

LEVEL OF POLLUTION WITH ORGANOCHLORIDE PESTICIDES IN LAKE MOARA DOMNEASCA

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Abstract

Research studies regarding various types of waters pollution with organochlorine pesticides (POC) reveal the fact that these chemical substances with high biological activity often reach the aquatic ecosystem, sometimes in significant quantities that have a negative influence on the ecosystems equilibrium.

It is well known that POC belong to the category of synthetic substances produced by industry and due to their characteristics they are included in the "Long term persistent substances List". The problem of POC degradation is a very complex one, involving photochemical as well as biological aspects, sometimes requiring long period of time. Taking that into consideration, the harmonization of target values for POC with real bearing capacity of environmental factors becomes a priority for aquatic ecosystems as regards ecological risk decrease and environmental protection.

The lakes in the surrounding area of Bucharest are damaged by the anthropogenic impact added to the specific features of the geographical area. Such is the case of Moara Domneasca lake located on the Pasărea river.

The investigations were performed in the spring-autumn sampling campaigns of the period 2008-2009.

The data obtained from the POC analysis show a long term pollution caused by agricultural activities which can increase the risk for the lake ecosystem if they are not properly monitored.

INTRODUCTION

For several years, ecosystems pollution with organochlorine pesticides has become a problem in Romania; under these conditions, it has been necessary to study these pollutants both as regards their monitoring in the Romanian waters and their effects on the aquatic systems.

Organic micro pollutants are chemical substances of high risk as they have extremely toxic characteristics; they have a high degree of resistance to degradation as well as a high degree of accumulation in organisms and environment; moreover, they can be airborne easily to great distance and they can

be deposited far from the emission source and they can harm human health and environment, both close to and far away from their sources.

Consequently, the investigation of organic micro pollutants in the Moara Domneasca lake has become opportune. By analysing organochlorine pesticides and atrazine, an important compound belonging to triazine herbicides, one could get a clearer image of the water quality state as well as of their local impact on the lake. This paper presents the results of the investigations performed during the spring-summer-autumn campaigns of the period 2008-2009.

MATERIAL AND METHODS

Water samples have been taken from the middle zone the lake pontoon, from the lake outlet/ exit zone (weir) and from the lake inlet/ entry zone, as well as from the lake upstream and downstream in conformity with the provisions of ISO 5667-4:1987 and ISO 5667:1991. By performing this action, care has been taken so that water samples should not get contaminated with substances that may interfere with the analysed chemical compounds. In selecting these investigation stations, the arguments originated from the necessity to identify the risk factors for Moara Domneasca lake, especially the anthropogenic river activities (local farm activities included). Four sampling campaigns were carried out during three seasons: spring (April 2008), summer (August 2008 and June 2009) autumn (November 2008).

Sediment samples have also been taken from the lake middle zone during three of the four sampling campaigns.

The method of analysing organochlorine pesticides and atrazine, a compound representative of triazine herbicides, in water samples developed in conformity with ISO 6468:2000 standard.

The water samples analysis performed in order to identify organochlorine pesticides involved the liquid - liquid extraction of samples by using methylene chloride as solvent, followed by concentration and purification [2, 4].

Sediment samples were analysed according to the following procedure [1, 3]:

- ◆ **Drying** of samples (at room temperature);
- ◆ **Dry sieving** of samples (5-10 g);
- ◆ **Extraction** of samples (US EPA 3550-ultrasound extraction in organic solvent-methylene chloride);
- ◆ **Purification/cleaning** of samples (US EPA 3610-use of a alum earth/florisil column);
- ◆ **Concentration** of the purified sample through evaporation-obtaining the extract-test sample;
- ◆ **Analysis** of the extract obtained through gas chromatography with mass spectrometry detection (US EPA 8081-organochlorine pesticides).

The sample extracts were analysed through gas chromatography by using a gas chromatograph VARIAN CP 3800 equipped with a mass spectrometry detector SATURN 2200.

RESULTS AND DISCUSSION

The data obtained from the analysis of organic micro pollutants in water and sediment samples were interpreted with the help of the Order 161/2006 regarding the approval of the Set of norms for the classification of surface water quality necessary for establishing the ecological state of water bodies [6].

The analysed substances were the following; organochlorine pesticides of HCH class (lindane), namely 4 HCH (alpha-, beta-, gamma- and delta) isomers, compounds of DDT class (dichloro-diphenyl-tetrachloroethane) (4.4' DDE, 4.4' DDD and 4.4' DDT), compounds of drines class (aldrine, endrine and dieldrine) and heptachlorine.

In the analysed water samples from Lake Moara Domneasca, heptachlorine has not been found in any of the five investigated zones.

Out of the drines class, endrine has been detected in the lake upstream zone and its value (0.023 µg/l) has exceeded the quality standard during the June campaign, 2009.

Atrazine, an important compound of the triazine herbicides is present in water samples, but its values do not exceed the value of the above mentioned quality standard.

Out of HCH class, only the delta isomer has values below the detection limit, the other isomers being in quantities that exceed the quality standard- beta HCH (0.048 µg/l).

The *sum of the HCH compounds* has registered maximal values in the upstream zone (0.104 µg/l) during the campaign of August, 2008 and it has been observed a decrease of concentrations in the upstream zone towards downstream. It has been observed as well that the level of the HCH sum in the water samples from the campaign of June, 2008 is greatly lower than that of the previous year (Figure 1).

Out of the DDT class, the main isomer 4.4' DDT is present in all five zones with significant values between 0.028-0.058 µg/l which exceeded the quality standard (0.010 µg/l) in the campaign of June, 2009; in the other campaigns, its oxidation products 4.4' DDE and 4.4' DDD were present with values between 0.011 and 0.058 µg/l.

The DDT load in the analysed samples is better shown in Figure 2 where it can be noticed the same decreasing tendency from upstream towards downstream.

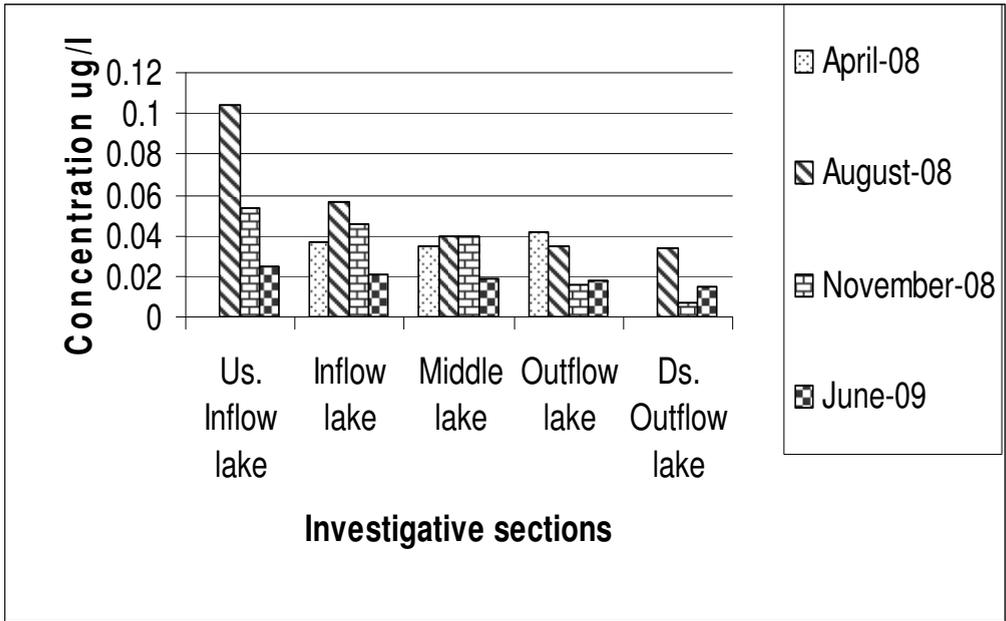


Fig. 1. Level of HCH sum in the water samples taken from Lake Moara Domneasca in 2008-2009

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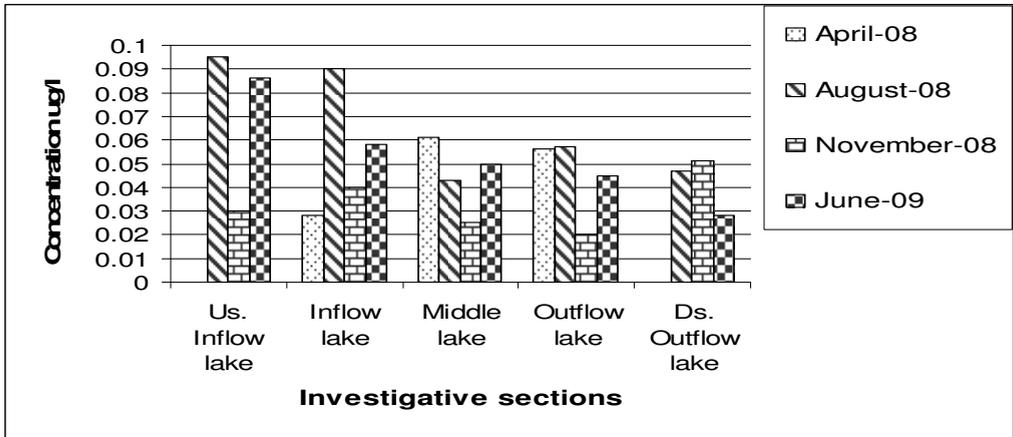


Fig. 2. Level of DDT sum in the water samples taken from Lake Moara Domneasca in 2008-2009

The level of water sample load with DDT compounds has the same tendency in June 2009 in comparison with the summer campaign of the previous year while being higher than the autumn campaign. This fact might occur due to the possible the use of fertilizers on some types of arable lands in spring-summer time.

The evolution of organochlorine pesticides in sediments is constant in all three sampling campaigns, with more diminishing values than in aqueous samples. Nevertheless, an exceeding of the quality standard can be noticed both for atrazine and organochlorine pesticides (Figure 3).

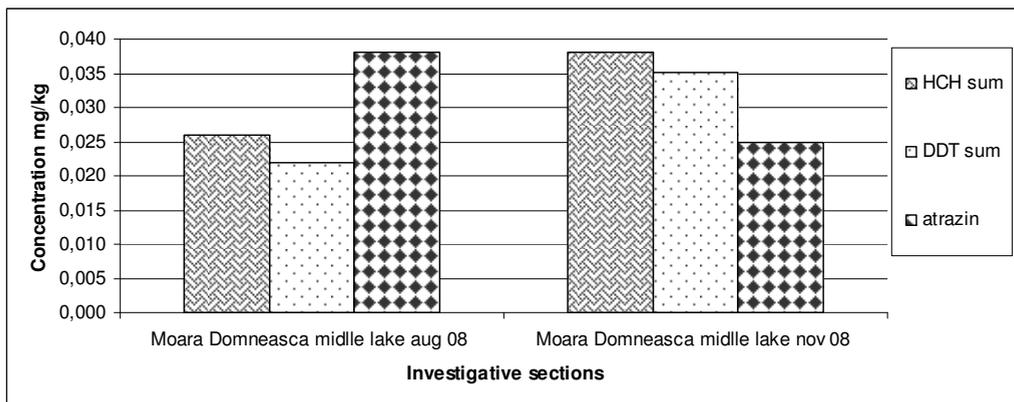


Fig. 3. Level of Lake Moara Domneasca sediment samples loading in 2008-2009

CONCLUSIONS

1. The level of load with HCH compounds is greater in summer campaigns than in autumn campaign; this occurrence is due to the possible processes of evaporation and concentration which take place during the dry season.
2. The sample load with DDT compounds is more significant in summer campaigns due to the possible use of fertilizers on some arable lands.
3. A decreasing concentration of HCH and DDT compounds can be noticed in the zone upstream towards downstream.
4. The data obtained from the analysis of organochlorine pesticides in the lake Moara Domneasca between 2008-2009 show a long term background pollution caused by agricultural activities [5].

REFERENCES

1. Chitimiea S., C. Toader, 2000. *Pesticides levels in water and soil-long term effects*. Pesticide Safety News no. 3.

2. Freeman R.R., 1981. *High resolution gas-chromatography*. 2nd edition, Hewlett Packard Company, Editor.
3. Luțai C., S. Chițimiea, A. Borș, 2004. *Poluanții organici persistenți-impactul asupra mediului: nivele de concentrație și evoluție în mediul acvatic*. Ediția III-a, Chiminform Data - ICECHIM.
4. Marcoci Simona, 1984. *Indrumar metodologic pentru urmărirea evoluției calității apelor*. București.
5. Sheehan P.J., D.R. Miller, G. Butler, P. Bourdeau, 1994. *Effects of pollutants at the ecosystem level*. John Wiley&Sons, New York.
6. Varduca A., 2000. *Protecția calității apelor*. Ed. HGA, București.