USGS

WATER RESOURCES RESEARCH GRANT PROPOSAL

Title. Atmospheric Deposition of Currently Used Pesticides to an Eastern Shore Watershed

Focus Categories. Non-point Source Pollution

Keywords. Atmospheric Processes; Agriculture; Contaminant Transport; Estuaries; Pesticides; Rainfall; Trace Organics

Duration. 9/99 to 8/00

Federal Funds Requested. $ 21,800.00

Non-Federal Funds. $ 43,675.00

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Congressional District. 5th District of Maryland

Statement of Critical Regional or State Water Problems

The Chesapeake Bay estuarine drainage system contains 57,000 km2 of harvested croplands, and according to a report by Pait et al. (1992) the area receives the highest pesticide application of any coastal area in the nation, with over 2.1 million kilograms per year. The Eastern Shore region of the Chesapeake Bay watershed is dominated by agricultural land use which makes the streams and tributaries in this area highly vulnerable to agricultural runoff as well as local or regional atmospheric transport and deposition of pesticides. The Eastern Shore is also the location of some of the most important aquatic habitat areas for the living resources of the Bay. Protection and improvement of these habitat areas has increasingly become a priority of regulatory agencies and citizen's groups.

The high vulnerability the Maryland Eastern Shore in general and of the Choptank watershed in particular has also direct economic implications. Researchers have indicated that Maryland oysters have declined from a high of 133 million pounds in 1880 to today's annual catch of about one million pounds. Disease, specifically Dermo and MSX, appears to be one of the major causes of the recent drastic decline in the oyster populations in the Chesapeake Bay and the Delaware Estuary, with over-harvesting and pollution also playing major roles in the Chesapeake Bay (USEPA, 1998). Researchers have recently indicated that toxic organics, such as triazines herbicides, which are heavily used in this area, can change the metabolic rates of marine phytoplankton (the source of food for oysters) and inhibit the growth of aquatic grasses important for marine habitats (Bester et al., 1995; Lytle et al., 1998).

As part of the Maryland's Targeted Watershed Project a number of government organizations and environmental groups are monitoring these watersheds in order to quantify the impacts of land use and nonpoint pollution control practices on water quality and aquatic life habitat and to determine long term trends in water quality and aquatic life communities. While the potential for runoff of pesticides as a source of non-point pollution into surface waters is high, atmospheric deposition of pesticides that have been volatilized from local and regional agricultural activity may also play a significant role in water quality deterioration. For example, some studies have estimated that atmospheric deposition counts for more than 25% of the total nitrogen entering the Chesapeake Bay. Very little is known regarding the atmospheric loading of pesticides, particularly on the Eastern Shore where land use is predominately agricultural.

The goal of the Chesapeake Bay Basinwide Reduction Strategy is to have a Bay free of Toxics by reducing or eliminating toxics from all controllable sources. Baseline measurements of atmospheric concentrations and deposition fluxes of pesticides in different parts of the Chesapeake Bay watershed are a fundamental part of determining the importance of atmospheric processes to the overall loading of pesticides to the Bay.

Recently, Rice et al., (1998) published the results of a Regional Transport Model of atmospheric transport and deposition of atrazine and metolachlor to the area around the Chesapeake Bay. The most significant result from this study was a dominance of the Eastern Shore region for volatilization and deposition of these two chemicals. The figures below show the highest predicted rates of wet deposition occurring in the upper Eastern Shore region. Another important result that came from this study was that while runoff losses for atrazine and metolachlor were calculated to be between 2.5 and 3.0%, volatile losses were 2.9% for atrazine and 13% for metolachlor. These types of models are very attractive to watershed managers and decision-makers as they only rely on meteorological and pesticide usage data. While this model strongly suggests that volatile losses of toxic organic chemicals could represent an important contribution to the overall input of those chemicals to the Bay, it is a conservative/equilibrium model that needs to be calibrated.

In this study, we propose to determine the magnitude of atmospheric deposition loadings of pesticides to the Choptank River watershed. We will concentrate our work on Maryland's Eastern Shore as it has been estimated to be a "hot" spot for atmospheric deposition of pesticides. The Choptank River Basin has been classified by the USEPA as a watershed with high vulnerability to decline in aquatic health, due to stressors such as pollution, and it has the greatest need for protection (USEPA, 1998).

Statement of Results or Benefits

This study will provide vital information on the importance of atmospheric deposition on pesticide loading to vulnerable ecosystems. The ultimate outcome will provide a test of the applicability of the current models and suggestions of whether there is a need to better assess the spatial and temporal atmospheric deposition of pesticides. Also, by working with Don Meritt, lead scientist at the Horn Point oyster hatchery, results may ultimately

be beneficial in determining any possible impact of pesticide residues in the river water on the oysters directly or indirectly on their food sources.

Nature, Scope, and Objectives of the Research

This project will be the first comprehensive investigation of the environmental fate and transport of multiple currently used pesticides in both the air and surface waters of an Eastern Shore tributary. This project is designed to use the Choptank River watershed as a model system in a first step towards testing the predictions of the Regional Transport model and to conduct actual measurements to determine the magnitude of atmospheric inputs of pesticides to the Eastern Shore region.

Dr. McConnell, in collaboration with Dr. Steven Lehotay also of the Environmental Chemistry Laboratory (ECL) and Don Meritt of UM Horn Point Laboratory, has already carried out two summers of water sample and oyster tissue collections and one year of sediment collections in the Choptank River as part of a NOAA funded project (Harman-Fetcho et al., 1998). This project will build on previous research by expanding the water sample collections to determine annual trends and will also include soil, air and rain sample collections for a more in-depth study of the fate of pesticides in the watershed.

The working hypothesis guiding the proposed research is that atmospheric deposition can represent a significant source of pesticides in some Maryland Eastern Shore watersheds. Researchers have indicated that atmospheric deposition can be a significant source of nutrients. To date, there is very little hard data on pesticide atmospheric deposition.

Specific objectives to be completed during the one-year project are:

1. Directly determine the total air concentrations, vapor/particle partitioning and wet deposition flux of selected pesticides at a site within the Choptank River watershed to observe temporal trends and relate them to expected local and regional sources.

2. Determine pesticide concentrations in surface waters and soils at representative sites within the watershed to use in gas exchange calculations and to estimate the reservoir of pesticides in watershed at different times of the year. As an on-going objective we plan to:

3. Use measured atmospheric deposition fluxes of atrazine and metolachlor in the Choptank River to test the conclusions of the Regional Atmospheric Transport Model. This will be accomplished by looking at predicted flux rates for the Choptank River watershed area compared with measured values.