

concentraciones 0,05; 0,08; 0,11; 0,14 y 0,17 mg/L de Cd(II). Los resultados de supervivencia se analizaron mediante análisis probit utilizando el programa PROBIT de la USEPA, estimándose la concentración letal 50 (CL50) para 7, 14, 21 y 28 días de exposición. Estos valores indican una sensibilidad baja de la especie comparada con otros invertebrados como los cladóceros, sin embargo se encuentra dentro del orden de magnitud de las reportadas para vertebrados.

WP014. Evaluation of zinc toxicity in tropical soil

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Heavy metals belongs a group of chemical elements, which has atomic number up 20, which form part of the environment and living matter, and may also have macro features or essential micronutrients to living beings. Included on heavy metals group, zinc is an essential nutrient that contribute in the physiological processes for respiratory chain of living beings, besides to act as an enzyme cofactor for plants, mammals and microorganisms. On the other hand, if the concentration of element used are greater than the required for living beings, the zinc presence may affect negatively this environment, showed that concentration of the chemical element are important to define the toxicity. In this study, the aim was evaluating the acute toxicity of zinc to juvenile *Folsomia Candida*, incorporated in two kinds of tropical soils, clay and sandy, and an artificial tropical soil (TAS). The TAS was prepare with sand, kaolin and coconut fiber, in a proportion of 7:2:1 (w:w:w), respectively. The tropical soils were collected in agrochemicals free areas. For the *F. cándida* acute toxicity tests were performed using glass jars containing 30 g of sample, 10 juveniles 10-12 days old and 2 mg dry yeast, with eight concentration, which were 0; 112.5; 225; 450; 900; 1800; 3600 and 7200 mg kg⁻¹ by five replicates. The test was raining by 14 days in order to determine the organism mortality. Other parameters, i. e., pH, particle size, organic matter, phosphorus, potassium, calcium, magnesium, aluminum, boron, copper, iron, manganese, zinc, sum of exchangeable bases and cation exchange capacity, also were determined in this tropical soils. The sand soil properties were 895 g kg⁻¹ of total sand, pH of 3.9 and 0.5 mg dm⁻³ of zinc and the clay soil properties were 295 g kg⁻¹ of total sand, pH 4.1 and 0.8 mg dm⁻³ of zinc. The mortality rates on the highest concentration of zinc were 88% for sandy soil, 44% for clay soil and 46% for artificial soil. The lower mortality was detected in the clay soil, that has smaller particle that probable help to retain zinc in the soil and decreased the zinc offer for the organism. Similar assumption was inferred to the SAT soil mortality, that present 10% of organic matter.

WP015. Extracción de Cromo por Ricino (*Ricinus communis* L.) asistida con ácido cítrico

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La fitoextracción asistida con quelantes orgánicos de bajo peso molecular como el ácido cítrico (AC) resulta una estrategia prometedora para la remediación de sitios contaminados con metales pesados. Los objetivos de este trabajo fueron cuantificar la capacidad de acumulación de cromo (Cr) por Ricino (*Ricinus communis* L.) mediante la aplicación de AC a sedimentos dragados del Río Matanza-Riachuelo y evaluar la capacidad de translocación y bioacumulación de Cr de esta especie. El bioensayo se llevó a cabo en invernáculo. Dos días antes de la cosecha se aplicaron los siguientes tratamientos: EDTA 5 mmol/kg de sedimento como control positivo, AC 40 mmol/kg de sedimento (AC 40) y AC 60 mmol/kg de sedimento (AC 60). En las plantas se determinó el peso seco y la concentración de Cr en tejidos. El efecto de la adición de AC sobre la redistribución de Cr entre las principales fases del sedimento se evaluó mediante una extracción química secuencial. En relación a la biomasa, no hubo diferencias significativas entre los tratamientos ($\alpha=0,05$). En todos los tratamientos, las concentraciones de Cr, a nivel radical se diferenciaron significativamente del control. El tratamiento AC 60 promovió la mayor acumulación del metal (901 mg/kg, aumento del 415% con respecto al control), seguido por el AC 40 (202%) y el EDTA (181%). A nivel aéreo, los tratamientos con AC se diferenciaron significativamente del EDTA y el control, el Cr en AC 60 aumentó 942% con respecto al control. La fracción lábil de Cr (F1) mostró diferencias significativas entre los tratamientos aumentando para el AC 40 y AC 60 con respecto al control (173% y 357% respectivamente), lo cual se corresponde con el aumento de las concentraciones del metal en tejidos. Tanto el factor de bioconcentración ($[Cr]_{a\acute{e}rea}/[Cr]_{sedimento}$) como el factor de translocación ($[Cr]_{a\acute{e}rea}/[Cr]_{ra\acute{z}}$) aumentaron significativamente en los tratamientos con AC aunque en todos los tratamientos se obtuvieron FT menores a la unidad. Los resultados de este trabajo mostraron que la aplicación de AC en altas dosis promovió sustancialmente la

acumulación de Cr en Ricino, mostrando el potencial uso de esta especie en la recuperación de sitios contaminados con Cr.

WP016. Factors controlling methylmercury accumulation in river sediments and lake periphyton of a tropical high altitude basin (Bolivian Altiplano)

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High altitude tropical lakes and rivers are understudied regarding Hg contamination, but in particular the factors controlling methylmercury (MMHg) concentrations. We explored the significance of physicochemical and biological factors that may be related to MMHg accumulation in river sediments and lake periphyton of the Bolivian Altiplano. A set of variables including total Hg, pH, conductivity, salinity, dissolved oxygen, organic matter, algae composition and others were determined. There was a marked gradient of salinity among the rivers (178 to 105000 $\mu\text{S cm}^{-1}$) and different algae composition among the periphyton associated to *Schoenoplectus californicus* ssp. *tatora* (Totora) and *Myriophyllum* sp. at lake Uru Uru, as well as a gradient of methylmercury concentrations (2.9 to 26.5 ng g⁻¹ dw). In rivers MMHg concentrations were relatively low (up to 0.2 ng g⁻¹) and apparently strongly related to total mercury (up to 1.7 ng g⁻¹) and inversely related to salinity ($r^2 = 0.871$; $p = 0.021$). Chloride ions were the most strongly related ($r^2 = 0.872$; $p = 0.020$), suggesting that chlorides reduce availability of Hg to methylation. Unlike in rivers, physicochemical factors such as conductivity and total mercury don't seem to be related to MMHg accumulation, but the abundance of algae (*Oedogonium* sp.) is strongly related to MMHg concentration ($r^2 = 0.783$; $p = 0.0126$), suggesting these algae absorbs MMHg. Such accumulation capacity is relevant because many primary consumers feed on algae, but also because it could make MMHg unavailable for demethylation, which has been reported to be high in such biofilms. Together our data suggest different factors controlling MMHg accumulation in different compartments in the same basin, stressing the need to investigate MMHg accumulation in each compartment and component of a basin to fully understand Hg dynamics in the entire system.

WP017. Geoaccumulation of Pb and Zn in the last 100 years in Londrina city, Southern Brazil.

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The bottom sediments of aquatic environments located in urban areas of media and big cities have predisposed the accumulation of trace elements, they are susceptible to metal pollution from various sources including industrial waste, vehicle emissions and other activities.

WP018. Levels of Cd, Hg and Pb in tissues of blue crabs *Callinectes danae* from a subtropical protected estuary influenced by mining residues

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The Ribeira de Iguape River (RIR) forms the main hydrographic basin that contributes to the Cananéia-Iguape-Peruíbe estuarine complex (CIP). Although mining and metallurgy activities have been closed, their influence can still be observed in the RIR and in the CIP estuarine complex, as slags and tailing piles were deposited on the river banks. Organisms can be used as biomonitors of evaluate environmental contamination. However, their use requires the understanding of uptake processes, including the main pathways and the internal regulatory mechanisms. Blue crabs of the genus *Callinectes* have been used as environmental biomonitors. This study aimed to evaluate Cd, Hg and Pb concentrations in tissues of blue crab *Callinectes danae* from the CIP region. In October 2014, blue crabs were collected in the South portion of CIP. All organisms were collected at the intermolt stage in order to minimize the effects of lower or upper concentrations during pre-molt and molt stages. The species and sex were identified. The maturation stage due to the shape and degree of

adherence of the abdomen to thoracic sternites, total weight, carapace length and width were also measured. Muscles, hepatopancreas and gills were removed by dissection. Pb and Cd concentration were determined by graphite furnace atomic absorption spectroscopy (GF-AAS). In particular, Hg concentration was determined using cold vapor generation (CV-AAS). Certified reference material (NIST 1566 b -Oyster tissue) was used for analytical methodology validation in terms of precision and accuracy. Kruskal Wallis (Pb and Hg) and Mann Whitney (Cd) tests were applied to compare the metal concentrations among different tissues. Pb and Cd median concentrations in gills were higher than those found in muscles and hepatopancreas, respectively. It was not detected any differences between Hg results. The obtained concentrations were in ppb magnitude (ng g⁻¹), except Cd concentrations in hepatopancreas and some results for Pb in gills, which were higher than the Brazilian legislation limits (Cd and Pb= 0.5 ug g⁻¹). We concluded that *Callinectes danae* from CIP is not contaminated, however new efforts to monitor Cd concentrations must be performed.

WP019. Metallothionein, trace-elements and methylmercury in hard and soft tissues of *Spheniscus magellanicus* found stranded on the Southern Brazilian coast

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Magellanic penguins (*Spheniscus magellanicus* (Forster, 1781)) are the most abundant species on the coast of South America. They have been reported as good biomonitors for several types of pollutants, including trace-elements. In this context, selenium (Se), total mercury (Hg), methylmercury (MeHg), inorganic mercury (Hginorg), cadmium (Cd) and lead (Pb), as well as metallothionein (MT) levels, were evaluated in the feathers, liver and kidney of juvenile Magellanic penguins found stranded along the coast of Southern Brazil. Hg was determined by cold vapor atomic absorption spectrometry, using NaBH₄ as a reducing agent. Se, Pb and Cd were determined by graphite furnace atomic absorption spectrometry, using palladium nitrate as chemical modifier. MeHg was identified and quantified in the toluene layer on a Shimadzu gas chromatograph GC-14 with an electron-capture detector-ECD. The values corresponding to the concentrations of Hginorg were calculated as the difference between the values found for Hg and MeHg concentrations. MTs were quantified using a spectrophotometric method at 412 nm. Magellanic penguins presented low concentrations in the hard and soft tissues, which were comparable to those found in previous studies with this seabird. The highest concentrations of all trace-elements and MeHg were found in soft tissues. Concentrations of Cd and Se in feathers were extremely low in comparison with their concentrations in soft tissues. The results showed that Se in liver plays a relevant role in detoxification of Cd, Pb and Hginorg, as well as in the detoxification of MeHg. MT has also showed to play a role in the detoxification of trace-elements and Hginorg, with the exception of MeHg, in the liver of Magellanic penguins.

WP020. Prospección de hongos filamentosos resistentes a metales pesados

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El incremento de las actividades relacionadas a la industria del cemento, colorantes, curtiembres, fertilizantes, materiales fotográficos, pinturas anticorrosivas y, en mayor medida la minería, constituyen las principales fuentes de contaminación de los suelos con cromo trivalente y hexavalente. Este tipo de contaminación tiene un impacto directo sobre el ambiente y afecta, de forma indirecta, a la biota. Existen diversas estrategias para el tratamiento de metales pesados, siendo la más común la precipitación, sin embargo muchas veces son incompletas en su remoción y/o resultan económicamente inviables. La utilización de microorganismos como una alternativa potencial para la remoción y recuperación del metal está cobrando un creciente interés debido a su bajo costo, escaso consumo de energía y por ser ambientalmente seguros. El fundamento de esta alternativa se basa en la gran capacidad de los materiales biológicos de adsorber los metales, y en muchos casos, de concentrarlos. El objetivo de este trabajo consistió en evaluar la resistencia a metales pesados de hongos filamentosos de pudrición blanca (WRF) y degradadores de hojarasca (LDF), además de determinar el posible efecto protector de compuestos derivados

del metabolismo de la lignina. Por otra parte se estudió la relación entre la resistencia al metal y el efecto del protector con la actividad de enzimas ligninolíticas. Para ello, se utilizó cromo hexavalente (CrVI) como modelo y se determinó la velocidad de crecimiento de las distintas cepas en un medio agarizado contenido CrVI en una concentración 1 mM. De las 24 cepas evaluadas, se determinó la concentración efectiva 50 (CE50) de aquellas cepas que fueron capaces de crecer en el medio (6 WRF y 7 LDF). De cada grupo de hongos, se seleccionaron las dos cepas con mayor CE50 para evaluar el efecto protector del ácido vainílico sobre el crecimiento del hongo. Paralelamente, se observó un incremento en la actividad enzimática de lacasa y Mn peroxidasa en presencia del metal.

WP021. Responses of metallothioneins in tissues of bullfrog tadpoles, *Lithobates catesbeianus*, following exposure to the metals zinc, copper and cadmium

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Metallothioneins (MTs) play a key role in the cellular protection against toxic metals and against environmental stress. The objective of this study was to examine the effects of isolated and combined metals (Zn, Cu and Cd - at 1 µg L⁻¹) in the liver, kidney and muscle of bullfrog tadpoles, *Lithobates catesbeianus*, exposed during 2 and 16 days. MT levels in the liver and the muscle decreased after 2 days in the groups exposed to Zn, Cu, Zn+Cu and Zn+Cu+Cd. In the kidney, MT levels decreased in the groups exposed to Zn and Cd, and increased in the muscle in the groups exposed to Zn and Cu after 2 days. After 16 it was observed an increase in MTs in the liver, muscle and kidney after exposure to Zn, Cu, Zn+Cu, Zn+Cd, Cu+Cd, and Zn+Cu+Cd. Therefore, the binding of MTs to the accumulated metals seems to represent a strategy developed by the species to promote detoxification. However, comparing MT levels between animals exposed to isolated metals, it was observed a decrease in its levels after 16 days of exposure when compared to 2 days. In contrast, in the groups exposed to combined metals (Zn+Cu, Zn+Cd), the levels of MT in the muscle were higher after 16 days of exposure, when compared to the group exposed during 2 days. Indeed, MT levels increased in the kidney of the groups exposed to Zn and Cu, but decreased in the groups exposed to Cd during 16 days compared to the groups exposed during only 2 days. After 16 days, the concentration of MTs accumulated in the tadpoles' tissues was much higher in response to the exposure to the combined metals than those observed for the essential metals Cu and Zn. This seems to confirm that tadpoles have mechanisms to regulate (at least to a certain extent) the uptake and/or excretion of essential and non-essential metals. Financial support: FAPESP Proc. 507523/2011.

WP022. Simultaneously Extracted Metals and Acid-Volatile Sulfide (SEM/AVS) in sediments of an estuary in southeastern Brazil.

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The Estuarine-Lagoon Complex of Iguape-Cananéia, located in southeastern Brazil, suffers different human pressures on its northern and southern portions. In Cananéia (south) it is observed less impact than in Iguape (north), caused by the bigger anthropogenic presence and the inflow of the Ribeira de Iguape River. This river, upstream, housed several mines of Pb, which contaminated the sediments, allowing the input of metals to the system through the suspended solids. Studies with aquatic organisms in the region reveal extensive incorporation of different metals in both portions. The method of SEM/AVS can help to understand the bioavailability of metals and estimate the toxicity of local sediment. For this purpose SEM/SVA ratio of Fe, Zn, Mn, Co, Cu, Cr, Cd, Pb and Ni was assessed at 8 points along the system in two different seasons in 2013. The SVA varied of 0.45 to 3.44 milimol.kg⁻¹, and the average of the highly bioavailable metals was in order of Fe>Mn>Zn>Pb>Cu. The others ions were not detected. Higher values for all metals were observed in the north, although Fe and Mn were found in high concentrations in all system, being associated with local geology. SEM/SVA ratio showed greater toxicity of the environment in the winter and next to Iguape. However, all points had SEM/AVS > 1 in at least one season, evidencing the toxic potential of the system. This can occur by the existence of little sulfide in relation to the high amount of divalent metals, alerting the possible potential of bioavailability of these metals, once it may reveals that an important attachment phase of the metals to the sediments (SVA) is saturated.