PERSISTENT ORGANOCHLORINE RESIDUES IN BLUBBER OF ANTARCTIC HUMPBACK WHALE, *Megaptera novaeangliae*.

Lailson-Brito J[1,2], Dorneles PR[1,2], Azevedo e Silva CE[2], Secchi ER[3], Dalla Rosa L[4], Bassoi M[3], Vidal L[1], Azeredo A[2], Azevedo A.F[1], Malm O[2], Torres JP[2].

[1] Laboratório de Mamíferos Aquáticos – Departamento de Oceanografia, UERJ, Rio de Janeiro, Brazil. 20550-013. [2] Laboratório de Radioisótopos E.P.F. - Inst. de Biofísica Carlos Chagas Filho, UFRJ, Rio de Janeiro, Brazil. 21941-900; [3] Laboratório de Tartarugas e Mamíferos Marinhos Departamento de Oceanografia - FURG e Museu Oceanográfico "Prof. Eliézer de Carvalho Rios" - Rio Grande, RS, Brasil. [4] Marine Mammal Research Unit, UBC, Aquatic Ecosystems Research Laboratory, 2202 Main Mall, Vancouver, British Columbia, V6 T 1Z4, Canada. *E-mail address: lailson@uerj.br*

Introduction

The humpback whale, *Megaptera novaeangliae*, is found in all oceans. The species occurs from polar zones to equatorial regions, since it carries out long latitudinal migration.[1] In winter months, humpback whales search for low latitudinal shallow waters for breeding and, in spring, summer and fall, the species can be observed in high latitudinal waters, where it migrates for feeding purposes.[2]

The humpback whale stocks were drastically reduced by whaling. Concerning the Southern Hemisphere alone, it is assessed that about 140000 individuals of the species were hunted. Population assessment studies carried out by the end of the 1970s and beginning of the 1980s have reported an estimated population of about 12000 humpback whales to the south of 30º S, between January and February , which probably represented the entire South Hemisphere stock.[3]

Studies carried out on humpback whales from Antarctic Peninsula, within the scope of the Brazilian Antarctic Programme, have tried: (i) to identify the individuals using photo-identification techniques; (ii) to characterize the stock genetically; and (iii) to determine organochlorine concentrations in these animals.

Considering the mentioned reduction of the stock, it is of great interest to investigate if the accumulation of toxic environmental persistent compounds can pose a threat to the marine mammal population concerned.

The aim of the present study was to verify the presence of traces of organochlorines in tissues of humpback whales that feed in Antarctic waters. In order to accomplish such objective, blubber samples from 11 whales biopsied during 1998/1999 (OA17) and 1999/2000 (OA18) summers, around Antarctic Peninsula, were analyzed.

Materials and Methods

During the Brazilian Antarctic Surveys (OA) XVII (1998/99) and XVIII (1999/2000), skin/blubber biopsy samples from humpback whales were obtained in waters around Antarctic Peninsula. Samples were collected from a 4 m long inflatable boat (eventually from the ship), using a 120-150 lb crossbow and a biopsy dart. To reduce the chances of analyzing biopsy samples from same individuals, sampled whales were photo-identified whenever it was possible. The blubber samples were kept frozen (-20^{o} C) until analysis.

Aliquots of approximately 0.3 g of blubber were homogenized with anhydrous Na_2SO_4 and extracted by continuous Soxhlet apparatus, using a soxhlet for 8 hours with a mixture of hexane:dichloromethane (1:1). An aliquot (1mL)

was mixed with sulphuric acid for the clean-up. After centrifugation and phase separation, an internal standard (octachloronaphtalene) was added for the quantification. The lipid content was measured gravimetrically.

A Shimadzu Gas Chromatographer-14B with a ^{63}Ni electron capture detector (ECD) was used in the analyses. Organochlorine concentrations are expressed as $ng.g^{-1}$ calculated on a lipids basis.

The analytical method was validated using a standard certified material (Cod Liver Oil – SRM-1588, National Institute of Standards and Technology – NIST). The accuracy of the method was even strengthened by an intercalibration exercise carried out with Tuna muscle from International Atomic Energy Agency, since it has produced satisfactory results as well. The recovery of all compounds used in this paper ranged from 60% to 140% in both methodological tests. The analyzed organochlorines were: HCB, *o,p*'-DDT, *p,p*'-DDT, *p,p*'-DDD, *o,p*'-DDE, and *p,p*'-DDE, and 18 PCB isomers and congeners (08, 28, 44, 49, 52, 60, 66, 70, 87, 101, 105, 118, 128, 138, 153, 156, 169, 170, 180).

Results and Discussion

Results are summarised in Table 1. There was no significant difference (*Mann-Whitney U test,* $p>0.05$) between organochlorine concentrations determined in the biopsy samples collected in the two distinct surveys (1998/99 and 1999/2000). It could be observed that the total PCB concentrations predominated in relation to both total DDT and HCB. The ratio DDTs/PCBs varied between 0.03 and 0.55. This pattern was different from the one observed by Aono *et al.* (1997), concerning minke whales from Antarctic waters, since the quoted authors reported that DDT predominated. [4]

Table 1 – Sex, lipid content (%) and DDTs, PCBs and HCB concentrations ($ng.g^{-1}$ on a lipid basis) of adipose tissues of eleven humpback whales biopsied during 1998/1999 (OA17) and 1999/2000 (OA18) summers, around Antarctic Peninsula.

Animal Code	Sex	Lipid content	DDTs	PCBs	HCB
OA17-04	F	42	36	301	55
OA 17-12	M	16	81	147	113
OA 17-34	M	13	242	1403	327
OA 17-43	F	41	13	32	29
OA 17-47	F	40	152	1555	113
OA 17-62	M	21	<DL	173	42
OA 18-05	M	45	77	2988	140
OA 18-09	F	20	44	257	131
OA 18-10	M	40	42	91	158
OA 18-16	F	66	101	758	68
OA 18-18	F	46	13	36	66

The PCB concentrations showed in the present study are similar to those found in humpback whales from Canadian Coast.[5] However, with regard to DDT, the values observed in humpback whales from Antarctic were lower than the ones reported for animals from the Canadian Coast. Regarding ΣPCB and ΣDDT, the comparison between the data generated by the present study and information from the literature must be viewed with caution, since the number of congeners and isomers was different from those of the quoted investigations.

Among all the determined organochlorine compounds, only HCB and PCB-28 were detected in all individuals. It can be clearly observed that the lower chlorinated compounds predominated. As a consequence of a great distance from source areas, a more important contribution of the less hydrophobic and chlorinated organochlorines is verified. The singular transport capacity of each congener or isomer explains the differentiation in the magnitude in which each compound reaches the polar regions.[6,7] Concerning the ΣPCB, the tri- and tetra-biphenyl compounds predominate. Beyer *et al.* (2000) corroborate this observation. Those authors suggested that the three and four chlorinated PCBs, like PCB-28 and PCB-52, present a greater dispersion capacity through both water and atmosphere.

The present study is part of a greater research effort that intend to analyze blubbler samples of about 50 humpback whales that were biopsied in different summers from 1998/1999 to 2004/2005. The future amplification of the number of samples to be analyzed, as well as organochlorine determination in other components of the Antarctic marine food web, including sampling in different areas around Antarctic Continent, should shed further light on the observed differences in the pattern of DDT and PCB accumulation between minke and humpback whales. Therefore, these investigations are strongly recommended.

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