

**Title**

Use of barnacles as potential biomonitors for persistent organic pollutants in selected sites of Peninsular Malaysia

**Aim**

1. To investigate the levels of POPs in barnacle's soft tissues from seven sites in west and east coast of Peninsular Malaysia
2. To assess the possibility of using barnacles as biomonitoring units for bioavailability of POPs in aquatic environment

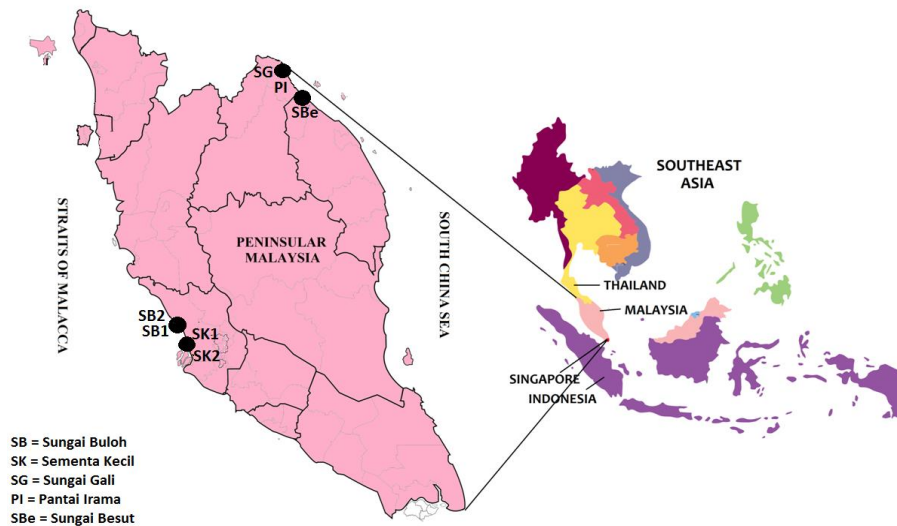
**Procedure**

Barnacle samples were collected from seven sampling stations in the west and east coast of Peninsular Malaysia (Fig 1). This was the first study on bioaccumulation patterns of POPs in barnacles. The collected barnacles were from three different species as shown in Fig 2. Sampling locations were selected based on inclusion of polluted areas as well as less polluted and remote sites of Peninsular Malaysia. Samples were transferred on ice to the lab and stored at -20 °C. Later, barnacles' soft tissues were separated from the shells, homogenized and freeze-dried. The freeze-dried soft tissues were transferred to CMES for further analysis. Briefly, samples were extracted using an accelerator solvent extractor and spiked with surrogate standards. The extracts were then subjected to gel permeation chromatography (GPC) using hexane/DCM (1:1) for lipid removal. The extracts were concentrated and eluted using a glass column packed with baked silica gel. For this purpose, 80 ml of 5% DCM/hexane were used. The elution were concentrated and internal standard was added. Later, the elution was evaporated to near dryness with gentle stream of nitrogen. Gas chromatography mass spectrometry was used to analyze target compounds. The concentrations were calculated from the peak area of the sample to the corresponding external standard.

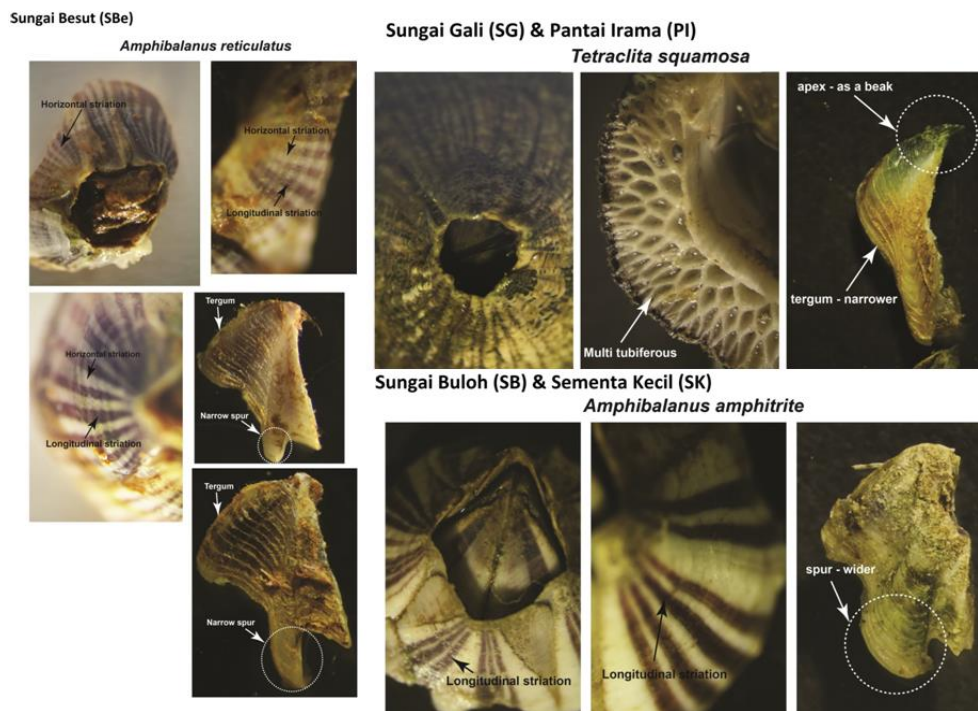
**Result**

The highest concentrations of OCPs were detected in SK1 at 365.19 ng/g lipid wt, while the lowest concentrations were found in PI at 18.31 ng/g lipid wt. SK1 is located nearby the Port Klang which is one of the busiest ports in Malaysia. The Klang River in the west coast of Peninsular Malaysia which is notoriously recognized as the most polluted river in Malaysia passes through the capital city of Kuala Lumpur and ends to the narrow Strait of Malacca receiving various land-based and sea-based organic and inorganic pollutants. The highest levels of DDTs, HCBs and CHLs were detected in SK1 at 173.25, 4.03 and 181.14 ng/g lipid wt, respectively, while the highest levels of HCHs were detected in SBe in the east coast at 4.03 ng/g lipid wt. A comparison between the levels of HCHs, CHLs and DDTs in barnacles from SB stations (state of Selangor) with those previously detected in mussels from Bagan Lalang in the state of Selangor showed higher loads of these pollutants in barnacles' body (Fig 3) (Monirith et al., 2003).

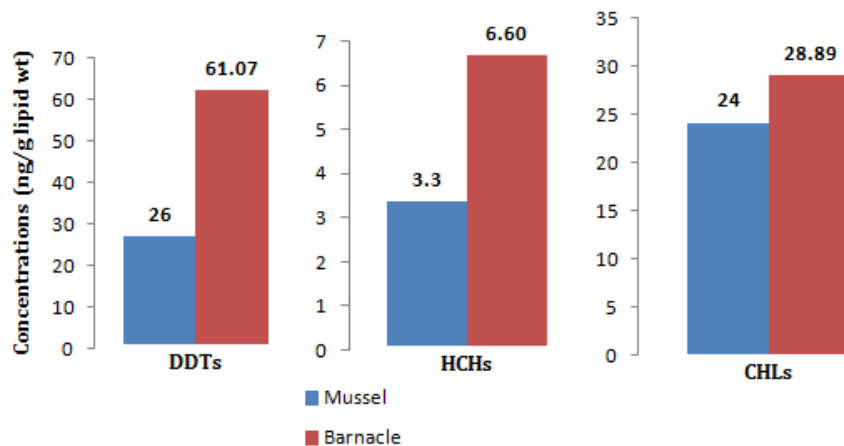
The concentrations of PCBs in barnacles' soft tissues ranged from 23.13 to 176 ng/g lipid wt in PI and SK1, respectively. Similar to OCPs outcomes, the highest levels of PCBs were detected in polluted areas in the west coast of peninsula, while the east coast which is less influenced by anthropogenic activities showed the lowest levels. PCB congeners 28 and 52 were the predominant PCBs in the barnacles' soft tissues, while a total of 15 PCB congeners were detected in all of the sites. Generally, the concentration of PCBs detected by Monirith et al. (2003) in Malaysian mussels was in low range from <4.2 to 60 ng/g lipid weight which is lower than the levels detected in this study in barnacles' soft tissues.



**Fig 1.** Barnacles sampling locations in Peninsular Malaysia



**Fig 2.** Barnacles species collected from selected locations in Peninsular Malaysia



**Fig 3.** A comparison between DDTs, HCHs and CHLs in barnacles and mussels in the state of Selangor

### Publication

“The possibility of using barnacles as biomonitors of persistent organic pollutants (POPs): A case study in Peninsular Malaysia” In preparation.

### Conference presentation

The data will be presented in the upcoming South China Sea (SCS) conference in Kuala Lumpur scheduled for 24<sup>th</sup> – 28<sup>th</sup> June 2019

### Perspectives in future

This preliminary study showed the potentiality of barnacles to be used as biomonitors for POPs in the aquatic environment. Moreover, the outcomes suggested an increasing trend in the levels of POPs in coastal areas of Peninsular Malaysia which can pose risks for the coastal ecosystem and local community. Therefore, the future study will aim to expand the study area to other important coasts all around Peninsular Malaysia as well. Many of these locations are under intensive industrial and agricultural activities, but the studies on POPs are rare and this would be a pioneering research on POPs in these locations. Besides, we plan to further investigate POPs bioaccumulation patterns in barnacles’ soft tissues and compare the bioaccumulation patterns of POPs in barnacles with mussels from similar locations. The green-lipped mussel, *Perna viridis*, has frequently been used as biomonitor throughout the Indo-Pacific region for persistent organic pollutants. These organisms are adapted to life in streams and rivers, while barnacles are marine organisms inhabiting shallow or tidal waters. Thus, the future study will make a comparison between the bioaccumulation capability and patterns of mussels and barnacles for POPs considering their lipid weight and physical characteristics and provide a comparative discussion on suitability of barnacles to be used as a biomonitor in marine habitats.