Jordan King

Aquatic Indicator Species:
Exploring Environmental and Public Health Linkages in South Carolina

ABSTRACT

The Uplands of South Carolina is home to a diverse assemblage of freshwater fish fauna. Alterations in these fish community dynamics are indicative of exposure to biological, chemical, or physical stressors, which through ecosystem services also affect humans and their health. Monitoring and managing ecosystem resources to maintain water quality and life can utilize chemical analyses and analytical toxicology to discern and quantify substances in the water or in biota/seafood[3], but these chemical methods are not efficient or inexpensive. Measurements of habitat Biological Integrity (BI) better accounts for the adaptive capacity and homeostasis of species diversity and communities[4].

The main objective of this project was to examine relationships between Uplands SC water quality data amassed by the SC Department of Health and Environmental Control (DHEC), that categorizes stream and river quality and habitat suitability as "Impaired" versus "Unimpaired," with indices of Biological Integrity using fish populations, amassed by the SC Department of Natural Resources (DNR).

Fish species were categorized by indicator groups – Conservation-Priority, Sediment-Sensitive, Non-Native, and Endemic/Cosmopolitan. The Relative Abundance (RA) was calculated for each. An Endemic-Cosmopolitan Score was calculated by subtracting RA of Cosmopolitans from RA of Endemics at each site. MANOVA was conducted in R to compare the means of each indicator group.

Based on P-values for each metric, the null hypothesis can be rejected for the Sediment-Sensitive fish metric at the 95% confidence level (P=0.007), meaning the alternative hypothesis can be accepted that there are significant differences in Sediment-Sensitive fish species between the Unimpaired and Impaired sites.

Expected patterns in fish indicator metrics were observed. Abundance of Sediment-Sensitive fishes was significantly higher in Unimpaired sites, with weaker evidence for both positive Endemic-Cosmopolitan Score (P=0.065) and low mean abundance of Non-Native fish (P=0.076). Land-use and development in the Uplands region is predicted to reach 1.5 million acres by the year 2030[2]. Urbanization and increased land-use are known contributors to sedimentation of waterways, which degrades biological integrity[11] and impacts human health via fish consumption and contact with impaired waters. Limitations of this project include small sample size and high variance in the Unimpaired streams and rivers (n=10), which contributed to lack of statistical significance in fish metric analysis.

COMPETENCIES

Master of Public Health core competencies strengthened through this project include:

2) diagnosing and investigating health problems and health hazards in the community using an ecological framework,
3) informing, educating, and empowering people about health issues – as all information from both DHEC and DNR is made available to the public,
4) mobilizing community partnerships and action to identify and solve health problems,
5) developing policies and plans that support individual and community health efforts,
6) applying laws and regulations that protect health and ensure safety,
9) conducting research for new insights and innovative solutions to health problems, and
10) communicating effectively with public health constituencies in oral and written forms.

Concentration (Environmental and Global Health) core competencies strengthened through this project include:

1) describe to specific communities or general populations the direct and indirect human and ecological effects of major environmental agents,
4) specify approaches for assessing, preventing, and controlling environmental hazards that pose risks to human health and the environment, and
5) develop a testable model of an environmental insult or design a way to evaluate an environmental insult.

RELEVANCE

The public health relevance of this project revolves around the inherent linkages between human health and environmental health. Humans have a complex relationship and dependency upon various ecosystem services that the natural environment provides. With the development of land for both agricultural and urban uses, there are repercussions that affect nearby water resources and related ecosystem services. Displaced soil makes its way into local waterways as sedimentation, which disrupts aquatic ecosystems and also makes it difficult for municipal and industrial water treatment facilities to efficiently or effectively operate, affecting humans both physically and economically. Sedimentation can also limit flow in drainage ditches (contributing to flash floods), damage pump systems and pipes (affecting agricultural production), introduce higher risk during recreational water activities (due to a decreased riparian buffer zone and thus an increased *Escheria coli* count in waterways), and reduce reservoir storage capability (contributing to drought-like conditions and increased financial burden for access to water resources). Each year, 18 million tons of soil are eroded in South Carolina alone[12]. This project was conducted as a smaller portion of the various South Carolina streams and rivers assessments, which aim to inform stakeholders of conservative land-use development for the future preservation of South Carolina waterways.

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