PCB TRENDS IN STRIPED DOLPHINS FROM THE WESTERN MEDITERRANEAN SEA

Alex Aguilar * and Asunción Borrell

Dept. of Animal Biology, University of Barcelona, 08071 Barcelona, Spain - * aaguilar@ub.edu

Abstract

The aim of the study was to investigate timetrends in PCB loads in the offshore waters of the western Mediterranean Sea. As bioindicator we selected the striped dolphin, a long-lived oceanic species, and analysed blubber samples obtained during 1987 2002 from 186 freeranging individuals by means of biopsy techniques. Concentrations of PCBs decreased throughout the period. This decline in oceanic waters is consistent, albeit not always, with trends observed in coastal surveys. Dolphins and other top predators are thus proposed as useful indicators to assess long-term trends of pollutants in oceanic ecosystems and large water masses.

Keywords: PCBs, striped dolphin, western Mediterranean Sea, temporal trends, bioindicator

Introduction

The use of PCBs was worldwide discontinued in the 1980s but, due to the stability of these compounds, they have remained as ubiquitous pollutants in marine environments. PCBs are usually monitored through coastal organisms and therefore information on offshore water masses is scarce or nonexistent. Here we investigate the use of dolphins as bioindicators of PCB pollution in oceanic ecosystems.

Material and methods

Between 1987-2002, with the exception of 1990 and 1994-1999, we collected blubber samples from 186 striped dolphins in the offshore waters between mainland Spain and the Balearic Islands. The tissue was excised from bow-riding dolphins using a biopsy dart (1) and preserved in deep freeze. Quantification of PCBs was made by gas chromatography with electron capture detector and SPB 5 capillary column. Data were log-transformed (base 10) and temporal trends investigated through regression analyses.

Results and conclusions

PCB concentrations (mean=199, SD= 150, in mg PCBs /kg lipid tissue?) were of the same order of magnitude as those reported by previous studies on the same species in north-western Mediterranean Sea (2, 3), but about 2-10 times higher than those found in other less polluted water masses (4).

Mean PCB concentrations declined significantly ($p<0.0001$) from 342 mg/kg in 1987 to 76 mg/kg in 2002 (Fig. 1):
log PCB=112.1-0.0552t (R^2=0.707, SE (slope)=0.003, SE(intercept)=5.23)

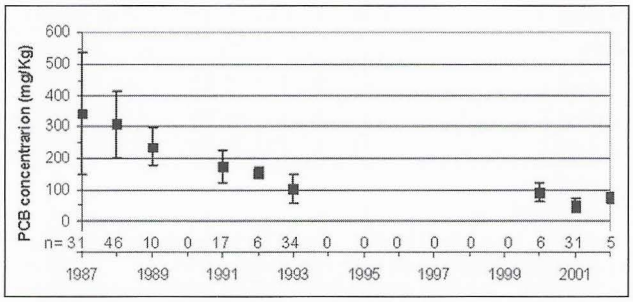

Fig. 1. Mean ± standard deviation of PCB concentrations, expressed as mg/Kg lipid basis for each sampling year (n= number of samples per year).

The observed decrease reflects the reduction of PCB inputs into the Mediterranean Sea since the 1980s and the subsequent decomposition/dispersion process undergone by the pollutant. The European countries bordering the western Mediterranean Sea manufactured in the past large quantities of PCBs; production in France, Italy and Spain alone was about 300.000 t during 1954-1984 (5). Since the mid-1980s, PCBs were much restricted though large quantities remained in uncontrolled disposal sites or were recycled. A significant fraction of the PCBs released ended up in the sea. Monitoring of marine ecosystems has been typically made using widely distributed coastal organisms, such as mussels, other shellfish, and inshore bottom fish, as bioindicators (5). Although results from short-term coastal surveys undertaken between the 1970s and the early 1990s tend to show either stabilization or a decreasing trend in PCBs (5), data are not consistent (6, 7, 8, 9). Comparable information on the oceanic water masses is scarce or nonexistent, mostly because appropriate indicators are not available. Given that organochlorines are bioaccumulative and magnify through food chains, mobile –though resident- top predators such as dolphins, porpoises and seals, have been proposed as indicators (10). Our results show that the environmental levels of PCBs in the oceanic waters of the Western Mediterranean have decreased significantly during the last 15 years and suggest that data from coastal studies, particularly those from sediments (9), reflect only local, small-scale processes and may be non-informative of the long-term, wide-scale variation in the pollutant loads of large water masses, particularly oceanic.

Acknowledgements. Study funded by the Fundació pel Desenvolupament Sostenible (FDS) and the DGCONA, Ministerio de Medio Ambiente of Spain. Samples were supplied by the BMA bank with the support of the Pew Fellows Program in Marine Conservation and Earthtrust.

References

1 - Aguilar A. and Borrell A., 1994. Assessment of organochlorine pollutants in cetaceans by means of skin and hypodermic biopsies. Pp. 245-267. *In:* Fossi, C. and Leoncio C. (eds), Nondestructive Biomarkers in Vertebrates. Lewis, Boca Raton, FL.

2 - Aguilar A., 2000. Population biology, conservation threats, and status of Mediterranean striped dolphins (*Stenella coeruleoalba*). *J. Cetacean Res. Manag.*, 2: 17-26.

3 - Marsili, L., Casini, S., Marini, L., Regoli, A., and Focardi, S., 1997. Age, growth and organochlorines (HCB, DDTS and PCBs) in Mediterranean striped dolphins *Stenella coeruleoalba* stranded in 1988-1994 on the coasts of Italy *Mar. Ecol. Prog. Ser.,* 151: 273-282.

4 - O'Shea T. J. and Aguilar, A., 2001.Cetaceans and Sirenians. Pp. 427-496. *In:* Shore, R. F. and Rattner B. A. (eds), Ecotoxicology of Wild Mammals, John Wiley & Sons, Chichester, UK.

5 - Tolosa I., Readman J. W., Fowler S. W., Villeneuve J. P., Dachs J., Bayona J. M., and Albaiges J., 1997. PCBs in the western Mediterranean. Temporal trends and mass balance assessment. *Deep-Sea Res. II*, 44: 907-928.

6 - Villeneuve J. P., Carvalho F. P., Fowler S. W., and Cattini, C., 1999. Levels and trends of PCBs, chlorinated pesticides and petroleum hydrocarbons in mussels from the NW Mediterranean coast: comparison of concentrations in 1973/1974 and 1988/1989. *Sci. Total Environ.*, 237/238: 57-65.

7 - Burns A., Villeneuve J. P., and Fowler S. W., 1985. Fluxes and residence times of hydrocarbons in the coastal Mediterranean, how important are the biota? *Estuar. Coast. Shelf Sci.*, 20: 313-330.

8 - Solé M., Porte C., Pastor D., and Albaigés, J., 1994. Long-term trends of polychlorinated biphenyls and organochlorinated pesticides in mussels from the Western Mediterranean Coast. *Chemosphere*, 28: 897-903.

9 - Tolosa I., Bayona J. M., and Albaigés J., 1995. Spatial and temporal distribution, fluxes, and budgets of organochlorinated compounds in Northwest Mediterranean sediments. *Environ. Sci. Technol.*, 29: 2519-2527.

10 - Aguilar A., Borrell A., and Reijnders P. J. H., 2002. Geographical and temporal variation in levels of organochlorine contaminants in marine mammals. *Mar. Environ. Res.* 53: 425-452.