LEVELS AND POTENTIAL SOURCES OF PAHs IN MARINE FISH CULTURE IN MALAYSIA

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Outline

- Introduction
- Methodology
- Findings
- Conclusion
- Acknowledgement

Introduction

Why study PAHs

Ambiguous

Persistent
Bioaccumulate

Acute
Chronic
toxicity

Carcinogenic
Mutagenic

Endocrine
disruptors

Sources of PAHs

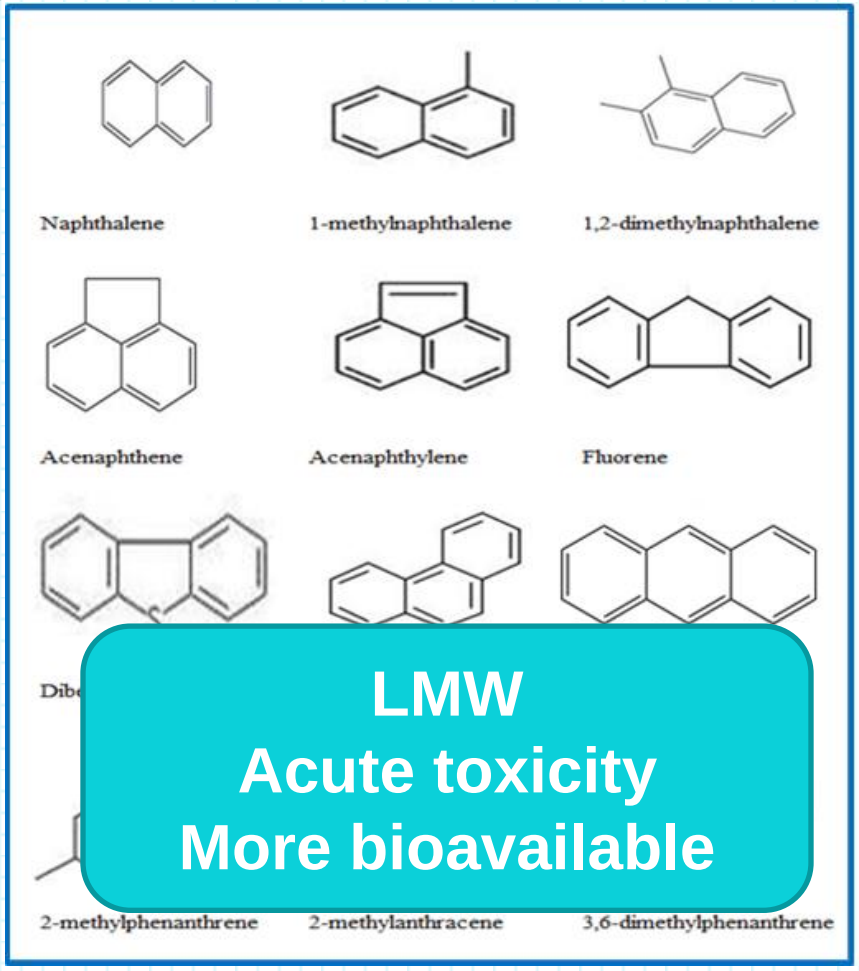
Pyrogenic

combustion of organic matter

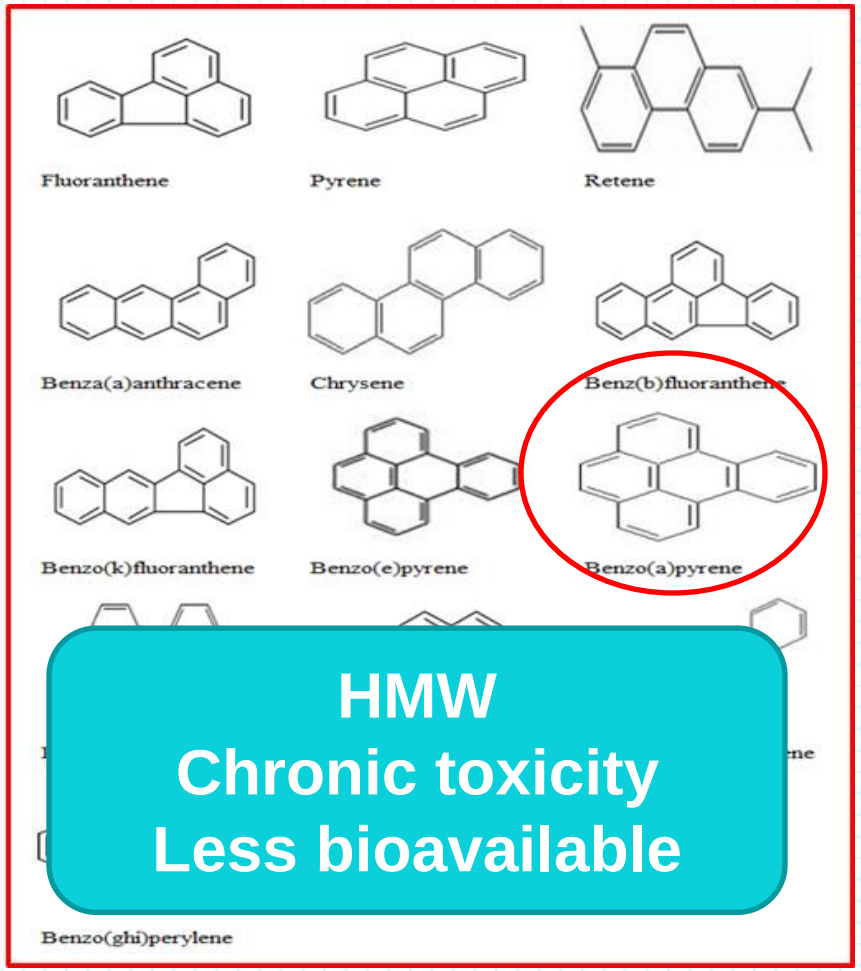
Petrogenic

petroleum or petroleum products

Structures of PAHs compounds

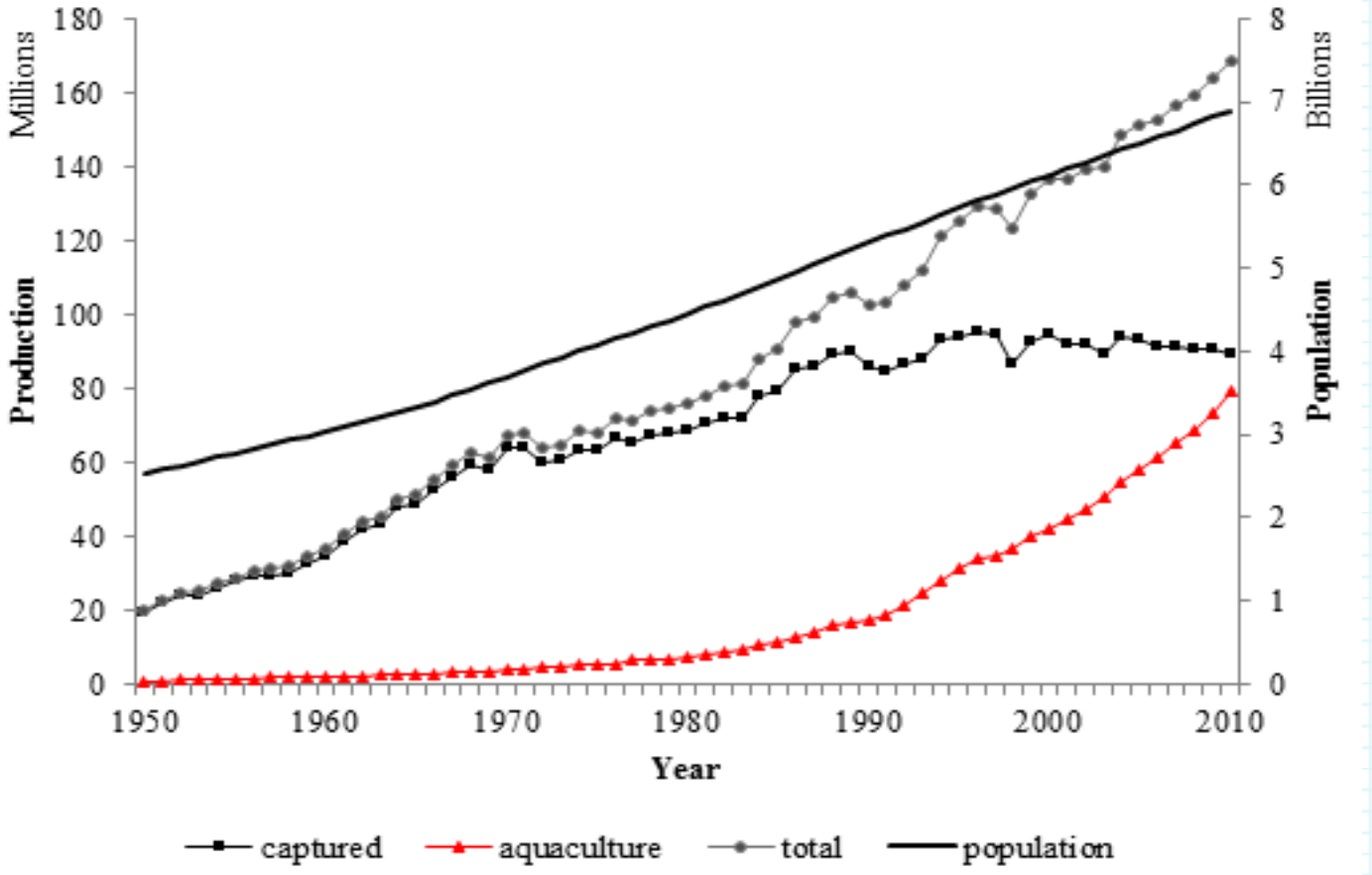


LMW
Acute toxicity
More bioavailable



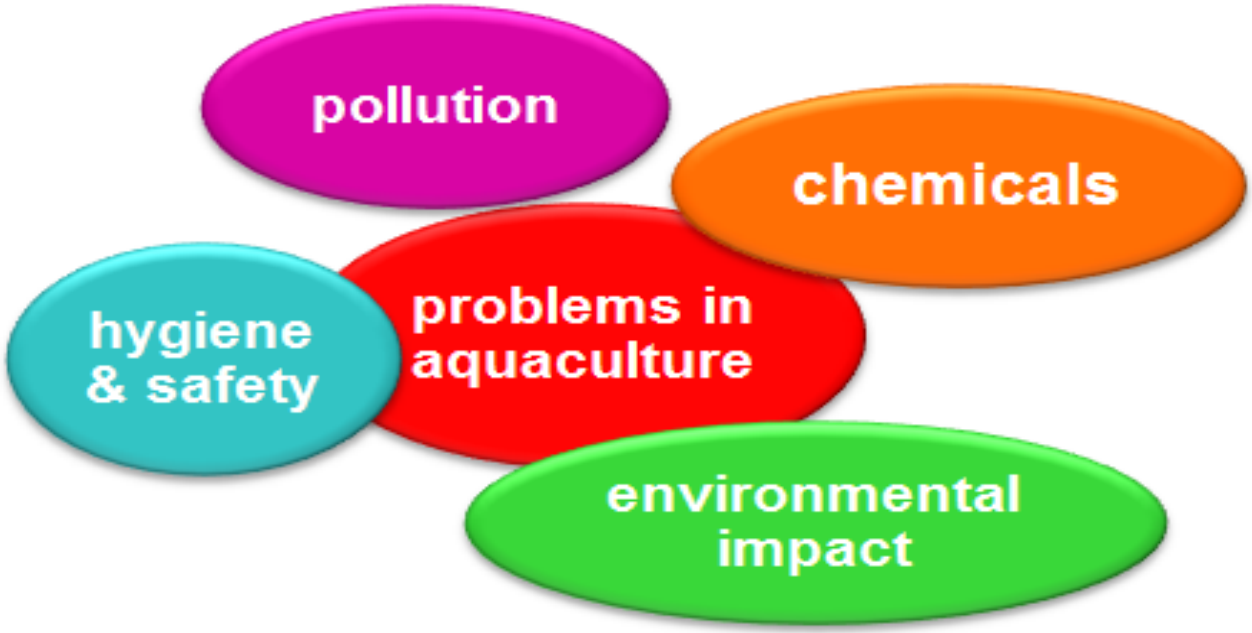
HMW
Chronic toxicity
Less bioavailable

What we know about aquaculture



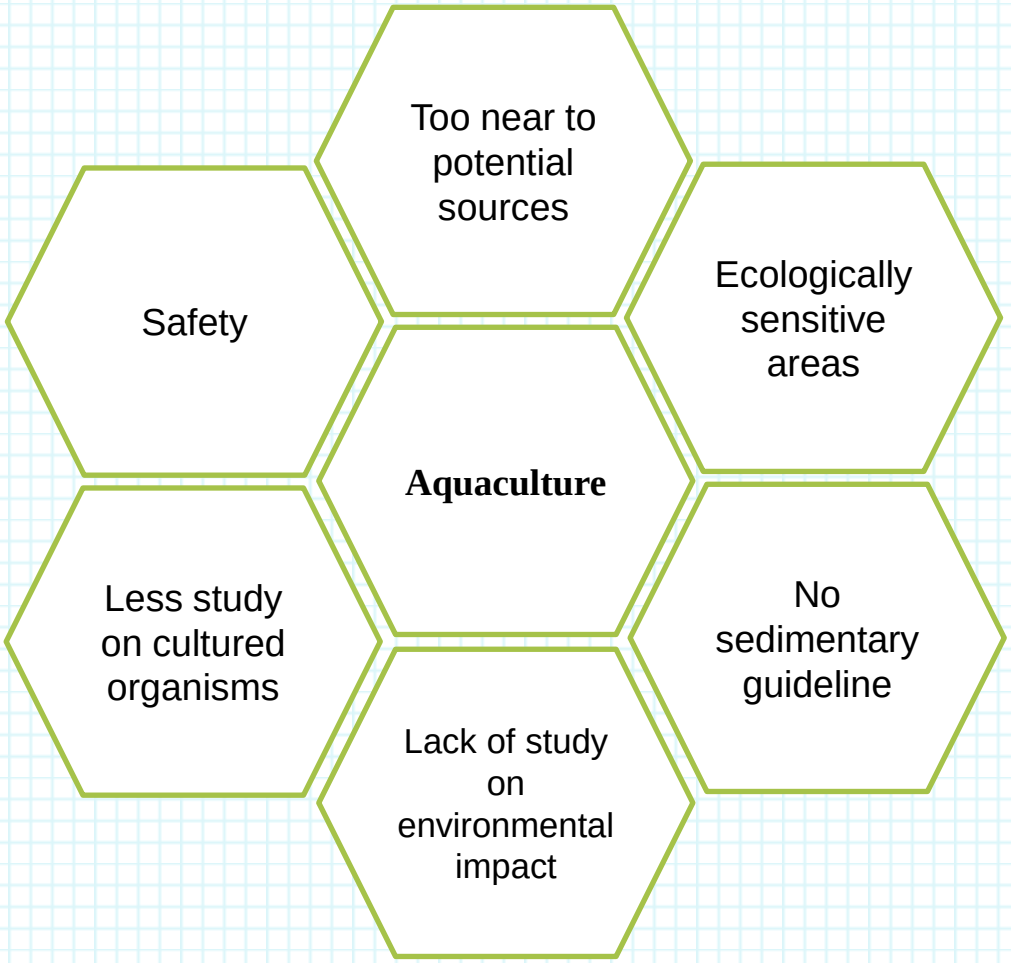
- ↑ seafood demand : 1) ↑ human population 2) ↑ living standard 3) ↑ need for quality protein
- Captured fish fully and/or over exploited
- Aquaculture rapid growth, 43% world seafood production

What we know about aquaculture (cont.)



- Environmental impact: enrichment of organic matter, nutrient & pollutants (Wu, et al., 1995; Sather et al., 2006; Wang et al., 2012); destruction of natural habitat (Das et al., 2004); new species (Cole et al., 2009)
- Unintended chemicals micro pollutants, medicines & antifoulants (Easton et al., 2002; Tsapaksi et al., 2010): affecting food web (Russel et al., 2011)
- Pollution: high human activities - resuspend and remobilize (Wang, et al., 2010a); too near to potential pollution sources (Kechik, 1995); reduce natural population (Martinez-Porchas & Martinez-Cordova,, 2012)

Problem statement



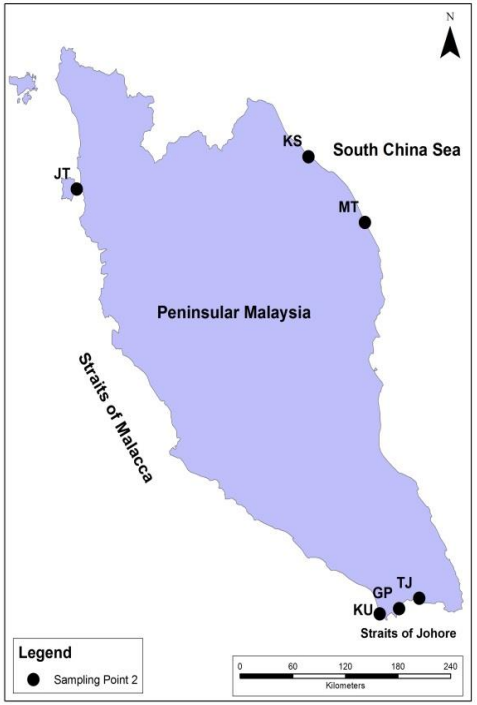
Upmost reason to assess the levels of PAHs in aquaculture environment and the risk associated with the safety of cultured organisms for human consumption

Objectives

1. To determine the levels of PAHs in various aquaculture compartments
2. To evaluate the relationship between biota, levels of bioaccumulation and the contributing sources

Materials and Methods

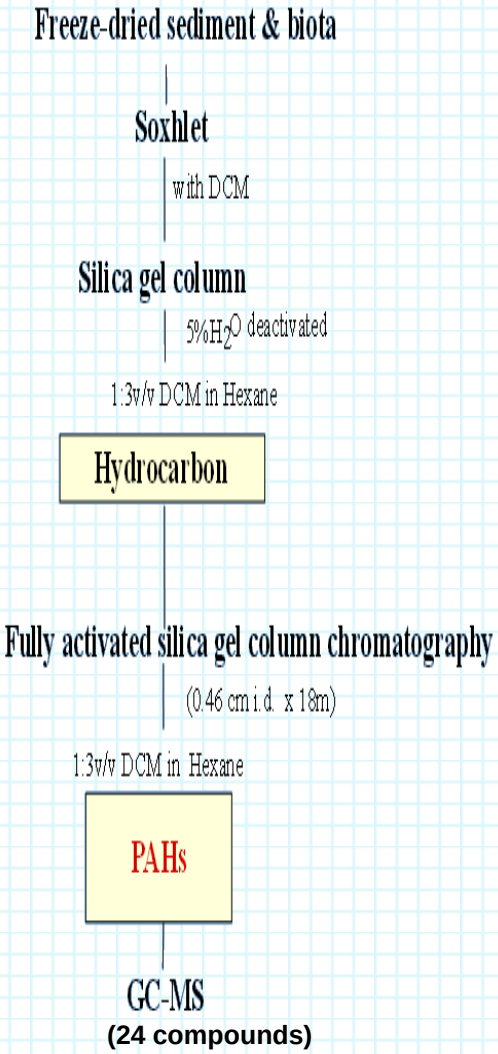
Sampling



No.	Sampling Site	ABV	Latitude	Longitude	Feeding mode	Descriptions
1	Jelutong, Pulau Pinang	JT	5° 22' 51"N	100° 20' 16"E	Fish meal	Located in urbanized, industrialized area of Penang Island, black mud sediment
2	Merchang, Terengganu	MT	5° 3' 6"N	103° 17' 24"E	Fish meal	Relatively unpolluted area, black mud sediment
3	Kuala Setiu, Terengganu	KS	5° 40' 42"N	102° 42' 39"E	Fish meal	Relatively unpolluted area, active aquaculture zone,black mud sediment
4	Pulau Kukup, Johor	KU	1° 19' 27"N	103° 26' 23"E	Fish meal	Second largest cage farming, near bus y shipping lane Straits of Malacca, black mud sediment
5	Gelang Patah, Johor	GP	1° 22' 28"N	103° 38' 22"E	Fish meal and trash fish	Near busy second link bridge, black mud sediment
6	Teluk Jawa, Johor	TJ	1° 28' 21"N	103° 50' 40"E	Trash fish	Located at most industrialized, urbanized and port area of Pasir Gudang and Sembawang at Straits of Johore, black mud sediment

Chemical analysis

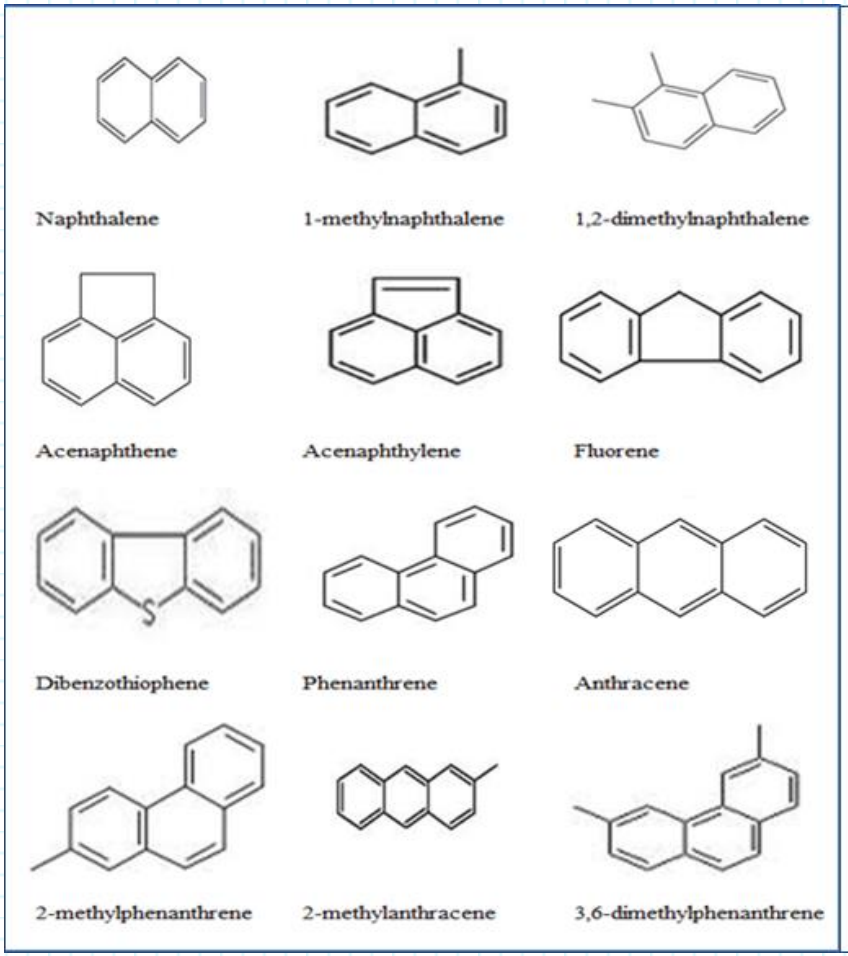
PAHs analysis

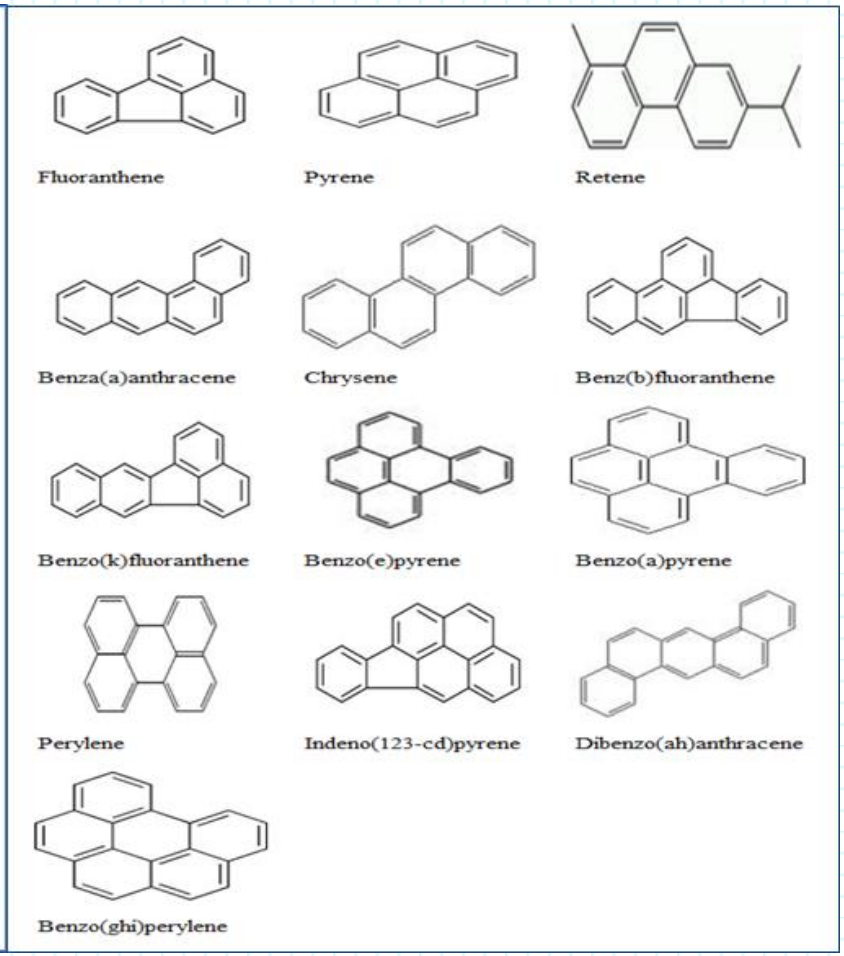


Quality control

- 5 point calibration, R^2 0.995- 0.999
- Spike recovery ranged 45-121%
- MDL ranged 0.06 - 7.01 ng/g
- Surrogate internal standard recovery 60- 120%

PAHs compounds





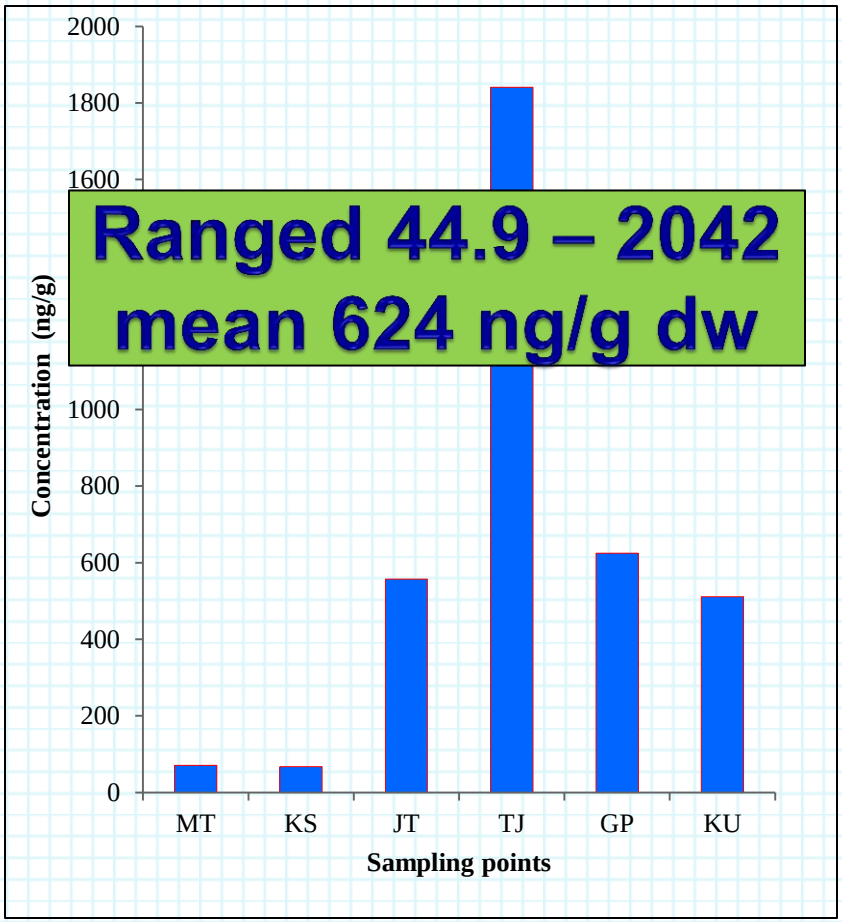
Data analysis

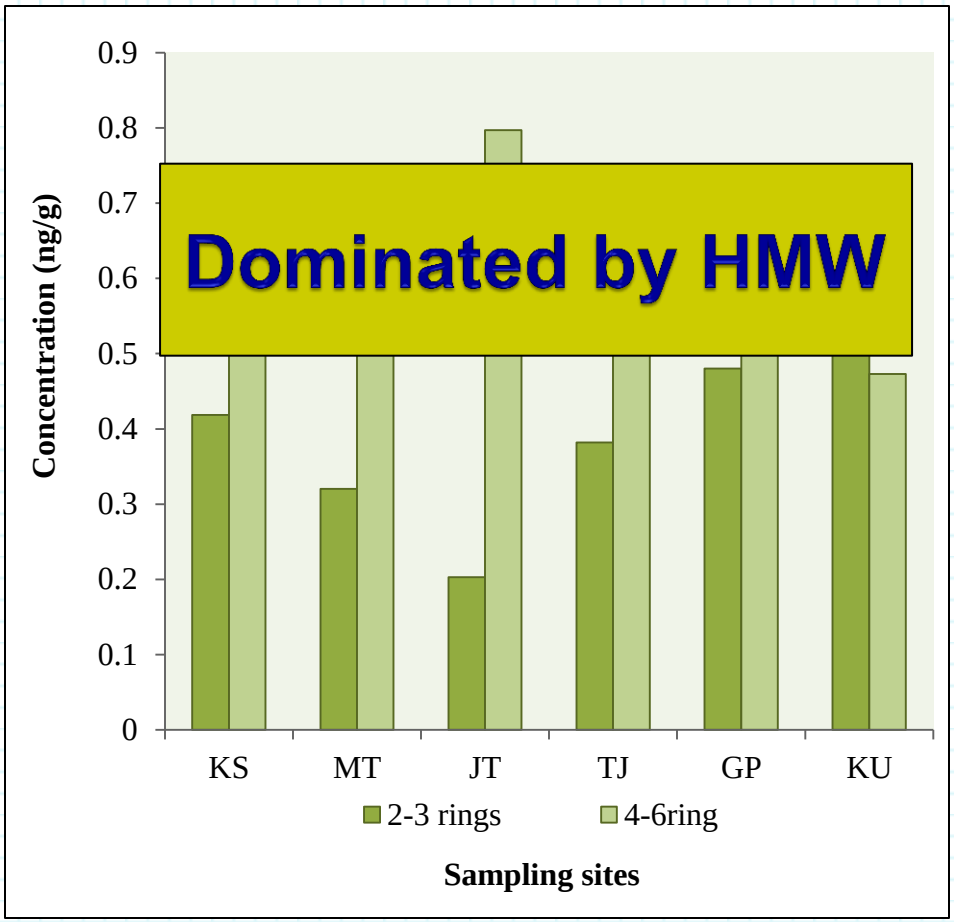
- **Molecular markers**
- **Chemometric**

- Cluster analysis (CA)
  pattern recognition for classification & source identification
- Discriminant analysis (DA) discriminate naturally occurring clusters
- PCA/MLR - pattern recognition for source identification & source apportionment

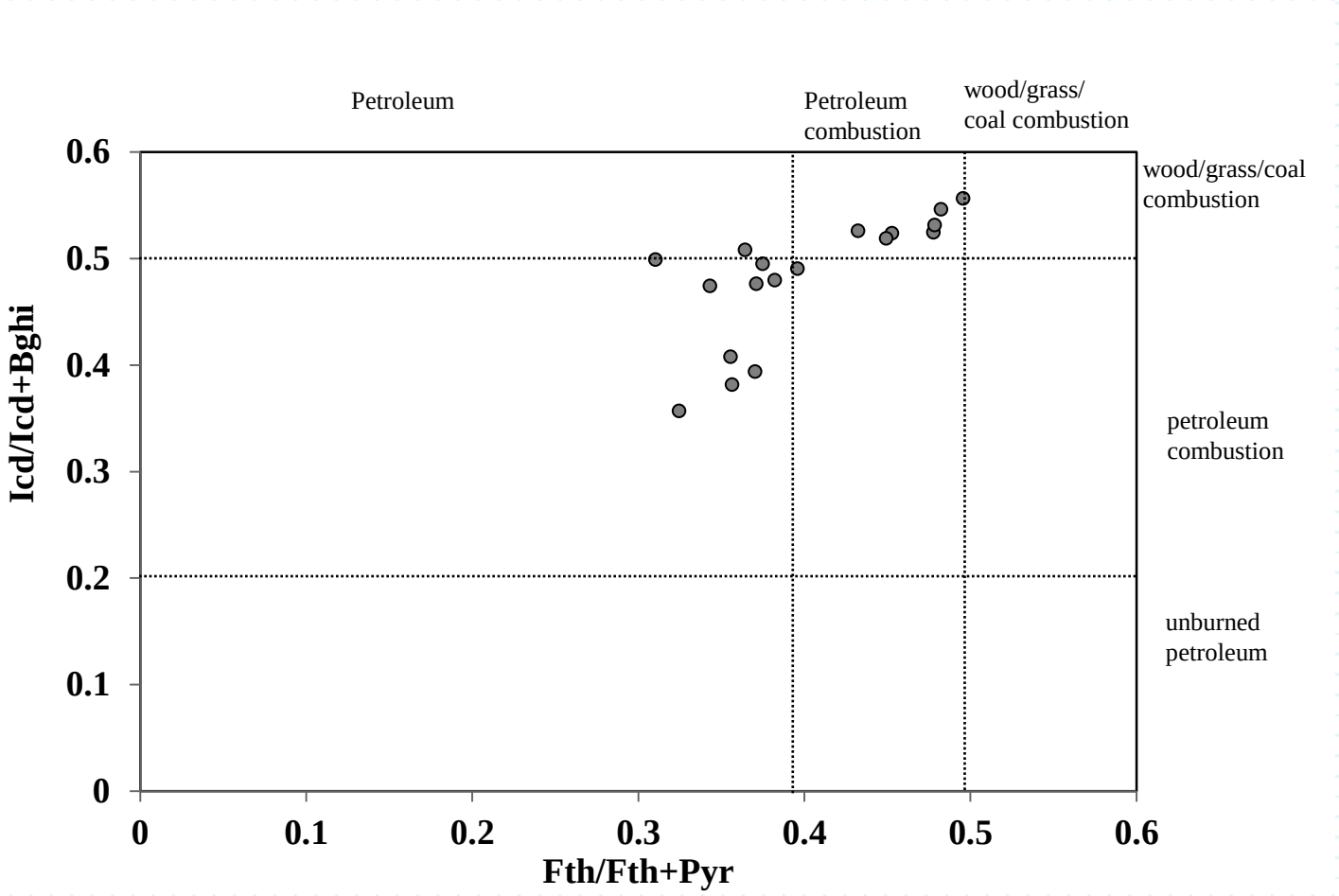
Findings

Levels and profile in sediment



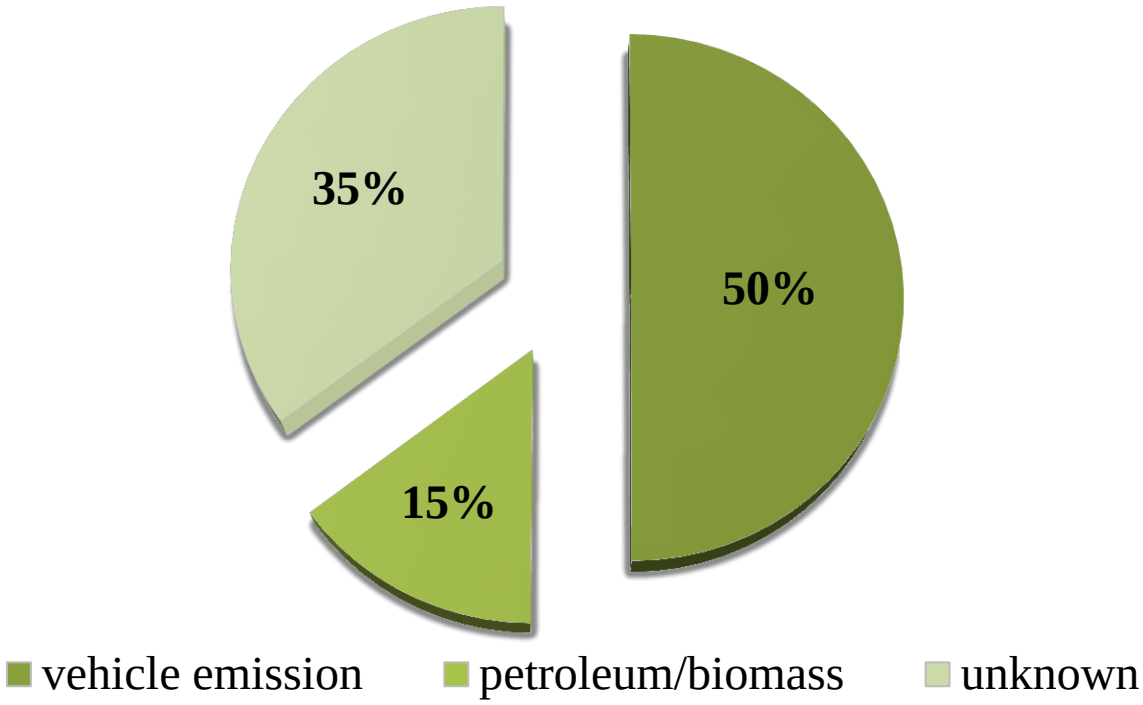


Sources in sediment



- Mix sources of petroleum and petroleum combustion

Sources in sediment (con't)

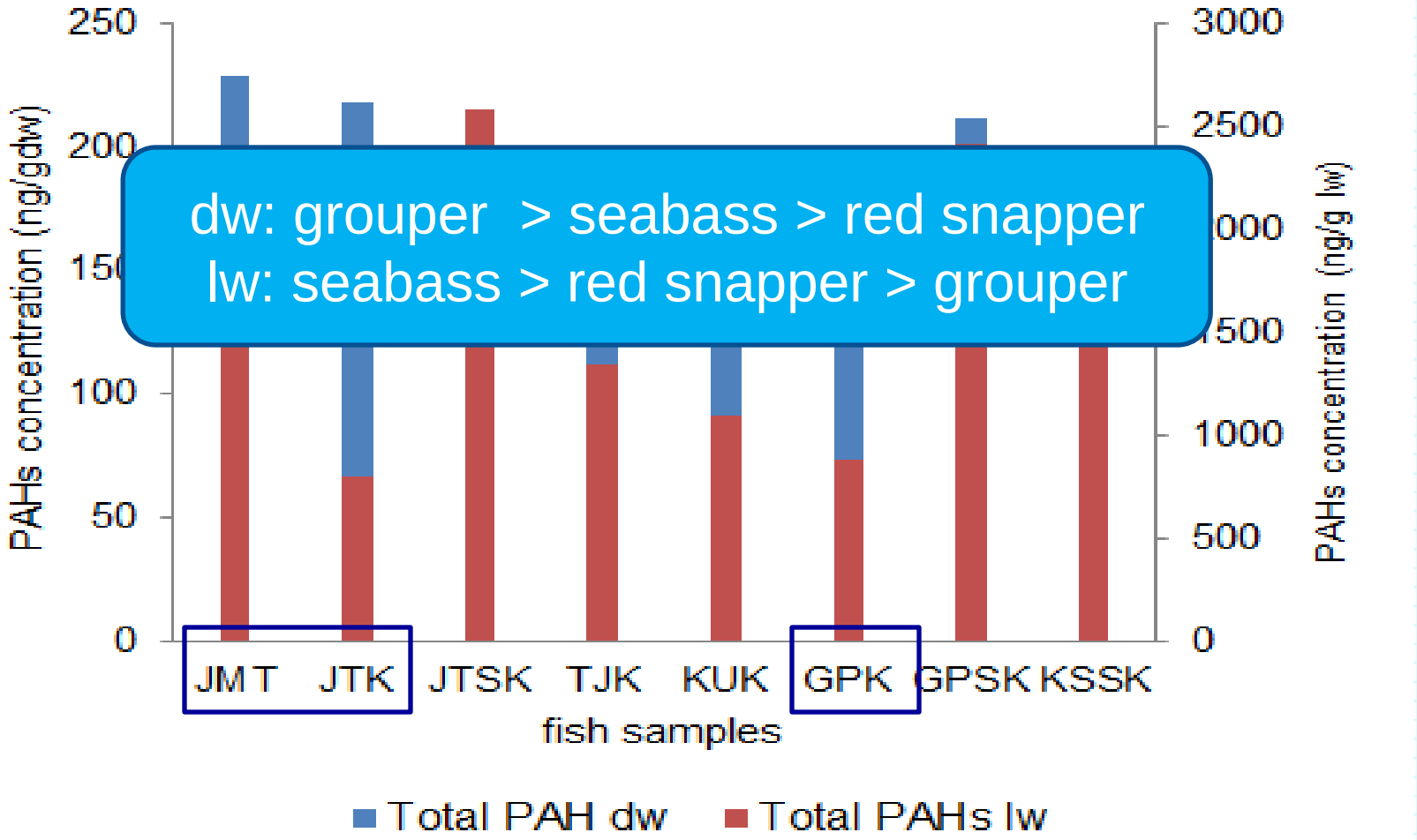


- PCA/MLR:

- dominated by vehicle emission

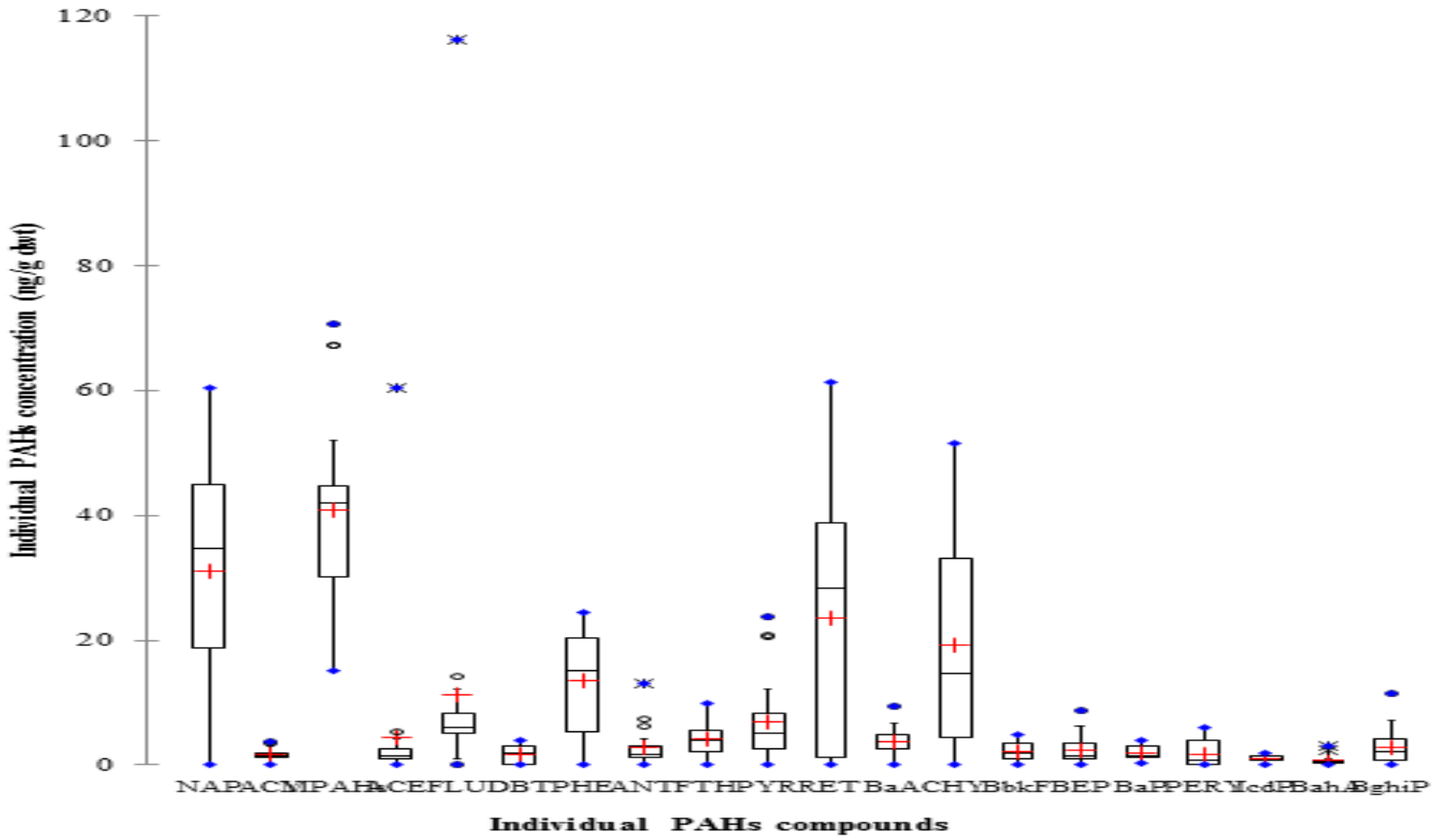
- unknown source

Level and profile in fish



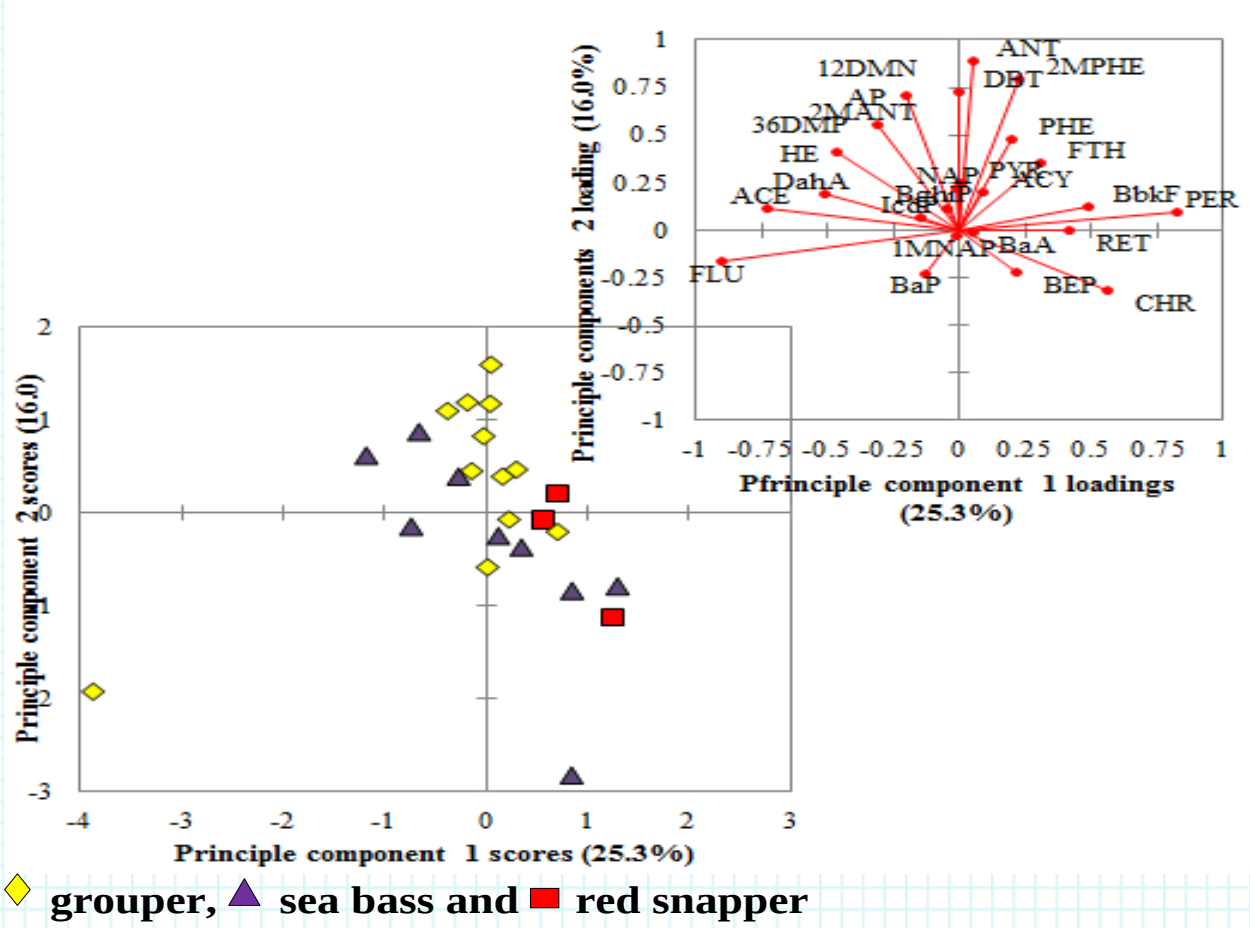
- TTEC & $PAHs_{lipid}$: strong significant correlation (r^2=0.70, $p<0.05$)

Level and profile in fish (cont.)



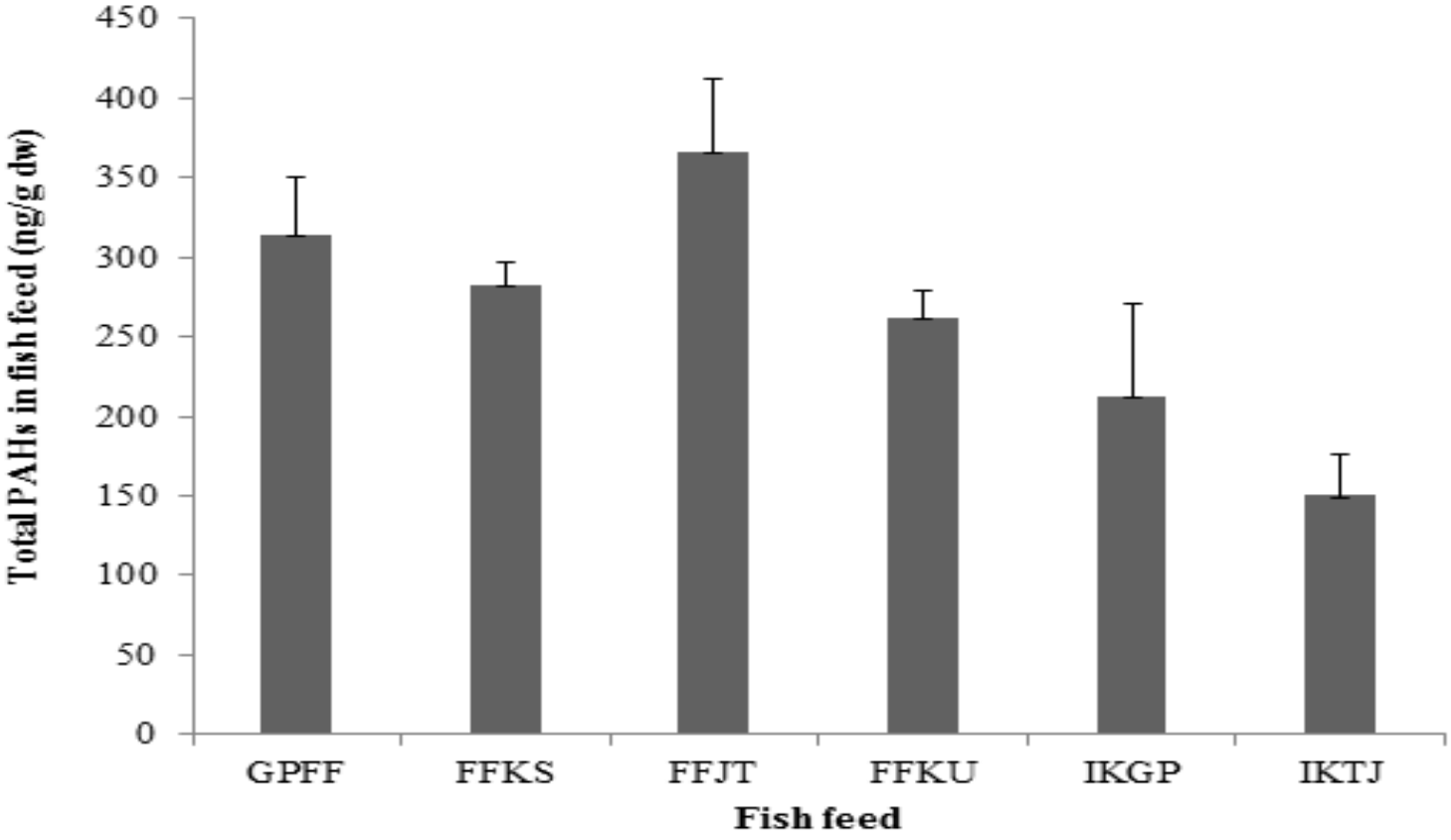
- Domination of LMW reflecting their bioavailability

Bioaccumulation in fish



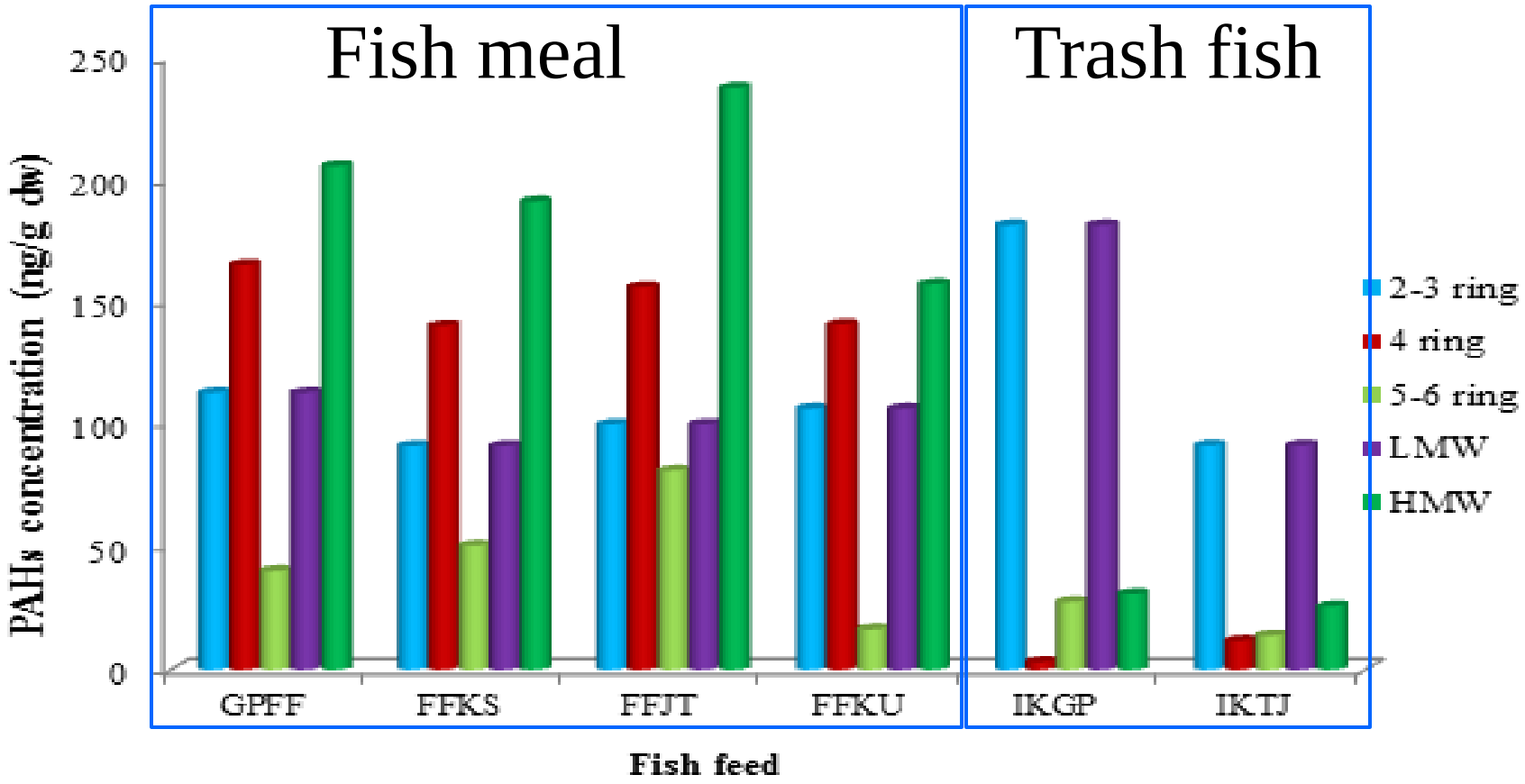
- Bioaccumulation affinity differ according to species

Level and profile in fish feed



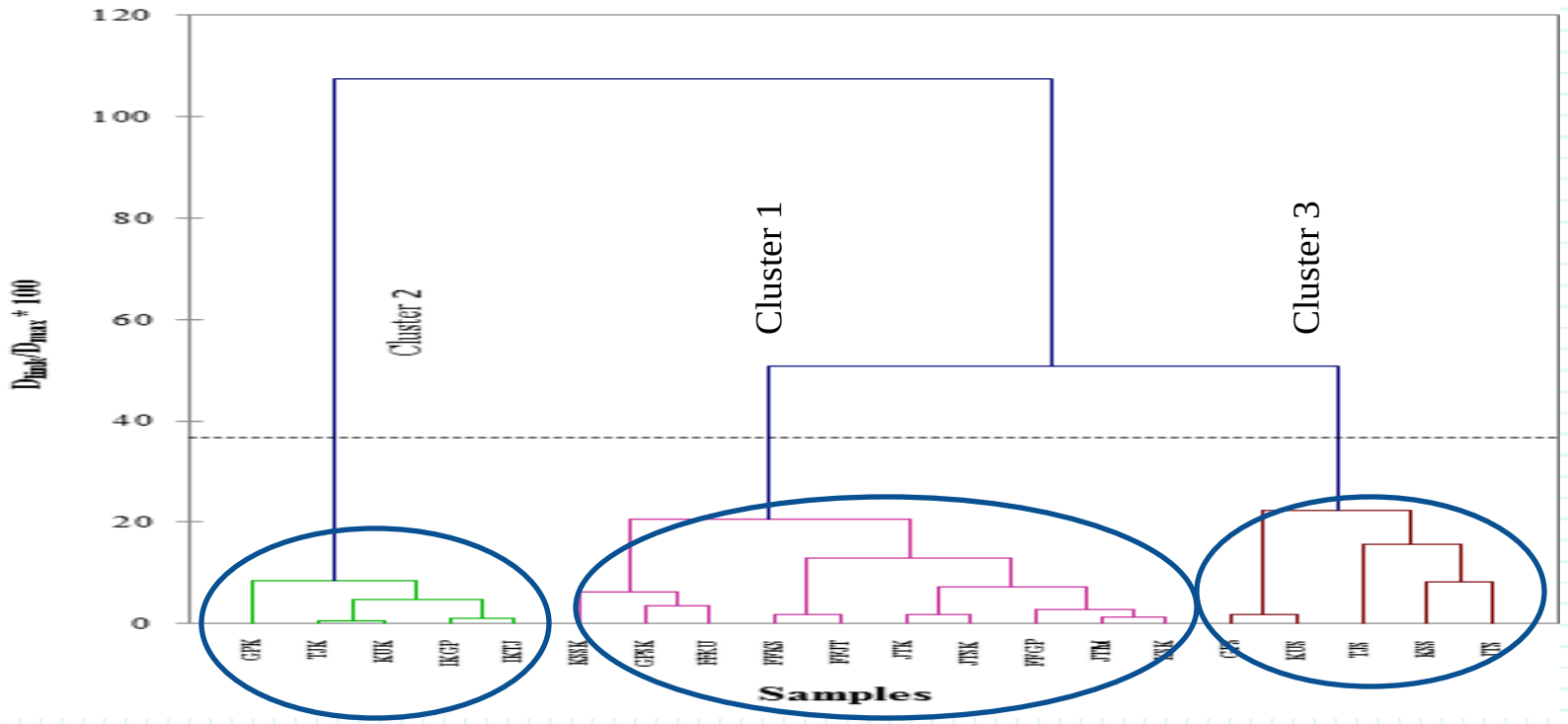
- PAHs in fish feed ranged from 150 - 366 ng/g dw with mean value of 264 ng/g dw

Levels and profile in fish feed (con't)



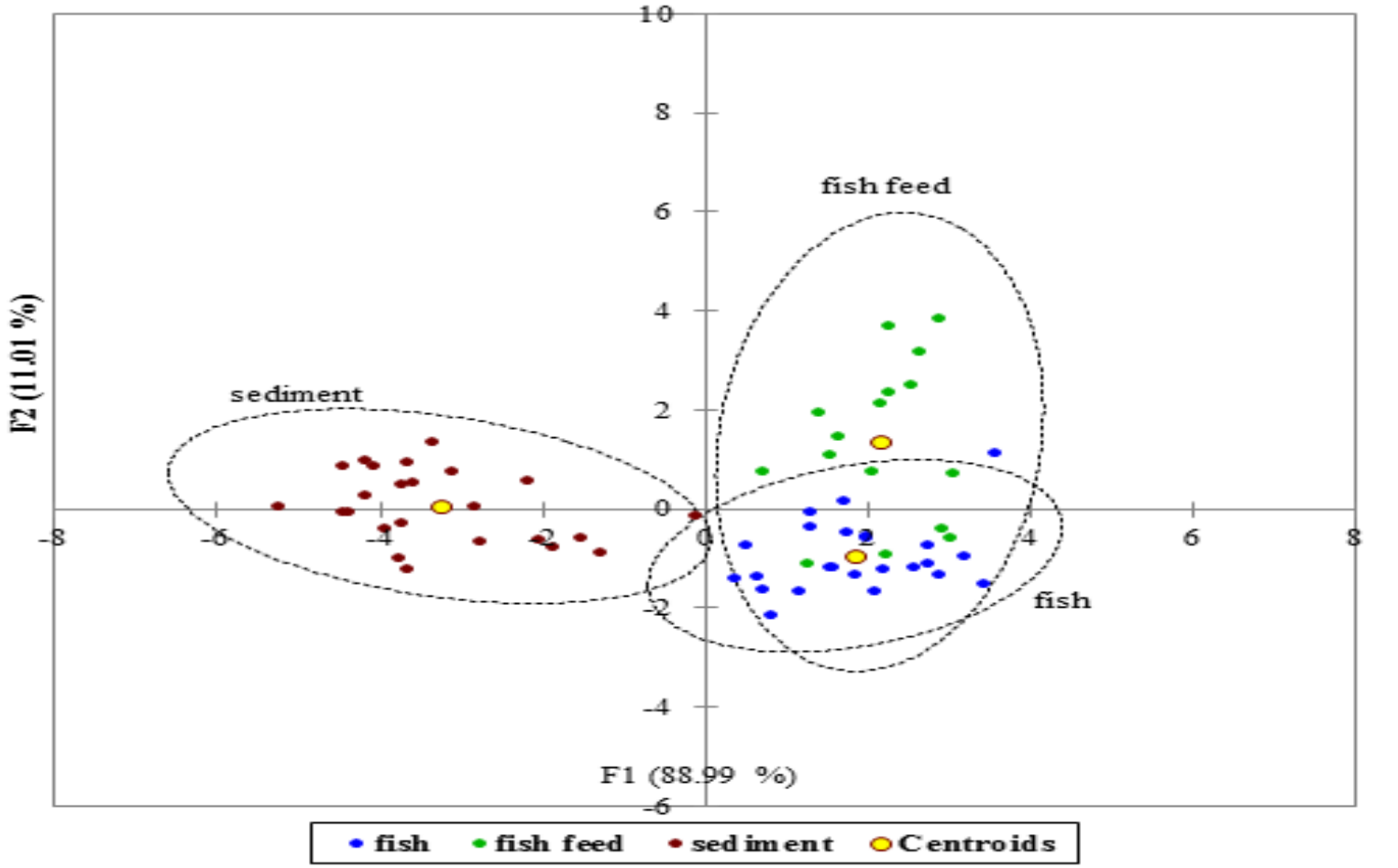
- Fish meal - HMW; Trash fish - LMW
- Strong significant correlation: sediment and fish feed (r^2=0.760, $p<0.05$)

Sources in fish



- Strong significant correlation: PAHs in fish & fish feed (r^2=0.806, $p<0.05$)
- PAHs in fish tissue may come from fish feed
- PAHs in fish tissue clustered according to feed
- Sediment grouped in different cluster altogether

Sources in fish (cont.)



- DA segregated fish tissue and fish feed from sediment indicating fish feed as major source into fish tissue

Conclusion

- Moderate level PAHs pollution in sediments
- Mix sources: petroleum and petroleum combustion
- dominated by vehicle emission
- Moderate level PAHs: fish and fish feed
- PAHs bioaccumulation: differ by species
- Fish feed: main source of PAHs in fish

Acknowledgment

1. FRGS
2. Ministry of Science, Technology and Innovation (MOSTI)
3. Universiti Putra Malaysia (UPM)
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8. Anonymous contributors

Thank you