Ecotoxicology and Environmental Safety 84 (2012) 355–359

Contents lists available at SciVerse ScienceDirect

Ecotoxicology and Environmental Safety

journal homepage: www.elsevier.com/locate/ecoenv

# PCB concentrations in freshwater wild brown trouts (*Salmo trutta trutta* L) from Marche rivers, Central Italy

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ARTICLE INFO

*Article history:*
Received 13 July 2012
Received in revised form
4 August 2012
Accepted 7 August 2012
Available online 21 August 2012

*Keywords:*
Fish
River pollution
Biometry
Organic pollutants

ABSTRACT

The purpose of this study is to evaluate the degree of PCBs contamination of wild brown trouts (*Salmo trutta trutta* L) caught in Marche Region rivers and to study the percentage contribution of the sum of the six indicators PCBs with respect to the sum of eighteen congeners in wild brown trouts. The determination of eighteen PCBs was made on the edible portion (fillets) of trouts by GC–ECD analysis. Fish samples were collected from fourteen rivers, selected to represent the fluvial pollution in the Marche Region. The total sum of eighteen congener concentrations was $8.2 \pm 0.9$ ng/g wet weight. All the analysed samples showed a high variability of their congener profile even though the six PCBs indicators stood for 49.8% of the total PCBs. In the muscle of brown trout the Σ eighteen PCB and the Σ six PCB concentrations were not statistically correlated with the length and the body mass of specimens. Total PCB (Σ eighteen PCBs and Σ six PCBs) concentrations measured in the different sampling sites showed significant statistical differences among districts and, in the same district, among rivers ($p < 0.01$). In particular, the lowest PCB levels ($p < 0.01$) were detected in fish caught in Pesaro–Urbino Province rivers with the mean total PCB concentrations of $102.4 \pm 6.3$ ng/g fat weight while the highest PCB levels were measured in specimens coming from Macerata Province rivers ($1147.8 \pm 456.6$ ng/g fat weight).

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## 1. Introduction

Although PCBs have been banned in many countries for over twenty years, they still constitute a danger for the environment and human health because of their persistence, and also because they continue to be used by third world countries. As well documented, their levels have decreased in some areas, often the most contaminated, but have also increased in previously clean areas (Huestis et al., 1997; Vuorinen et al., 1997; Brown et al., 1998). As a result of improper disposal and long range atmospheric transport, these organic pollutants are widely distributed in many aquatic ecosystems (Cotham and Bidleman, 1991; Burt and Ebell, 1995; Maes et al., 2008) and are frequently found at low levels in human tissues. The bioaccumulation of PCBs in aquatic food chains is undesirable because of their adverse effects on aquatic organisms and top predators, as well as the humans (Binelli and Provini, 2003). At environmental concentrations PCBs can damage the reproductive system, retard growth and increase embryonic mortality (Ghosh and Thomas, 1995; Binelli et al., 2001).

In Italy, the monitoring of PCBs has mainly focused on water, sediments and marine biota in the Mediterranean Sea (Perugini et al., 2004; Perugini et al., 2006; Picer, 2000), but very few data have been reported on the PCB concentrations in the freshwater fish from the Italian rivers (Viganò et al., 2000). Fish can be used for the assessment of aquatic ecosystems because they can be found everywhere in the aquatic environment, because they play a major ecological role in the aquatic food-webs and because of their function as a carrier of energy from lower to higher trophic levels (Beyer et al., 1996). The exposure of wild brown trouts (*Salmo trutta trutta* L) to PCBs depends on the concentrations of these compounds in the surrounding environment (water and sediment). Wild brown trouts are predatory species on top of the trophic levels; they are abundant in many freshwater ecosystems and they are also subjected to exploitation being part of the human diet.

In Marche Region the water qualities of all the rivers and streams have been investigated since 2005 according to Italian Legislative Decree No. 152/1999, concerning the protection of waters against pollution, implementing directive 91/271/EC. Generally the freshwater status in the mountain areas is classified to be very good, while the quality of water gets worse going from the hill, in the middle of the region, to the coast and becomes awful near the river mouth. The reason for the decreasing of water quality from the source to the mouth can be found in the anthropic activities such as

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0147-6513/$ - see front matter © 2012 Elsevier Inc. All rights reserved.
http://dx.doi.org/10.1016/j.ecoenv.2012.08.013

in industrial wastewater or domestic sewage that strongly influence the natural status of all aquatic ecosystems.

As far as the authors know, this is the first study on concentrations of PCBs undertaken in the wild brown trouts living in the rivers of Marche Region. The aim of this study was to evaluate the level and distribution of the eighteen PCB congeners ($T_3$CB-28, $T_4$CB-52, $P_5$CB-95, $P_5$CB-99, $P_5$CB-101, $P_5$CB-105, $P_5$CB-110, $P_5$CB-118, $H_6$CB-138, $H_6$CB-146, $H_6$CB-149, $H_6$CB-151, $H_6$CB-153, $H_7$CB-170, $H_7$CB-177, $H_7$CB-180, $H_7$CB-183 and $H_7$CB-187) in wild brown trout fished in Marche Region rivers, Central Italy. Fillet (lateral muscle) of wild trout, due to its high lipid content, is a good bioindicator of PCBs presence and moreover the levels of PCBs can be correlated to the environmental status of freshwater. Trouts contamination is, thereafter, also a matter of concern for human health.

## 2. Materials and methods

### 2.1. Study area and sampling

Study area and sampling rivers (Fig. 1) are located in the Marche Region, Central Italy. The freshwater courses were selected along the Marche Region from north to south considering to represent the main four districts: Pesaro–Urbino (PU), Macerata (MC), Ascoli Piceno (AP) and Ancona (AN). For this study only the wild brown trouts (*Salmo trutta trutta* L) were taken, for a total of 83 specimens. This species are the most common fish living in Marche Region rivers and, as predators, represent the secondary consumers.

### 2.2. Sample preparation

The samples were wrapped in aluminium foils, immediately frozen and transported to the laboratory. The total length (cm) and the weight (g) of each trout were measured before the analytical procedures. The dorsal muscle tissues were sampled from each trout, homogenized and stored at $-20$ °C.

### 2.3. Analytical methods

The samples were analysed from the Istituto Zooprofilattico Sperimentale dell'Umbria e delle Marche in the Ancona analytical laboratory (Italy). Pesticide-grade reagents and solvents (Carlo Erba, Milano, Italy) were used for the analysis. 30 g of muscle was weighted on a Petri glass plate, frozen at –80 °C overnight and freeze dried (8 h). The lyophilized samples were extracted with a 1:1 mixture of *n*-hexane/acetone by means of an accelerated solvent extractor (ASE 200 Dionex Corporation, Sunnyvale, CA). The extracts were cleaned up on an Extrelut NT-3 (Extrelut® NT Merck, Darmstadt, Germany) column acidified with 3 mL of concentrated sulfuric acid connected on top of a silica cartridge 1 g/6 mL (International Sorbent Technology Mid Glamorgan, UK). The analytes were then eluted with 13 mL *n*-hexane. The solvent was removed from the purified extracts under nitrogen stream and the sample dissolved in 0.5 mL iso-octane and injected in an Agilent-Technology Gaschromatography (6890 N) equipped with a 7683 series automatic injector, a PTV inlet and a μ-ECD. 1 μL of the

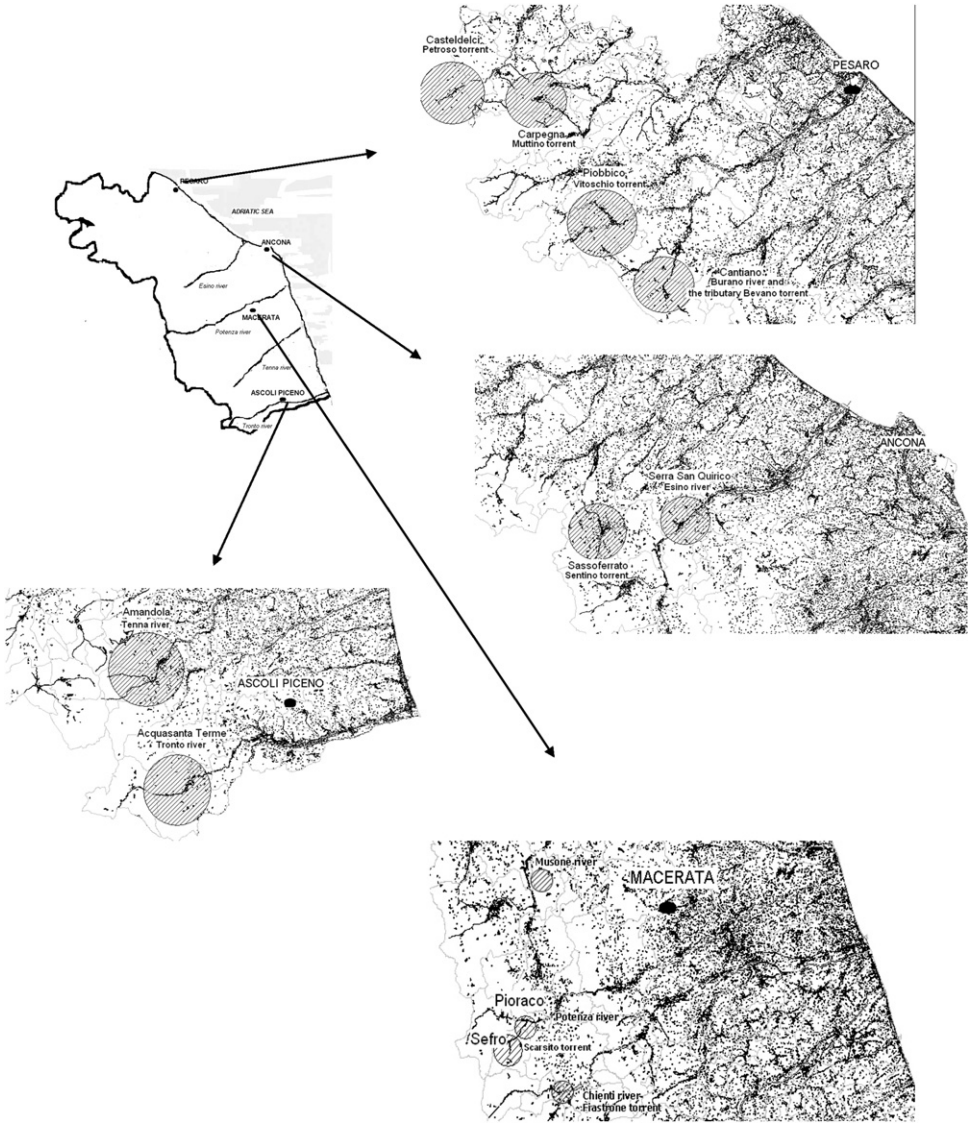


**Fig. 1.** Geographic situation and localization of the studied Marche rivers.

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