

ABSTRACT

The concentrations of Co, Ni, Cu, Zn, Cd, Pb, As, Fe, Mn and Al were determined in sediments and biota of Songkhla Lake; a shallow coastal lagoon, located in southern Thailand. In June 2006 surface sediments were sampled in forty-four stations in the three sections of the lake (inner-, middle- and outer section). Sediment cores were also sampled in thirteen stations in three cross-sections of the lake. In surface sediments, trace- and major elements, organic matter, sediment grain size analysis and sulfides were determined and in the sediment cores redox profiles were made. Soil samples were also collected at garbage dumping sites in the vicinity of the lake. In addition, the metal accumulation in two catfish species (*A. maculates* and *O. militaris*) and the crustacea (*Apseudes sapensis*) was also investigated. Trace element concentrations in sediments of Songkhla Lake show that especially the Outer Section of the lake; in particular the sediments at the mouths of the Phawong, U-Taphao and Samrong Canals are significantly enriched in trace elements due to municipal, agricultural and industrial discharges entering the lake through the canals. Aluminium normalized enrichment factors throughout the lake vary from 0.4-1.7 for Ni, 0.3-3.3 for Cu, 0.2-7 for Zn, 0.1-14 for As, 1-24 for Cd, 0.7-6.8 for Pb and 0.1-7.8 for Mn. Correlations between the elements and sediment characteristics show that Cu, Zn, Cd and Pb are essentially associated with the sulphide fraction; that Ni and Co are predominantly bound to the clay minerals and iron oxy-hydroxides and that As is principally bound to iron oxy-hydroxides. The accumulation of trace elements between muscle tissue, liver and eggs of *A. maculates* and *O. militaris* is element specific but concentrations of trace elements in fish muscle tissue are well within the limits for human consumption.

In this study the feasibility of the use of the indigenous species, tanaidacea *Apseudes sapensis* for whole (bulk) sediment toxicity assessments was investigated. The test was first validated by determining the dose-response relationships for aqueous cadmium chloride solutions. This showed that the LC₅₀ value after 96-hour exposure and at a salinity of 5‰ was 0.097 mg L⁻¹ cadmium (95% CL=0.086-0.110 mg L⁻¹) which is similar to the LC₅₀ of the standard test organism which is the Amphipod, *Leptocheirus plumulosus*. Whole sediment toxicity tests were performed for both acute (96-hour) exposure and chronic (28-day) exposure. Test sediments came from the three most important canals in the Outer Section of Songkhla Lake, which receive important amounts of anthropogenic inputs, namely the U-Taphao canal, the Phawong canal and the Samrong canal. The control sediment was collected in a remote part of the Middle Section of the Lake, named Khukut. The results show that the Samrong canal is a “hot spot” with a 89% mortality rate at the end of the acute toxicity test. The mortality rate in the chronic tests showed a significant positive correlation with the initial amount of total acid volatile sulfides (TAVS) in the sediments, which in turn showed a

positive correlation with the contents of Cu, Zn, Cd and Pb in the sediments. The mortality rate is however higher than what would be expected from the comparison of metal concentrations in sediments with sediment quality guidelines (SQRs).

The socio-economic study was based on an environmental approach. Two targeted populations were selected; one group involved local fishermen living in 13 districts located around the surrounding areas of Songkhla Lake and the other group involved secondary students from 13 schools surrounding the Lake as well. A multi stage sampling method was used in drawing 365 participants of fishing households from a total population of 4,227 fishing households. The sample size of the students was simply determined from a number of 30 participants per school for in total 13 schools. Thus, there were 10 students from each of Matayomsuksa 1 (ages around 13 years old), Matayomsuksa 2 (ages around 14 years old), and Matayomsuksa 3 (ages around 15 years old). The results showed that the majority of fishing households agreed that the quantity of catches were decreased thus, their incomes were reduced. There was a need expressed by local communities concerning preservation of natural resources for future generations, as well as the intention that all community members should participate in natural resources' management. Impressively, most fishermen knew that the sediment was also a key factor in relation to their fishing and they knew that the benthic fauna was an important food source for fishes. These findings will be helpful in formulating a realistic management of sediment quality based on the present assessments. The study revealed that most students had a good understanding of Songkhla Lake's environmental conditions in general and that they have positive attitudes towards the improvement of the Lake's environment as a whole.

To combine scientific data and local knowledge can be done using GIS as a tool for decision makers to evaluate various alternative management scenarios. The strategy we propose here is to restore the Lake sediments back into its original natural state as much as possible. This will consist of 1) Prevent further chemical contamination of Lake's sediments that may cause unacceptable ecological imbalances or human health risk to the surrounding lake' environment by law enforcement, 2) Reduce the volume of existing sediments at the severe siltation in the lake by Partial dredging of the upper layers and 3) Develop and consistently apply methodologies for analyzing contaminated sediment and for evaluating the bioaccumulation and toxicity potential of specific sediments samples by using a standard bioassay test.