Annual Report of the LaMer Project FY 2019

1. Title:

Utilization of Samples Stored in es-Bank for Assessment of Persistent Organic Pollutants (POPs) in Fish Collected in Indian Ocean of Southern Java Waters, Indonesia.

2. Members' Names and Affiliations:

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3. Aim:

Oceans and coastal regions worldwide, including Indian Ocean are coming under increasing environmental pressures, one of which are from land-based and marine pollution. Within the countries of Indian Ocean rim, maintaining the integrity of the regional environment is one of the most important common interests. Monitoring and managing the environmental impacts of human activity on the ocean is essential to the maintenance of the living resources of the ocean. In this context, the knowledge of levels and patterns of contaminants is necessary to understand the risk for organisms, including humans, and it is very important for evaluating the global environmental health. However, there is still data gap on toxic pollution within the region of Indian Ocean. In particular, there is no data available on the occurrence of toxic pollutants in eastern Indian Ocean (EIO) within Indonesian boundary. The aim of this study was to utilize of samples stored at es-Bank of Center for Marine Environmental Studies (CMES) to characterize the level of Persistent Organic Pollutants (POPs) in fish and human risk assessment through fish consumption from Eastern Indian Ocean of Southern Java Waters, Indonesia,

4. Procedure:

Samples and Sampling

A total of 48 numbers of fish samples (n=48) belong to 16 species of fish from Eastern Indian Ocean of Southern Java Waters, Indonesia during 2015 and stored in es-Bank of CMES, Ehime University, Japan (http://esbank-ehime.com/dnn/) were used in this study for analyzing of Persistent Organic Pollutants (POPs). These fish samples were collected by trawl from 5 station trawls using RV. Baruna Jaya IV belong to Agency for the Assessment and Application of Technology (BPPT), Indonesia at fisheries management area of Indian Ocean of Southern Java Waters, Indonesia during 2015 through fish stock assessment project by Ministry of Marine and Fisheries, Republic of Indonesia.

Chemical Analysis

The targets of POPs in the present study were hexachlorocybenzene (HCB), hexachlorocyclohexanes (HCHs), Chlordane compounds (CHLs), Dichlorodiphenyltrichloroethane and its metabolites (DDTs), polychlorinated biphenyls (PCBs) and polybrominated diphenyl ethers (PBDEs). The POPs analyses were conducted in the Laboratory for Environmental Chemistry of CMES, Ehime University, Japan based on the analytical methods published elsewhere (Malarvannan et el., 2011).

5. Result:

All POPs analyzed in this study were determined in the samples (*n*=48) belong to 16 species of fish collected from Southern Indian Ocean (SIO) of Southern Java Waters, Indonesia during 2015. Figure 1 shows concentration of POPs (ng/g lipid wt.) detected in fish of the present study. To our knowledge, this is a first study showing the contamination of POPs in fish from Eastern Indian Ocean of Southern Java Waters, Indonesia. Among the POPs analyzed, DDTs (sum of *p,p'*-DDE, *p,p'*-DDD and *p,p'*-DDT) and PCBs were the predominant in the same order magnitude concentration with mean and range of 37 (21-70)

ng/g lipid wt. and 28 (17-37) ng/g lipid wt., rispectively, while CHL compounds, HCHs, HCB and PBDEs were 1 to 3 order of magnitude lower. Global comparison over world ocean (Figure 2) indicate that these POPs levels (concentration on wet weight basis) were generaly similar to those fish collected from western Indian Ocean (Bonito et al., 2016) and South China Sea (Sun et al., 2014; Hao et al., 2014), but lower than those from Pacific Ocean, Atlantic Ocean and Mediteranian Sea (Bonito et al., 2016). Contamination pattern of OCs were generally in the order of DDTs>PCBs>CHLs>HCHs≥HCB>PBDEs (Figure 1) which is generally in accordance with fish collected from west Indian Ocean, South China Sea and Pacific Ocean (Figure 2).

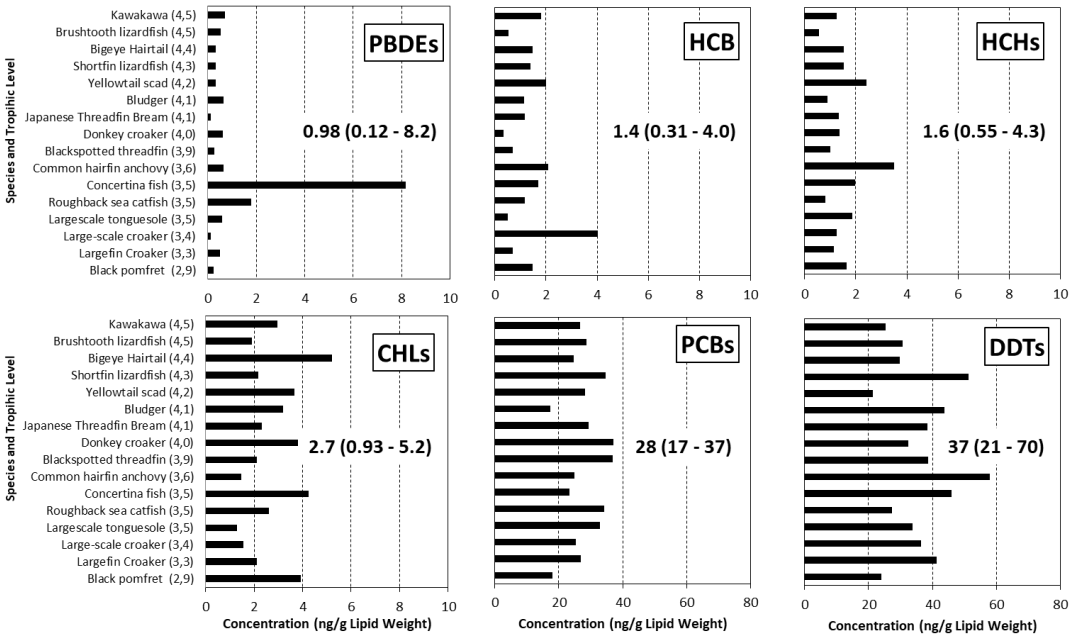

Figure 1. Concentrations of POPs in 16 species of marine fish (*n*=48) collected from Indian Ocean of Southern Java Waters, Indonesia during 2015.

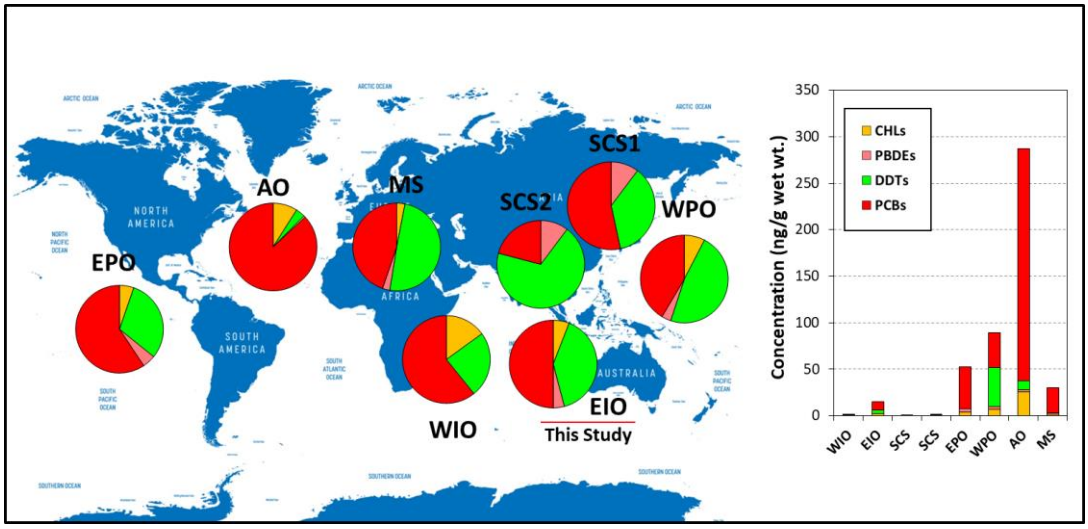

Figure 2. Concentration (ng/g wet wt.) and composition of POPs in fish over world oceans such as WIO= west Indian Ocean, SCS= South China Sea, EPO= East Pacific Ocean, WPO= West Pacific Ocean, AO= Atlantic Ocean, MS= Mediteranian Sea, EIO= East Indian Ocean of Southern Java Waters (Bonito et al., 2016 and references therein, Sun et al., 2014; Hao et al., 2014).

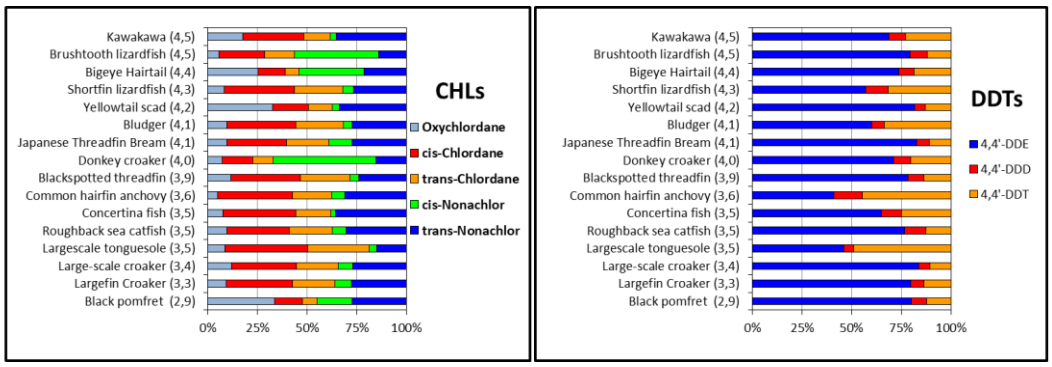

Figure 3. Composition of CHLs and DDTs in fish from Indian Ocean southern Java waters.

Composition of each compound showed that among POPs, BDE-47 was the only congener detected for PBDEs, and β-HCH was the only isomer for HCHs. Whereas the composition of CHL compounds, DDT and its metabolites (Figure 4) as well as PCB congeners (not shown) varied within the samples. In general, the metabolite of *p,p'*-DDE was the major of DDTs indicating that the occurence of DDTs in the present study due to past usage of DDT. However, certain fish such as Largescale tongouesole and common hairfin anchovy also have high proportion of *p,p'*-DDT. The ratio of (DDE + DDD)/DDTs are often used to indicate the historically input of DDT. The ratio of (DDE + DDD)/DDTs > 0.5 can be thought that DDTs are derived from historical use instead of new input (Yu et al., 2011). The higher proportion of metabolites (DDE + DDD) compared the parent compound p,p'-DDT indicate that the occurence of DDT in the present study was due to the past usage of DDT. As for CHLs, *cis*-chlordane and *trans*-chlordane were generally compounds found in fish of the present study. The bioaccumulative PCBs, such as CB-153, CB-138, CB-101, CB-99, CB-52, CB-49, CB-74, CB-180 and CB-187 were the predominant and commonly found in fish of the present study.

Finally, hazard quotient (THQ) as ratio between daily intake of POPs and their reference doses (Health Canada, 1996) were calculated to assess human health risk. Based on Indonesian fish daily intake of 120.36 g/Capita/Day and average body weight (BW) of 57.7 kg (KKP, 2016); the average of daily intake of HCBs, HCHs, CHLs, DDTs, PCBs and BDE-47 were 8.4 x 10^{-5}, 1.0 x 10^{-4}, 1.7 x 10^{-4}, 1.5 x 10^{-3}, and 3.6 x 10^{-5} µg/kg BW/day, rispectively. None of POPs analyzed in the present study have HQ exceded than 1 (HQ<<1) indicating no human health risk was expected due to fish consumpsion by Indonesian.

Table 1. Values of hazard quotient (THQ) of POPs for fish of the present study.

POPs	Concentration (ng/g wet wt)	Daily Intake (µg/Kg BW/day)	Reference Dose* (µg/Kg BW/day)	Hazard Quotient (HQ)
HCBs	4.0x10^{-2} (3.1x10^{-4} - 2.0x10^{-1})	8.4 x 10^{-5} (6.0 x 10^{-6} - 4.2 x 10^{-4})	2.7 x 10^{-1}	3.0x10^{-4} (2.4x10^{-6} - 1.5x10^{-3})
HCHs	4.9x10^{-2} (4.4x10^{-4} - 3.9x10^{-1})	1.0 x 10^{-4} (9.0 x 10^{-7} - 8.2 x 10^{-4})	3.0 x 10^{-1}	3.4x10^{-4} (3.1x10^{-6} - 2.7x10^{-3})
CHLs	8.2x10^{-2} (1.3x10^{-3} - 3.7x10^{-1})	1.7 x 10^{-4} (2.8 x 10^{-6} - 7.6 x 10^{-4})	5.0 x 10^{-2}	3.4x10^{-3} (5.5x10^{-5} -1.5x10^{-2})
DDTs	4.7x10^{-1} (6.8x10^{-3} - 5.0x10^{0})	9.7 x 10^{-4} (1.4 x 10^{-6} - 1.1 x 10^{-2})	2.0 x 10^{1}	4.9x10^{-5} (7.1x10^{-7} - 5.3x10^{-4})
PCBs	7.0 x 10^{-1} (2.3x10^{-2} - 2.2x10^{0})	1.5 x 10^{-3} (4.9 x 10^{-5} - 4.5 x 10^{-3})	1.0 x 10^{0}	1.5x10^{-3} (4.9x10^{-5} - 4.5x10^{-3})
BDE-47	3.6 x 10^{-5} (2.0x10^{-6} - 2.0x10^{-4})	3.6 x 10^{-5} (2.0 x 10^{-6} - 2.0 x 10^{-4})	1.0 x 10^{-1}	3.6x10^{-4} (1.8x10^{-5} - 2.0x10^{-3})

* Indonesian Fish Daily Intake: 120.36 g/Capita/Day (KKP, 2016); BW: 57,7 Kg; *RfD (Health Canada, 1996)

References

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Wheatley, B., Kuhnlein, H., 1999. Human health implications of environmental contaminants in Arctic Canada: a review. The Science of the Total Environment 230, 1–82.

Malarvannan G, Takahashi S, Ikemoto T, Isobe T, Kunisue T, **Sudaryanto, A.,** Miyagi T, Nakamura M, Yasumura S, Tanabe S. (2011). Levels and distribution of polybrominated diphenyl ethers and organochlorine compounds in sea turtles from Japan. *Marine Pollution Bulletin*, 2011;63(5-12):172-8.

Hao, Q., Yu-Xin Sun, Xiang-Rong Xu, Zi-Wei Yao, Bi-Xian Mai. 2014. Occurrence of Persistent organic pollutants in marine fish from the Natuna Island, South China Sea. Marine Pollution Bulletin, 85, 274-279.

Sun, Y., Qing Hao, Xiang-Rong Xu, Xiao-Jun Luo, Bi-Xian Mai. (2014). Persistent organic pollutants in marine fish from Yongxing Island, South China Sea: Levels, composition profiles and human dietary exposure assessment. Chemosphere 98, 84-90.

6. Publication/Conference presentation:

a. Currently preparing for a scientific paper. A tentative tittle and authorship are as follow: Sudaryanto, A., Ilyas, M., Watanabe, T., Tanabe, S., Kunisue, T. Characterisation of Persistent Organic Pollutants in Fish from Indian Ocean of Southern Java Waters, Indonesia, In Preparation (Scientific Pubication).

b. Part of the result finding has been presented at LaMer Special Seminar (32nd LaMer Special Seminar) titled “Environmental Occurrence of Toxic Pollutants in Fish from Eastern Indian Ocean of Southern Java Waters: Trace Elements, Persistent Organic Pollutants and Radionuclides”, held CMES, Ehime University, Japan, Matsuyama 11 November 2019.

7. Perspectives in Future:

The present study makes clear the contamination status of POPs in fish over world ocean in which fish of the present study from eastern Indian Ocean of southern Java waters, Indonesia are considered has lower level (similar to sorrounding waters such as south china sea and west Indian Ocean) compared to those of Pacific Ocean, Atlantic Ocean and Mediteranian Sea. This study provides useful baseline data for future research on environmental occurrence and bioaccumulation of these compounds in eeastern Indian Ocean.

Collaboration by using storage samples in environmental specimen Bank (*es*-Bank)

Kind of samples used and Date of Received the samples from *es*-BANK.

Samples are muscle of fish samples collected from Indian Ocean of Southern Java Waters, Indonesia during 2015 with total of 48 number of sample (n= 48). The samples are stored in es-Bank at Box Number 01-641 (http://esbank-ehime.com/dnn/) and Sample ID number as follows. Samples of fish used in this study were received from es-Bank between the period of 31 May – 30 August 2019.

Table. Kind of samples used in the present study from es-Bank of Ehime University.

No	Sample ID	Sample	Common Name	Number of Sample (*n*)
1	INA-F15-003	Fish	Shortfin lizardfish	1
2	INA-F15-004	Fish	Shortfin lizardfish	1
3	INA-F15-005	Fish	Shortfin lizardfish	1
4	INA-F15-007	Fish	Yellowtail scad	1
5	INA-F15-008	Fish	Yellowtail scad	1
6	INA-F15-009	Fish	Yellowtail scad	1
7	INA-F15-011	Fish	Large-scale croaker	1
8	INA-F15-012	Fish	Large-scale croaker	1
9	INA-F15-013	Fish	Large-scale croaker	1
10	INA-F15-014	Fish	Black pomfret	1
11	INA-F15-015	Fish	Black pomfret	1
12	INA-F15-016	Fish	Black pomfret	1
13	INA-F15-017	Fish	Largescale	1
14	INA-F15-018	Fish	Largescale	1
15	INA-F15-019	Fish	Largescale	1
16	INA-F15-022	Fish	Common hairfin	1
17	INA-F15-027	Fish	Largefin Croaker	1
18	INA-F15-028	Fish	Largefin Croaker	1
19	INA-F15-029	Fish	Largefin Croaker	1
20	INA-F15-032	Fish	Bigeye Hairtail	1
21	INA-F15-033	Fish	Bigeye Hairtail	1
22	INA-F15-034	Fish	Bigeye Hairtail	1
23	INA-F15-035	Fish	Roughback sea	1
24	INA-F15-036	Fish	Roughback sea	1
25	INA-F15-037	Fish	Roughback sea	1
26	INA-F15-038	Fish	Japanese Threadfin	1
27	INA-F15-039	Fish	Japanese Threadfin	1
28	INA-F15-040	Fish	Japanese Threadfin	1
29	INA-F15-051	Fish	Donkey croaker	1
30	INA-F15-052	Fish	Donkey croaker	1
31	INA-F15-053	Fish	Donkey croaker	1
32	INA-F15-062	Fish	Common hairfin	1
33	INA-F15-065	Fish	Common hairfin	1
34	INA-F15-069	Fish	Blackspotted threadfin	1
35	INA-F15-070	Fish	Blackspotted threadfin	1
36	INA-F15-071	Fish	Blackspotted threadfin	1

Table. Kind of samples used in the present study from es-Bank of Ehime University (Continue).

37	INA-F15-072	Fish	Bludger	1
38	INA-F15-073	Fish	Bludger	1
39	INA-F15-074	Fish	Bludger	1
40	INA-F15-079	Fish	Brushtooth lizardfish	1
41	INA-F15-080	Fish	Brushtooth lizardfish	1
42	INA-F15-081	Fish	Brushtooth lizardfish	1
43	INA-F15-088	Fish	Concertina fish	1
44	INA-F15-089	Fish	Concertina fish	1
45	INA-F15-090	Fish	Concertina fish	1
46	INA-F15-094	Fish	Kawakawa	1
47	INA-F15-095	Fish	Kawakawa	1
48	INA-F15-096	Fish	Kawakawa	1