Chlorinated Hydrocarbons in Red Mullet *(Mullus barbatus)* from the Greek Seas

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This study reports on the concentration of PCBs and DDTs in the flesh of red mullet collected at 8 locations in Greek waters from 1986 till 1988. Concentrations of chlorinated hydrocarbons and lipids were determined according to the procedure proposed by SATSMADJIS et al (1988). GC analysis was performed with a GC (Varian 3700) equipped with a 63 Ni electron capture detector and a fused silica Megabore column DB-1, 30m long.

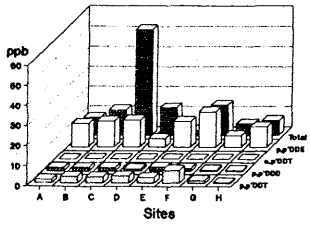


Figure 1. Mean concentrations of DDTs and total PCBs (ppb wet weight) in the flesh of red mullet from Greek waters.
A: Alexandroupolis, B: Chios, C: Pagassitikos, D: Saronikos, E: Rhodes, F: Heraclion, G: Chania, H: Preveza.

The higher mean concentration of total PCBs coincided with the shallow, enclosed gulf of Pagassitikos (52.6 ppb wet weight), where a considerable outflow of urban and industrial wastes takes place (Fig 1). The lowest value (2.6 ppb) was detected off Rhodes island (open S. Aegean Sea) while in the other locations PCBs fluctuated between 5.6 and 15 ppb. The main compound of DDTs was p,p´ DDE (Fig 1). DDTs values ranged from 15.2 to 25.6 ppb at the 5 sites (A, B, C, E, F) of the Aegean Sea. Saronikos Gulf, although exhibiting high p.p´ DDT values, displayed low concentrations of all other DDTs (8.9 ppb). Low DDTs values were also found in the two locations off western Greece (8 ppb off Chania and 11.1 ppb off Preveza).

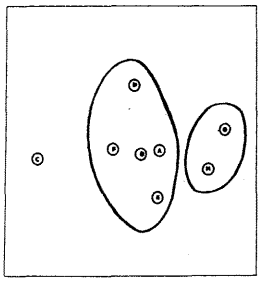
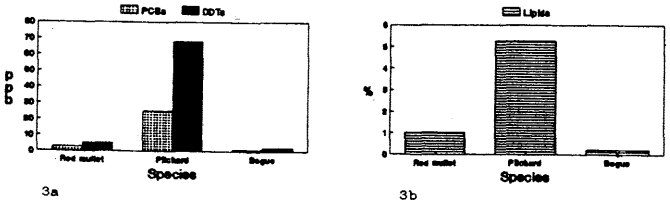


Figure 2. Multidimensional scaling plot for 8 sites according to the concentration of PCBs and DDTs.
A: Alexandroupolis, B: Chios, C: Pagassitikos, D: Saronikos, E: Rhodes, F: Heraclion, G: Chania, H: Preveza.

Nonmetric multidimensional scaling performed on the mean concentations of PCBs and DDTs (Fig. 2), using the PRIMER algorithms (CLARKE & WARWICK, 1989) revealed three groups of sites. Group I was formed by sites A, B, D, E and F (Aegean Sea), which exhibited relatively high DDTs concentrations, fact related to the extensive use of DDT on the close by Mediterranean coast of Asia and Africa during the last decade (PICER & PICER, 1978). Site C (Pagassitikos Gulf) displaying the highest PCBs concentrations was separated from all others (group II), while sites G and H (western Greece) presenting low values of both PCBs and DDTs formed group III.



3a 3b

Figure 3. PCBs, DDTs (3a) and lipid concentration (3b) in red mullet, pilchard and bogue caught in the same area/season.

Chlorinated hydrocarbon (Fig. 3a) and lipid (Fig. 3b) concentration values in red mullet were compared with those of two other species, Sardina pilchardus (pilchard) and Boops boops (bogue), caught in the same area/season. Both values were higher in pilchard and lower in bogue, as compared to those in red mullet. This possibly implies a positive relation between lipids and chlorinated hydrocarbons, as has been found in six species from the NW. Atlantic (STOUT, 1980).

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Characterization and Distribution of Organic Matter in recent sediments from Elefsis Bay (Saronikos Gulf, Greece)

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Within Recent sediments from Elefsis Bay, two types of geogenic and two types of anthropogenic organic matter may be expected:

1: From autochthonous, biogenic marine organisms like phyto- and zooplankton as well as from benthos.
2: Wind- or river transported plant debris (spores, pollen, plant tissues).
3: Petroleum contamination from oil refineries, shipyards and harbour areas as well as other organic compounds from industrial sources.
4: Sewage effluents from the Athens metropolitan area.

The objective of our investigations is to provide an organic-geochemical survey of the sediments from Elefsis Bay, to identify the four above mentioned organic matter types and to establish the presence of potential anomalous organic concentrations.

Sediment samples were taken in March and October 1989 using a modified Reineck corer on board the Greek R/V "Aegeio". Recovered sediments constitute about 80% clay plus silt, in which approximantely about one half is represented by carbonate and the other half predominantly by clay minerals.
Many of our basic organic-geochemical results confirm the findings by VOUTSINOU-TALIADOURI & FRAGOUDAKI (1986) who determined total organic carbon contents (TOC) of up to 4%.
Total content of soluble organic matter, as well as relative amounts of aliphatic to aromatic hydrocarbons to heterocompounds (N,S,O), do not exhibit any significant variation, most probably due to the various sources of organic matter within Elefsis Bay. Only the concentration of aromatic hydrocarbons seem to monitor the proximity of industrial effluents.

The individual types of organic matter were elucidated as follows:
Macro- and microscopic observations indicate that the autochthonous biogenic, marine constituents of the sediments from Elefsis Bay are nearly exclusively made up of carbonate shells. Because shell particles are concentrated with the sand fraction, their regional contribution to the sedimentary input can be estimated via the carbonate content. The amount of preserved organic matter, however, has to be identified via the total organic carbon content of the sand fraction. As we have observed, most pelecypods and gastropods preserve at least some of their organic matter within their shells.
Relative amounts of the marine versus terrestrial organic matter present within the sediments were evaluated by concentrations of the C_{15} to C_{18} versus C_{21} to C_{25} aliphatic hydrocarbon fractions. Within the sediments from Elefsis Bay, terrestrial plant material predominates. This is in accordance with the very close shoreline and the wind direction from the inland area. Nevertheless it can also be argued that anthropogenic contamination of Elefsis Bay has reduced the quality of living conditions for marine organisms and therewith the primary availability of marine organic matter. The stress factor within Elefsis Bay is especially expressed by the scarcity of marine species.
As outlined above, a major contamination in Recent Elefsis Bay sediments is represented by petroleum together with other organic compounds. Within all anoxic sediments we found an "Unresolved Carbon Mixture" (UCM) in the C_{15+}-aliphatic hydrocarbon fraction which seems to correlate to an UCM within the C_{15+}-aromatic hydrocarbon fraction. At the reference site outside Elefsis Bay, an UCM could still be identified, however, with a considerable lower concentration. No UCM was observed within the underlying oxic sediments.
Preliminary investigations reveal that the UCM is confined to the clay fraction of the sediment, especially to its adsorption capacity as expressed by the size of specific surface area.
The effects of sewage effluents within Elefsis Bay have not been evaluated so far. However, for this purpose, analyses of low-molecular-weight hydrocarbons are in progress.

The incorporation and preservation of marine, as well as of terrestrial organic matter, in Recent Elefsis Bay sediments, has been demonstrated from the results of our organic-geochemical survey.
Within anoxic sediments, organic, anthropogenic contamination is degraded to a considerably lower extent than within oxic sediments. As organic contamination seems to be strictly tied to clay minerals, we recommend detailed physico-chemical analyses to evaluate the chance and importance of potential remobilization processes.

References:

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