Report for 2001NJ1481B: Effects of the Biopollutant, Phragmites australis, On the Nutritional Status (Biochemical Condition) of Juvenile Weakfish

- Conference Proceedings:
  - Litvin, Steven, Vincent Guida and Michael Weinstein. 2002. The use of thin layer chromatography with flame ionization detection (TLC/FID) to assess the biochemica l condition of juvenile weakfish in Delaware Bay in American Association of Limnology and Oceanography Annual Meeting, Victoria, BC, 72.
  - Litvin, Steven, Michael Weinstein and Vincent Guida. 2001. Trophic linkages and relative importance of salt marsh habitats to resident and marine transient finfish in Delaware Bay: a stable isotope and "biochemical condition" approach in Estuarine Research Federation Bi-Annual Meeting, St. Pete Beach, FL, 63.

Report Follows:

Problem and Research Objectives:

Phragmites australis ranks among the most aggressive plants in wetland landscapes. By altering the marsh through its influence on hydroperiod, and geomorphology, *P. australis* reduces nekton access to the marsh plain, and by affecting the exchange of materials including organisms (trophic relays; Kneib 1997), presumably negatively influencing the production of commercially and recreationally important species. Yet, *virtually nothing is known about the trophodynamic role of P. australis in salt marsh food webs in North America.* This gap in our knowledge begs the question as to whether the presumed fisheries impacts of *P. australis* genuinely warrant widespread efforts at control and prevention of proliferation of this species. In the past 50 years, *P. australis* has become the dominant macrophyte in many brackish marshes of the mid-Atlantic seaboard. For example, more than 16,000 ha of salt marsh are presently covered with a near monoculture of *Phragmites* on the Delaware side of the Delaware Bay, and the magnitude of coverage is similar on the New Jersey side (Weinstein and Balletto 1999, Figure 1).

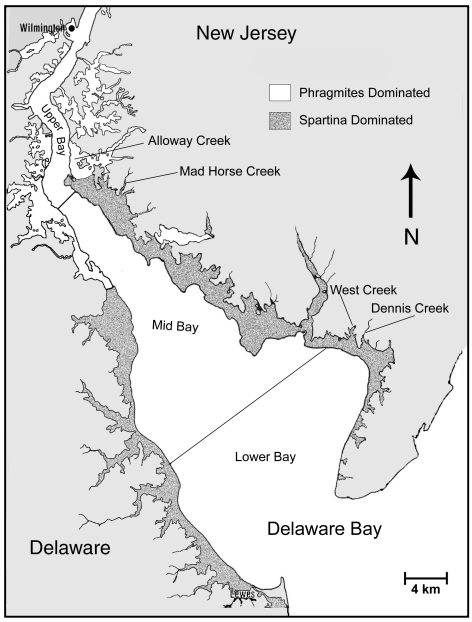

Figure 1.

Whether *Phragmites* affects the quality of habitat and contributes nutrients to the estuarine food web by export (POM and Fish) to the estuary and coastal waters is the key focus of the proposed study. Our goal is to compare the nutritional status (hereinafter," biochemical condition") of juvenile weakfish that have resided in waters influenced by *Phragmites* as a nutrient source, versus those in waters most influenced by *Spartina* spp. By doing so, we will have the basis to not only integrate the quality of habitat in terms of nutrient flux, but also as it influences fish biochemical condition, secondary production, and survival potential.

The stable isotopes of carbon, sulfur, and nitrogen have been used to advance our understanding of food-web structure and energy flow in estuaries. The basic premise of the approach is that isotopic ratios are conservative and that physical mixing of end member sources determines the isotopic distributions of organic matter in natural systems (Cifuentes *et al.* 1988). This last point is particularly important because it allows for discrimination among mixtures of carbon and other nutrient sources, as opposed to single sources. Taken together, $\delta^{13}C$ and $\delta^{34}S$ can distinguish phytoplankton signatures from among terrestrial, marsh and benthic algal signatures. Variability of $\delta^{34}S$ is observed to be lowest in macroalgae and phytoplankton ($\delta^{34}S \approx +18‰$) because they use seawater sulfate. $\delta^{34}S$ values for microphytobenthos are intermediate in range (4 to 14‰) depending upon the proportions of reduced sulfur and seawater sulfate at the sediment/water interface (Sullivan and Montcrieff 1990; Currin *et al.* 1995; Newell *et al.* 1995). Thus, stable sulfur and carbon isotopes can be used to differentiate between benthic versus pelagic nutrient sources, and rooted macrophyte versus algal nutrient sources. Our recent work has shone that fish in New Jersey salt marshes adjacent to Delaware Bay and in the open bay itself have stable isotope signatures that reflect the marsh macrophytes present in that region of Delaware bay (Weinstein et al. 2000).

Data on the intensity and direction of fat deposition and the level of body fat reserves are extensively used to assess the "degree of well being" or biological condition of finfishes (Schulman and Love 1999). The fattening cycle of many species is adapted in such a way that fat reserves are used as the energy source for overwintering, migration, gamete production, spawning, or a combination of these. For juveniles that accompany adults offshore in the fall, such as weakfish, it is the energy surpluses at the end of the first growing season that is the subject of this proposal. Are individuals from different regions, especially those from regions where the food web is influenced by *Phragmites*, equally fit for the rigors of coastal migration and overwintering? It has been generally observed in wild populations of fish that the rate of growth and size of depots of energy reserves can be correlated with the availability and nutritional content of the food. Although biochemical condition factors may sometimes be labile, the choice of relatively large samples,

specific life stages (juveniles), sexually immature individuals (thereby eliminating sex-related and gonad maturation differences), and sampling restricted populations (a single year class in a given system) can largely limit variability to *habitat* specific differences (Schulman 1974; Evans 1998). By reducing within sample variation to a manageable level, differences in the biochemical condition of juveniles from waters with Phragmites as a significant nutrient source (as determined by stable isotope analysis) can be compared waters with Spartina spp. as a nutrient.

Methodology:

Juvenile weakfish were collected in September (2001) in the lower, mid and upper Delaware Bay open waters. In the laboratory, individual fish were measured for body depth and standard length (SL) to the nearest mm. Fish from each region were weighed to the nearest 0.001g, freeze-dried, re-weighed, and ground dry. Samples of dry homogenate will be analyzed for lipids via thin layer chromatography-flame ionization detection or TLC/FID (Parrish 1987). This combination of analyses will provide a complete and detailed picture of both the magnitude and biochemical distribution of energy reserves.

TLC/FID lipid method was chosen because it provides a sensitive means of assessing lipid storage, since it allows the separate quantification of lipids by biochemical class, unlike total lipid methods by gravimetric or chemical means. For example, the degree of variation in lipid storage among individual juvenile weakfish captured in a preliminary study at a restored marsh (Dennis Township Salt Hay Farm) and a reference marsh (Dennis Creek) in 1999 is made much more evident by comparing neutral lipid fractions (especially TAG, which ranges from near zero to about 3 mg g^{-1} dry wt between about 25 mm and 125 mm SL, followed by a dramatic increase to near 180 mg g^{-1} dry wt at about 190 mm SL). Values of structural lipids including sterols, phospholipids, shpingolipids and other polar fatty acids form a fairly consistent proportion of total body weight over this same length interval. It appears that much of the incoming energy in the form of lipids is utilized for somatic growth between 25 and 125 mm SL (approximately June to mid-September) with energy reserves rapidly laid down as fish continued to grow and made preparations for their fall migration to overwintering grounds.

Aliquots of homogenate from each fish were also subjected to stable isotope analysis for $\delta^{13}C$ and $\delta^{34}S$. The stable isotope and lipid data, taken in conjunction, will let us to determine if the biochemical condition of juvenile weakfish that have resided in waters influenced by *Phragmites* as a nutrient source differ from those that have resided in waters most influenced by *Spartina* spp.

Progress to Date:

138 juvenile weakfish from throughout the open waters of Delaware Bay in September of 2001. The weakfish are in the midst of preparation for stable isotope and TLC/FID analysis. The goal is to have both analyses for all fish completed by the end of 2002.

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