Functioning and dynamics of natural and perturbed ecosystems – D. Bellan, G. Bonin, C. Emig, Eds.

Zinc and copper accumulation in the clam *Ruditapes decussatus* l. (Bivalvia) field mesocosms and laboratory experiments.

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RESUME

L'accumulation du zinc et du cuivre chez la palourde *Ruditapes decussatus* L. (Mollusque Bivalve), a été suivie en milieu naturel et en laboratoire. Les résultats obtenus ont été comparés.

Des palourdes en provenance d'une zone non contaminée de la Ria Formosa ont été transplantées dans l'estuaire du Sado. Les essais se sont poursuivis pendant deux mois. Les concentrations mesurées en milieu naturel (0,07; 0,08 et 0,25 $mg.l^{-1}$ pour le zinc et 0,01; 0,03 et 0,07 $mg.l^{-1}$ pour le cuivre), ont été reproduites en laboratoire.

Dans chaque aquarium rempli avec 12 l d'eau de mer filtrée (0,45 µm) avec une salinité de 33,5‰, ont été placées 80 palourdes ayant une taille moyenne de 29,90±0,31 mm. Le laboratoire étant climatisé à 15±2°C. Les animaux ont été nourris avec une culture de *Phaeodactylum tricornutum*.. L'eau est aérée en permanance et renouvelée toutes les 48h. Des prélèvements de 10 individus ont été faits après 0, 2, 7, 14, 28 et 48 jours en laboratoire, et après 0, 2, 7, 14, 28, 48 et 60 jours en milieu naturel.

Les dosages des métaux des parties molles du corps ont été déterminées par spectrophotométrie d'absortion atomique après digestion (5 HNO_3:1 H_2O_2) à 100°C dans des conteneurs en téflon.

Les taux de bioaccumulation et les facteurs de bioconcentration et de contamination ont été déterminés.

L'accumulation du zinc suit le même comportement en milieu naturel et en laboratoire. La concentration létale minimale déterminée est de 65,80 $mg.l^{-1}$. Le taux d'accumulation varie entre une valeur maximale de 2,29 $\mu g.g^{-1}.d^{-1}$ et une valeur minimale de 1,47 $\mu g.g^{-1}.d^{-1}$.

La concentration en cuivre atteint la stabilité après 15 jours dans la nature, alors qu'en laboratoire elle suit une progression linéaire avec le temps. La concentration léthale minimale en cuivre est de 32,92 $mg.l^{-1}$.

Les taux d'accumulation vont jusqu'à 3,83 $\mu g.g^{-1}.d^{-1}$ par rapport à ceux observés en milieu naturel à peine jusqu'à 0,65 $\mu g.g^{-1}.d^{-1}$.

Les facteurs de bioconcentration (FB), ont toujours été plus élevés en laboratoire (max. 5178 pour le cuivre et 2537 pour le zinc) de même que les facteurs de contamination (FC), exprimant le rapport entre les concentrations initiale et finale dans l'organisme.

ABSTRACT

Zinc and copper accumulation, in the clam *Ruditapes decussatus* were followed in the field and in laboratory experiments and the results obtained were compared.

Clams from an unpolluted area of Ria Formosa were transplanted to the Sado estuary. Experiments were run during two months.

Concentrations in the particulate matter at field sites, 0,07 , 0,08 and 0,25 $mg.l^{-1}$ for zinc and 0,01 , 0,03 and 0,07 $mg.l^{-1}$ for copper, were used in the laboratory experiments.

Bioaccumulation rates, bioconcentration and contamination factors were determined.

Zinc accumulation shows a similar pattern both in the field and in the laboratory. Copper concentration in clams seems to reach stability after 15 days in the field, while in the laboratory, uptake is linear with time.

Keywords: *Ruditapes decussatus*, zinc, copper, bioaccumulation

Introduction

Marine invertebrates, especially molluscs, can accumulate trace metals (Phillips 1977, Bryan *et al.* 1980,1985) and thus their body concentrations can reach high metal levels. The net accumulation of any metals taken up depends on environmental and biological conditions, but less is known about toxic effects.

Laboratory and field studies are required to assess metal accumulation and regulation ability by any organism, as well as its toxic action (Chan 1988).

Zinc and copper have been the objective of several studies because their concentrations are increasing significantly in the sea. Up to certain levels both metals are essential to many organisms and thus evaluation of concentrations that have toxic effects is even more important (D'Silva & Kureish 1978, Harrison 1986).

The aim of the present study is to compare the bioaccumulation of copper and zinc in clams (*Ruditapes decussatus* L.) in field and laboratory mesocosms.

Material and methods

Clams of the species *Ruditapes decussatus* were collected from an unpolluted area of Ria Formosa (southern of Portugal) and transplanted to three sites in the Sado estuary (Fig.1). Net boxes with 200 clams were left lying on the sediment during a two months period.

Laboratory experiments were run using particulate matter concentrations of copper and zinc found at the field sites, which were 0,07; 0,08 and 0,25 $mg.l^{-1}$ for zinc and 0,01; 0,03 and 0,07 $mg.l^{-1}$ for copper. Mean individual size was 29,90±0,31 mm and temperature was 15±2°C. In each container 80 clams were placed in 12 l of 0,45 μm filtered seawater of 33,5‰ salinity. They were fed with *Phaeodactylum tricornutum* from laboratory cultures with EDTA free media. Water was continuosly aerated and renewal, feeding and contamination took place every 48h.

Sampling times were 0, 2, 7, 14, 28 and 48 days for laboratory, and 0, 2, 7, 14, 28, 60 days for field. At all times ten clams were removed for the determination of metal content.

Metal content of clams (soft parts) was measured through AAS after digestion (5 HNO_3:1 H_2O_2) at 100°C in TFE containers (Ferreira et *al* 1990).

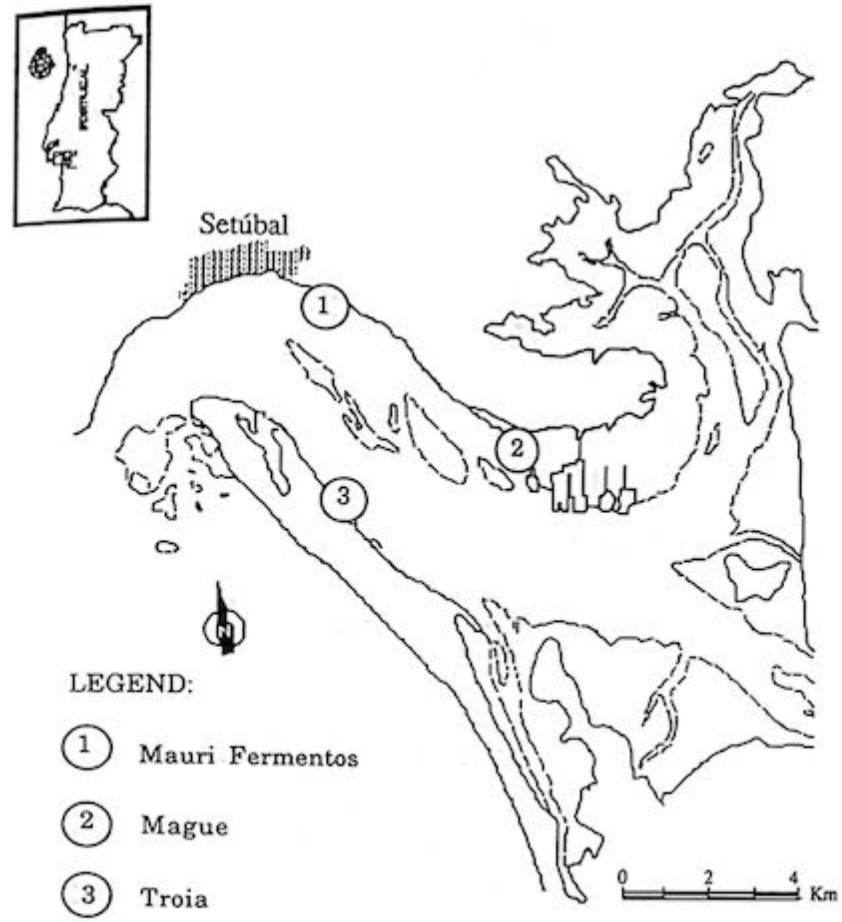

Figure 1 - Map of Sado Estuary with the localization of the net boxes.

In order to characterize the accumulation cinetics, bioconcentration and contamination factors were determined, wich were defined as:

BF - Bioconcentration factor

$$BF = C / C'$$

CF - Contamination factor

$$CF = C / C_i$$

were:

C - Organisms metal contamination (mg.k^{-1}dry weight);

C' - Environmment metal concentration (mg.l^{-1});

C_i - Organisms initial metal concentration (mg.Kg^{-1}).

Results and discussion

Zinc accumulation showed a similar pattern both in the field and in the laboratory (Fig.2).

In the laboratory the minimum lethal zinc concentration was 66 mg.l^{-1} for the lowest exposure concentration, however higher levels (0,08 and 0,25 mg.l^{-1}) enabled survival with higher body concentrations. Accumulation rates varied between max. 2,3 µg.g^{-1}.d^{-1} and min. 1,5 µg.g^{-1}.d^{-1}. These results seem to indicate that this species can regulate body content of zinc up to a threshold level, as was also found by Chan (1988) for other bivalves.

Bioaccumulation of copper is more important in the laboratory, as it can be seen from Fig.2, which agrees with the results. Copper accumulation rates were much higher in the laboratory experiments (up to max. 3,8 µg.g^{-1}.d^{-1}) than in the field (up to max.0,65µg.g^{-1}.d^{-1}).

Copper concentration in clams seems to reach stability after 15 days in the field, while in the laboratory uptake is linear with time. At 0,07 mg.l^{-1} all clams died after 14 days. Minimum lethal copper concentration was 33 mgl^{-1}.

Bioconcentration factors (BF) were always higher in the laboratory than in the field experiments (max. 5178 for copper and 2537 for zinc) (Fig.3).

The contamination factor (CF) relating initial to final body burdens was generally higher in the laboratory experiments for both metals (Fig.3).

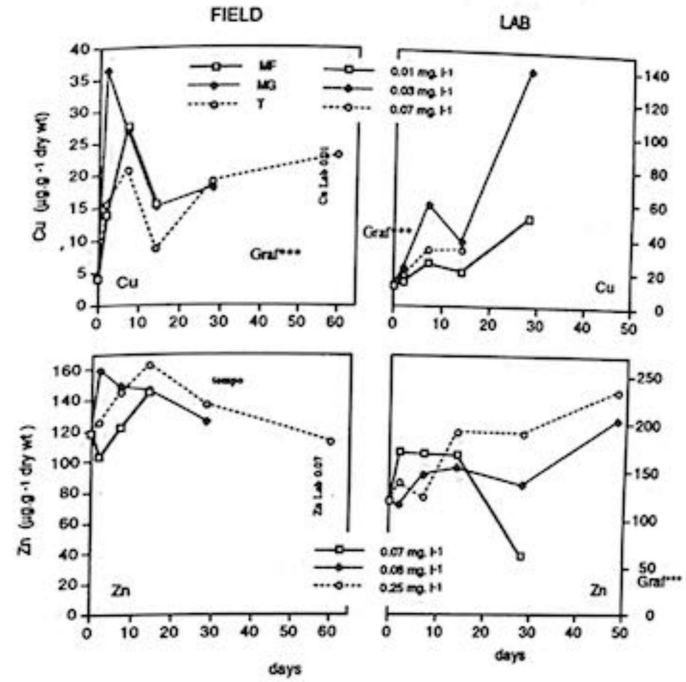

Figure 2 - Cu and Zn bioaccumulation in the field and in the laboratory experiments.

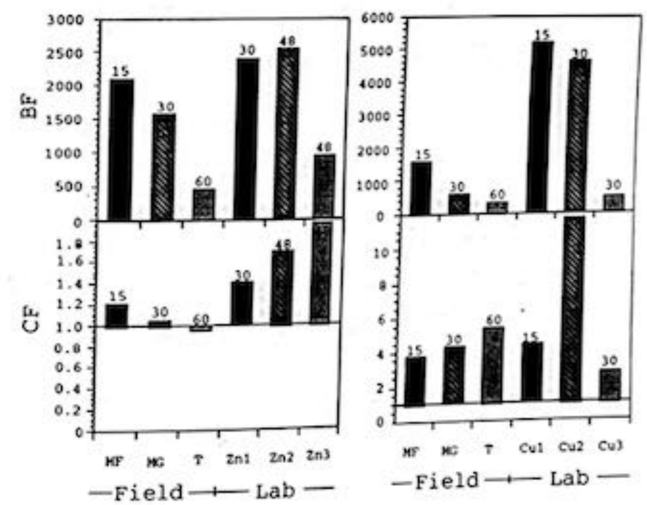

Figure 3 - Bioconcentration (BF) and contamination (CF) factors for field and laboratory experiments. The lasting period of each test (15, 30, 60, 48) is shown.

In the field some detoxification seems to have occurred for zinc after 2 months. For copper CFs increase with time, reflects the linearity of the accumulation pattern generally found for this metal.

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Effects of human impact on forest environment : the tunisian case.

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RESUME

Les auteurs illustrent, à partir d'indicateurs écologiques que sont les types biologiques, les types forestiers et un indice de biodiversité: l'indice de SIMPSON, les effets de l'urbanisation en zone forestière en Kroumirie, région Nord-Ouest de la Tunisie.

Utilisant un gradient écologique marqué par une succession de groupements forestiers et préforestiers s'étalant du bioclimat thermoméditerranéen au mésoméditerranéen, ils montrent que l'impact humain n'a pas la même signification selon la nature du groupement forestier concerné.

Les suberaies de l'étage thermoméditerranéen appartenant au *Myrto-Quercetum suberis*, comme celles de l'étage mésoméditerranéen du *Cytiso-Villosi-Quercetum suberis* subissent la perturbation la plus importante car elles se trouvent au niveau des implantations des nouvelles agglomérations et semblent aussi plus vulnérables aux activités humaines.

Les forêts à *Quercus canariensis* des *Quercetea ilicis* bien que très perturbées montrent un degré de dégradation moins intense, lié à des activités sylvo-pastorales plus traditionnelles.