PESTICIDES AND PHYTOPLANKTON BIOMASS IN THE TAGUS ESTUARY, PORTUGAL

Paula Viana1, Lourenço Cabeçadas2, Cláudia Gama2, Marta Nuguesa2
1 Agência Portuguesa do Ambiente, APA 2 Instituto Nacional de Investigação Agrária e das Pescas, INIA-IPIMAR

INTRODUCTION

Tagus estuary (Fig. 1) is a complex, dynamic system with varying river flows (200 - 2000 m³ s⁻¹), a typical residence time of three weeks, under the pressure of large urban populations, large agricultural area, and subjected to numerous sources of stress. A variety of pesticides are applied in large quantities to the Tagus estuary agricultural areas mainly over Tagus valley (1200 ha) and over Serra valley (4000 ha) specifically on rice fields, posing potential risks to living phytoplankton. The biological effects of a pesticide on the aquatic environment depend on several factors, including the concentration of the pesticide in water and the length of time the phytoplankton is exposed.

MATERIAL AND METHODS

The investigation was carried out from 12-26th May 2000 aboard Monte Corvo, a small boat (13m), equipped with Niskin bottles. For nutrient determinations, through MSI Acetate Plus (Watman GF/F filters at 70°C, 24h). Dissolved oxygen was measured using a Winkler method. Pesticides were determined using solid-liquid extraction (47 mm SDBV disks) followed by gas chromatography – mass spectrometry with capillary column (GC-MS).

Sampling

Sampling was carried out in Tagus estuary and adjacent coastal zone in May 2000 along the whole salinity gradient, 0-35, (at ebb tide conditions), covering a total of 16 stations. Physical data, nutrients, pesticides, and chlorophyll (a) concentrations with mean river flows, Tagus and Sado estuaries, were carried out using a CTD and a rosette sampler equipped with Niskin bottles and triplugs. Equipment: Sea Bird CTD and a source General Oceanics, equipped with Niskin bottles.

DATA ANALYSIS

The analysis of Chl a in relation to environmental variables temperature T, salinity S, dissolved oxygen DO, nitrate NO₃, ammonium NH₄, phosphate PO₄, silicate Si, particulate suspended matter SM and molinate M was carried out within the framework of a Multiple Regression Model using Brodgar Software (2006). A graphical exploratory analysis was applied to the data, which met assumptions of normality, homogeneity, and lack of autocorrelation in residuals. A multiple regression which met assumptions of normality, homogeneity, and lack of autocorrelation in residuals. A multiple regression analysis, using backward procedure, was applied for Chl a, entering 9 independent variables together into the model. Using the Akaike Information Criterion (AIC), non-significant terms were dropped, once at a time, in order of decreasing AIC, which translated a better fit of the model. The adjusted R-Squared, Multiple R-Squared and F(9,1) were 0.9869, 0.9757 and 44.81 respectively, meaning a model of good fit.

RESULTS

Inputs - pesticides

Pesticides loads into the Tagus estuary

Molinate loads were calculated by multiplying measured molinate concentrations with mean river flows, Tagus and Serra tributary, which represent approximately 15% of Tagus flow.

OBJECTIVES

- To assess the levels of pesticides along the Tagus estuary to the adjacent coastal waters
- To identify the main pesticide sources to the estuary and adjacent coastal waters
- To attempt to evaluate the effects of herbicides on estuarine/marine phytoplankton

Environmental variables including pesticides and Phytoplankton biomass

Analysis of Chl a in relation to environmental variables T, S, DO, NO₃, NH₄, PO₄, Si, SM and M was carried on and the optimal linear regression model found was the following:

\[
\text{Chl a} = 23.461 - 0.534 T - 0.212 S + 0.296 NH₄ - 0.534275 T - 0.212 S + 0.296 NH₄
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