The University of the South Pacific
School of Agriculture, Geography, Environment, Ocean, and Natural Sciences

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Cold Vapour Determination of Mercury in Seaweeds and Seagrasses Collected Along Nasese Seashore in Suva, Fiji

OTIWA, Simon Ofana
Commonwealth Scholar

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CAPE TOWN INTERNATIONAL CONVENTION CENTRE

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Outline

1. Introduction
   - Research gaps
   - Hg Uptake
2. Literature Review
   - Hg Studies in Fiji
3. Methodology
   - Sampling Location
   - Sampling Technique
   - CVAAS
4. Results & Discussion
5. Conclusion

Number of articles published every year between 1976 and 2022 on the topic of seagrass and metal elements

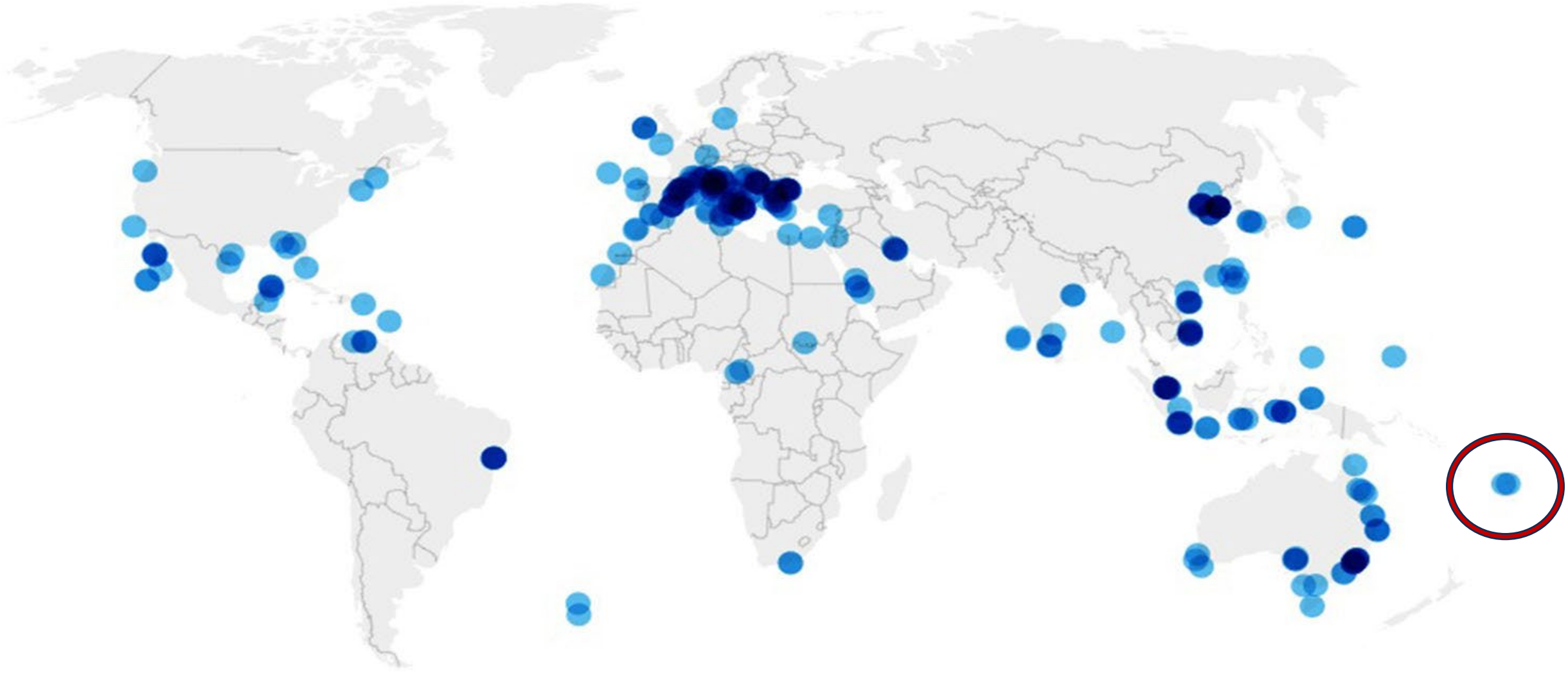


Figure 1. World map indicating the study locations where sampling was reported in 191 reviewed articles (Lee et al., 2023)

Enteromorpha flexuosa (Wulfen) J. Agardh (Chlorophyta: Ulvales) – Evaluation as an Indicator of Heavy Metal Contamination in a Tropical Estuary

Published: April 2002

Volume 75, pages 201–213, (2002) Cite this article

Environmental Monitoring and Assessment

Aims and scope →

Submit manuscript →

J. N. Tabudravu, P. Gangaiya, S. Sotheeswaran & G. R. South

Abstract

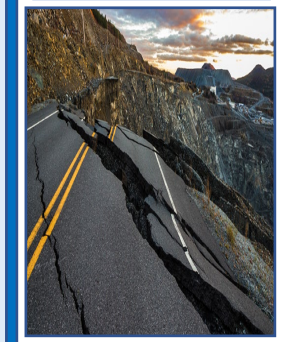
The use of bioindicators for contaminant monitoring ispopular in all sectors of the environment but quite oftenbioindicators are utilised without rigorous evaluation oftheir viability as an indicator. We report field andlaboratory investigations into the value of a commonlyfound macroalga, *Enteromorpha flexuosa* (Wulfen) J.Agardh (Chlorophyta:

Figure 2. Publication on HM concentration in seaweed.

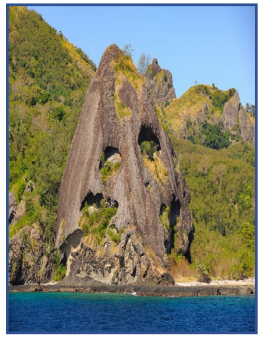
Mercury contributing factors in Fiji

1. Mining

2. Coal tar

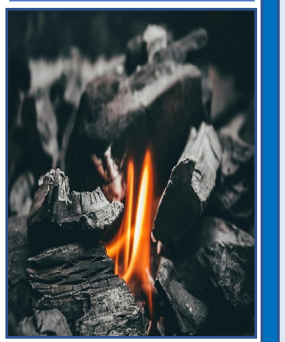


3. Rocks

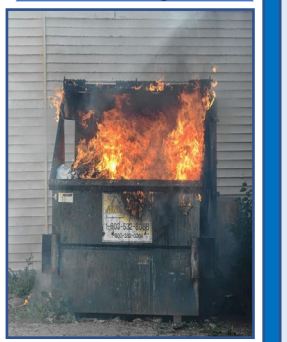


4. E-waste

5. Charcoal



6. Open burning



Literature review

Table 1. Review of publications on Hg analysis in Fiji

Hg species	Method	Matrix/sample type	Level (mg/kg)	Recommended limit	Inference from study	Location	Reference
Total Hg	HG –AAS	Fish	< 0.02 – 1.76	-	Other types of fish steaks, smaller reef fish, shellfish, canned tuna and mackerel had average levels below the guidelines. While predatory fishes like Whole Marlin and Swordfish were higher.	Fiji	Kumar et al., 2004
Total Hg	INAA	sediments	0.2 – 0.9	1 mg/kg (EPA)	Although the Hg level remained below limit, the study suggested antifouling and shipwrecks as potential causes of Hg pollution.	Laucala Bay, Suva Harbour	Garimella et al. 2002
Total Hg	AAS	Sediments Shellfish	0.2 – 1.34 0.55 – 0.95	-	The cardinal factor as buttressed in this study is the washing away of dump refuse into water bodies through flooding and heavy rainfall causing pollution.	Suva	Naidu and Morrison, 1994
Total Hg	HG-AAS	Sediments Shellfish	0.039 – 90.24 0.22 - 0.56	-	This site is an important location for contamination study in the South Pacific Ocean because of species enrichment and pristine nature. Site is relatively unpolluted.	Great Astrolabe Lagoon	Morrison et al., 1997
Total Hg	CV-AAS	Sediments	0.061 - 0.185	-	Human activity was thought to have contributed, and the amount of enrichment from these sources was negligible.	Laucala Bay, Suva	Morrison et al., 2001

Uptake of metal ions by SW/SG species

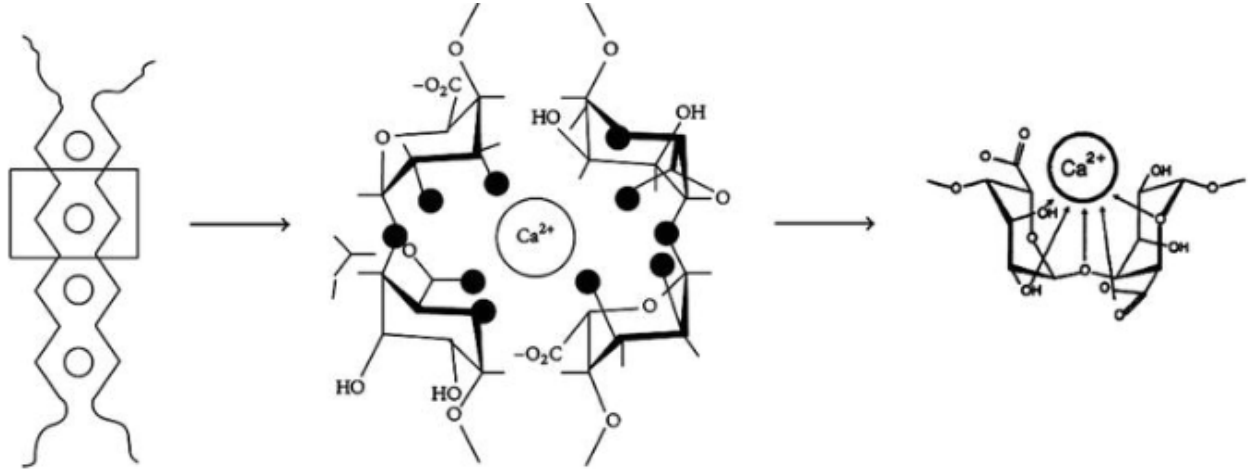


Fig. 3. Egg-box model for Adsorption of metal ion to alginate (Saber et al., 2024)

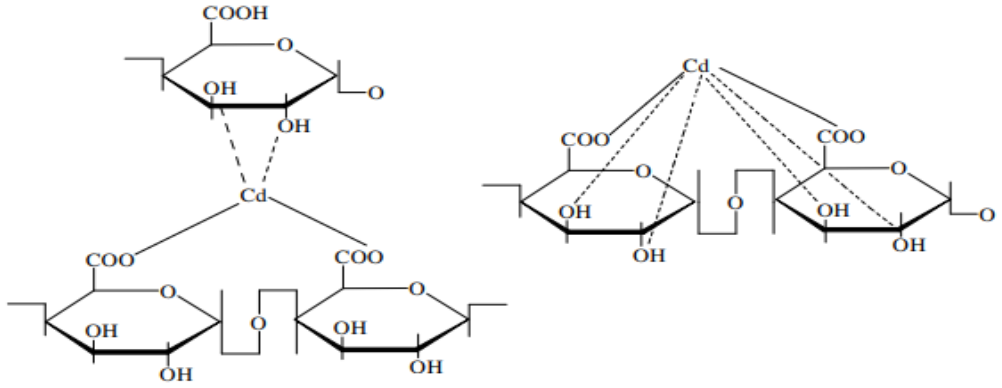


Fig. 4. Possible Cd binding to seaweeds (Murphy, 2007)

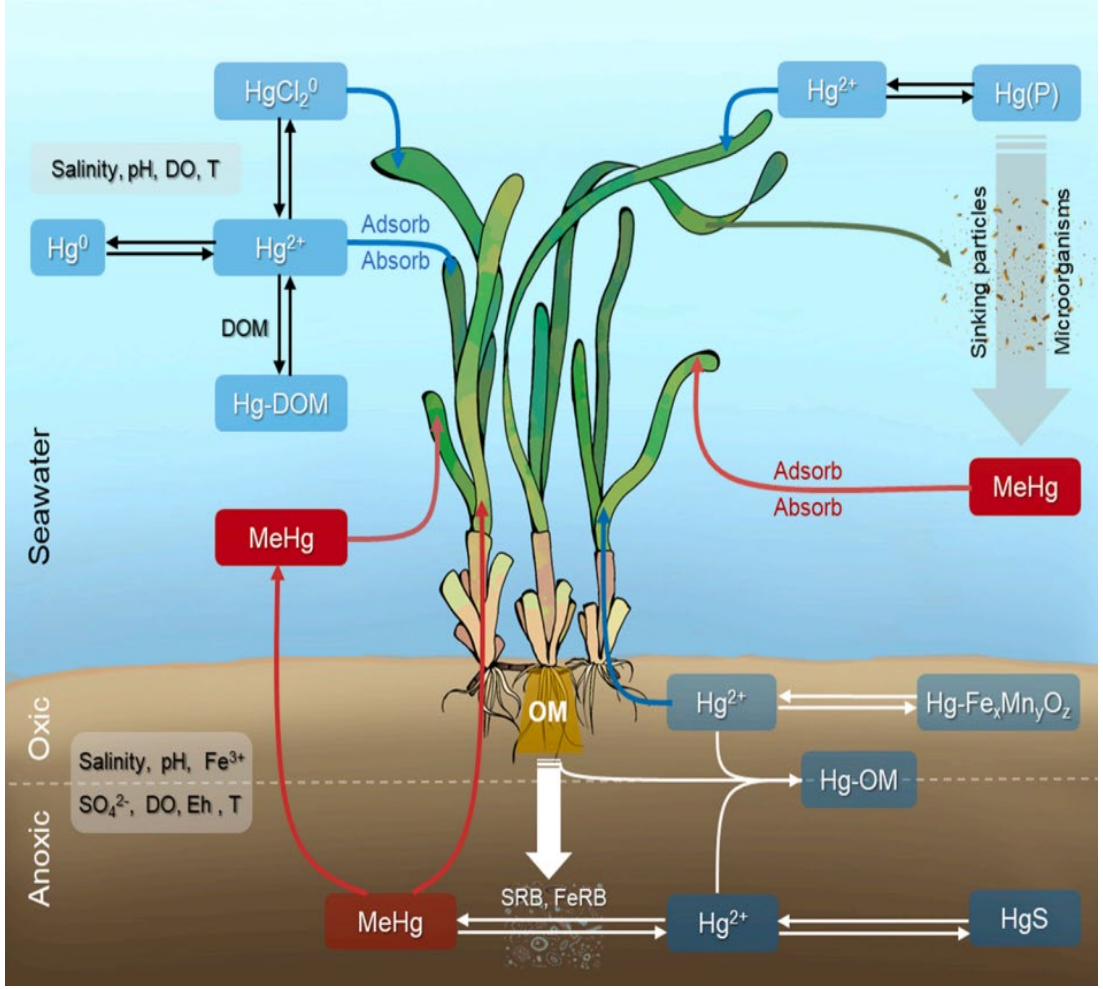


Fig. 5. Hg Accumulation in seagrasses and influencing factors (Li et al., 2023)

Aim and Objectives

Aim: To determine the level of total Hg in selected species of seaweeds and seagrasses

Specific objectives of the study

- To collect seaweeds and seagrass species growing at the Nasese seashore.
- To determine the physicochemical properties of Nasese seawater.
- To quantify total Hg present in seaweed and seagrass species.
- To calculate the bioaccumulation factor, with reference to the level of Hg present in seawater.

Nasese Sea, Queen Elizabeth Road, Suva, Fiji

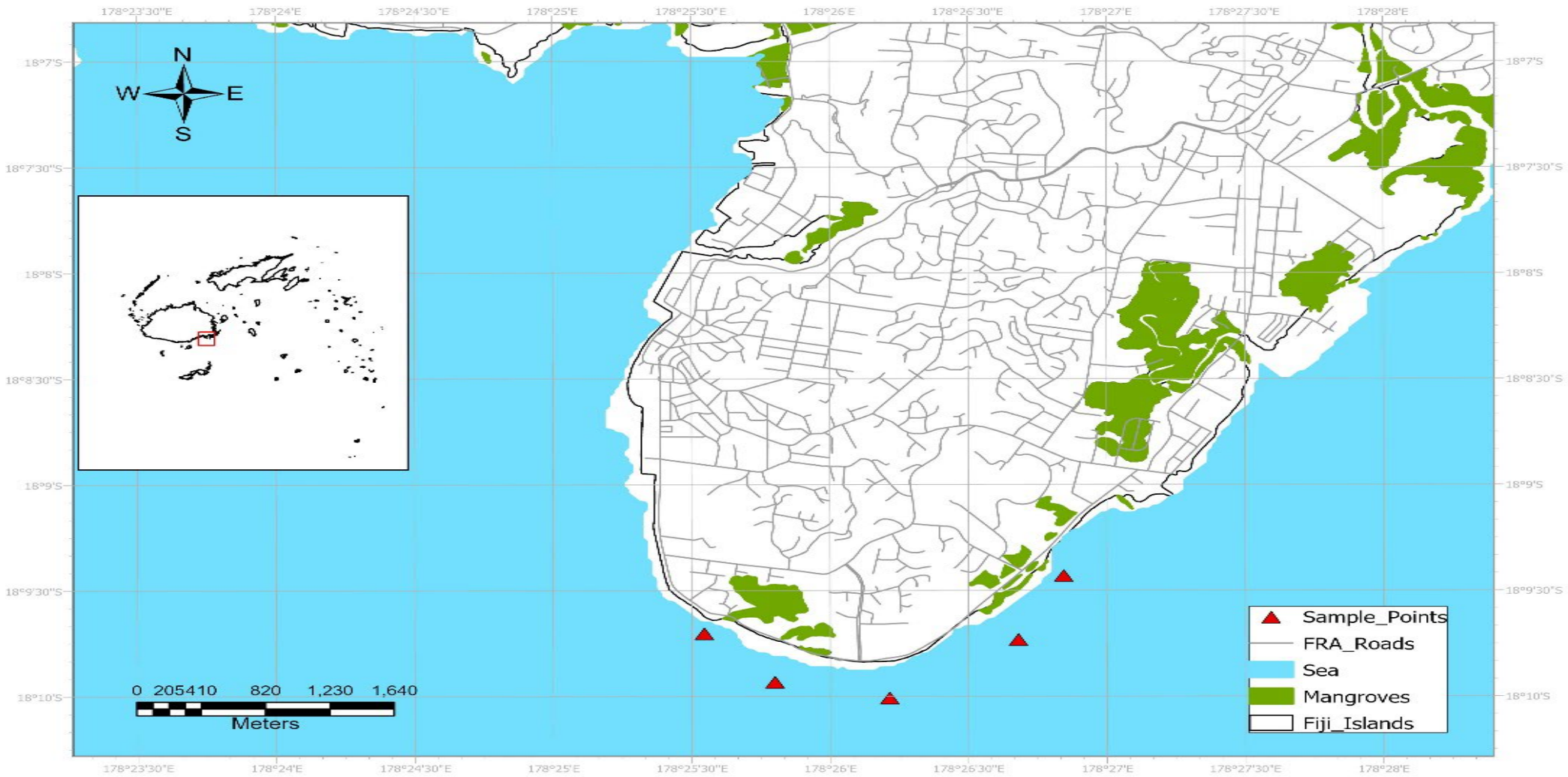
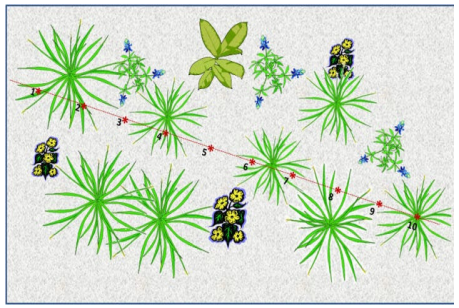
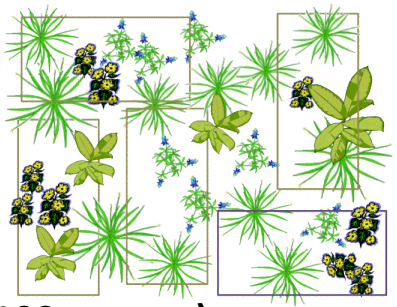


Fig. 6. Sampling location

Sampling





Sampling me(50, 100m apart)
Method: Line transect

SG1

SW2

SW3

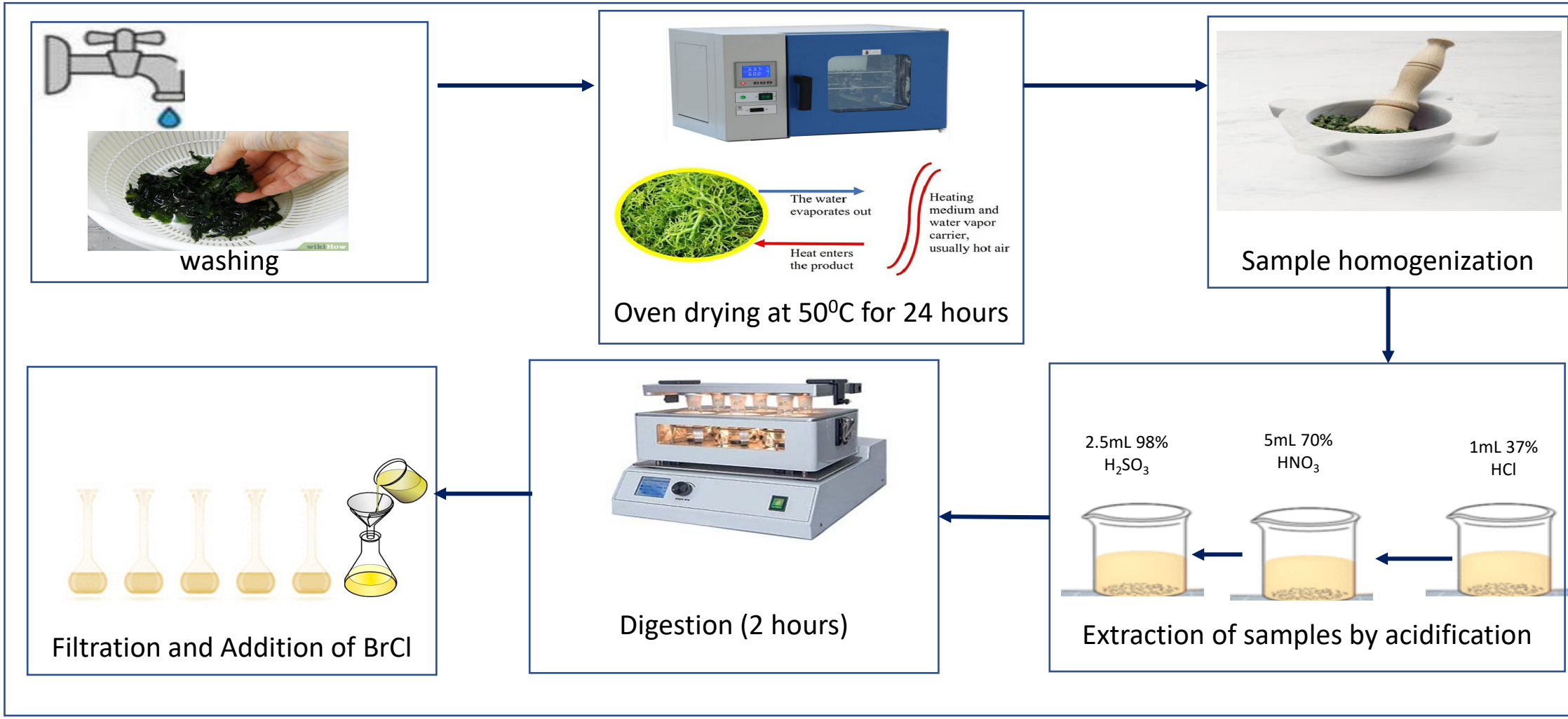
SG4

SW5

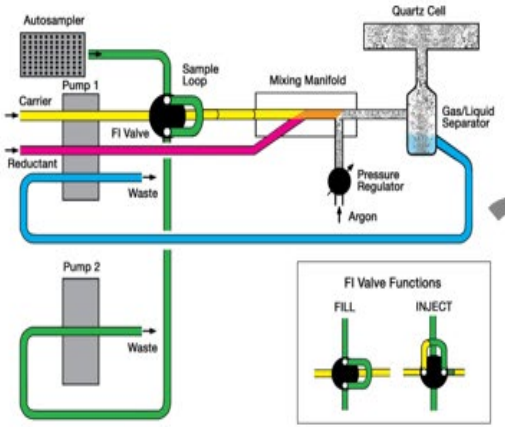
SW6

Method

Sample preparation



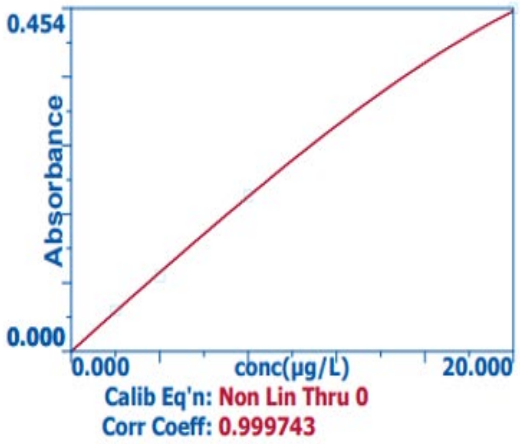
Methods
Instrumentation

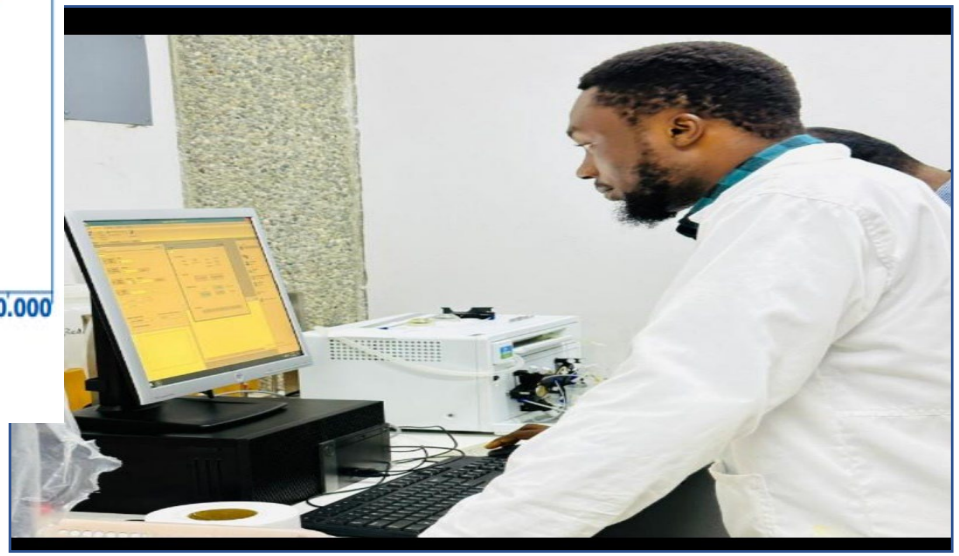


Principle of operation

Generation of Calibration Curve

Hg 253.7





Results

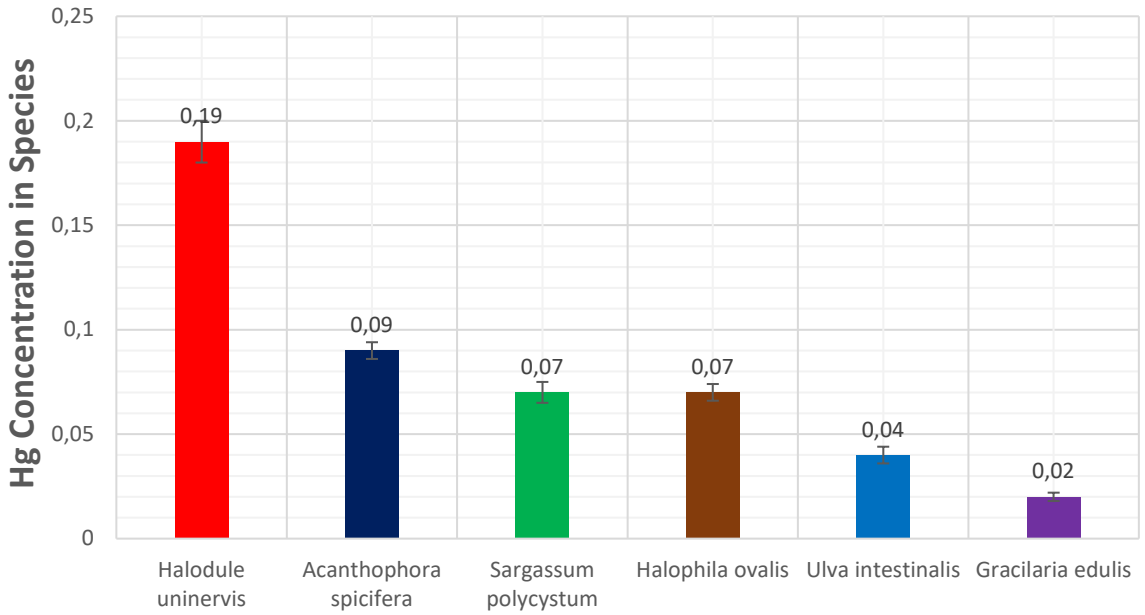
Physicochemical parameters

Sampling point	pH	Temperature (^{0}C)	Salinity (PSU)	(DO) (mg/L)	(TDS) (mg/L)	EC (µS/cm)
1	8.05	27.39	7.19	7.19	12.55	6784
2	8.25	28.66	6.71	6.16	11.79	6543
3	8.11	28.54	8.77	5.89	13.51	6651
4	8.43	28.10	6.91	6.54	12.14	6072
5	8.90	28.88	7.23	7.28	12.66	6333
Mean	**8.35**	**28.11**	**7.36**	**6.61**	**12.53**	**6476.6**

- **The result is comparable with Rathnayake et al., 2014**

Result and Discussion

Mercury (Hg) Level in Seaweeds and Seagrasses (ug/g)



- ***H. univervis>A. spicifera>S. polycystum>H. ovalis>U. intestinalis>G. edulis*.**

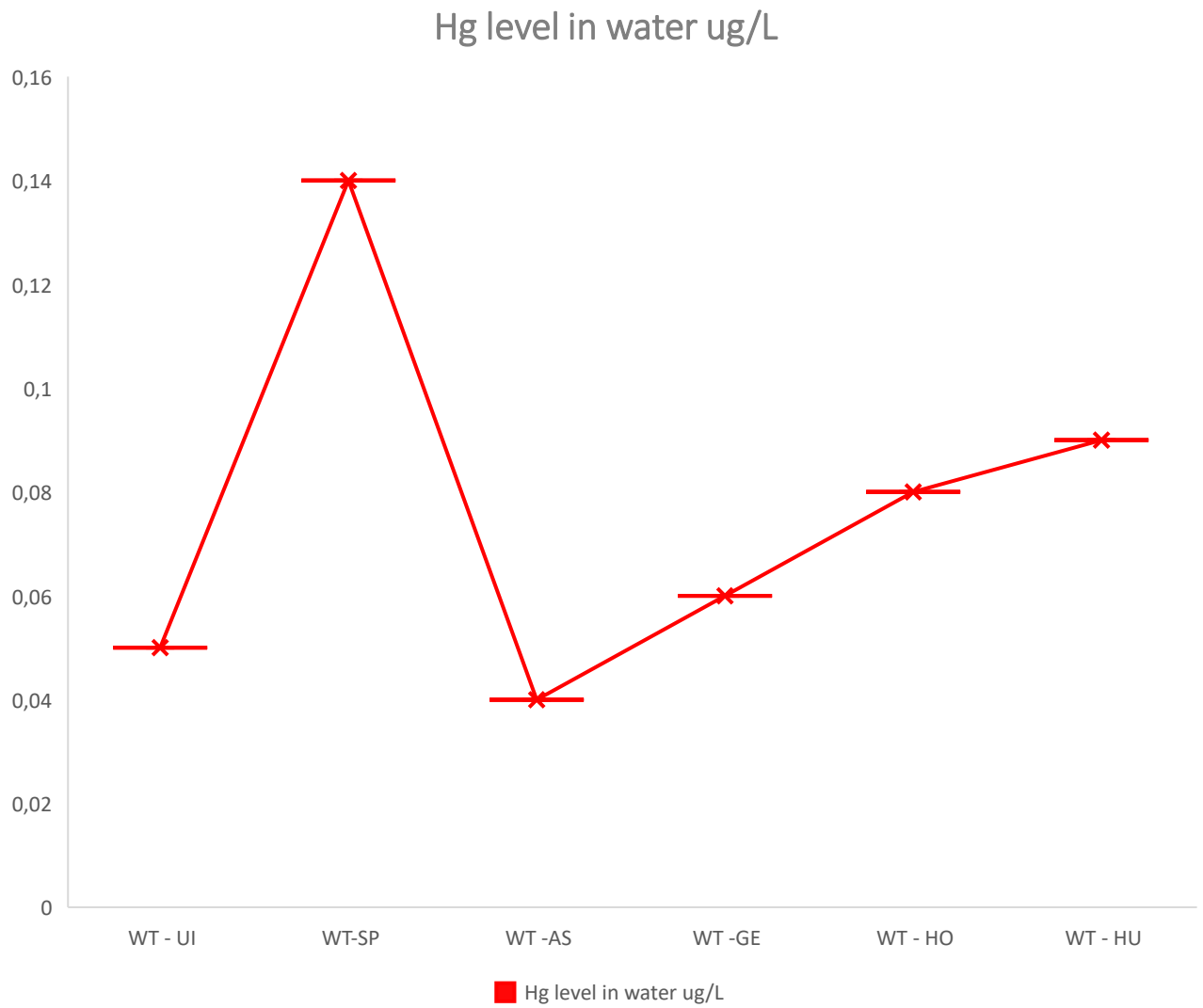
- **Data for each species exhibit normal distribution at significance level of 0.01 according to the Shapiro wilk test.**

- **Significance at p value of 0.01**

Table 2: Quality control parameters

Reference material NIST 1641e	**Certified value 88 – 115 ug/L**	**Recovered value 108.64 ug/L**
% Spike Recovery	**Seaweed 99.2%**	**Seagrass 111.2%**
Detection limit	**LOD 0.018 mg/kg**	**% R^2 99.97**
RSD: 1-7%, Wavelength: 253.7nm		
Recommended limit – 0.1 ug/g (CEVA, 2014)		

Hg Concentration in Seawater



Hg Concentration in Seawater

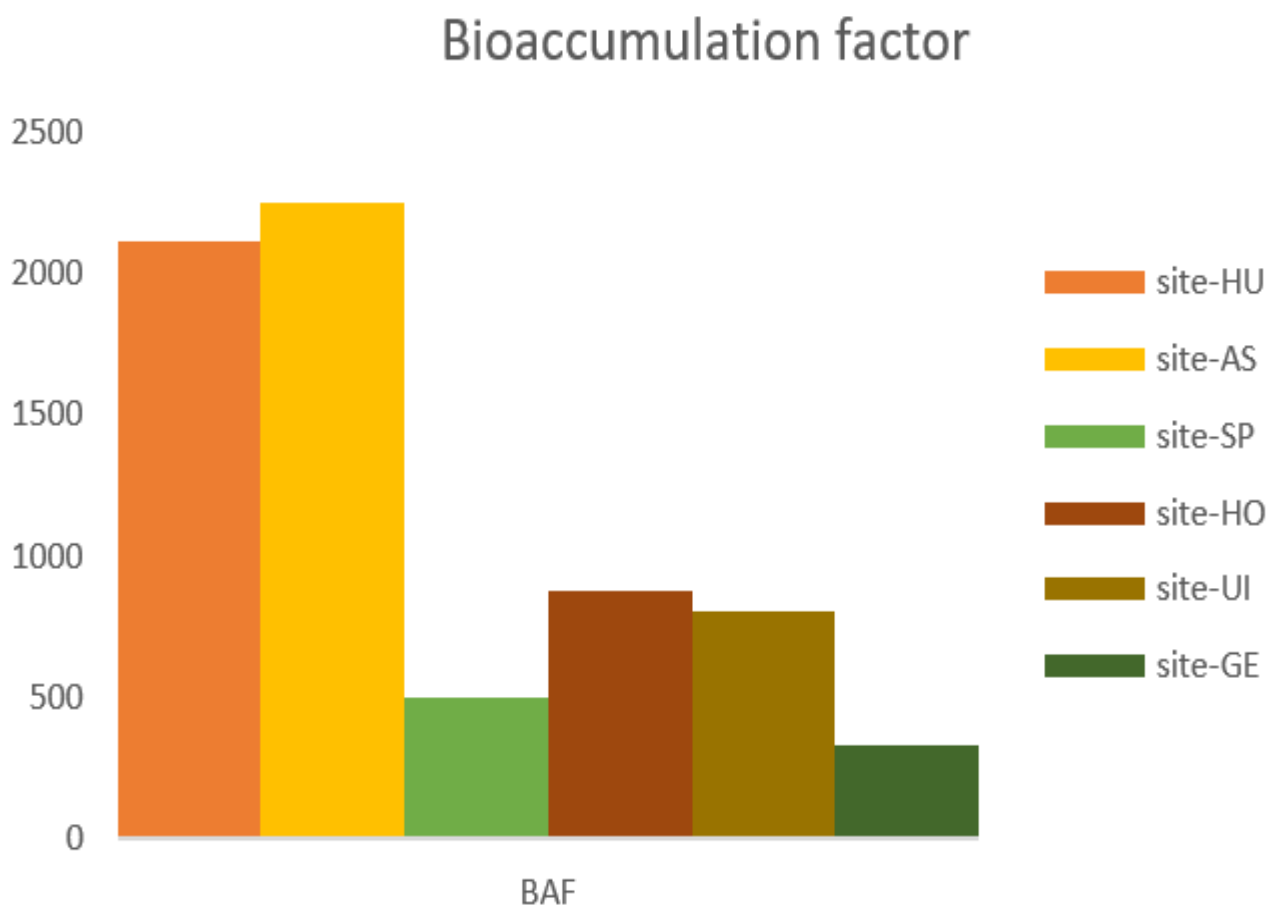
- **The highest concentration of Hg was found at the sampling point where *S. polycytum* was collected**
- **The result below WHO limit of 0.006 ug/L**
- **Results comparable with KopyŚĆ et al., (2000); Hadi, (2009); Yazdi et al., (2013); Conchado-Amado et al., (2023).**

Correlation between Hg level and Physicochemical parameters

	Hg level in water samples (ug/L	pH	Temperature (°C)	Salinity (PSU)	DO (mg/L)	TDS (mg/L)	Conductivity (µS/cm)
Hg level in water samples (ug/L	1	0.339	0.524	-0.695	-0.089	-0.792	-0.301
pH		1	0.571	-0.296	0.484	-0.143	-0.658
Temperature (°C)			1	0.132	-0.292	0.063	-0.302
Salinity (PSU)				1	-0.437	.956**	0.385
DO (mg/L)					1	-0.155	-0.065
						0.770	0.902
TDS (mg/L)						1	0.368
Conductivity (µS/cm)							1

**. Correlation is significant at the 0.01 level (2-tailed).

Bioaccumulation factor



- **Highest species with BAF was *Acanthaphora specifera*, closely followed by *H. uninervis*. (numerical difference of 139)**
- **The species with the lowest BAF was *Gracilaria edulis*.**
- ***G. edulis* has an agar-like cell wall component which act as barrier against the uptake of certain contaminants like Hg (Andrade et al., 2010).**
- **Bioaccumulation is dependent on growth rate, Hg dilution effects, metabolic activity, habitat condition, and cell wall composition.**

Conclusion

- **Singh et al. (2021) found Cu, Fe, Mn, and Zn in three seagrass species at Nasese seashore, indicating contamination. This study is the first to analyze Hg concentration in both SW/SG species in Fiji.**

- **The pH and temperature show a positive correlation with the level of Hg in seawater. However, the relationship was insignificant at p-value of 0.01.**

- **The significant concentration of Hg in *H. uninervis* and other seagrass species could be a potential threat to the habitat and forage of the aquatic animals such as sea turtles and herbivorous fish found in this location.**

- **The observed variations in BAF among species indicate that the metabolic condition and lifecycle stage of individual species could affect their metal uptake and accumulation.**

- **The presence of Hg in the respective species might be due to anthropogenic activities in Suva.**

- **While CVAAS may not possess the sensitivity of other methods such as AFS and ICP-MS, it proved effective in accurately determining the elemental mercury levels in this study.**

Acknowledgment

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Prof. Surendra Prasad

Professor of analytical and food chemistry, Head, SAGEONS, USP

Dr. Antoine de Ramon N'Yeurt

Seaweed Taxonomist. Director, The Pacific Center for Environment and Sustainable Development.

Dr. Francis Mani

Senior Lecturer and Consultant, Atmospheric Chemistry

Dr. Vincent Lal

Manager, Institute of Applied Science, USP, Fiji

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Questions?