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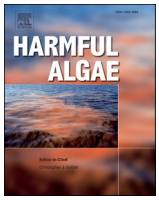

Diversity and distribution of harmful microalgae in the Gulf of Thailand assessed by DNA metabarcoding

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ABSTRACT

Information on the diversity and distribution of harmful microalgae in the Gulf of Thailand is very limited and mainly based on microscopic observations. Here, we collected 44 water samples from the Gulf of Thailand and its adjacent water (Perhentian Island, Malaysia) for comparison in 2018. DNA metabarcoding was performed targeting the partial large subunit ribosomal RNA gene (LSU rDNA D1–D3) and the internal transcribed spacers (ITS1 and ITS2). A total of 50 dinoflagellate genera (made up of 72 species) were identified based on the LSU rDNA dataset, while the results of ITS1 and ITS2 datasets revealed 33 and 32 dinoflagellate genera comprising 69 and 64 species, respectively. Five potentially toxic *Pseudo-nitzschia* (Bacillariophyceae) species were detected, with four as newly recorded species in the water (*Pseudo-nitzschia americana/brasilliana, Pseudo-nitzschia simulans/delicatissima, P. galaxiae* and *P. multistriata*). The highest relative abundances of *P. galaxiae* and *P. multistriata* were found in Trat Bay and Chumphon (accounting for 0.20% and 0.06% of total ASVs abundance, respectively). Three paralytic shellfish toxin producing dinoflagellate species were detected: *Alexandrium tamiyavanichii, Alexandrium fragae*, and *Gymnodinium catenatum*. The highest abundance of *A. tamiyavanichii* was found in the surface sample of Chumphon (CHO7 station), accounting for 1.95% of total ASVs abundance. Two azaspiracid producing dinoflagellate species, *Azadinium poporum* ribotype B, *Azadinium spinosum* ribotype A, and a pinnatoxin producing dinoflagellate species *Vulcanodinium rugosum*, with two ribotypes B and C, were revealed from the datasets although with very low abundances. Six fish killing dinoflagellate species, including *Margalefidinium polykrikoides* group IV, *Margalefidinium fulvescens, Karenia mikimotoi, Karenia selliformis* ribotype B, *Karlodinium australe*, and *Karlodinium digitatum* were detected and all representing new records in this area. The findings of numerous harmful microalgal species in the Gulf of Thailand highlight the potential risk of human intoxication and fish killing events.

1. Introduction

The Gulf of Thailand (GOT) is a semi-enclosed tropical sea bordered by Thailand, Cambodia, Vietnam, and Malaysia. It covers an area approximately 320,000 km^2 and affected mainly by the dry northeast (November–January) and the wet southwest (May–August) monsoons (Buranapratheprat et al., 2008). GOT provides major marine resources for the surrounding countries. For instance, 20,000 to 25,000 tons of oyster were harvested each year in Thailand and the majority was from GOT (Szuster et al., 2008). However, anthropogenic activities including discharge of untreated waste water have led to severe eutrophication in GOT (Cheevaporn and Menasveta, 2003). Consequently, algal blooms caused by the green *Noctiluca scintillans, Tripos furca*, and the blue-green algae *Trichodesmium* have been frequently observed in the Gulf due to eutrophication (Lirdwitayaprasit, 2006; Wattayakorn, 2006; Sriwoon and Pornsilp, 2008; Thongdonphum et al., 2014).

The first survey of dinoflagellates in the Gulf of Thailand was dated back to year 1899 when the species *Ostreopsis siamensis* had been

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