FIRST REPORT ON BIOMONITORING OF COASTAL CONTAMINATION BY TRIBUTYLTIN IN THE MEDITERRANEAN USING IMPOSEX IN A NEOGASTROPOD

V. AXIAK[1], D. MICALLEF[1], A. VELLA[2], P. CHIRCOP[1], B. MINTOFF[2]

[1] Marine Ecotoxicology Laboratory, Department of Biology. [2] Department of Chemistry, University of Malta, Msida, Malta

Being the active biocide in antifouling paints, very high levels of tributyltin (TBT) and its derivatives have been reported in harbour areas and yacht marinas along the Mediterranean. Chemical analysis of organotins at low environmental levels which may still be expected to cause some biological impact (ie. less than 50 ng l^{-1}), pose several analytical problems. Such problems have stimulated the use of highly specific biological responses to TBT as tools for biomonitoring purposes.

STATION:	1	2	3	4	5	6	7	8	9
% imposex in ♀	30	60	60	94	100	100	100	100	100
RPS Index (%)	0	13	6	2	93	102	107	86	68
VDS Index (mean)	0.5	1.9	1.8	2.1	4.7	4.8	4.7	4.2	3.9
% ♀ with split capsule glands	0	10	20	0	67	72	62	16	0

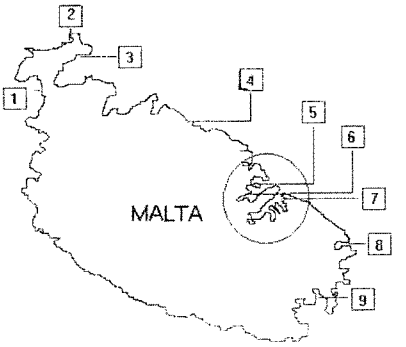

Fig.1. Imposex in *H. trunculus* as expressed in various indices, at different sites. Harbour area are circled.

Imposex, or the development of additional male sex organs in prosobranch gastropods, has been widely used as a biomonitoring tool for TBT outside the Mediterranean. To date, no other xenobiotic except TBT, is known to cause prosobranchial imposex. The present study reports on the first biomonitoring survey of TBT levels in Mediterranean coastal waters using imposex induction in *Hexaplex trunculus* as an index. This species is one of the most common muricid in the Mediterranean. 600 specimens of *H. trunculus* were collected by divers from 9 coastal stations along the north-eastern coastline of Malta (Central Mediterranean) during the period Oct.-Dec. 1992 (Fig. 1). The degree of imposex was quantified by various indices, including : the Relative Penis Size Index (RPS) which is the ratio between the cubed mean penis length in imposexed females to that in males for a given population; and the Vas Deferens Sequence (VDS) Index, whereby imposex development is divided into various stages of vas deferens development, with each stage being given a score. A synthesis of the data is presented in Fig.1. All populations showed some degree of imposex., which was however mostly evident in harbour areas exposed to release of TBT from yacht marinas and ship-repairing yards. Stations which were located downstream with respect of the harbour areas (the prevalent surface coastal water currents being from the NW), also exhibited significant degrees of imposex induction in this species. This phenomenon was moreover related to the levels of TBT in the organisms as well as in sediments. Details of analytical methods and levels of butyltins in biota and sediments are presented elsewhere (AXIAK *et al.*, in press). Fig.2 shows the relationship between the levels of TBT in digestive glands/gonads of females and RPS indices, with the estimated logarithmic correlation line also being shown. The various imposex indices were found to increase sharply at very low levels of butyltins and then to level off also at relatively low levels of the contaminants. Based on a logarithmic correlation line, a 50% index value for RPS was reached at 6 ng Sn g^{-1} dry weight (DW) in the digestive gland/gonad, and at estimated levels of as low as 3.5 ng Sn g^{-1} DW for TBT in whole soft flesh of females. In fact there is evidence to suggest that of all the neogastropod species investigated so far, this species is the most sensitive with respect to its biological response to TBT. This is evident from a comparative review of the relative sensitivities in imposex response to TBT levels in a series of neogastropods as shown by AXIAK *et al.* (in press).

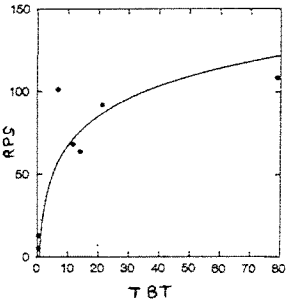

Fig.2. Relation between TBT in digestive gland/gonad of females (ng Sn/g dry weight) and RPS index (%)

Most of the body burdens of TBT (but not of DBT and MBT) were generally found in the digestive gland of exposed snails, indicating that feeding is the major route of uptake of this contaminant for this test species. Females tend to accumulate more TBT than males. No preferential female mortalities was recorded in populations exposed to high levels of TBT. However, a reported shift in the size frequency distribution of animals in contaminated sites, towards bigger snails, may suggest reduced reproductive potential. Imposex in females may lead to sterility either through the occlusion of the vagina or the splitting of the capsule gland. While vagina occlusion does not occur in this species, the majority of females in the highly contaminated sites exhibited split capsule glands. Further data is required to assess whether imposex in this species is leading to sterility of females.

This study has shown that imposex induction in this test species is a highly specific biomarker response; it may be easily quantified; it is extremely sensitive to very low levels of butyltins; it is fast and cost-effective and as such satisfies all criteria for a useful biomonitoring tool which may be applicable to the whole Mediterranean.

This work was partly supported by the Commission of European Communities through its MedSPA programme under contract number MedSPA-91-1/UK/002/INT/06.

REFERENCES

AXIAK V., VELLA A.J., MICALLEF, D., CHIRCOP P. and MINTOFF B. Imposex in *Hexaplex trunculus* : First results on biomonitoring of TBT in the Mediterranean. Marine Biology. In press.