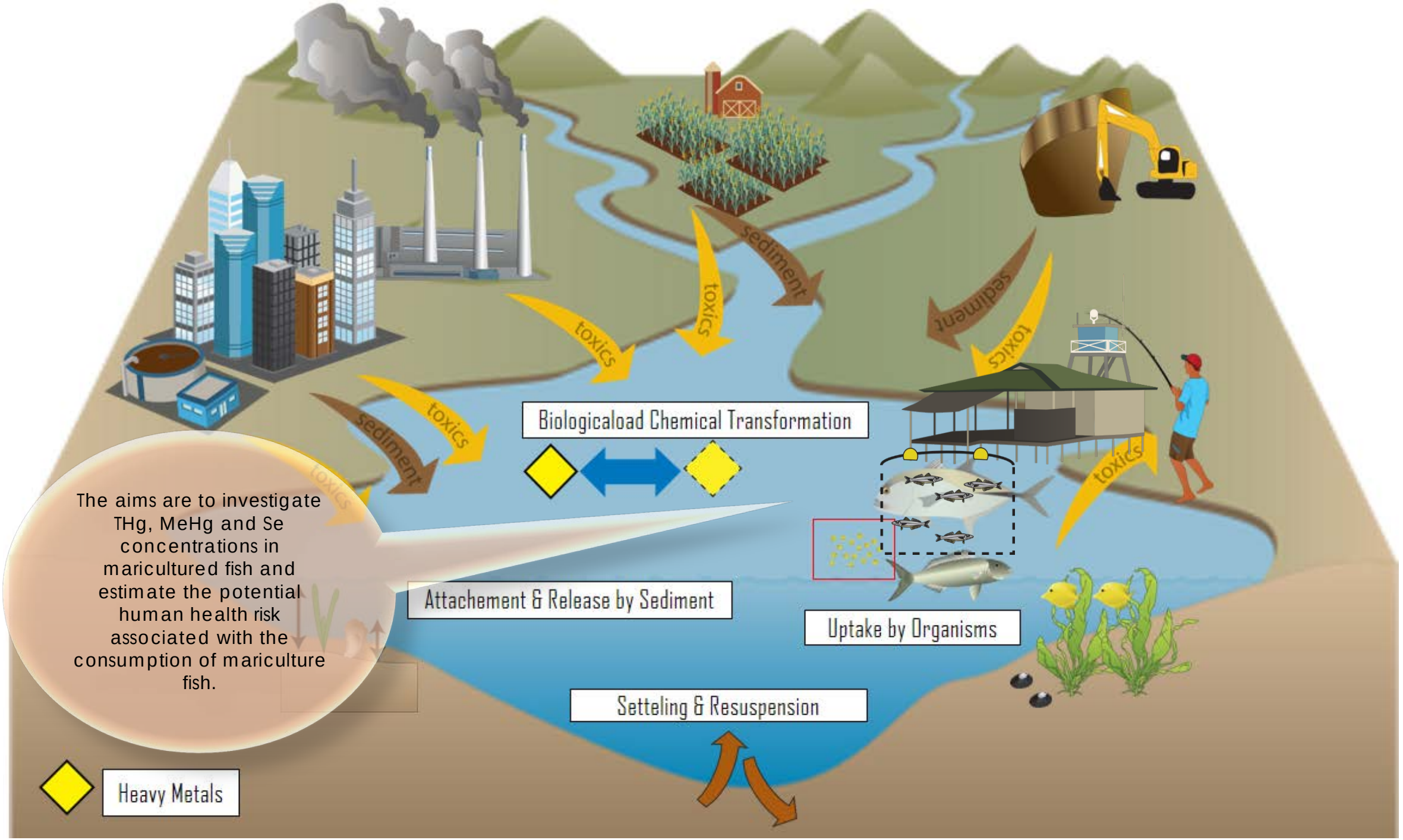
3rd National Environment & Health Action Plan (NEHAP) Conference 2017

Mercury, Methylmercury & Selenium in Maricultured Fish

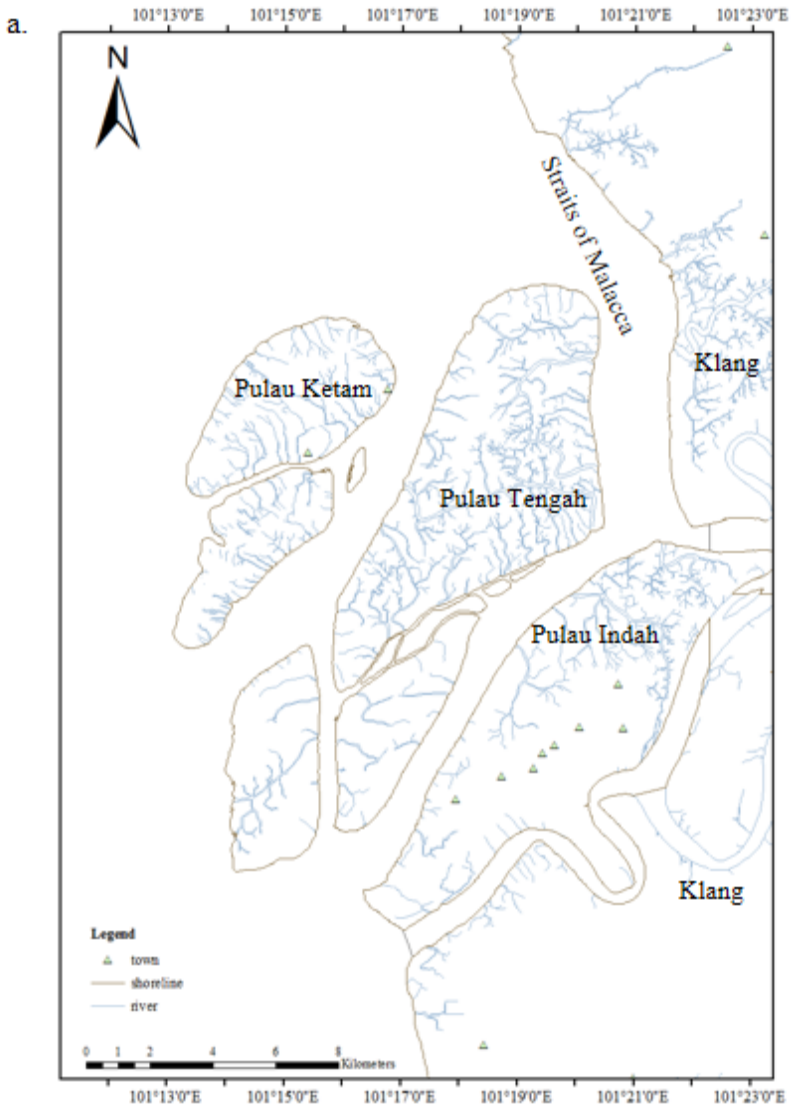
NOR NASYITAH SOBIHAH BINTI MOHD NASRI

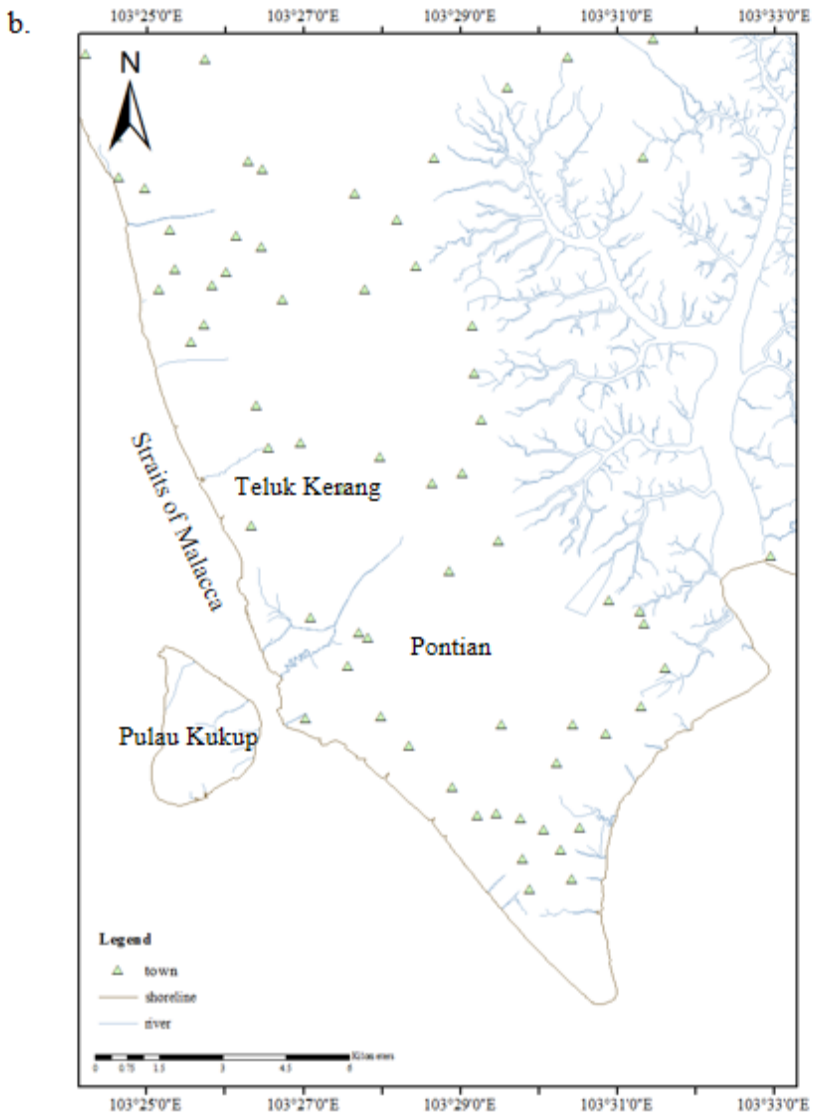
SUPERVISOR: PROF. DR. AHMAD ZAHARIN ARIS

NEHAP MALAYSIA
National Environmental Health Action Plan


toxics
sediment
toxics
sediment
toxics
sediment
toxics
toxics
Biologicaload Chemical Transformation
The aims are to investigate THg, MeHg and Se concentrations in maricultured fish and estimate the potential human health risk associated with the consumption of mariculture fish.
Attachement & Release by Sediment
Uptake by Organisms
Setteling & Resuspension
Heavy Metals

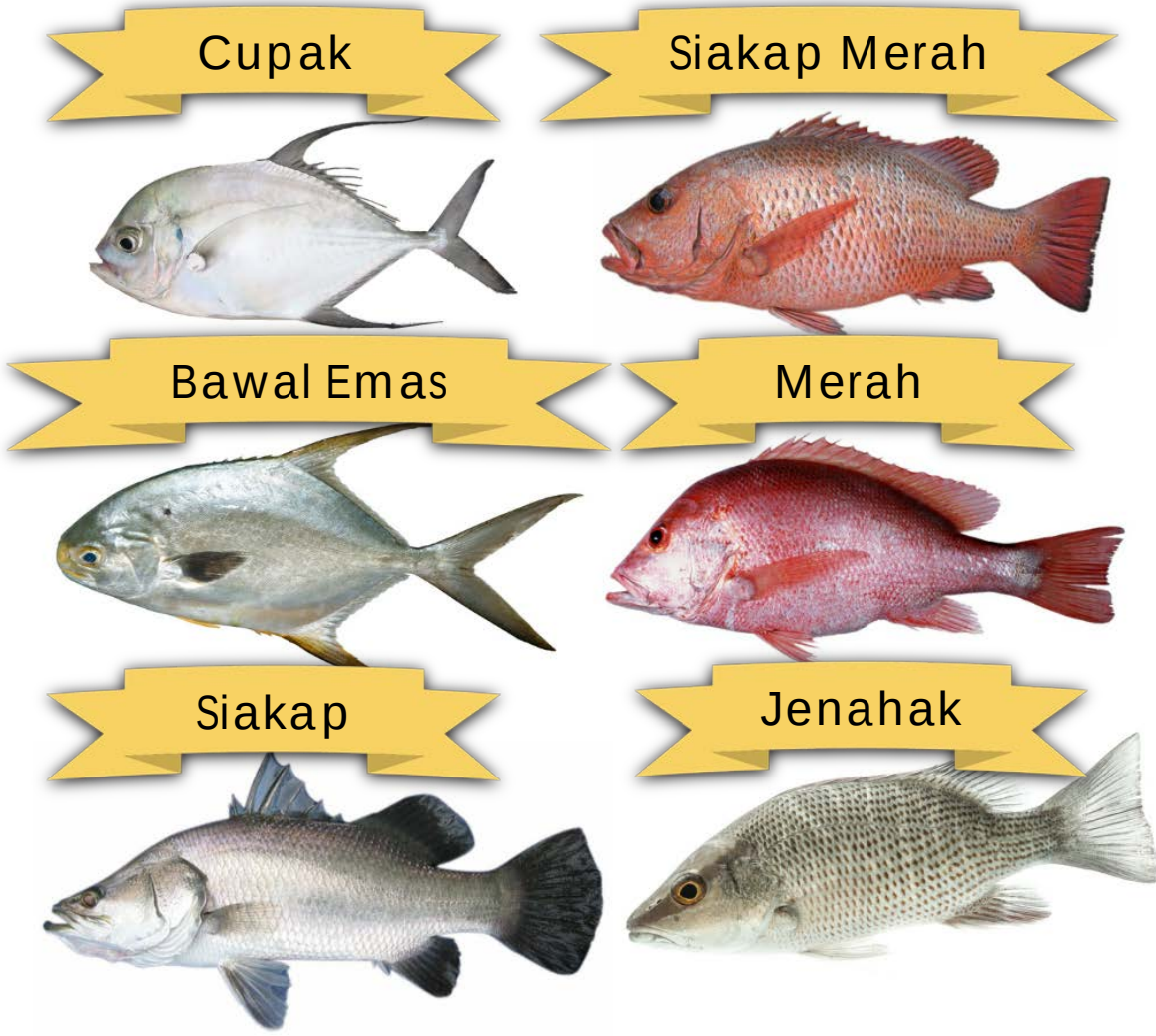
Sampling Location





Species collected

- *Carangoides armatus* (Longfin travelly)
- *Lates calcarifer* (Barramundi)
- *Lutjanus argentimaculatus* (Mangrove red snapper)
- *Lutjanus campechanus* (Red snapper)
- *Lutjanus griseus* (Grey snapper)
- *Trachinotus blochii* (Golden pomfret)



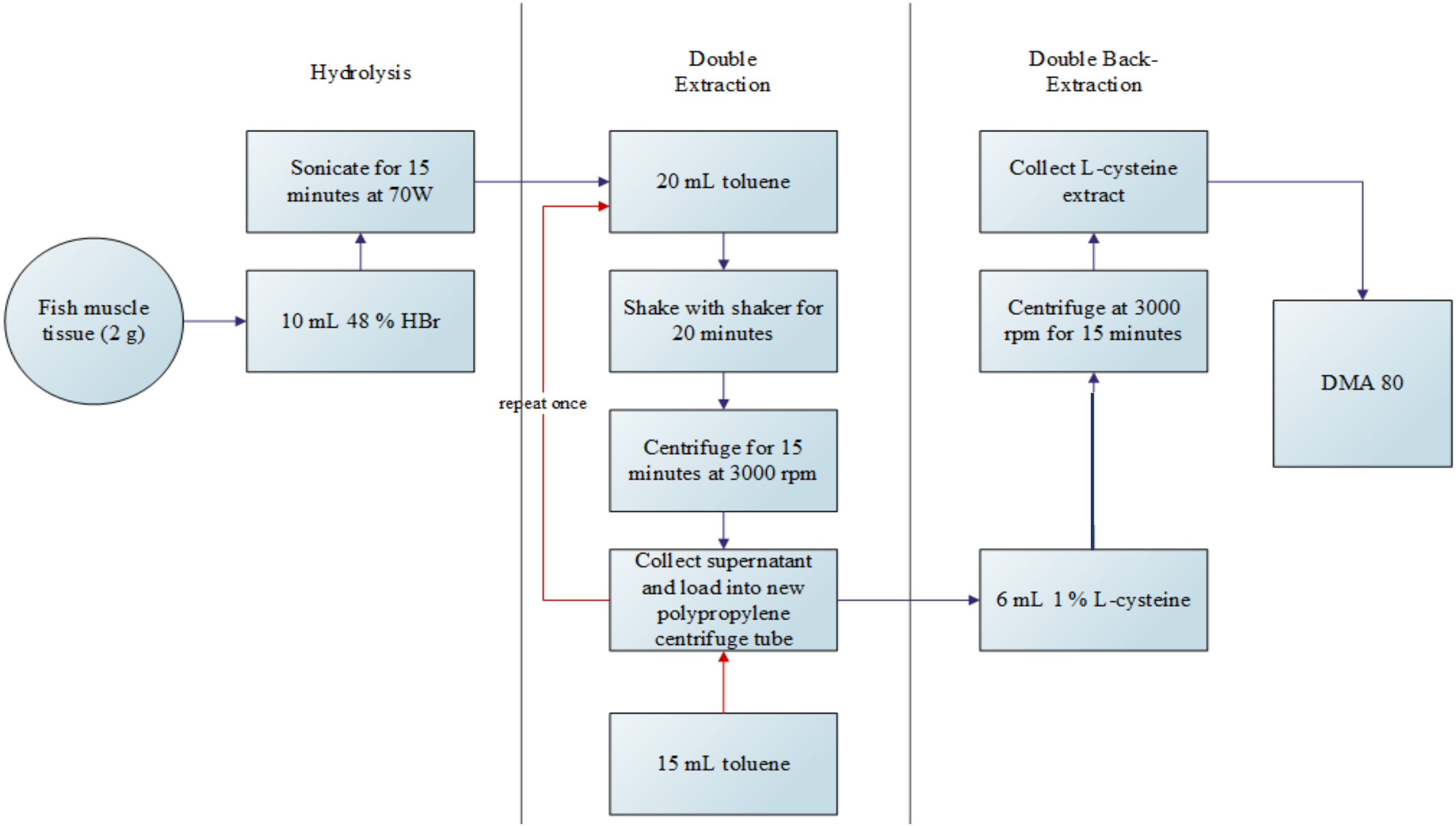
Total Mercury (THg) Determination

Homogenized dried fish muscle tissue were analysed using direct mercury analyser (DMA-80, Milestone, CT, USA)

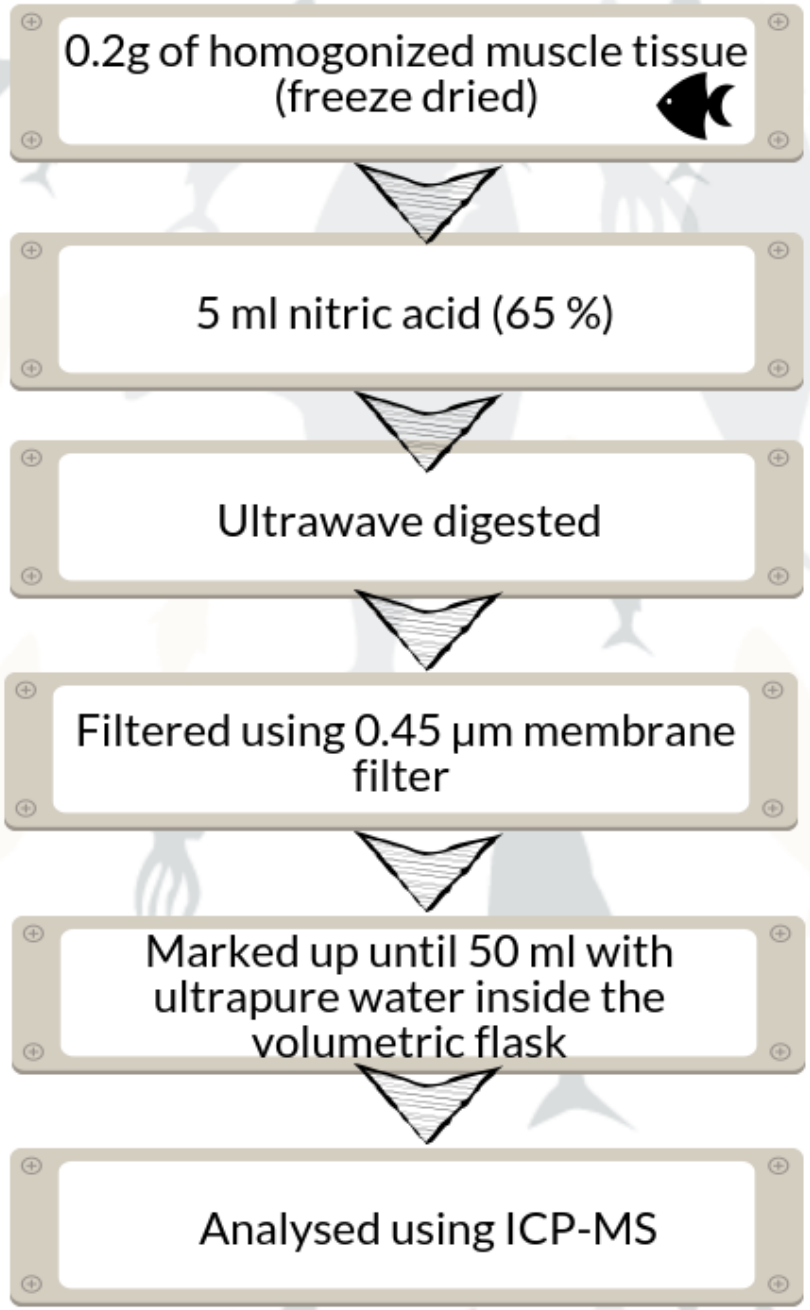
Approximately 1.0 g of sample being introduced to the instrument.

Methylmercury (MeHg) extraction procedures

Source: Modified from Maggi et al. (2009) & Looi et al. (2016).


Hydrolysis
Double Extraction
Double Back-Extraction
Fish muscle tissue (2 g)
10 mL 48 % HBr
Sonicate for 15 minutes at 70W
20 mL toluene
Shake with shaker for 20 minutes
Centrifuge for 15 minutes at 3000 rpm
Collect supernatant and load into new polypropylene centrifuge tube
15 mL toluene
repeat once
6 mL 1 % L-cysteine
Centrifuge at 3000 rpm for 15 minutes
Collect L-cysteine extract
DMA 80

Selenium (Se) Determination


0.2g of homogonized muscle tissue (freeze dried)
5 ml nitric acid (65 %)
Ultrawave digested
Filtered using 0.45 µm membrane filter
Marked up until 50 ml with ultrapure water inside the volumetric flask
Analysed using ICP-MS

Quality Assurance & Quality Control

1. All materials used during the digestion procedure and elemental analysis were acid washed using 30% (v/v) HNO_3 prior to use.
2. Homogenized samples were collected in triplicate (n= 3)
3. The standards and method blanks were analysed to determine the background correction
4. Recovery tests were done before and after the analysis in order to check the accuracy of the data
5. Accuracy of the procedure was determined by the analysis of certified reference material, THg: 93.13%, MeHg: 94.92%, Se:96.00%

Total Mercury & Methylmercury Assesment

Estimated Weekly Intake

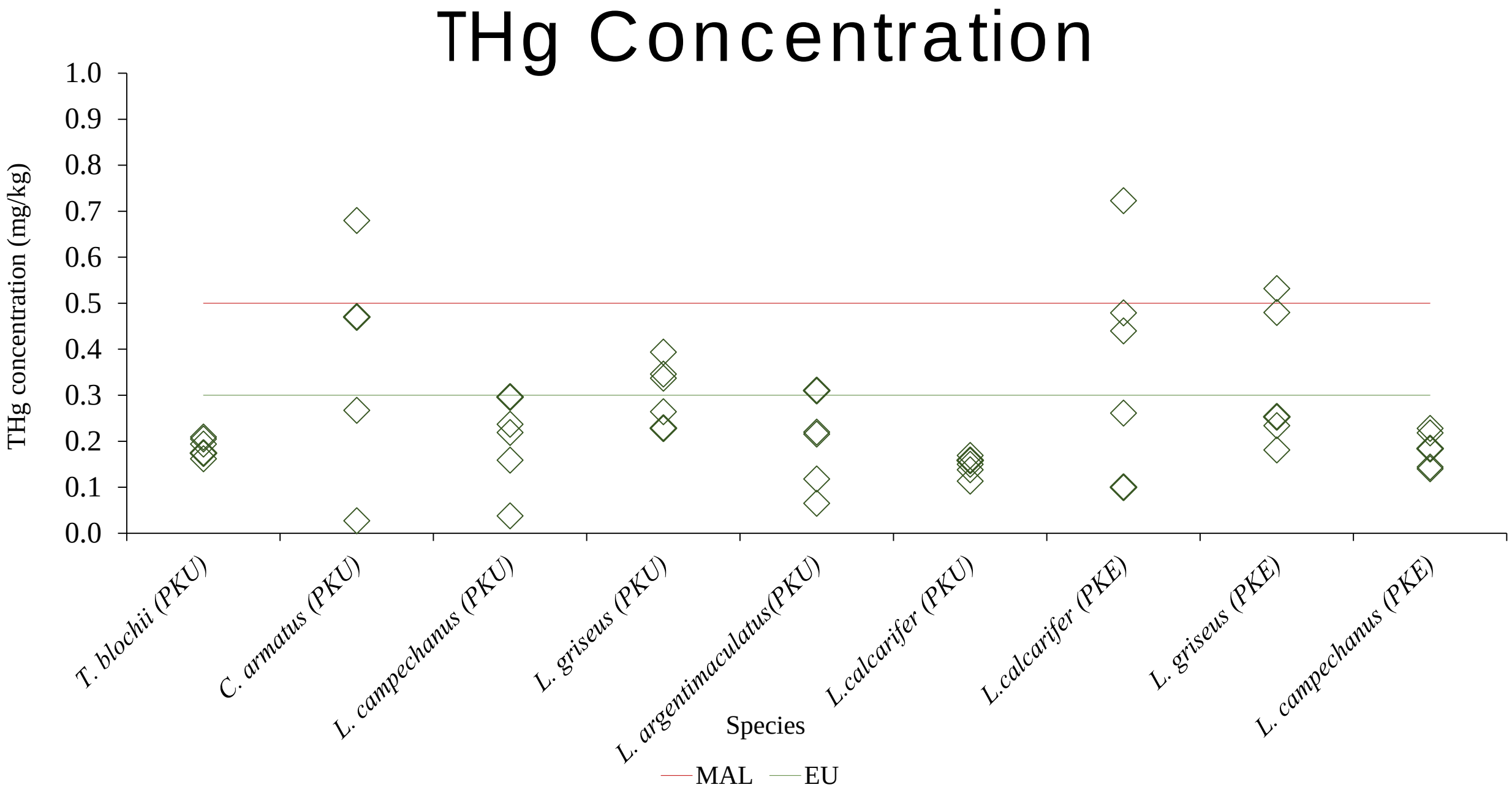
- The intake of THg and MeHg (µg/Kg body weight) was compared to the PTWI (THg:5 mg/kg, MeHg: 1.5 mg/kg) established by Joint FAO/WHO Expert Committee on Food Addictives (JECFA).

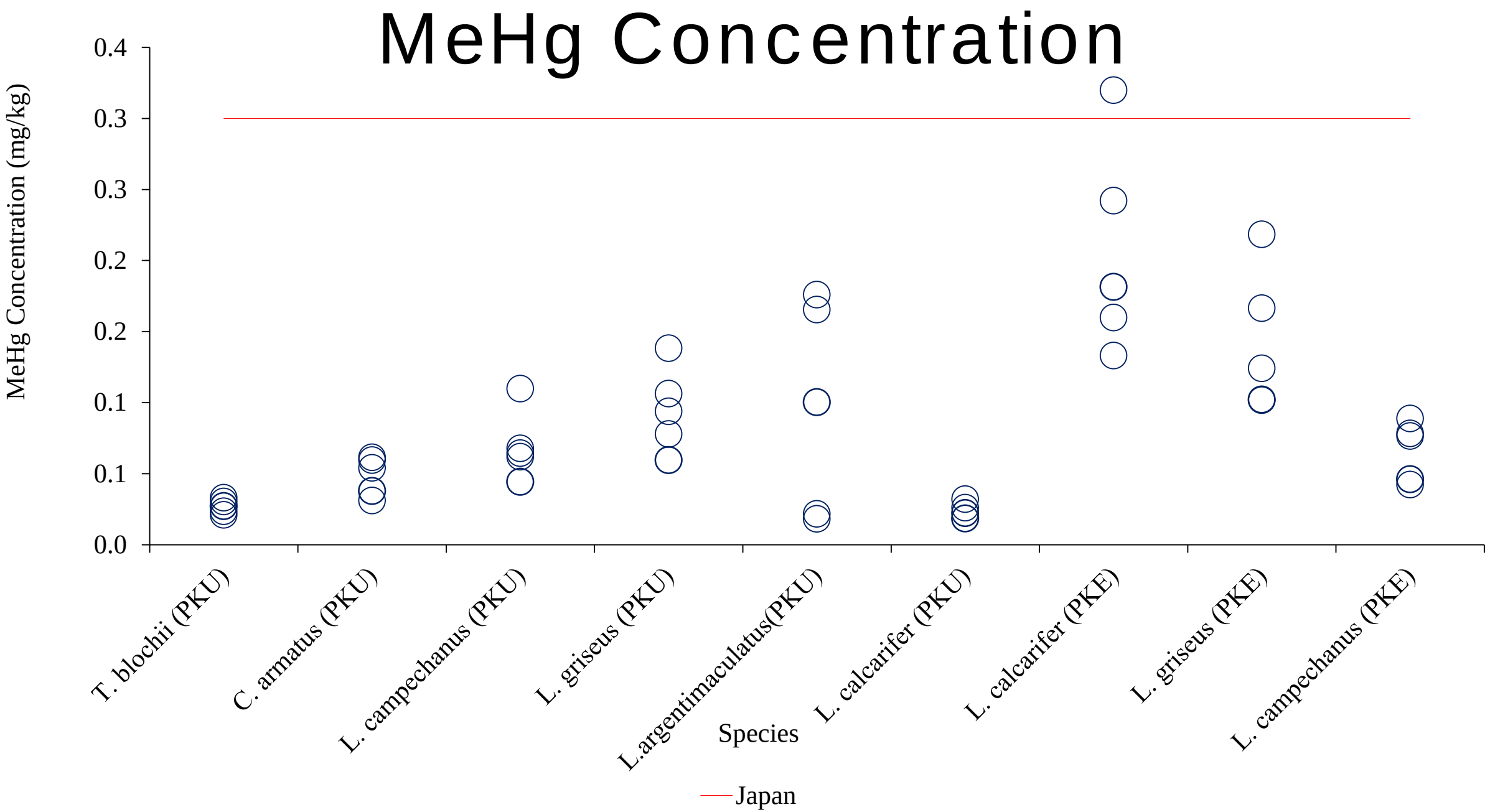
$$EWI = \frac{[\text{Amount of fish ingested per week (kg) x mercury concentration in the fish ingested (µg/Kg/week)}]}{\text{body weight (64 kg)}}$$

HBVSe calculation

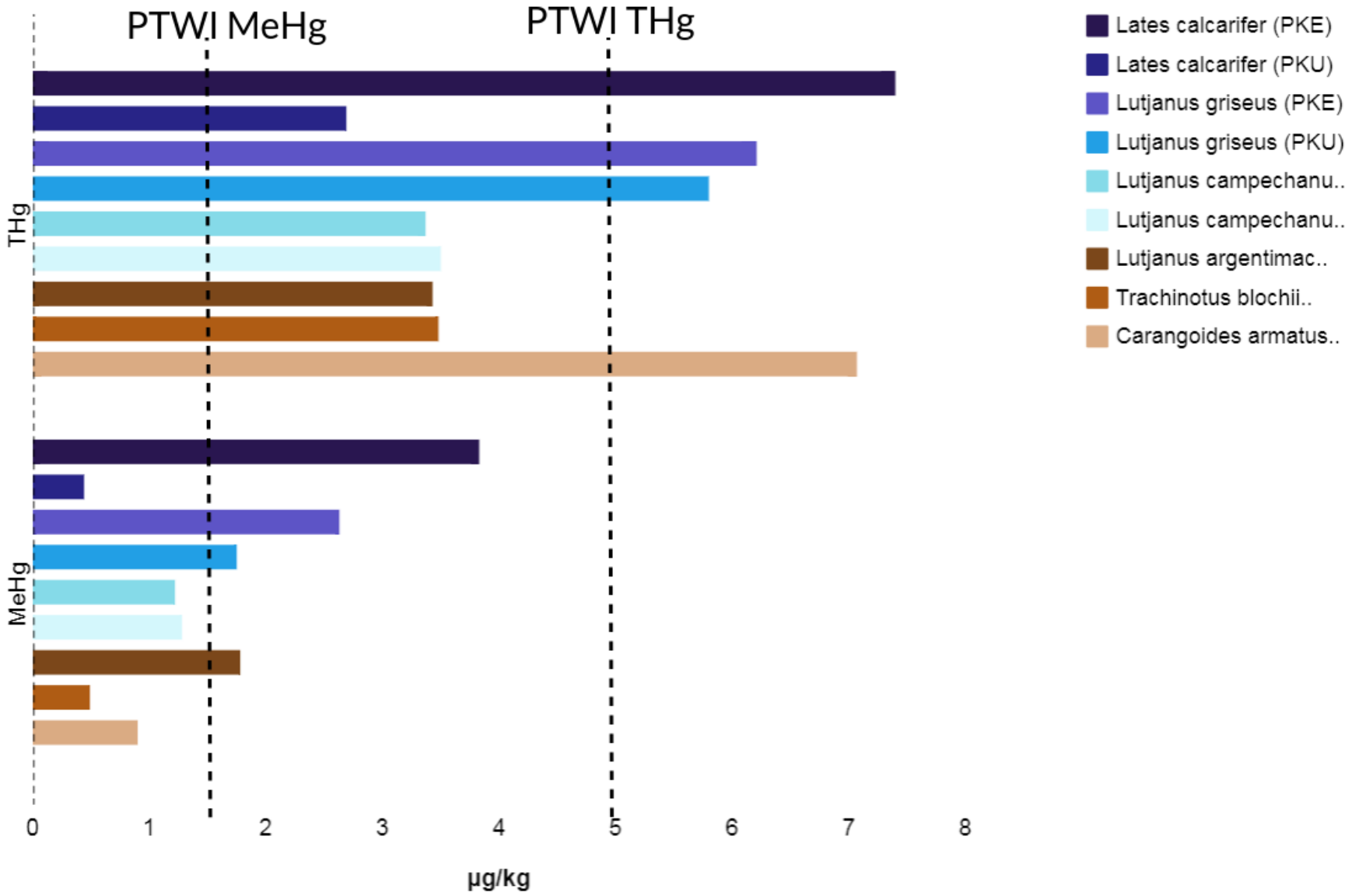
- Kaneko & Ralston (2007) proposed a Selenium Health Benefit Value (Se-HBV) to estimate and evaluate the nutritional benefits of Se in relation to potential Hg exposure risks posed by the consumption of the species.

$$HBV_{Se} = \frac{Se - Hg}{Se} \times (Se + Hg)$$


THg Concentration
THg concentration (mg/kg)
1.0
0.9
0.8
0.7
0.6
0.5
0.4
0.3
0.2
0.1
0.0
T. blochii (PKU)
C. armatus (PKU)
L. campechanus (PKU)
L. griseus (PKU)
L. argentimaculatus(PKU)
L.calcarifer (PKU)
L.calcarifer (PKE)
L. griseus (PKE)
L. campechanus (PKE)
Species
MAL
EU


MeHg Concentration
MeHg Concentration (mg/kg)
0.4
0.3
0.3
0.2
0.2
0.1
0.1
0.0
T. blochii (PKU)
C. armatus (PKU)
L. campechanus (PKU)
L. griseus (PKU)
L.argentimaculatus(PKU)
L. calcarifer (PKU)
L. calcarifer (PKE)
L. griseus (PKE)
L. campechanus (PKE)
Species
Japan

EWI THg & MeHg


PTWI MeHg
PTWI THg
THg
MeHg
0
1
2
3
4
5
6
7
8
µg/kg
Lates calcarifer (PKE)
Lates calcarifer (PKU)
Lutjanus griseus (PKE)
Lutjanus griseus (PKU)
Lutjanus campechanu..
Lutjanus campechanu..
Lutjanus argentimac..
Trachinotus blochii..
Carangoides armatus..

Conclusion

THg concentrations were below the permissible limits recommended by European Commision (0.3 mg/kg) and the Malaysian food Regulation 1985 (0.5 mg/kg), meanwhile MeHg concentrations were below the permissible limits recommended by Ministry of Health, Labor and Welfare, Japan (0.3 mg/kg).

The selenium: mercury (Se:Hg) molar ratio were above 1 and the positive selenium health benefit value (HBVSe) suggesting the possible protective effects of Se against Hg toxicity.

On the other hand, the EWIs of MeHg for *C. armatus, L calcarifer, L. agentimaculatus* were above the PTWI for MeHg.

Based on the calculated EWIs, the intake of these mariculture fish species may contributes low Hg toxicity risk.

These studies provide an update on the mercury and methylmercury concentrations in mariculture fish that may negatively affect fish health and pose a risk for human consumption.


Thank You