The French action plan on polychlorobiphenyls (PCBs) was adopted in 2008. An important element of the plan is to produce information leading to an improved understanding of the fate and transport of these contaminants. The first step, addressed by this study, is to better understand the relation between PCB contamination of sediment and that of biota. The objectives of the study presented in this report were (i) to develop a bioaccumulation model that relates PCB concentrations in sediment to those in fish, (ii) in order to predict a "safe" PCB concentration in sediment, i.e., that corresponds a PCB concentration in fish tissue that is less than the current regulatory maximum for fish consumption (8 pgTEQ.g-1 wet weight), and (iii) to describe spatial and temporal trends in PCBs in Rhône River sediment and fish.

Spatial and temporal trends in PCBs in Rhône sediment were investigated by collection and analysis of sediment cores from five locations along the Rhône (La Morte, Crépieux, Grand Large, Table Ronde, and île du Beurre) and from one location on a tributary (the Gier River). Dates of deposition of sediments in the cores were determined on the basis of the date of site construction or connection to the Rhône, occurrence of radionuclides, and changes in grain-size distribution corresponding to major flood events. Eighteen PCB congeners were analyzed at 1-cm intervals in one core from each site. Additionally, 16 samples of surface sediments were collected in the Grand Large, a fluvial lake of 144 ha, in order to map PCB contamination of surficial lake sediments. The data collected for this first part of the study show that PCB concentrations increase in a downstream direction, with significant releases to the river both upstream and downstream of Lyon and its suburbs. Although concentrations at all sites decrease toward the top of the core (corresponding to recently deposited sediments), this tendency is more pronounced upstream of Lyon, whereas downstream of Lyon the Gier River continues to contribute substantially to the PCB contamination of Rhône sediments. The role of floods, and, more generally, hydro-sedimentary dynamics are reflected in changes in grain-size distribution and PCB congener patterns throughout the system, and upstream of Lyon sediment flushing events also affect PCB congener patterns.

Three fish species (the common bream *Abramis brama*, the barbel *Barbus barbus*, and the chub *Squalius cephalus*) and their invertebrate prey (chironomid larvae, freshwater shrimp, ephemera, and bivalve mollusks corbicula and pisidium) were collected at three of the sediment-sampling locations (La Morte, Grand Large, and Ile du Beurre). All samples were analyzed for isotopes of carbon ($\delta^{13}C$) and nitrogen ($\delta^{15}N$) and seven to 18 PCB congeners. Biometric characteristics (size, weight and age) were recorded, and fish stomach contents were analyzed. All available variables were used to develop (i) a log-linear model relating PCB contamination of fish tissue to that of sediment, and (ii) a generalized linear model that estimates the probability that the PCB contamination threshold for fish consumption is exceeded for a given concentration of PCBs in sediment. For both models, three significant variables were identified by backward stepwise regression: fish size, the proportion of fish diet composed of detrital carbon, and the maximum PCB concentration in sediment to wish the fish were exposed over their lifetime. Using these three variables, the log-linear model was able to explain 78% of the total contamination variability (all species from all locations combined), and the generalized linear model, which determines the probability that the consumption concentration threshold is exceeded, was able to explain 70% of the variability. These results confirm the importance of the relation between PCB contamination of sediments and that of fish.

physiology-based food-web model was developed for the PCB congener #153 using the experimental data obtained during this study, historical records of water temperature, and literature data on fish physiology and invertebrate contamination kinetics. The model, discretized by fish age classes, predicts large seasonal variations in the contamination of individuals, although this result could not be confirmed experimentally. Comparison of predicted and observed concentrations demonstrates that the model is fairly robust, with only one false negative out of 114 cases. The rate of false positives (overestimation of contamination level) was higher, and occurred principally for chubs. This likely is because fish diet in the model is fixed regardless of fish age, and because

chubs are opportunistic feeders. A sensitivity analysis indicated that none of the model parameters affected the rate of false negatives. The parameters that most affected the model fit were those describing the trophic exposure route (assimilation efficiency, feeding preferences, PCB concentration in prey, and PCB concentration in sediment) and the excretion rate.

The two modeling approaches were used to determine the PCB concentration in sediment below which PCBs in fish tissue are likely to be at a concentration that does not exceed the regulatory maximum for consumption. On the basis of the log-linear model, 90% of the fish in the study database would have a PCB concentration less than that of the regulatory maximum if the PCB concentration in the sediment were less than 5.9 $ng.g^{-1}$ (dry weight). If the food-web model was constrained so that no fish would exceed this maximum, the resulting benchmark concentration for sediment varied between 2.6 and 14 $ng.g^{-1}$ (dry weight), depending on fish species and location, a result that is consistent with that of the log-linear model.

On the basis of what was learnt regarding temporal trends in PCB concentrations in sediment, PCB concentrations in fish at La Morte likely have decreased almost continuously since the 1970s. In contrast, PCB concentrations in fish at Grand Large probably increased until 1997-98 and now are decreasing. However, the date at which all the fish in the Grand Large would contain PCBs at a concentration below the regulatory threshold for fish consumption cannot be predicted with the statistical model. At Ile du Beurre, PCB contamination of fish likely decreased during 1995-2009 relative to previous decades, but the large variations in sediment PCB concentrations, which are affected by the flow regime and contributions from the Gier River, hamper any prediction of trends in fish contamination in this area.