An ecotoxicological study of tributyltin in the coastal areas of Indonesia and Japan

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（インドネシアおよび日本沿岸域におけるトリブチルスズ汚染に関する生態毒性学的研究）

区　　分　：甲

論　文　内　容　の　要　旨

Tributyltin (TBT) has been widely used as an antifouling agent in marine environments since the early 1960s. TBT is highly toxic to non-target aquatic organisms; therefore, its use has been banned in many countries by the International Marine Organization, including Japan in 2003. However, TBT is still being used in some tropical countries, which has resulted in TBT contamination. Accordingly, the present study was conducted to investigate TBT contamination in Indonesia and Japan, and to identify suitable biomonitoring species.

Sediment samples (<5 cm from the surface) were collected from 20 stations in the seaport areas of three cities (Jakarta, Bali and Manado) in Indonesia in January 2011 and from three stations in Hakata Port, Fukuoka, Japan in 2010. TBT and its metabolite, dibutyltin (DBT), were detected in all collected sediment samples. Additionally, high concentrations of TBT were found in sediment samples collected in front of the shipyard area at Bitung Seaport (4.25 μg/g wet.wt) in Manado, Indonesia and in Hakata Port (0.63 μg/g ww) in Fukuoka, Japan, suggesting that shipyard activity might be a significant source of TBT pollution in Indonesia and Japan.

To monitor pollution of TBT in demersal fish, five species of fish (*Sphoeroides pachygaster*, *Dentex tumifrons*, *Chelidonichthys kumu*, *Niphon spinosus* and *Monocentris japonica*) and two crustacean species (*Macrocheira kaempferi* and *Ibacus cilliatus*) were collected from the East China Sea on April 6, 2010. In addition, common japanese conger (*Conger myriaster*) were collected from the East China Sea and Hakata Bay from June 2009 to September 2011. Aquaculture fish (*Paralichthys olivaceus*, *Pargus major*, and *Trachurus japonicus*) were also collected from a fish market in Fukuoka, Japan on March 10, 2010. No TBT or DBT (< 0.05 ng/g) were detected in the blood, liver and muscle of the five species of fish, the midgut gland of the two crustaceans or the livers of common japanese conger collected from the East China Sea. However, TBT (2.13 – 38.6 ng/g) and DBT (8.36 – 59.9 ng/g) were detected in the livers of common japanese conger collected from Hakata Bay. Moreover, TBT was detected in the blood, liver and muscle of three species of cultured fish obtained from the fish market in Fukuoka at levels ranging from no detected (<0.05 ng/g) – 210 ng/g tissues. These results suggest that no TBT contamination occurred in the East China Sea, while common japanese conger from Hakata Bay and cultured fish were still contaminated by TBT.

To identify a species for monitoring of TBT in aquatic systems, we examined the accumulation of TBT in the wharf roach (*Ligia exotica* Roux). In an exposure test, wharf roaches were exposed to TBT via diet for 2 d. TBT accumulated in wharf roach, and its metabolite dibutyltin was detected. The concentrations of these compounds gradually decreased during the depuration period, but they were still detected 12 d after exposure ceased (TBT 290 ± 140 ng/g; dibutyltin 1280 ± 430 ng/g). Based on these findings, the biological half-life of TBT in wharf roach was estimated to be about 4 d. In a field study conducted in 2011–2012, wharf roaches were collected from 15 coastal sites in Japan and three sites in Manado, Indonesia and TBT was detected in both Japanese and Indonesian samples. During that field study, the highest concentration of TBT was found in wharf roaches collected at Bitung Ferry Port, Manado (57.9 ± 16.5 ng/g), which is close to a shipyard, while the highest concentration observed at a Japanese site was 12.3 ± 6.2 ng/g. Thus, we were able to detect organotins in coastal environments by testing wharf roach, suggesting that *L. exotica* might serve as a good bioindicator for monitoring organotins in such areas.

To identify a model species for tropical marine fish, we conducted an exposure test of Banggai cardinal fish (*Pterapogon kauderni*) to evaluate the toxicity and bioconcentration of TBT. The results indicated that *P. kauderni* is a good species for monitoring organotins because it showed high sensitively to TBT; accordingly, *P. kauderni* might be a good model species for predicting the risk of chemical impacts on tropical areas.

Overall, these results indicate that TBT pollution still continues in Indonesia and Japan, and that *L. exotica* and *P. kauderni* might be useful for monitoring of TBT contamination