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Ecological Indicators 7 (2007) 209–214

ECOLOGICAL
INDICATORS

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Survey of imposex in prosobranchs mollusks along the northern Mediterranean coast of Morocco

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Received 8 March 2004; accepted 28 September 2005

Abstract

Imposex, i.e., the superimposition of male sex organs on female gonochoristic neogastropods has been observed in more than 140 species worldwide and suggested as a suitable biomarker of tributyltin pollution in the marine environment. In this study, an imposex survey for three neogastropod species: *Murex trunculus*, *Murex brandaris* and *Thais haemastoma* was conducted for the first time at five sites along the northern Mediterranean coasts of Morocco. The imposex phenomenon was observed in the all surveyed sites. Nevertheless, rates of occurrence and degree of imposex were more important in both harbours sites (Tangier and Mdiq) characterized with heaving shipping activity than in the three seaside stations (Martil, Azla and Amsa) where only sporadic and small boats are used in traditional fishing activities.

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Keywords: Tributyltin; Mollusks; Imposex; Moroccan Mediterranean coast

1. Introduction

The imposex phenomenon in gastropods (Smith, 1971) also known as pseudohermaphroditism was first observed in the British population of the dogwhelk *Nucella lapillus* (Blaber, 1970). The condition consists of the superimposition of male sexual characteristics including a penis and/or a vas deferens on the female's own genitalia (Bryan et al., 1988). In its extreme case, the vas deferens occludes the opening of the pallial

oviduct preventing the release of egg capsules and rendering the females effectively sterile (Gibbs and Bryan, 1986; Fioroni et al., 1991). The occurrence of imposex has been extensively documented throughout the world. To date, imposex has been described in more than 140 species worldwide (Oehlmann et al., 1998) and higher development of this phenomenon has been detected in organisms living close to shipping activity such as harbours and marinas.

Fields and dose response assay have established that imposex is strongly correlated to TBT exposure and uptake (Smith, 1981a; Gibbs et al., 1987). Subsequently, Oehlmann et al. (1995) claimed that imposex is the most sensitive response of all known

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pathological conditions in non target aquatic organisms following an exposure to tributyltin. The same study showed also that the phenomenon is not induced by any other metal except by tin in laboratory tests. Hence, the imposex phenomenon of prosobranchs has proved to be the most sensitive and precise parameter to assess TBT pollution in the aquatic environment (Stroben et al., 1995; Smith, 1996). This organotin compound has entered the marine environment as a result of their use as principal biocide in antifouling paints for ship hulls, boats and aquaculture equipment. Goldberg (1986) has described TBT as the most toxic substance ever deliberately introduced into natural water. TBT was detected in considerable amounts in marinas and areas with heavy shipping activity (Tolosa et al., 1992; Morcillo et al., 1997) and it is reported to induce deleterious effects in a wide range of aquatic biota (Evans et al., 1995). Thus, concentrations of a few nanograms per litre induce reduction of growth in marine microalgae (Beaumont and Newman, 1986), production decrease and abnormal shell thickening in the pacific oyster (Alzieu et al., 1986; Claisse and Alzieu, 1993). Also, it has been noted that environmental levels of few micrograms per litre is sufficient to induce thymus atrophy and histological alterations in fish (Bushong et al., 1988).

This damage and other adverse impacts of TBT on non target aquatic life have proved environmental concern. In fact, legislation has been implanted since 1989 in the European Union, and since 1991 in the Mediterranean region is aiming to ban the use of TBT-based paints on vessels under 25 m of length. Despite these bans and restrictions on its use in several countries, monitoring programs revealed the presence of toxic levels of these compounds mainly in the vicinity of harbours (Minchin et al., 1995) where the contamination was high enough to cause imposex (Solé et al., 1998).

Owing to the important growing activity of marine embarkation in Moroccan coasts, the present study aims to map the imposex occurrence and intensity in three neogastropod species from coastal waters of Morocco and relate them to the intensity of shipping activity.

2. Material and methods

A total of 915 individuals of prosobranchs mollusks were sampled from five different sites along the Moroccan northern Mediterranean littoral between March 2000 and April 2001 (Fig. 1). All organisms

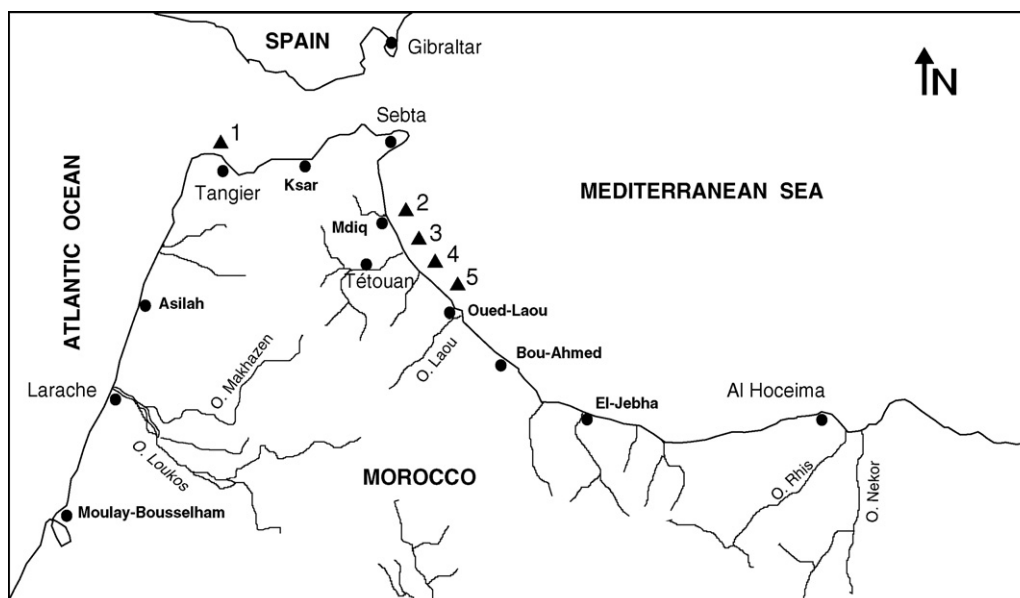


Fig. 1. Location map showing sampling sites: (1) Tangier harbour, (2) Mdiq harbour, (3) Martil, (4) Azla, (5) Amsa.

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