



UNIVERSITI PUTRA MALAYSIA

**ASSESSMENT OF TRACE METAL POLLUTION IN THE STRAITS OF JOHOR BY
USING TRANSPLANTED
CAGED MUSSELS *Perna viridis* L.**

EUGENE NG YEW JING

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By

EUGENE NG YEW JING

**Thesis Submitted to the School of Graduate Studies, Universiti Putra Malaysia,
in Fulfilment of the Requirements for the Degree of Master of Science**

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Abstract of thesis presented to the Senate of Universiti Putra Malaysia in fulfilment
of the requirement for the degree of Master of Science

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Faculty : Science

In this study, mussels *Perna viridis* from a polluted site at Kampung Pasir Puteh (KPP) were transplanted to relatively clean site, Kampung Sungai Melayu (KSM) and Sungai Belungkor (SB) along the Straits of Johor. Zn was the metal which accumulated fastest in the transplanted mussels while Cd was the slowest. This study indicated that the byssus of *Perna viridis* was most effective for biomonitoring of Cd, Ni, Pb and Zn, while the shell could be used for the biomonitoring of Cu, Ni and Pb and the total soft tissue for the biomonitoring of Ni since they were able to accumulate and eliminate the respective metals well.

From the depuration of the total soft tissues (TST) of mussels for 6 weeks' time from KPP to KSM and SB, KPP had higher levels of Co, Cr, Hg, Sr and V when compared

to KSM and SB. Hence, the coastal waters at KSM and SB can be used for depuration of the trace metals Co, Cr, Hg, Li, Sr and V since their levels were lower when compared to KPP population after transplantation. However, it was found that after weeks 2 and 6 of transplantation from KPP, KSM and SB had higher levels of Ag, As, Be and Se if compared to KPP. This indicated that unknown sources of trace metals pollution for Ag, As, Be and Se exist at KSM and SB. Apart from TST, the metal levels in shells were determined as well. It was found that significant ($P < 0.05$) decreased levels of Ag, Li and Se were found in mussels shell transplanted to KSM and SB after 2 and 6 weeks. However, significant ($P < 0.05$) increased levels of As, Mn, Sr and V were found in shells transplanted to KSM. When comparing between KSM and SB, decreased levels of Ag, As, Li, Mn and Sr in SB were found to be more significant ($P < 0.05$) than KSM. Meanwhile there was no significant ($P > 0.05$) changes for Cr, Be and Hg levels at both sites after the transplantation periods.

On the other hand, TST of mussels transplanted from KSM to KPP showed increased concentrations of As, Co, Cr, Hg, Li, Be, V, Cs, Mn and Sr but not the concentrations of Ag and Se after 2 and 6 weeks of transplantation. After transplantation periods of weeks 2 and 6 to SB, the concentrations of Co, Cr, Hg, Be, V, Cs, Se, Mn and Sr decreased. This verified that SB is a suitable coastal water site for the depuration for these metals. Besides that, it was found that significant ($P < 0.05$) increased levels of Li, Hg and Sr in the mussels shell were found in KPP after transplantation periods of 2 and 6 weeks. However, significant ($P < 0.05$) increased levels of Cs and Hg were found in SB after the transplantation. While significant ($P < 0.05$) decreased levels of

Ag, Mn and Co were found in KPP and decreased level of As, Ag, Co, Li and Mn were found in SB after transplantation periods of 2 and 6 weeks. Last but not least, there was no significant ($P > 0.05$) changes for Be, Cr, Se and V levels for both sites after the transplantation periods.

By using mussels as a biomonitor, we concluded that KPP is having the highest bioavailabilities of Cd, Co, Cu, Cr, Cs, Fe, Hg, Li, Ni, Pb, Sr, V and Zn than KSM and SB based on the TST and shell data we obtained. However, future studies are necessary to investigate and understand the anthropogenic sources for the elevated levels of trace metals such as Ag, As, Be and Se in KSM and SB.

Abstrak tesis yang dikemukakan kepada Senat Universiti Putra Malaysia sebagai memenuhi keperluan untuk ijazah Master Sains

PENILAIAN PENCEMARAN LOGAM SURIH DI SELAT JOHOR DENGAN KUPANG SANGKARAN *Perna viridis* L.

Oleh

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Dalam kajian ini, kupang *Perna viridis* dari kawasan yang dicemari, Kampung Pasir Puteh (KPP) telah di translokasi ke kawasan yang kurang dicemari iaitu Kampung Sungai Melayu (KSM) dan Sungai Belungkor (SB) dimana semua kawasan ini terletak di Selat Johor. Zn adalah elemen yang paling pantas terkumpul di dalam kupang manakala Cd adalah yang terlambat. Kajian ini membuktikan bahawa byssus dalam *Perna viridis* adalah organ yang paling efektif untuk memantau Cd, Ni, Pb dan Zn, manakala cangkerang adalah organ yang baik untuk memantau Cu, Ni and Pb dan tissue lembut untuk Ni. Ini adalah kerana semua organ ini dapat mengumpul dan menyingkir logam respektif dengan baik.

Dari kajian penyingkiran logam dalam tisu lembut bagi kupang sepanjang 6 minggu dari KPP ke KSM dan SB, KPP menunjukkan aras Co, Cr, Hg, Sr dan V yang lebih tinggi jika dibanding dengan KSM and SB. Oleh itu, kawasan pantai sekitar KSM dan SB adalah sesuai digunakan untuk menyingkirkan logam Co, Cr, Hg, Li, Sr dan V sebab aras bagi logam-lagam ini adalah lebih rendah jika dibandingkan dengan populasi KPP selepas translokasi. Bagaimanapun, selepas translokasi selama 2 dan 6 minggu ke KSM dan SB, aras untuk logam Ag, As, Be dan Se di KSM dan SB adalah lebih tinggi dari KPP. Ini membuktikan bahawa sumber pencemaran yang tidak diketahui berada di KSM dan SB. Selain dari tisu lembut, cangkerang untuk kupang dikaji juga. Signifikasi ($P < 0.05$) aras yang menunjukkan menurun bagi Ag, Li dan Se di cangkerang yang di translokasi ke KSM dan SB selepas 2 dan 6 minggu. Tetapi, signifikasi ($P < 0.05$) aras yang menunjukkan tinggi bagi As, Mn, Sr dan V di kupang yang di translokasi ke KSM. Dalam perbandingan antara KSM dengan SB, Ag, As, Li, Mn dan Sr yang menurun di SB adalah lebih signifikasi ($P < 0.05$) dari KSM. Dalam masa yang sama, tiada perubahan yang signifikasi ($P > 0.05$) untuk logam Cr, Be dan Hg dalam kedua-dua kawasan tersebut selepas translokasi.

Selain itu, tisu lembut untuk kupang yang di translokasi dari KSM ke KPP dan SB menunjukkan perkumpulan untuk As, Co, Cr, Hg, Li, Be, V, Cs, Mn dan Sr manakala Ag dan Se menurun selepas translokasi selama 2 dan 6 minggu. Selepas translokasi selama 2 dan 6 minggu ke SB, aras untuk logam Co, Cr, Hg, Be, V, Cs, Se, Mn dan Sr menurun. Ini membuktikan bahawa SB adalah kawasan yang baik untuk menyingkirkan logam tersebut. Signifikasi ($P < 0.05$) aras yang menunjukkan menaik

bagi Li, Hg and Sr di cangkerang yang di translokasi ke KPP selepas 2 dan 6 minggu. Signifikasi ($P < 0.05$) aras yang menunjukkan menaik bagi Cs dan Hg ditemui di SB. Signifikasi ($P < 0.05$) aras yang menunjukkan menurun bagi Ag, Mn dan Co di cangkerang yang di translokasi ke KPP and As, Ag, Co, Li dan Mn di SB. Dalam masa yang sama, tiada perubahan yang signifikasi ($P > 0.05$) untuk Be, Cr, Se dan V dalam kedua-dua kawasan selepas translokasi.

Dengan menggunakan kupang sebagai pemantau biologi, kami mengkonklusikan bahawa KPP merupakan kawasan yang mempunyai logam kesediaan biologi yang tertinggi bagi logam Cd, Co, Cu, Cr, Cs, Fe, Hg, Li, Ni, Pb, Sr, V dan Zn jika dibandingkan dengan KSM dan SB berdasarkan maklumat yang kami diperolehi dari tisu lembut dan cangkerang. Walaubagaimanapun, kajian melanjut harus dijalankan supaya sumber pencemaran untuk logam Ag, As, Be dan Se di KSM dan SB disiasat dan diketahui.

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I certify that a Thesis Examination Committee has met on 26 December 2012 to conduct the final examination of Eugene Ng Yew Jing on his thesis entitled “Assessment of Trace Metal Pollution in the Straits of Johor using Transplanted Caged Mussels *Perna viridis* L.” in accordance with the Universities and University College Act 1971 and the Constitution of the Universiti Putra Malaysia [P.U.(A) 106] 15 March 1998. The Committee recommends that the student be awarded the Master of Science.

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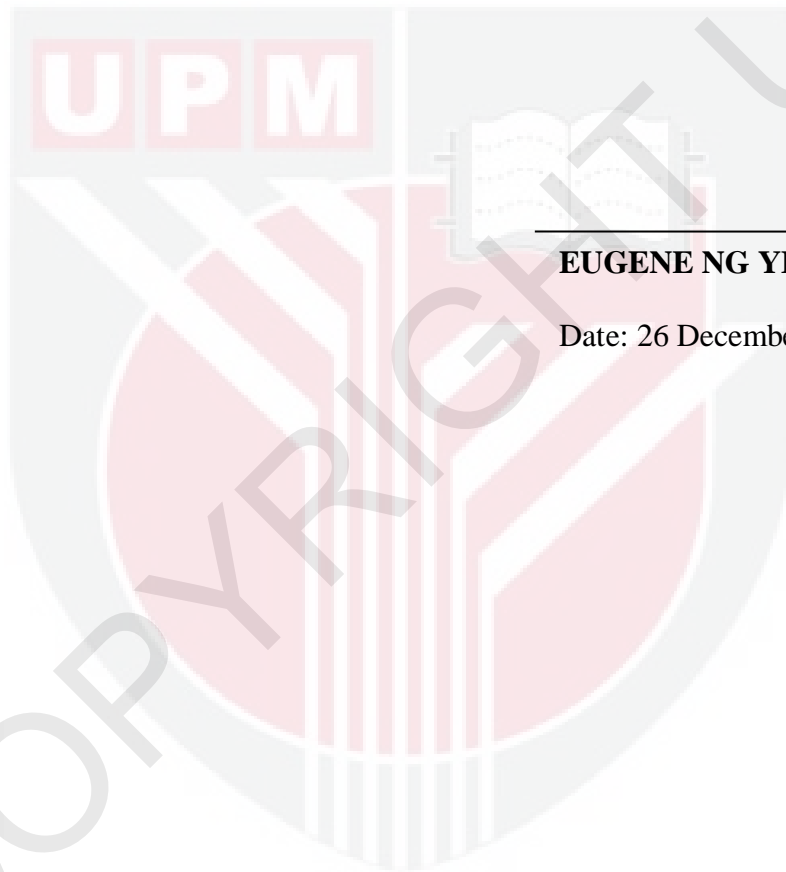
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DECLARATION

I declare that the thesis is my original work except for quotations and citations which have been duly acknowledged. I also declare that it has not been previously, is not concurrently, submitted for any other degree at Universiti Putra Malaysia or at any other institution.



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Date: 26 December 2012



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