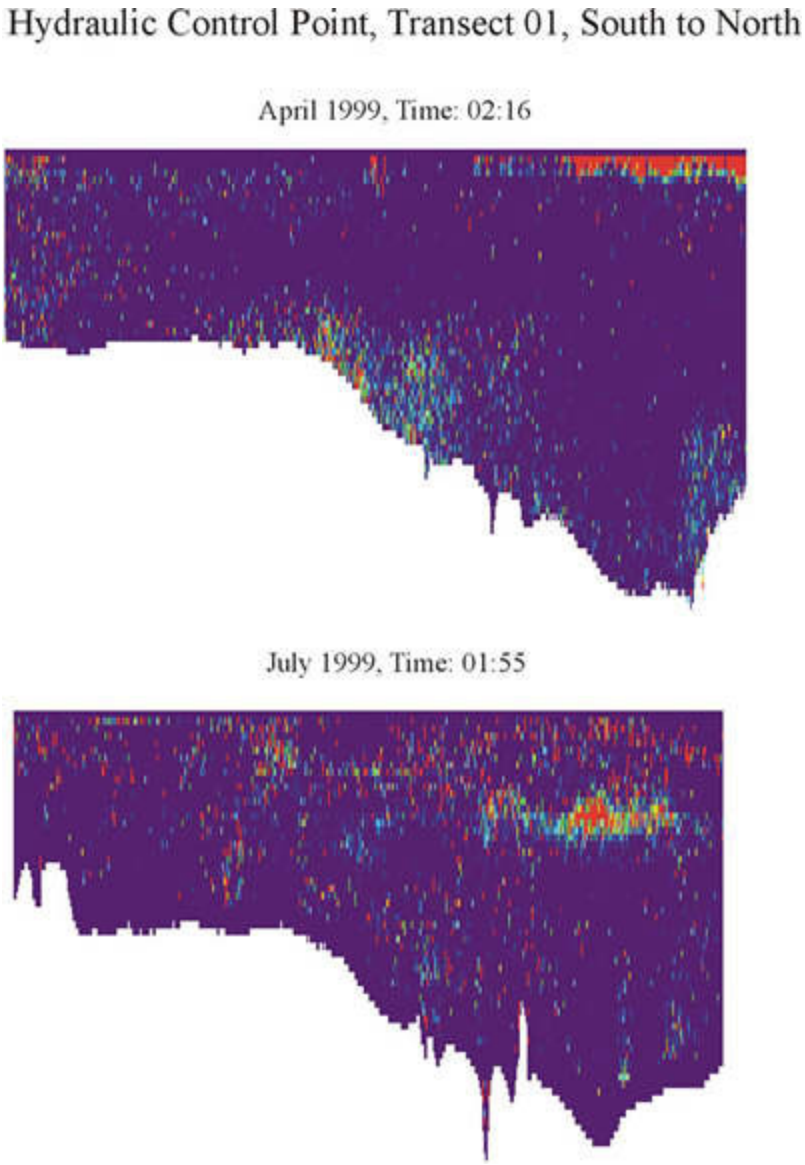

Figure 1: *Hydraulic Control Point, Transect 01, South to North*