



# **Mercury levels in some locally consumed fish, freshwater mussels and canned fish in Fiji Islands.**

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# Outline

- Introduction
- Aims and objectives
- Methodology
- Results and Discussion
- Conclusion
- References



Elemental  
Inorganic and  
organic  
distributions

AN EMERGING  
CONTAMINANT

Toxic, persistent and  
bioaccumulative  
element

Readily crosses  
placental  
barrier

Naturally occurring:  
volcanic eruption  
and weathering of  
rocks.



Non-essential element

Toxin to the central  
nervous system.

anthropogenically  
introduced: artisanal and  
small scale gold mining;  
Industrial processes;  
Improper disposal of e-  
waste.



MINAMATA  
CONVENTION  
ON MERCURY

Only element in  
the periodic  
table to have its  
own convention

# Mercury levels in different tuna species of the SWCPO Region.

Tuna species ( <i>scientific name</i> )	Geographical location	Portion analysed	Hg concentration [mg/kg or ug/g; dw]	Study
Yellowfin tuna [n= 326] ( <i>Thunnus albacares</i> ), Skipjack tuna [n=148] ( <i>Katsuwonus pelamis</i> ) Bigeye tuna [n=116] ( <i>Thunnus obseus</i> )	South western Pacific Ocean (New Caledonia-Fiji sub region) between 2001-2018.	Muscle	<b>Bigeye tuna:</b> 2.7 ± 1.7 ug/g <b>Yellowfin tuna:</b> 0.7 ± 0.5 ug/g <b>Skipjack tuna:</b> 0.7 ± 0.3 ug/g	Médiu et al. 2021
Skipjack tuna [n=661] ( <i>Katsuwonus pelamis</i> )	Pacific ocean including WCPO	Muscle	<b>Skipjack tuna:</b> 0.01 to 3.15 ug/g	Médiu et al. 2022
Bigeye tuna [n = 88] ( <i>Thunnus obseus</i> ) Yellowfin tuna [n= 60] ( <i>Thunnus albacares</i> )	WCPO	Muscle and blood	<b>Blood sample</b> <b>Bigeye tuna:</b> 1.77 ± 2.30 ug/g <b>Yellowfin tuna:</b> 0.16 ± 0.14 ug/g <b>Tuna muscle</b> <b>Bigeye tuna:</b> 1.20 ± 1.32 ug/g <b>Yellowfin tuna:</b> 0.54 ± 0.45 ug/g	Barbosa et al. 2022
Bigeye tuna [n=364] ( <i>Thunnus obseus</i> ) Yellowfin tuna [n=417] ( <i>Thunnus albacares</i> ) Albacore tuna [n=163]	WCPO	Muscle	<b>Bigeye tuna:</b> 1.4 ± 1.5 mg/kg <b>Albacore tuna:</b> 1.0 ± 0.5 mg/kg <b>Yellowfin tuna:</b> 0.6 ± 0.5 mg/kg	Houssard et al. 2019
Yellowfin tuna [n = 10] ( <i>Thunnus albacares</i> )	SWPO	Muscle	<b>Yellowfin tuna</b> THg: 0.239 ug/g; ww  MHg: 0.234 ug/g; ww	Nicklisch et al. 2017

# Fish literature from the Pacific Island Countries

Country	Sample description	Total mercury concentration (THg) (mg/kg)	Study
Samoa	Acanthurus lineatus (H)-surgeon fish	0.00104 - 0.005592	Morrison et al. 2015
	Mullidae spp ( C )-Goat fish	0.0269 - 0.2513	
	Sphyraena qenie ( C )- Barracuda	0.105 -0.741	
New Caledonia	Fish	0.053	Kumar-Roine et al. 2022
New Caledonia	Fish	0.026 - 2.063	Chouvelon et al. 2009
New Caledonia	Fish	0.01 - 0.48	Fey et al. 2019
New Caledonia	Anguilliform fish	0.065	Bonnet et al. 2014
New Caledonia	Anguilliform species	0.02 - 0.6	Briand et al. 2014
Wallis and Futuna	Fish	0.009 - 0.26	Fey et al. 2019
French Polynesia	Fish	0.008 - 0.6	
Republic of Marshall Islands	Reef and pelagic fishes	0.01 - 3.65	Nalley et al. 2023
Northern Mariana Islands	Lethrinus harak	0.028 - 0.212	Denton et al. 2011
	Myripristis sp	0.008 - 0.423	
Papua New Guinea	Barramundi	0.31 - 0.8	Currey et al. 1992
Papua New Guinea	Freshwater fish	0.005 – 0.478	Suzuki et al. 1988
Papua New Guinea	Canned fish	0.02 - 1.01	Kyle and Ghani 1983
Papua New Guinea	Fish	0.23 - 1.40	Kyle and Ghani (1982)
Papua New Guinea	Fish species	0.049 - 0.5	Bowles et al. 2001
French Polynesia	Seafood	0.18 - 0.3	Zidane et al. 2019

# Mercury studies in aquatic biota within the Fiji Islands.

Country	Matrix studied	Total mercury (THg) (mg/kg; dw)	Instrumentation	Analytical procedure	Reference study
Fiji	Shellfish Anadara sp	0.34	Hydride generation AAS	Conc. HNO <sub>3</sub>	Morrison et al. 1997
Fiji	Shellfish Anadara sp	0.037- 0.079	CVAAS	Acid digestion in a Teflon bomb	Morrison et al. 2001
Fiji	Shellfish (Crassostrea mordax)	0.55 – 0.95	AAS	Open beaker digestion using HNO <sub>3</sub> /HCl/HF. AAS	Naidu and Morrison 1994
Fiji	Seafoods (fresh, canned and steak fish)	< 0.02 – 1.76 (ww)	Hydride generation AAS	HNO <sub>3</sub> /HCl/H <sub>2</sub> SO <sub>4</sub> acid digestion at rt for 1 hour plus hot water bath digestion for 2 hours	Kumar et al. 2004 (technical report)

# AIMS and OBJECTIVES

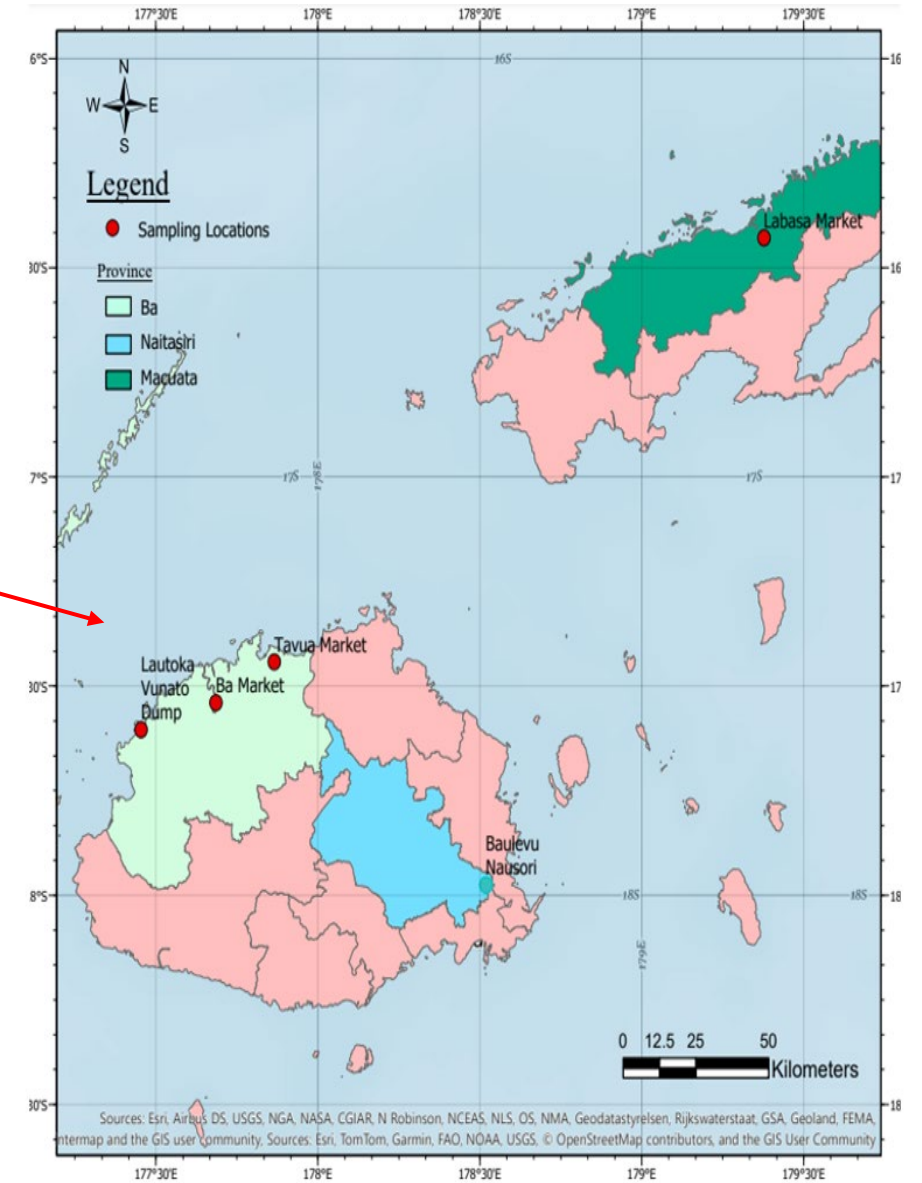
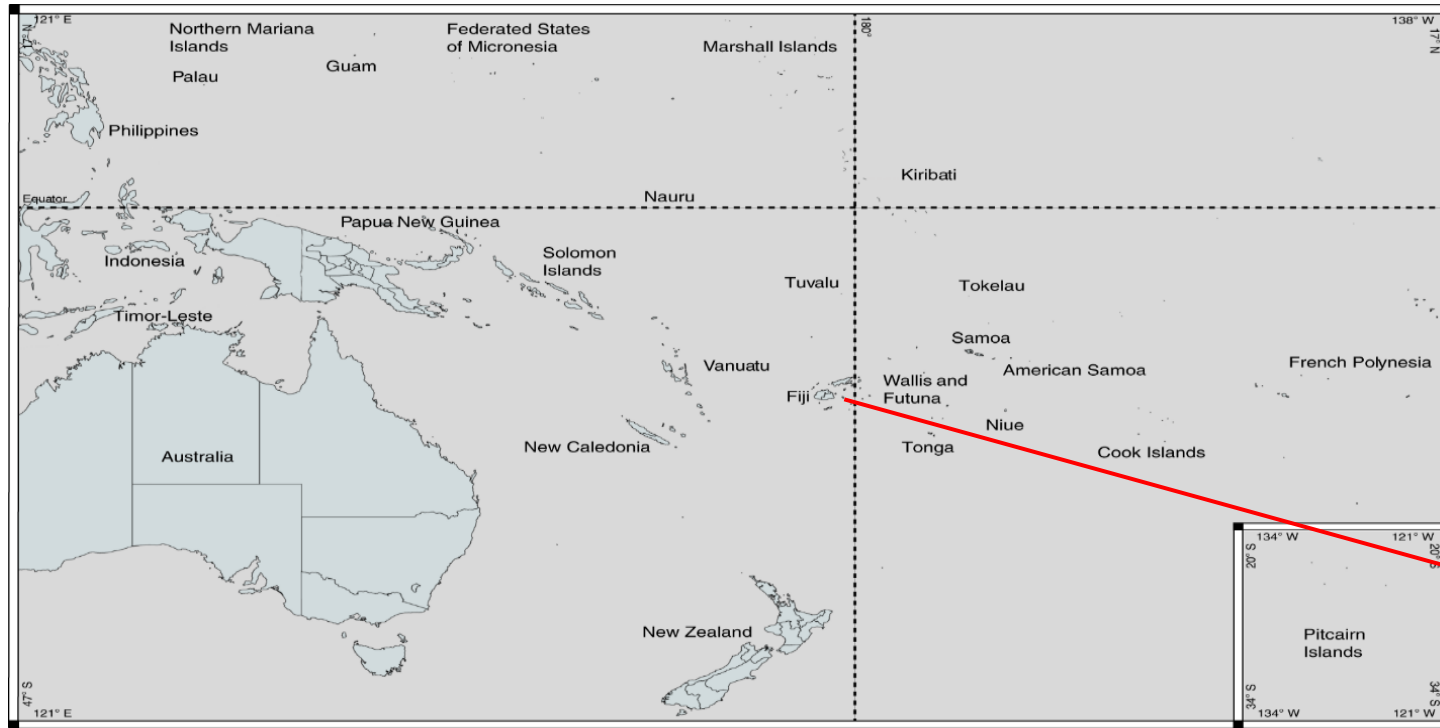
- AIMS

- To determine mercury levels in aquatic biota associated with land-based activities in different parts of Fiji.

- OBJECTIVES

- To collect biota around water sources associated with land-based activities.
- To ascertain the levels of mercury in the collected biota using an accredited laboratory method.
- To determine the levels of mercury in locally produced canned tuna.
- To determine the human health risk assessments based on the mercury data obtained.

# STUDY LOCATIONS AND MATRICES



## Study Matrices:

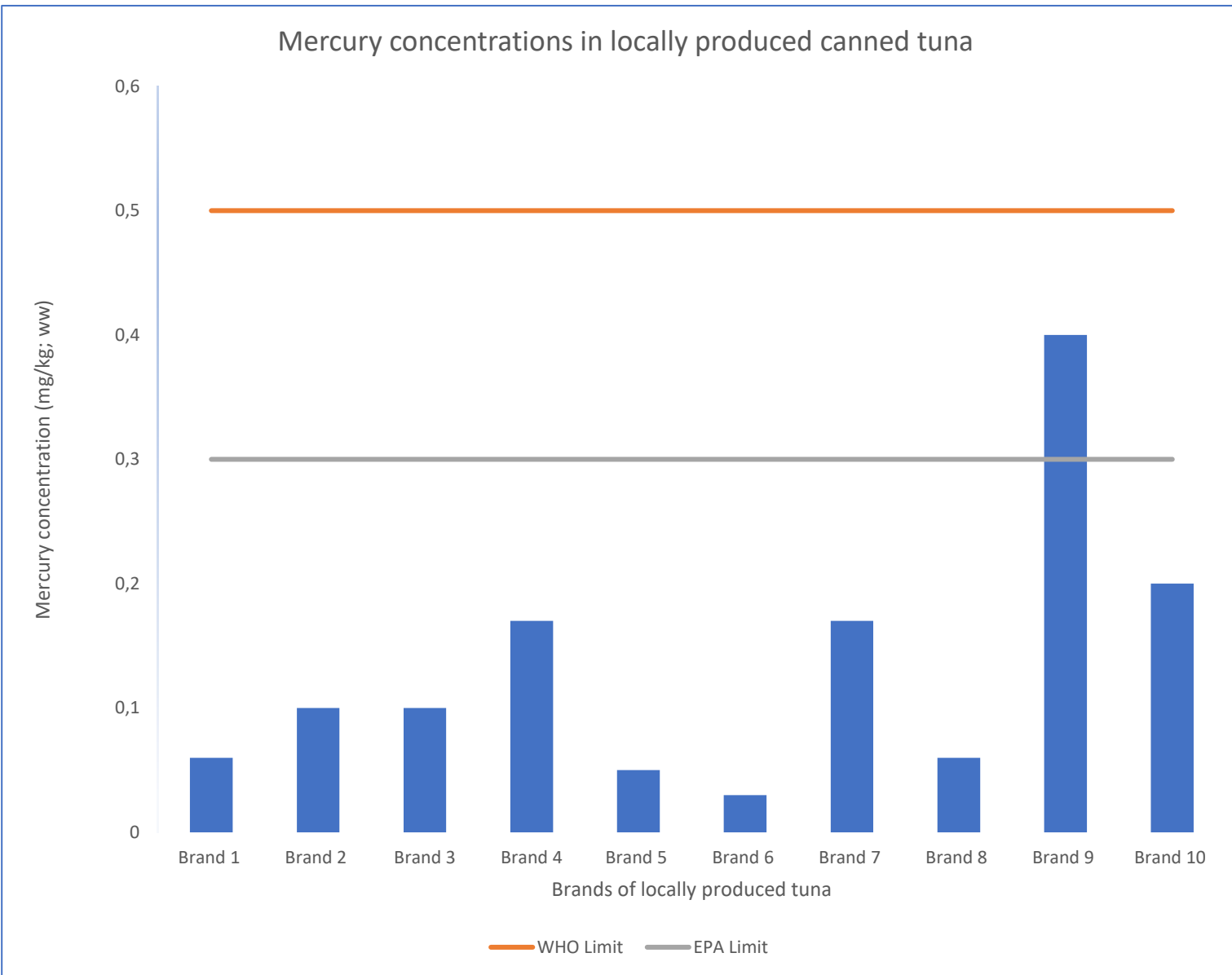
- \*Fish locally consumed
  - Caught by locals for sustenance
  - Caught by locals for sales.
- \*Freshwater mussels
- \*Canned tuna (Locally produced)
- \*Fish steaks (Local fish shops)

# Methodology

- EPA 1631 Appendix A was used to analyze Hg using cold vapor atomic absorption spectroscopy (CVAAS).
- Pre-digestion.
- Refluxed for 2 hours in a water bath (90 – 100 °C).
- Sample analysis using the Flow Injection Mercury System (FIMS400).
- Quality control measures were followed.

# Results

Figure 1 showing Mercury levels in locally produced canned tuna



brand 1	Skipjack Tuna
brand 2	Albacore tuna
brand 3	Skipjack Tuna
brand 4	Albacore Tuna
brand 5	Katsuwonus pelamis; Thunnus albacares; Auxis Thazard
brand 6	Yellowfin tuna
brand 7	Tuna
	Katsuwonus pelamis; Thunnus albacares; Thunnus
brand 8	Alaluna; Auxis Thazard
brand 9	Albacore tuna
brand 10	Albacore tuna

Nutritional information labels on canned tuna products:

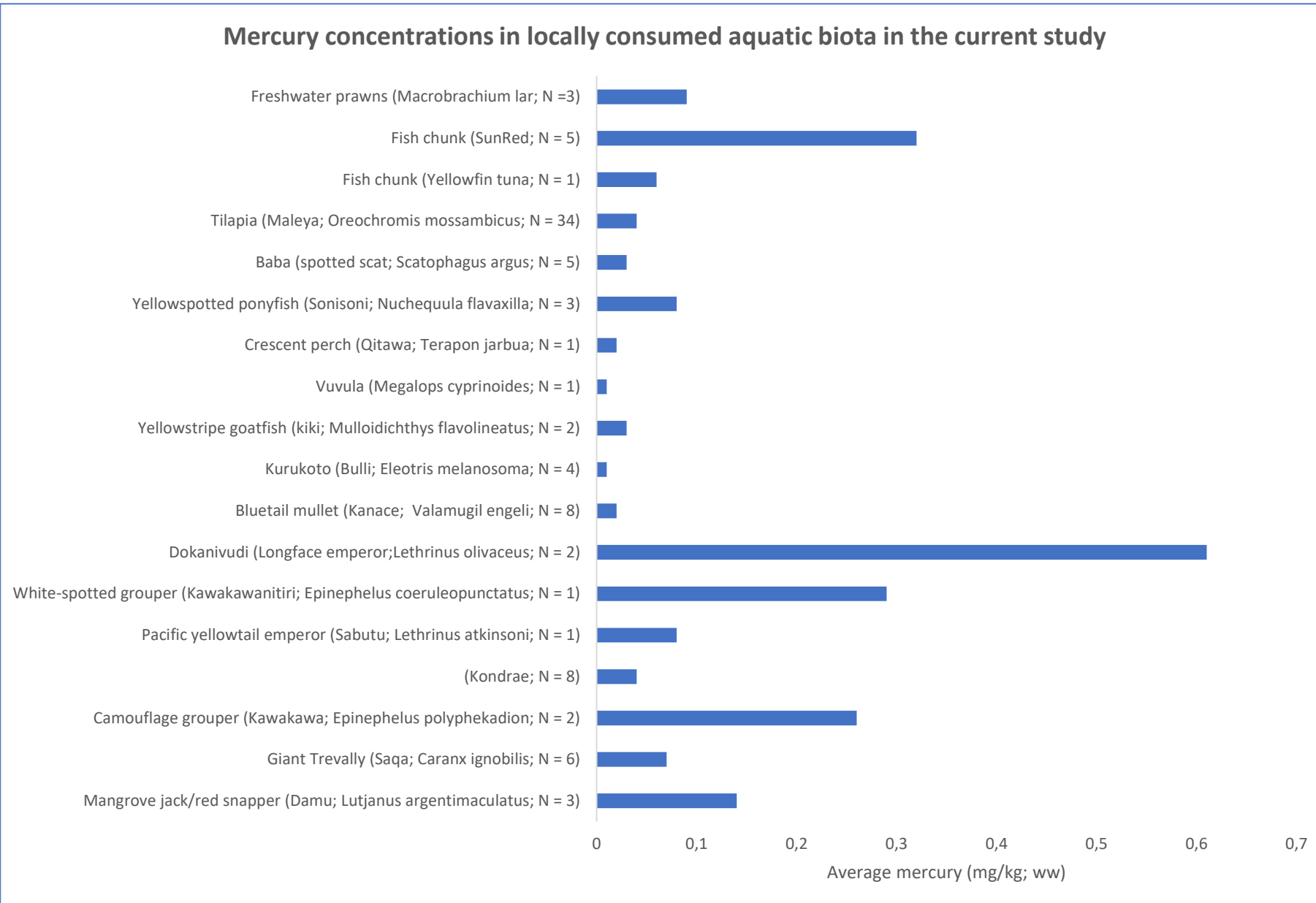
\*provide essential information either per 100 g serving or per serve with some variability in the level of details.

\*provide a standardized format of reporting; making it easier to compare amongst the products.

**\*Do not provide relevant information about the Hg content in the different canned fish products.**

# Results cont'd

Figure 2 shows Mercury levels in locally consumed fish



\*Higher Hg levels were obtained in carnivorous (Groupers and Emperor).

\*Camouflage as well as White-spotted grouper had Hg levels close to 0.3 mg/kg.

\*Mercury levels exceeded the EPA and WHO limits for Longface emperor.

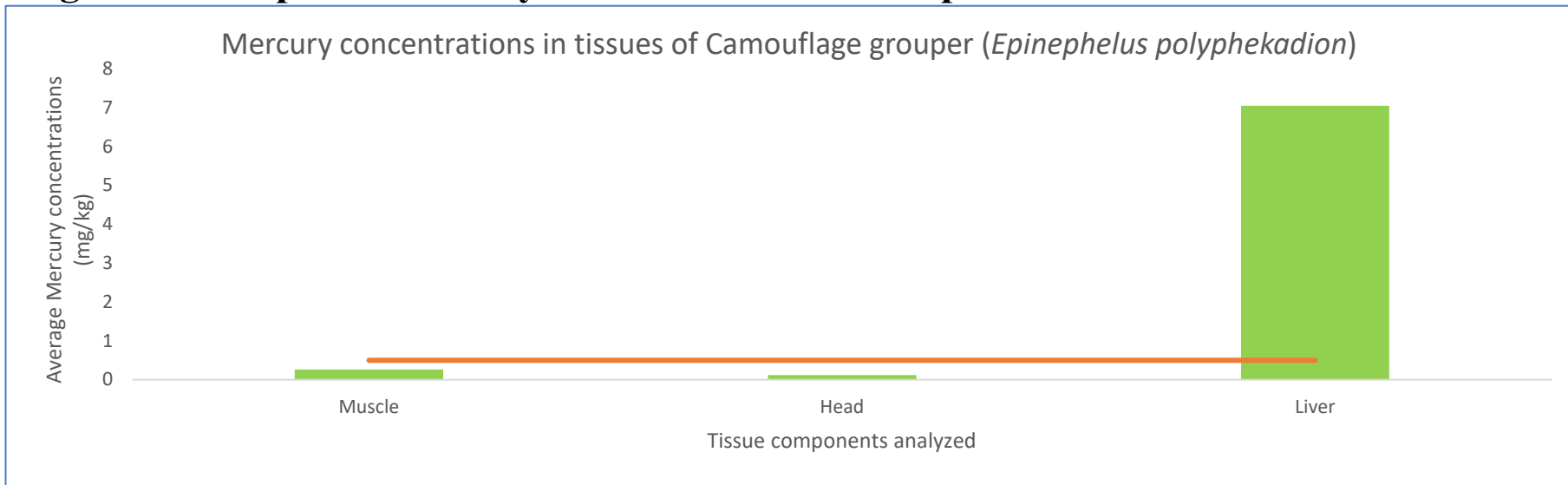
\*Fish steak (sunred) had Hg concentration > 0.3 mg/kg.

\*Majority of omnivorous fishes; had relatively low levels of Hg (< DL).

\*Similar Hg concentrations have been observed from studies in the PICs.

# Results cont'd

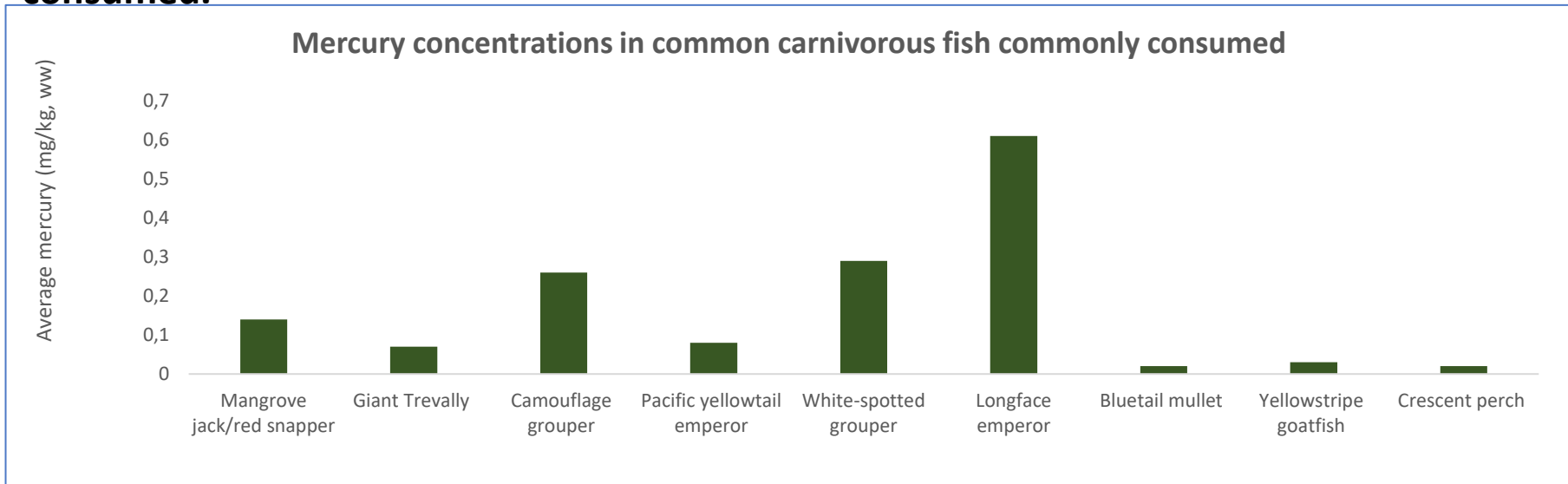
**Figure 3a compares Mercury levels in different components of carnivorous fish**



\*Liver contained highest levels of Hg in comparison to other components.

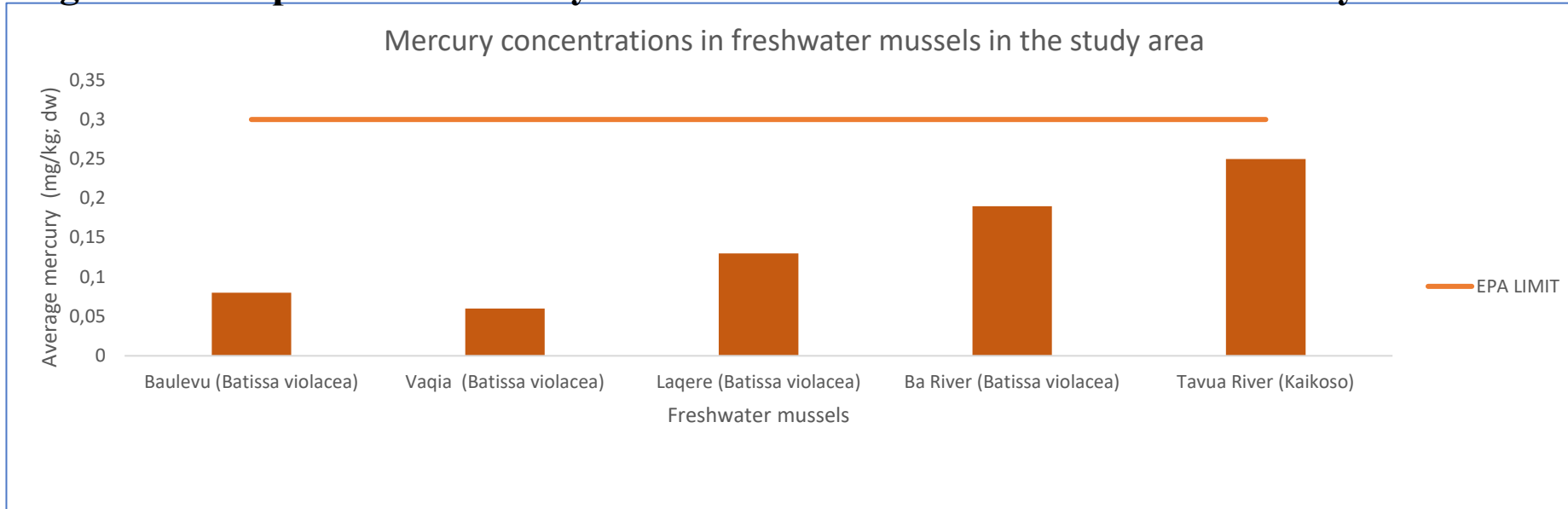
\*fish liver is a delicacy amongst the locals

**Figure 3b compares the Mercury levels in different carnivorous fish locally consumed.**



\*Amongst the carnivorous fishes, Longface emperor had higher Hg concentrations followed by the groupers.

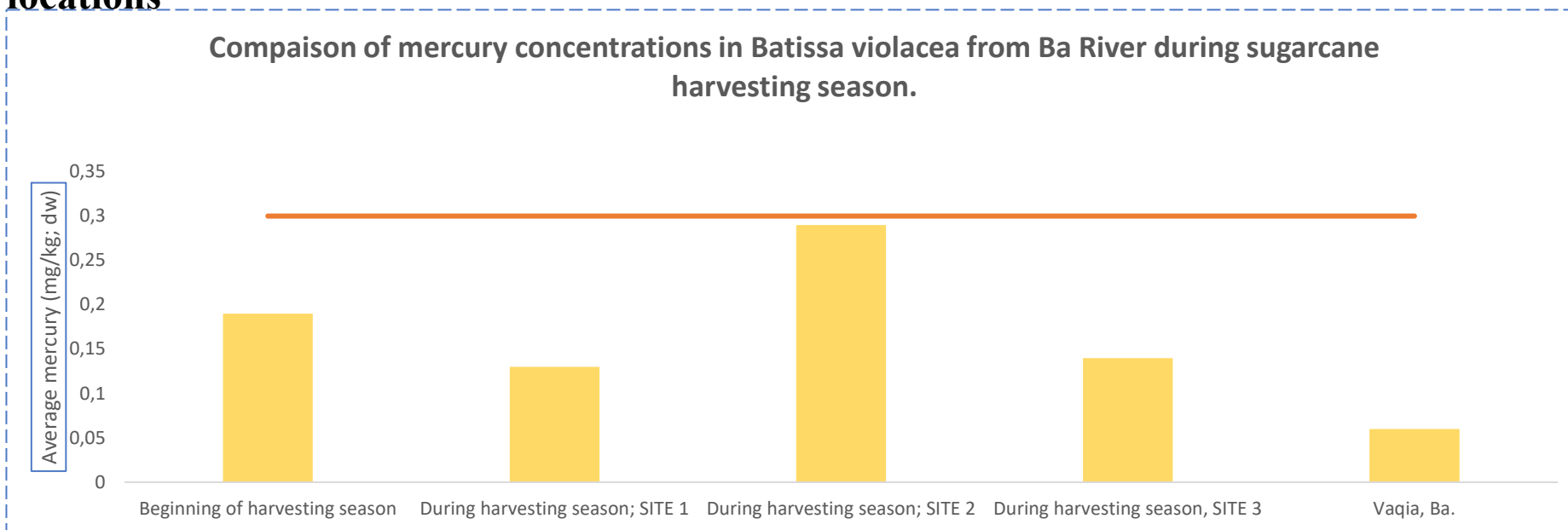
**Figure 4a compares the mercury levels in freshwater mussels from this study**



\*Higher Hg concentrations were obtained in *kaikoso* (*Anadara antiquata*) than *Batissa violacea* (*nakai/kai*).

\*Vaqia site was an upstream site, thus had low Hg concentration.

**Figure 4b compares the mercury levels in freshwater mussels from Ba River at different locations**



\*SITE 2 had higher Hg concentrations. This site was closer to the Ba Bridge, and received an influx of waste water from Ba sugar mill; a few km on the upper part of the Ba River.

\*Hg levels in bivalves were lower than the EPA limit.

# Health Risk Assessment

- EPA and WHO levels
- USEPA - USFDA: Hg concentrations are interpreted in the context of the number of fish meals that could be consumed to stay within USEPA health-based reference dose for MHg.

Hg in fish (ug/g, ww)	Fish consumption guideline
< 0.15	Best choice: 2 -3 meals per week
< 0.23	Good choice: 2 meals per week
< 0.46	Good choice: 1 meal per week
> 0.46	Choices to avoid: 0 meals per week

# Discussion

- Brand 9 canned (Albacore) tuna had higher Hg concentrations.
  - The high levels could be attributed to larger fish size used for processing.
  - Kumar et al. (2004) also obtained high Hg levels in fresh albacore (0.34 mg/kg) and 0.2 mg/kg in canned albacore.
- On the contrary, canned tuna which had skipjack and yellowfin tuna reported lower levels of Hg.
- The USEPA-FDA fish consumption guideline for this study:
  - Best choices: Shrimp, tilapia, tuna (light –canned including skipjack tuna).
  - Good choices: groupers, snapper, tuna (albacore/yellowfin tuna).
  - Choices to avoid: -
- USEPA-FDA chart fish choices should be used when deciding which fish to buy through interactions with indigenous people.

# Discussion cont'd

- Higher Hg concentrations had been obtained in the liver of the Camouflage grouper.
  - Metian et al. (2013) reported liver Hg concentrations of reef fishes to be in the range of 0.03 – 6.66 mg/kg in their study.
- Morrison et al. (1997, 2001) reported Hg concentrations in *Anadara sp.* to be 0.34 and between 0.037 – 0.079 mg/kg respectively; whilst this study reported 0.25 mg/kg for THg.
- Kumar et al. (2004) reported low levels of Hg in *Batissa violacea* (0.03 mg/kg).
  - However, this study reported higher levels of Hg in *Batissa violacea*; suggesting that land-based activities such as industrial waste discharge to the waterways.

# Conclusion

- Certain carnivorous fish exceed the THg permissible levels (WHO/EPA).
- Herbivorous/omnivorous fishes have lower Hg levels.
- An increased concentration of Hg is associated with land based activities:
  - Ba river (waste discharge).
  - Nasivi river (mining activities).
- Lower levels of Hg obtained for Baulevu and Vaqia suggesting lower levels of anthropogenic inputs.
- Highly recommended to observe the USEPA-FDA guidelines whilst purchasing/consuming fish.
  - Involvement of indigenous people and Ministry of Fisheries.

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**THANK YOU FOR YOUR  
ATTENTION!**