

SEASONALITY OF PCB s IN PLANKTON OFF ERDEMLI, NORTHEASTERN MEDITERRANEAN

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ABSTRACT

Concentrations of polychlorinated biphenyls (PCBs) in plankton off Erdemli, northeastern Mediterranean, were measured from November 1984 to October 1985. It was observed that the PCBs concentrations of plankton were generally low from November to March and were high in the following months. Significant correlations were observed between the sea surface temperature, lipid content and biomass of plankton and their PCBs contents. The PCBs values of this study were compared with those obtained in plankton from different oceanic regions.

INTRODUCTION

Polychlorinated biphenyls (PCBs) are an important group of chlorinated hydrocarbon chemicals due to their toxicity to living organisms, persistancy and increasing widespread occurency in the environmegt. Conspicuous concentrations of these pollutants have also been reported for the seawater off Erdemli (KIDEYS and SALIHOĞLU, 1988).

Direct uptake of PCBs from seawater is the main route of accumulation of these compounds by phytoplankton. The transfer of PCBs from suspended microparticulates to phytoplankton cells provides another mechanism for the accumulation of these compounds in primary producers (HARDING and PHILLIPS, 1978). Zooplankton takes up the PCBs either from water or from contaminated phytoplankton (CLAYTON et al., 1977; WYMAN and O'CONNORS, 1980).

PCBs have been shown to alter the species composition of mixed phytoplankton cultures (MOSSER et al., 1972; O'CONNORS et al., 1978) and inhibit the reproduction of certain zooplankton (WILDISH, 1972 cited in CLAYTON et al., 1977).

The seasonal variation of pollutant concentrations in organisms is a major source of inference in monitoring surveys. The present work aimed to evaluate the seasonal variation in concentrations of PCBs in plankton off Erdemli and also to study the factors which result in these variations.

MATERIAL AND METHODS

Plankton samples were collected with montly intervals during a year from November 1984 to October 1985 by the research vessel R/V "LAMAS" at a preselected station about 3.5 nautical miles off the coast of Erdemli, South of Turkey, in the Northeastern Mediterranean (Fig. 1). They were taken by making several oblique tows between 75 m depth and the surface with a standard net (55 μ m aperture) during 15-30 minutes at a speed of about 2 knots. Samples were washed with tap water through a 55 μ m screen and the quantity remaining on the sieve were stored in glass vials at -20°C till analysis.

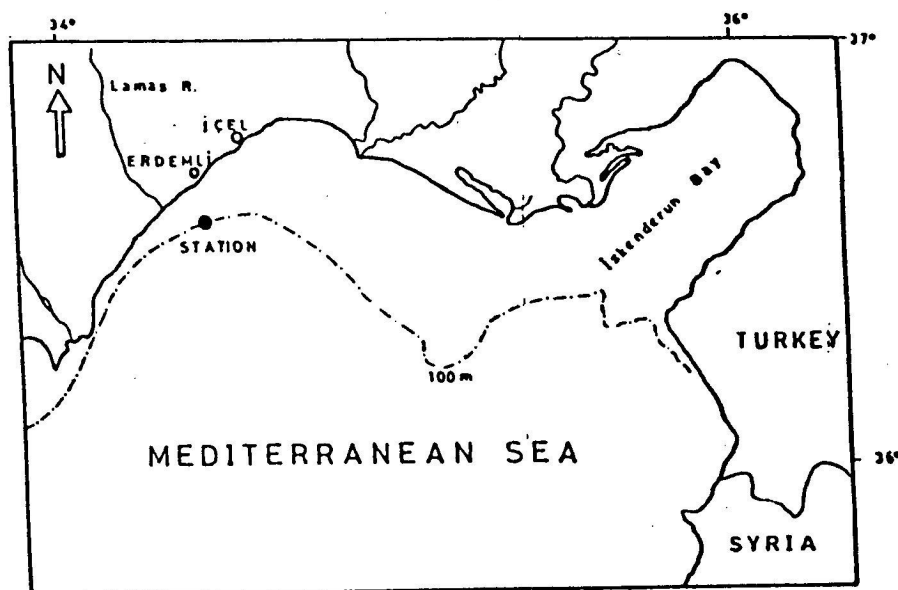


Figure 1. Location of sampling station

PCBs concentrations of plankton were analyzed via the Soxhlet extraction as described by UNEP (1985). A detailed description of the analysis is given elsewhere (KIDEYS, 1987). A Varian Aerograph Model 2700 gas chromatography equipped with a ^{63}Ni electron capture detector which is sensitive down to 10^{-12} g of halogenated hydrocarbon compounds was used for qualitative and quantitative analysis. A glass column of 6 feet (i.d. 4 mm) packed with 5% OV 101 on 80-100 mesh Chromasorb W, HP was attached to the instrument. During the analysis, carrier gas (N_2) flow rate was 60 ml/minute, and temperatures of the injection part, column and the detector were 225, 200 and 275 °C respectively.

During the course of analysis the possible contamination sources were tested for their PCBs contents. Arochlor 1232, 1242, 1254, 1260 supplied from BDH Chemicals Ltd. were used as reference standards for quantification.

RESULTS AND DISCUSSION

Concentrations of PCBs found in plankton during the study period are represented in Fig.2. As can be seen from this figure, the concentration of PCBs is low from November 1984 to March 1985 and after that time it started to increase and kept its high level until October 1985. This seasonal variation in PCBs concentrations of plankton is primarily related to their lipid contents, high lipid contents resulted in high accumulation of these compounds by these organisms. PHILLIPS (1980) pointed out that phytoplankton and other primary producers obviously take up chlorinated hydrocarbons from solution presumably by a mechanism approximating lipid-water partitioning. According to the same author this step is by far the greatest amplification of residues found in any single step of food chain. A significant positive correlation ($P < .01$, $r = 0.745$) found between lipid content of plankton and their PCBs concentrations supported this conclusion (SNEDECOR and COCHRAN, 1976). The importance of the lipids in the accumulation of chlorinated hydrocarbons was also indicated by some other authors (CLAYTON et al., 1977, PAVLOU and DEXTER, 1979).

Temperature should be another factor which influence the PCBs content of plankton. Since significant positive correlation ($P < .01$; $r = 0.787$) was also observed between temperature and plankton's PCBs content. In general, increases of ambient temperature lead to increased net uptake of pollutants by organisms which may correlate to physiological changes linked to metabolism e.g. filtration or ventilation rates (PHILLIPS, 1980). According to CLAYTON et al. (1977) the general accumulation characteristics of PCBs in biotic and abiotic phases of aquatic ecosystems may be influenced by salinity and temperature since changes in these parameters would affect the solubility and therefore the biological availability of these compounds.

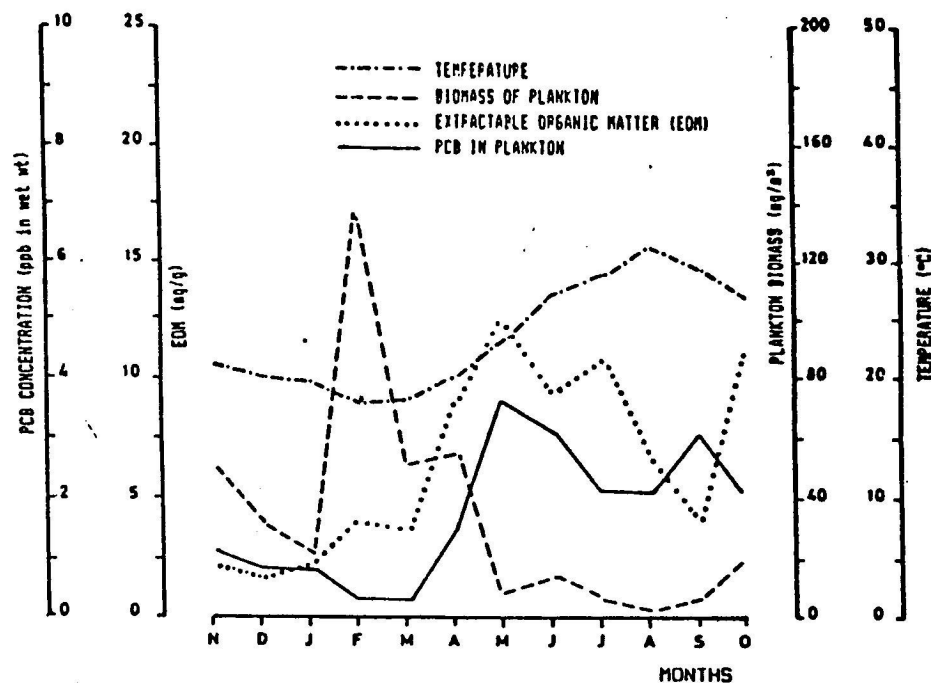


Figure 2. Seasonal variation in the concentrations of PCBs in plankton and related factors during study period (November 1984-October 1985)

The inverse increases and decreases in both biomass and PCBs content of plankton (Fig. 2) suggested the existence of a correlation between these parameters. A significant negative correlation ($P < 0.1$; $r = -0.748$) obtained in the present study between biomass and PCBs contents of plankton supports this suggestion. According to CONNELL and MILLER (1984) bioaccumulation factors decreases with increasing biomass at a given pollutant concentration. Similarly, PHILLIPS (1980) concluded that a high standing crop and turnover of phytoplankton would cause a greater dilution of the available pollutant-load throughout the primary producers. Therefore, the PCBs content of plankton will be low during its high biomass at certain periods

To date a considerably amount of effort has been spent especially by Marine Sciences Institute of Middle East Technical University (IMS-METU) for the determination of the levels of chlorinated hydrocarbon residues in various organisms in Eastern Mediterranean where there was no such a work attributed to plankton. Since the data related to PCBs residues in plankton are too sparse even in whole Mediterranean to compare regional patterns, the PCBs contents of plankton from the other regions of the world are also included in Table 1.

Table 1. Comparison of PCBs concentrations in plankton from different oceanic regions.

Area	Sampling date	PCBs concentration (ppb in wet weight) (mean)	Reference
French coastal waters	November 1974	NR (432.7)	FOWLER & ELDER (1978)
Southwestern coast of Finland	Summer and Autumn 1972-73	40-450 (190)	LINKO et al. (1974)
Gulf of St Lawrence	June-August 1972	2000-93000	WARE & ADDISON (1973)
Scottish Coast	April-June 1971-72	10-2200 (285)	WILLIAMS & HOLDEN (1973)
² Coast of Finland	July-August 1972	0.9-65 (12.5)	MIETTINEN & HATTULA (1978)
^b Stockholm Archipel.	September-October 1971, June 1972	3000-35000 (18428)	JENSEN et al. (1972)
² Northern Adriatic	June-November 1978	10.6-24.5	CATTANI et al. (1980)
^c South Adriatic	1976-78	200-1900 (760)	VILICIC et al. (1978)
^c Open Mediterranean	April-July 1977	15-225 NR	FOWLER et al. (1978)
Northeastern Medit.	November-October 1984-85	2-3147 (484)	Present study

NR not recorded, ²in zooplankton, ^bas fat weight, ^cas dry weight.

By comparison with other oceanic regions (Table 1) the PCBs concentrations in plankton found during present study are on about the same range as that reported for the Scottish coast (WARE and ADDISON, 1973) with a range value of 10-2200 ppb and 3-107 ppb, respectively, but higher than those reported for Mediterranean (FOWLER et al., 1978; VILICIC et al., 1978) except the values of FOWLER and ELDER (1978). The mean PCBs content in the present study (484 ppb), is only slightly higher than that obtained by the latter investigators (433 ppb) for the mixed plankton samples collected on a single night at a station approximately 5 km off the coast of Villefranche-sur-Mer, France. FOWLER et al. (1978) studied the PCBs and DDT concentrations of plankton in open Mediterranean and observed that there were surprisingly high concentrations of PCBs in plankton collected from eastern part of Mediterranean. The results found here showing high PCBs concentration in plankton are in good agreement with the findings obtained by these authors.

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