ACIDIFICATION AND ANADROMOUS FISH OF ATLANTIC ESTUARIES

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Abstract. The Hudson River Foundation convened a conference to evaluate evidence pertaining to the roles played by acid deposition and stream acidification in the decline of anadromous fish populations along the Atlantic coastal plain. The stimuli for the conference were that (1) some populations of Atlantic salmon, American shad, hickory shad, alewives, blueback herring and striped bass as well as a few species resident in coastal streams (yellow perch and white perch) are in a state of severe decline along portions of the east coast of North America; (2) several of these species have declined more or less simultaneously since about 1970; and (3) severe episodic pH depressions are observed in some streams of the Chesapeake Bay system. For example, the pH of Lyons Creek decreased from 7.0 to 5.9 in 1 hr during a rain event, returning to 7.0 a day later. After discussing several possible mechanisms for these observations, the conferees agreed that a combination of factors including stream and river acidification, toxic metals and organic compounds, eutrophication and overfishing appears to be contributing to the reduction in fish stocks. The essential point resulting from the conference is that the acid deposition hypotheses for stream acidification and declines of anadromous fish populations, a potential mechanism that has received very little attention heretofore, was shown to be viable for these coastal areas. Specific recommendations for research were agreed upon by the conferees.

1. Introduction

It has been suggested that acid deposition has caused increased acidity in low alkalinity coastal streams that serve as spawning and nursery grounds for many species of migratory fish, and this acidification may be contributing to recent and widespread declines in the populations of several fish species. In a remarkably insightful and thorough article in the popular magazine *Sports Illustrated*, Robert Boyle (1984) marshalled considerable information to support this suggestion, and noted the recruitment failure associated with acidic conditions in coastal streams. Citing ‘preliminary data and circumstantial evidence’, Boyle proceed to develop ‘the hypothesis that acid radian is significantly responsible for the decline of striped bass reproductive success’. This hypothesis is important because, if it is valid, then both the actual and potential costs of acid deposition may be very much larger than is currently believed. Furthermore, this hypothesis may provide a critical contribution to understanding why many anadromous fish stocks are declining, a full explanation for which has eluded fisheries experts and agency managers.

To evaluate this hypothesis, the Hudson River Foundation convened a meeting of experts in the fields of fisheries, limnology, and air pollution at West Point, NY, on October 16–18, 1985. This Conference on Acidification and Anadromous Fish of
Atlantic Estuaries was attended by thirty invited participants, most of whom were scientists specializing in the topic areas, and focused primarily on the freshwater habitats used by anadromous species. From this conference nine research papers have been developed that are included in the current edition of this journal. This paper presents the highlights of the conference and recommendations reached by the attendees.

2. Recent Declines in Fish Stocks

Evidence discussed at the conference (and in the accompanying papers) indicates that populations of several species of anadromous fishes (Atlantic salmon, American shad, hickory shad, alewives, blueback herring, and striped bass) as well as a few species resident in coastal streams (yellow perch and white perch) are in a state of severe decline along portions of the east coast of North America. In Nova Scotia, Atlantic salmon have been eliminated from some streams, and they have been significantly reduced in some others. Striped bass populations have been severely reduced or eliminated from the Roanoke River of North Carolina, numerous streams and rivers in the Chesapeake Bay area, and the Neuse and Tar rivers in North Carolina.

Several species have declined more or less simultaneously since about 1970. In the Chesapeake Bay (Speir and Carter, 1987), total landings of perch and herring have decreased sharply since 1969, with a sharper drop since 1975. The river herring catch declined by 94% between 1970 and 1980, and the catch remains low. There has been a sharp decline in the juvenile index of striped bass and shad in the Chesapeake Bay region since 1970, and there have been no strong year classes since then.

The 'Emergency Striped Bass Study' conducted by the U.S. Fish and Wildlife Service and the National Marine Fisheries Service, identified both overfishing and reduced early life stage survival as contributors to the decline of striped bass in the Chesapeake. At the same time, the population strength of menhaden, a marine reproducing species, has been increasing in the Chesapeake Bay despite increased fishing pressure. This emphasizes the point that it is primarily those species which reproduce in freshwater coastal streams that are in a state of decline.

3. Previously Suggested Causes of the Declines

Various mechanisms which might either have initiated these declines, or contributed to continuing depression of the affected populations, have been hypothesized. Those mechanisms heretofore considered to be most likely were eutrophication, changes in weather patterns, increased concentrations of metallic, and organic pollutants and overfishing. Although data on climate are available, there are few analyses by which its role in the declines can be assessed at this time.

There was some discussion of the hypothesis that fish population declines might be due to eutrophication of the Chesapeake Bay, leading to increased heating of the surface layer and decreased oxygen concentration in the underlying water. Larger fish, such as