

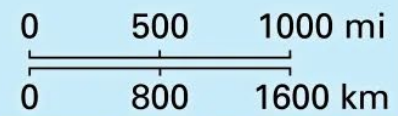
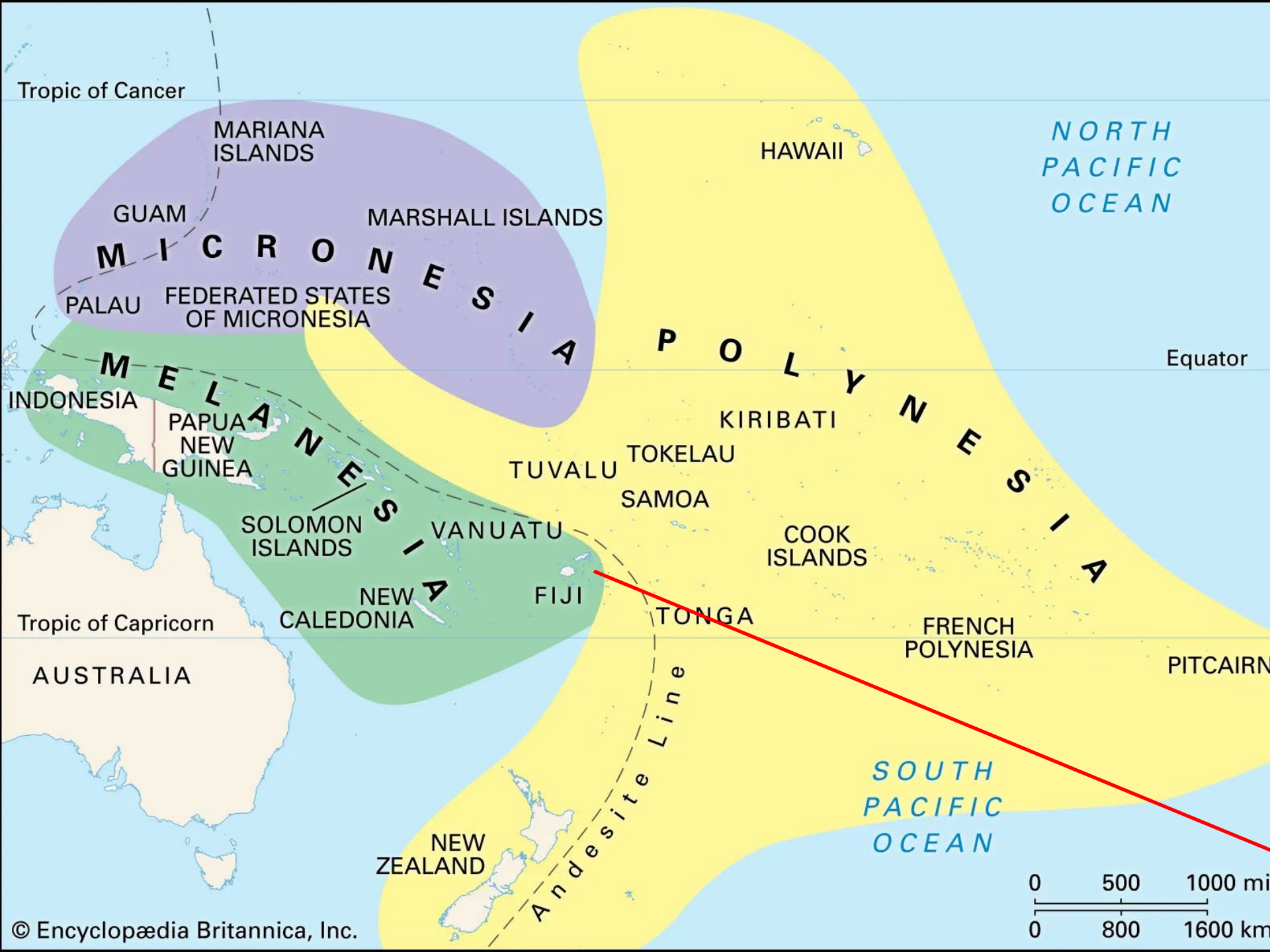


ICMGP 2024

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Vincent Lal

Lessons Learnt from 20-years of mercury analysis in tuna from the South West Pacific: Establishing a regional reference laboratory for long-term mercury monitoring in the Pacific Island Region



Background

- The Institute of Applied Sciences (IAS) is based at the University of the South Pacific (USP) in Fiji which is co-owned by the 12 member Pacific Island countries
- IAS has developed a regional mercury testing laboratory capacity
- Facilitating regional research and commercial testing of mercury in selected food, water and environmental samples
- Takes part in proficiency testing and Interlaboratory comparison activities for mercury (IAEA, fapas and UNEP)
- Accredited to ISO/IEC 17025 since 2004, mercury is an accredited test for food and water samples through IANZ (New Zealand)



History of collaboration in Mercury Research



IDEA Inc Consultants from Japan
MOEJ (Japan)
Training (January)

September
Workshop in
Manilla
Philippines

Training
workshop “wet-
deposition”
sampler in
Taiwan
June

APMMN
Meeting in
Indonesia

Taiwan ROC office
(Fiji), NCU and USP
staff commission wet
deposition sampler
and Workshop in Fiji
November

Attend the 12th
APMMN
Meeting in
Taipei, Taiwan

Expand
monitoring
activities, student
research,
purchase Direct
Mercury Analysis
system

2018

2018

2019

2019

2019

2023 - 2024



Covid throws a
huge spanner to
our operations
2020 – 2022
only online
contact

Establish a CoE
at USP Fiji for
mercury
sampling and
testing in Pacific
Islands



Analysis of mercury in Tuna



- Domestic tuna processing industry employs around 16,000 people, 0.8 % of Fiji GDP and is worth around 200 million dollars
- Exports are mainly to the European Union (EU), Asia and the USA
- USP Lab receives tuna samples from exporters, importers and distributors
- These include fresh and or frozen tuna slices and canned tuna samples
- Acid Digestion (muscle tissue) + Hydride Generation/Cold Vapour Atomic Absorption Spectrometry (CVAAS)

Aim

- to measure total Hg content in several types of tuna which are commonly sold in the Fiji Islands and is exported to the USA, Asia and the EU
- to identify capacity gaps in becoming a Centre of Excellence (CoE) for mercury analysis in the Pacific Island Region

Methodology

- Sampling (mainly fresh or frozen tuna slices) or canned tuna is sent to the laboratory by its customers
- On average around 1500 samples of tuna per year; ~10% request Hg test
- Samples are accepted based on “Sample registration requirements”
- Tuna samples mainly received include:
 1. Albacore Tuna (*Thunnus alalunga*)
 2. Yellowfin Tuna (*Thunnus albacares*)
 3. Skipjack Tuna (*Katsuwanas pelamis*)
 4. Bigeye tuna (*Thunnus obesus*)
 5. Marlin (exact species is not mentioned)
 6. Canned tuna (some do not specify the tuna species)

Methodology (preparation)

- All analyses were performed as soon as possible (usually <1 week) at the IAS laboratory at the University of the South Pacific
- Precautions were taken to avoid contamination of samples with mercury. All the glassware and plastic ware for use in the analysis soaked for at least 24 hours in a 10% nitric acid (HNO₃) bath and rinsed several times with deionised water prior to use
- The glass and plastic-ware dried in a laminar flow clean air cabinet

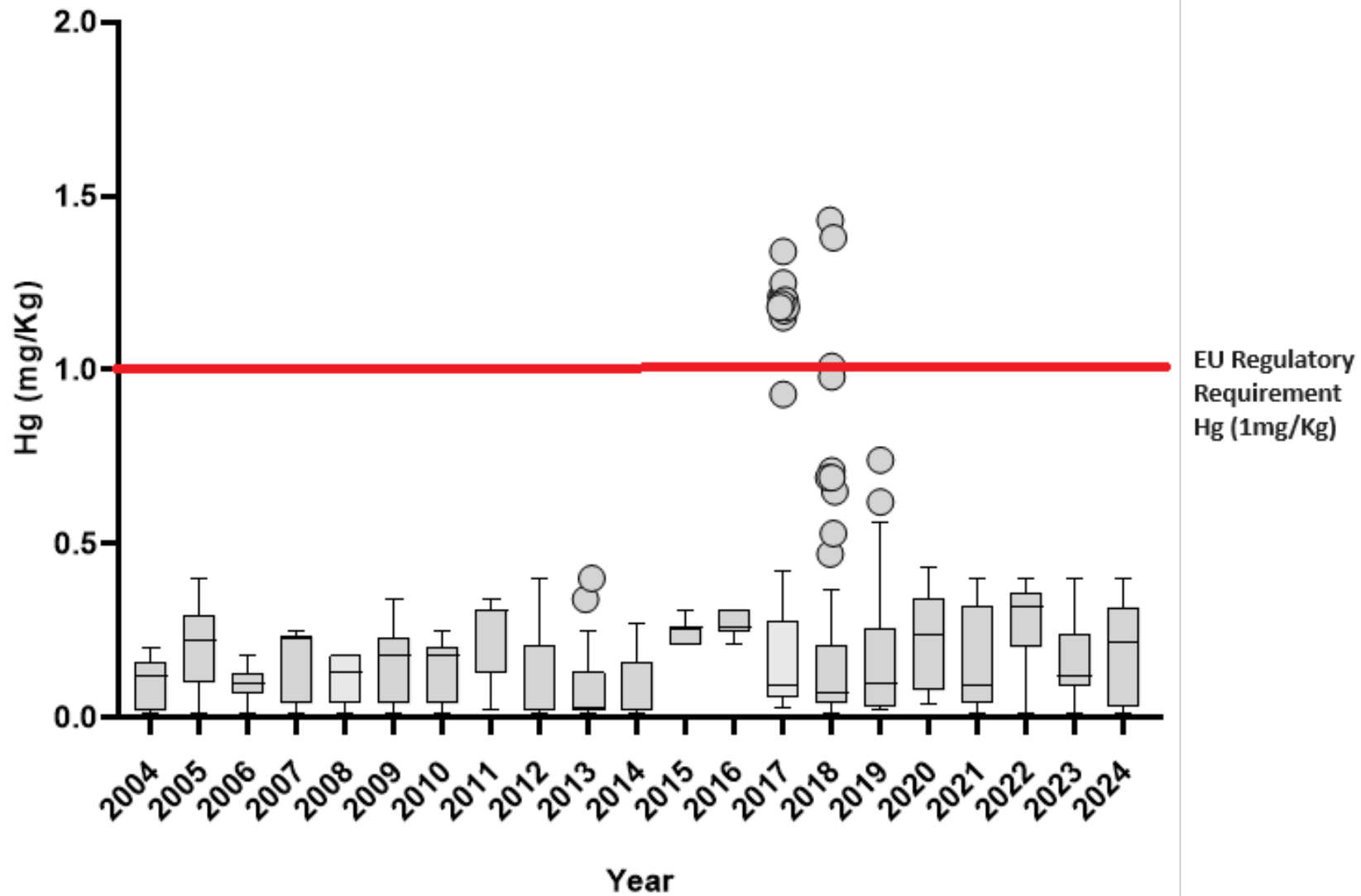
Methodology (analysis)

- The fish tissue (ww) digested by a nitric-sulphuric-hydrochloric acid digestion procedure
- An approximate weight of homogenized fish tissue (2g) acid-digested at room temperature for 1 hr followed by hot water bath digestion for approximately 2 hrs in a boiling tube with a glass marble placed on top.
- The solution cooled to room temperature and filtered into a 100 mL volumetric flask.
- Quantitatively 5mL of bromine chloride (BrCl, oxidizes all forms of Hg to Hg²⁺) added and the solution made up to the mark with distilled water
- The samples analysed by Hydride Generation Atomic Absorption Spectrometry (Perkin Elmer, FIMS 400)

Results (Tuna)

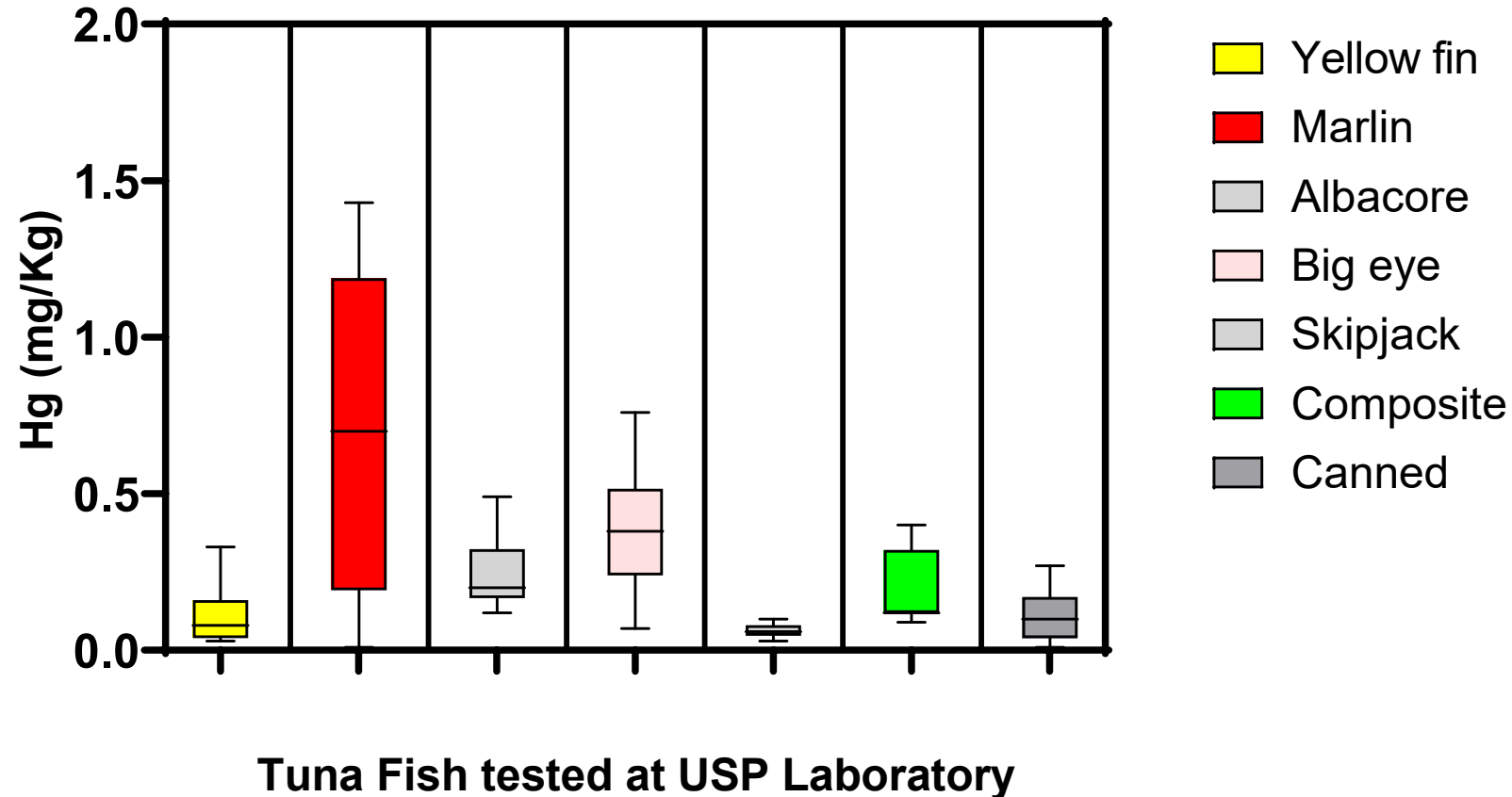
- Quality control and Quality assurance (QAQC) using laboratory blank, Tuna CRM #464 and spike recovery
- Total Hg measured in the range of 5.07-5.38 mg/kg (Certified value = 5.24 ± 0.10 mg/kg based on 0.2g dry weight of the SRM)
- Spike recoveries within 90-110%
- The detection limit for Hg 0.020 mg/kg based on the analysis of 2 g of the fish sample

Mercury levels in Tuna from the Western Pacific Ocean



- Most tuna samples tested below the maximum EU and FAO/WHO (Codex) Requirement of 1 mg/Kg
- Post-Covid decline in large tuna species being tested in the laboratory
- No significant changes in Hg concentration over 20 years in tuna from the SWP Region

Comparison of mercury levels in fresh and canned tuna



- Highest Hg concentration found in Large Predatory fish i.e. Marlin
- More composite fish samples (fresh and frozen tuna) are being tested post Covid
- Canned tuna had comparatively lower concentrations of Hg, mostly tuna species not indicated or is composite of different species

Other Hg Projects – MOEJ (Japan)



IDEA Consultants Researcher Miwako Ueda assists IAS Lab Technician Anaseini Turukawa in measuring hair samples for Mercury Analysis.



Hg levels – Ocean water, air and human hair

- Water (Ocean) and near shore in Laucala bay and Suva harbour, Fiji

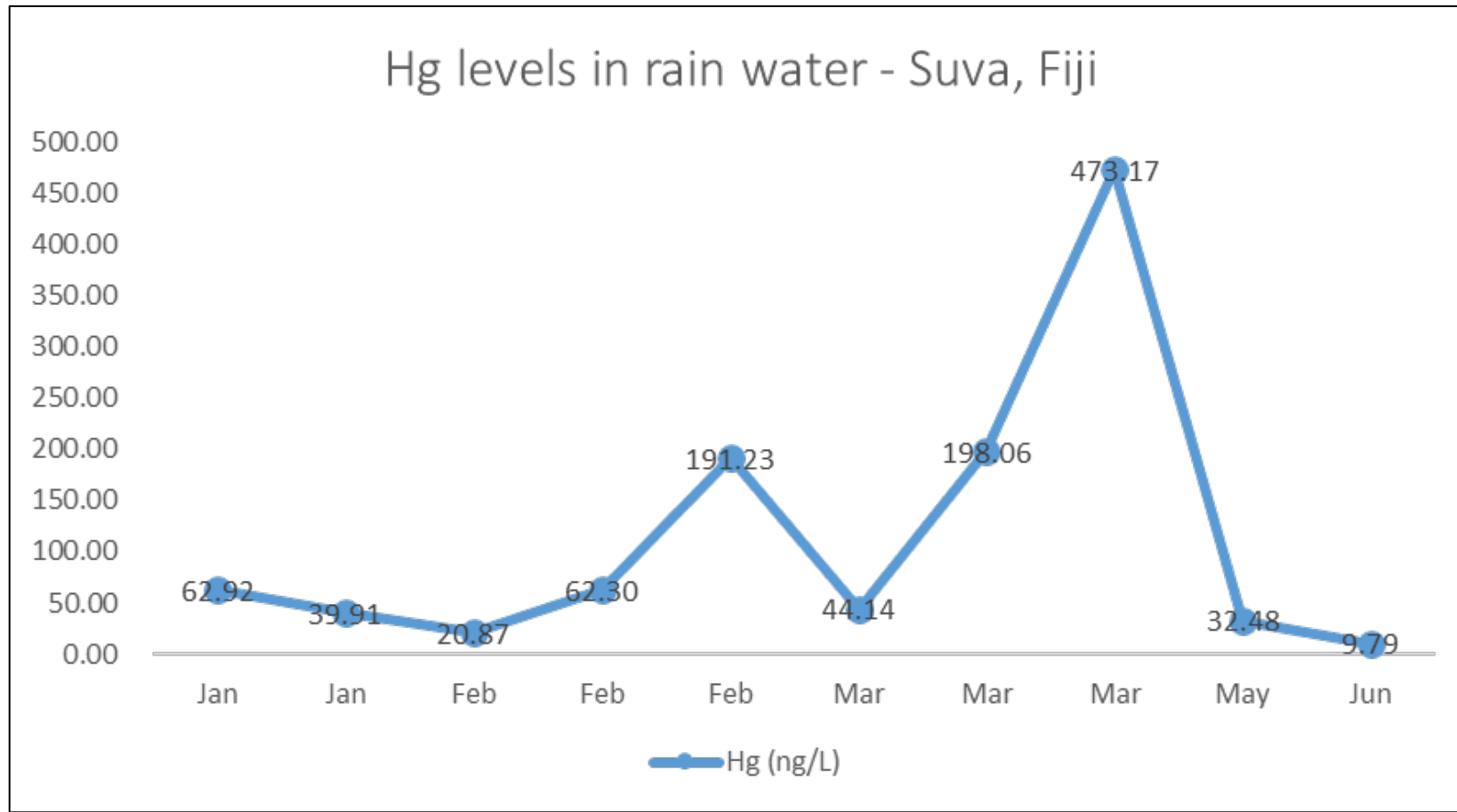
Site	Depth (m)	Concentration (ng/L)
1	10	0.41
2	10	0.83
3	1	1.76

- Air (ambient) from Laucala bay, Fiji – (1.2 ng/m³)
- Hair (human) for USP-IAS Laboratory staff – (1.46 ng/mg)

Other Hg Project – Taiwan EPA and NCU



Hg levels – wet deposition



Discussion and conclusions

- Further mercury analyses on tuna should continue using muscle tissue to build-up a database as part of long-term mercury monitoring program in the South West Pacific
- including an emphasis on understanding Hg levels in individual species particularly on the large predatory species as well as including liver tissue analysis in tuna
- Include metadata on geographical location of tuna from different Pacific Island Countries to account for climate-driven ecological changes that may relate to global Hg trends in the oceans
- This data does not show any significant Hg accumulation in tuna or temporal trends. This could relate to low anthropogenic emissions or sources in Pacific Island Countries

Discussion and conclusions

- The data does indicate interspecies difference and annual difference in Hg levels, with comparatively elevated concentrations in larger tuna species i.e. Marlin
- Most of the tuna tested are below the regulatory limit of 1 mg/Kg
- There is an increase in composite tuna being analysed which could indicate possible decline or migration of tuna from the South West Pacific region
- Capacity building; including technology transfer as well as training laboratory technicians and graduate students through collaboration with monitoring networks such as the APMMN as well as the UN Agencies (WHO, FAO and UNEP) and CROP Agencies (SPC, SPREP, PIFS and FFA)

Acknowledgement

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- Late Prof. William (Bill) Aalbersberg for setting up Hg testing at USP
- The APMMN Network, Taiwan EPA, US EPA and MOEJ (Japan) for supporting with passive air samplers (including MerPES) and active sampler and wet deposition sampler
- Laboratory technicians (Philip, Indar) and USP students (Sofia, Simon)

Thank you...any Questions.

