Ecological Recovery of the Kennebec and Androscoggin Rivers, Estuary, and Nearshore Marine Environment

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**Introduction**

Recovery of an ecosystem after degradation is a complex process. Biotic and abiotic components of an ecosystem respond differently to changes and thus recovery after collapse encompasses varying time frames. Merrymeeting Bay is a freshwater tidal ecosystem in midcoast Maine that experienced ecosystem collapse in the mid-20th century. Human activities including overfishing, land clearance, dams, and water pollution from mills contributed to the collapse. The Clean Water Act of 1972 initiated recovery, but living components of the ecosystem have been slower to recover than water quality. The focus of our study this summer was on two vital components of the ecosystem that were negatively impacted during the 20th century. Submerged aquatic vegetation provides key habitat for a variety of organisms present in the bay. Anadromous fish are economically and ecologically important fish that pass through the bay before and after spawning in freshwater systems. Studying vegetation and fish species can provide details on the status of recovery of biological components of the bay. Surveys of SAV and juvenile alevisids provide information that can be compared to past and future information about these vital populations in the bay. In addition, economic research has examined the valuation methods used in river restoration, including hedonic pricing theory, travel cost method, and benefits transfer. This research culminated in running focus groups on the subject of Maine rivers with participants from across the state. The results from the focus groups will be used to develop a contingent valuation survey that values different scenarios of river restoration.

**Submerged Aquatic Vegetation**

Submerged aquatic vegetation (SAV) are rooted aquatic plants and both freshwater and marine species are present in our study area. Our work this summer focused on freshwater species of Vallisneria and Potomogoton present in Merrymeeting Bay. Distribution data have existed since the 1950s, when the first of a series of aerial photographs were taken at low tide to capture vegetation. For the past two summers, a Trimble GeoXM GPS unit has been used to map vegetation beds on the ground (Figure 1). This new distribution data can be added to a graph (Figure 2) of area of MMB covered by SAV to determine whether SAV is continuing to recover from its low densities in the early 1970s. Preliminary analysis of 2011 data show that 9.5% of the 9554956 square meters of bay area surveyed are covered in SAV.

**Figure 2:** Percent coverage of submerged aquatic vegetation in Merrymeeting Bay from 1950-2000.

**Future Directions of Science Research**

Vegetation data collected this summer will be evaluated over the next year with the goal of determining how current area covered by SAV in the bay compares to the past. Knowledge of vegetation coverage in the bay can also be used to evaluate how much habitat for fish is available in the bay. A study of the diet of juvenile alevisids will provide information on how these fish utilize the bay.

**Anadromous Fish Studies**

Anadromous fish spend most of their life time in marine systems but spawn in freshwater. Three species of the genus Alosa play pivotal roles in Maine waters. Alewives, shad, and Blueback herring serve as nutrient transporters between freshwater and marine ecosystems. They are food sources for important groundfish such as cod and are preferred lobster bait. Passage upriver to spawning grounds is vital for anadromous fish in spring and early summer, but dams pose barriers to migrating alevisids. Fish ladders are effective for some species such as alevisids and Atlantic Salmon, but ladders are ineffective for shad passage. A study in coordination with the Maine DMR and Florida Power and Light initiated this summer to investigate the effectiveness of a fish elevator at the Brunswick-Topsham dam. A structure was engineered to simulate the flow generated by a fish lift with the goal of monitoring how shad react to the flow. Two underwater cameras were placed in the river and a computer program called SalmonSoft FishTick will be used to capture and review video of when shad passed the cameras.

To answer questions about alevisid activity in Merrymeeting Bay, weekly beach seines were conducted at Abbys Point. Species and length were recorded for each fish caught and alevisids that did not survive were brought back to lab and their stomachs were preserved in alcohol. Examining stomach contents of juvenile alevisids can provide information on diet, which has been previously unexplored for fish in the ecosystem. Diet analyses will answer questions such as how diets differ by species and size class and whether diets are composed primarily of planktonic or benthic invertebrates.

**Economics**

In August, four focus groups comprising Maine residents were held on the Bates and Bowdoin campuses to gauge perceptions regarding the state of Maine rivers and possible restoration efforts. Participants were asked how their uses of Maine rivers and perceptions of them changed over time, what they knew about dams and certain fish species, and how their opinions varied across different rivers. The focus groups are currently in the process of being transcribed. When transcription is completed, the results will be used in conjunction with a literature review to design a contingent valuation survey, which will be sent to a select group of Maine residents. The goal of the survey is to value a few scenarios of river restoration, taking into consideration the costs of restoration efforts and what residents are willing to pay for them. The results could then be used in shaping better policy outcomes on restoration efforts in Maine.