Global Monitoring Plan for Persistent Organic Pollutants (POPs)

National Report

Antigua and Barbuda

ACKNOWLEDGEMENTS

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The Government of Antigua and Barbuda remains committed to the improvement of POPs monitoring for evaluation of the effectiveness of the Stockholm Convention.

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Project Coordinator

June 2023

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LIST OF ABBREVIATIONS

AIR-GEF	UNEP/GEF GMPII Projects
ADC	Agriculture Development Corporation
BDE	Bromodiphenyl ether
DAS	Department of Analytical Services
DDD	Dichlorodiphenyldichloroethane
DDE	Dichlorodiphenyldichloroethylene
dl-PCB	Dioxin like Polychlorinated Biphenyls
GAPS	Global Atmospheric Passive Sampling
GEF	Global Environment Facility
GMP	Global Monitoring Plan
HBCD	Hexabromocyclododecane
HCB	Hexachlorobenzene
HCH	Hexachlorocyclohexane
LAPAN	Latin American Passive Atmosphere Network
LOQ	Limit of Quantification
PAS	Passive Air Sampling
PBB	Polybrominated biphenyl
PBDEs	Polybrominated diphenyl ethers
PCDD	Polychlorinated dibenzodioxins
PCDF	Polychlorinated dibenzofurans
PCB	Polychlorinated Biphenyls
PeCB	Pentachlorobenzene
PFAS	Per and Poly alkyl substances
PFHxS	Perfluorohexanesulfonic acid
PFOA	Perfluoro-octanoic acid
PFOS	Perfluorooctane sulfonic acid
POPs	Persistent Organic Pollutants
PUF	Polyurethane Foam

SOP	Standard Operating Procedures
TEQ	Toxic Equivalent
UNEP	United Nations Environment Programme
WHO	World Health Organisation

EXECUTIVE SUMMARY

Antigua and Barbuda as signatory to the Stockholm Convention on Persistent Organic Pollutants is committed to the fulfilment of its obligation to assess trends in Persistent Organic Pollutants (POPs) in core media as identified under the Convention. Hence, our participation in the Global Monitoring Plan (GMP) programme for successive rounds signals our commitment to the assessment of temporal data towards the evaluation of the effectiveness of the Convention.

The current round of the GMP provides a basis for comparison with the previous round as it relates to the initial 12 POPs in particular and provides information on newly listed POPS in various media. The core media included human milk, ambient air and water, and various food and environmental sampled (soil and sediment) as non-core media.

Ambient air data collect in the 2017-2018 campaign trended upward for most initial POPS with the exception of Toxaphene. The largest increases observed for Chlordane (145%) and Dieldrin (92%). Also, PFOS, PFOA and PFHxS trended upward during the 2017-2018 period.

The human milk survey was conducted in according with World Health Organization (WHO) guidance and was coordinated with the Ministry of Health Antigua. Mothers were between the ages of 18 and 40, and samples were taken within the first six (6) weeks of confinement. When compared to the 2008 WHO breast milk study, dioxin-like compounds decreased by 65% in 2018. Similarly, non-dioxin-like PCBs decreased by 60% in 2018 when compared to 2008.

There was a general decreasing trend of the initial POPs from 2008 to 2018. However, PBDE levels may necessitate further investigation.

The newly listed POPs were generally below the limit of detection. PFOS and PFOA were detectable, but PFHxS was below the limit of quantitation. PCN levels ranged from <0.035 pg/g fat to 15.25 pg/g fat.

National samples ranged from food items (vegetables, fish and eggs) to sediment and soil. Dioxin-like POPs were detected at higher levels in fish than other biotic samples. Levels in soil were generally higher than in sediment. Many of the initial POPS were generally undetectable with the notable exception of DDE and DDT in a single egg sample. Fish samples also contained PBDE levels three (3) times greater than the egg sample.

The analysis of samples at the national level proved challenging due to the equipment configuration and consistent analytical capacity. National measures have been instituted to ensure an increase in analytical capacity for subsequent rounds on the GMP, notably the acquisition of GC-MSD equipment. Institutional strengthening and governance improvement should significantly improve on laboratory performance in future rounds of the GMP.

INTRODUCTION

According to the World Health Organization (WHO), Persistent Organic Pollutants (POPs) are of global significance owing to their ability to: persist in the environment, be transported over long distances and bioaccumulate in ecosystems; consequentially rendering substantial harm to human health and the environment.[a] It was out of this need to monitor global trends in these ubiquitous “forever chemicals” why the Global Monitoring Plan was conceived, with a dual focus to evaluate the Stockholm Convention’s effectiveness. Through the monitoring of various abiotic and biotic matrices, the assessment of the environmental and human health impacts of POPS can be had. As a result, air, water, human plasma, and breast milk were deemed the core matrices to be monitored.

The nation of Antigua, Barbuda, and Redonda, nestled in the heart of the Eastern Caribbean, consists of coral islands which boasts of white and pink sandy beaches, endemic species, vibrant eco-tourism, sport-fishing, and yachting. Having no manufacturing sector and with such a relatively pristine environment and the significant reliance on tourism, it is irrefutable that environmental and human health concerns are paramount. Having become a signatory to the Stockholm Convention since 2001, the nation has sought to establish its national POPs baseline data while fulfilling its obligations through the monitoring of various matrices of national concern: air, human milk, water, and sediment. The nation successfully participated in two (2) rounds of the Global Monitoring Plan initiatives, as well as the World Health Organisation Breast Milk Study, facilitating a comparative analysis of human milk data to identify trends, demographics of concern and for potential follow-up studies. Additionally, the results of air, water, fish, eggs, and sediment, and the interlaboratory assessment will be elucidated. It is the nation’s hope to establish local data while monitoring threats to particularly vulnerable demographics and fragile ecosystems.

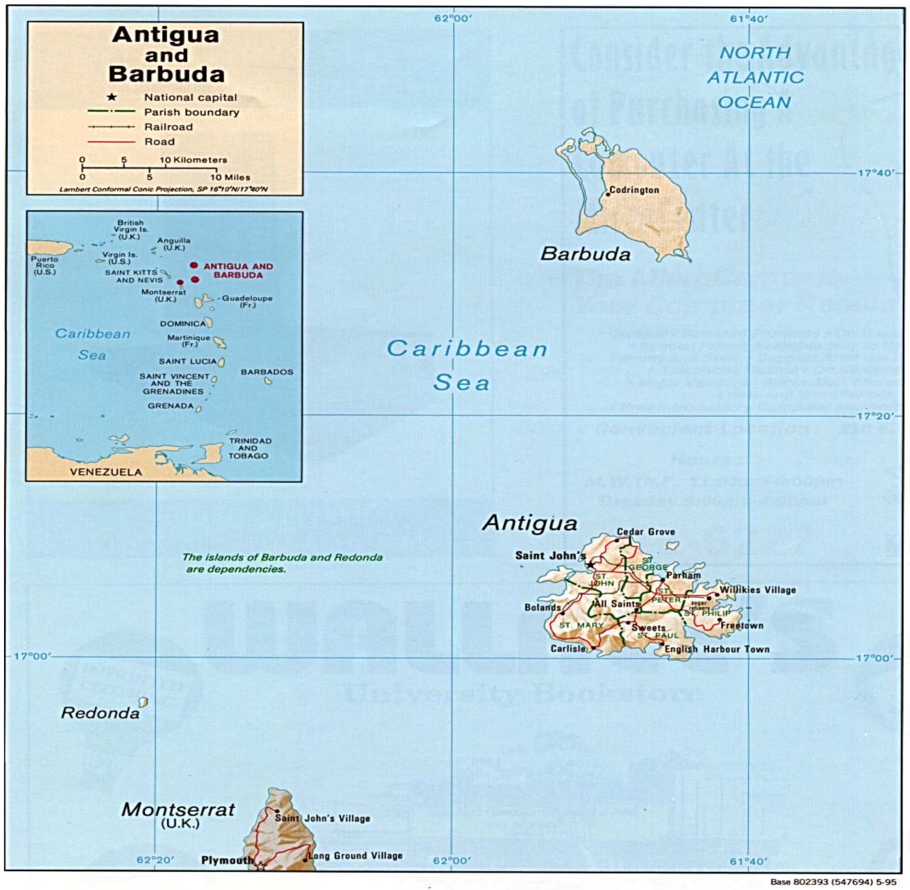

Figure 1- showing Antigua, Barbuda, and Redonda in relation to the Caribbean.[b]

AIR SAMPLING (PASSIVE)

Coordination:

Because of the inherent nature of POPs, ambient air monitoring was an excellent matrix to determine the nation's temporal trends towards the assessment of potential human health and environmental health impacts. Antigua and Barbuda's ambient air monitoring was conducted utilizing the Global Monitoring Plan (GMP) for Persistent Organic Pollutants (POPs), in the countries of Latin America and the Caribbean (AIR – GEF) Program.

The Passive Air Sampling (PAS) coordination was led by the Department of Analytical Services in collaboration with the Ministry of Agriculture, Fisheries and Barbuda Affairs. An air monitoring site was established at The Agricultural Development Corporation (ADC), located at the Diamonds Estate, St. Phillip, Antigua, a prime agricultural zone. Similarly, to the previous round of air quality monitoring, a mounted metal pole consisting of a welded metal bar, containing notches for five (5) samplers, was utilized. Each sampler was fitted with a polyurethane foam (PUF) disc per project stipulations.

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Figure 2-Pole Assembly for the Passive Air Samplers(PAS)

Methodology:

Passive air monitoring was conducted in 2010-2011 and 2017-2018 under the AIR-GEF Programme. The Programme utilised the following air monitoring site:

Passive Air Sampling Site Information:

Agricultural Development Corporation

Diamonds Estate

St. Phillip's

Antigua

Coordinates: 17°4´37.26"N, 61°45´36.84"W

Assembly & Deployment:

The five (5) samplers were assembled following the AIR-GEF Standard Operating Procedures below:

1. Place the axis in vertical position. At 3 cm of the end of the axis screw a nut. This nut will be the bottom limit.
2. Above the bottom limit nut, place the lower bowl, put a flat washer, the shorter distance tube and finally, another flat washer.
3. The foam must have a small central hole. The hole will be made with two tweezers with the tips wrapped in aluminium foil.
4. Place the foam into the axis with the help of the tweezers until to leave the foam above the flat washer.
5. Place another flat washer on the PUF. This step ensures stability to the polyurethane foam.
6. Put the longer distance tube followed by a flat washer and finally place the upper bowl. Screw a second nut to close the sampler and place the wing nut. This part keeps closed the PAS.

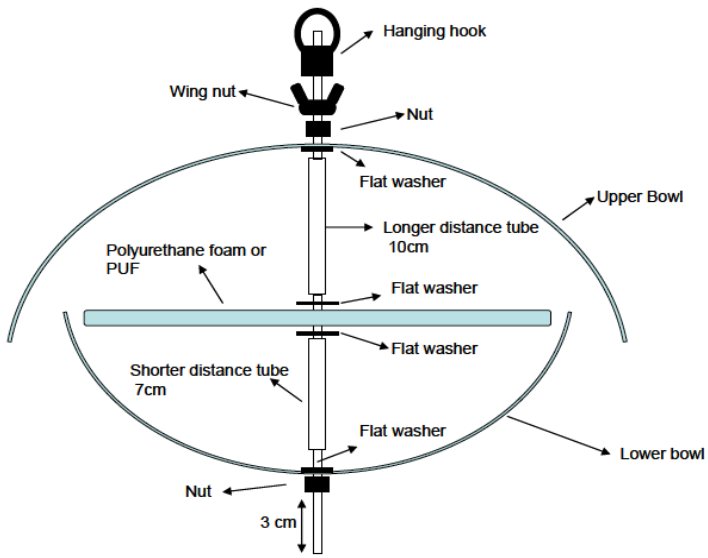

Figure 3-showing the components of the Passive Air Sampler

The PAS were identified with the following data of the sampling:

a) Location

b) Sampler identification

c) Polyurethane foam identification

d) Date of the beginning of sampling

e) Date of the ending of sampling

f) Type of compounds to be analysed

Identification of the PUFs:

URY - 1 (2016 - IV)

Country code Sampler year of sampling campaign Number identification

The established UN code for Antigua and Barbuda is ATG. An example of a PUF with the relevant code: ATG-1-2016-II

Sampling Periods:

The samplers were deployed typically on the first business day of the month, for three consecutive months.

Disassembly:

The disassembly was executed by the following steps:

1. Uninstall the PAS from the sampling support.

2. Disassemble the hanging hook and the hook adaptor.

3. Disassemble the upper bowl unscrewing the wing nut and the nut.

4. Remove the longer distance tube.

5. With a pair of tweezers, remove the Polyurethane foam from the PAS and wrap it in aluminium foil or similar.

6. Disassemble the rest of the PAS: shorter distance tube, flat washer, lower bowl, nut and axis.

After Disassembly, the PUFs were transported to the Department of Analytical Services Laboratory and treated according to the information in the tables below:

Table 1: List of Samplers and Responsible Party

Sample No.	Treatment
1	Analysis of basic POPs in Expert Laboratory
2	Analysis of basic POPs in National Laboratory
3	Analysis of basic POPs in Expert Laboratory
4	Analysis of basic POPs in National Laboratory
5	Analysis of dioxin-like POPs in Expert Laboratory
9	Analysis of basic POPs in Expert Laboratory
11	Analysis of PFOS, PFOA, PFAS precursors in Expert Laboratory

Table 2- PUF Campaigns Sample Shipments to Respective Expert Laboratories

	PUFs Shipments		
Shipment Date	**PUFs sent**	**Destination**	**Sent by**
6/3/17	ATG1-(2017-II)-CSIC	Spain	Lael
	ATG3-(2017-II)-CSIC	Spain	Lael
	ATG5-(2017-II)-CSIC	Spain	Lael
	ATG9-(2017-II)-CSIC	Spain	Lael
	ATG11-(2017-II)-MTM	Sweden	Lael
	ATG2-(2017-II)-NL	Antigua	Lael
	ATG4-(2017-II)-NL	Antigua	Lael
10/7/17	ATG1-(2017-III)-CSIC	Spain	Lael
	ATG3-(2017-III)-CSIC	Spain	Lael
	ATG5-(2017-III)-CSIC	Spain	Lael
	ATG9-(2017-III)-CSIC	Spain	Lael
	ATG11-(2017-III)-MTM	Sweden	Lael
	ATG2-(2017-III)-NL	Antigua	Lael
	ATG4-(2017-III)-NL	Antigua	Lael
1/2/18	ATG1-(2017-IV)-CSIC	Spain	Ayokunle
	ATG3-(2017-IV)-CSIC	Spain	Ayokunle
	ATG5-(2017-IV)-CSIC	Spain	Ayokunle
	ATG9-(2017-IV)-CSIC	Spain	Ayokunle
	ATG11-(2017-IV)-MTM	Sweden	Ayokunle
	ATG2-(2017-IV)-NL	Antigua	Ayokunle
	ATG4-(2017-IV)-NL	Antigua	Ayokunle
4/11/18	ATG1-(2018-I)-CSIC	Spain	Ian
	ATG3-(2018-I)-CSIC	Spain	Ian
	ATG5-(2018-I)-CSIC	Spain	Ian
	ATG9-(2018-I)-CSIC	Spain	Ian
	ATG11-(2018-I)-MTM	Sweden	Ian
	ATG2-(2018-I)-NL	Antigua	Ian
	ATG4-(2018-I)-NL	Antigua	Ian
7/12/18	ATG1-(2018-II)-CSIC	Spain	Ian
	ATG3-(2018-II)-CSIC	Spain	Ian
	ATG5-(2018-II)-CSIC	Spain	Ian
	ATG9-(2018-II)-CSIC	Spain	Ian
	ATG11-(2018-II)-MTM	Sweden	Ian
	ATG2-(2018-II)-NL	Antigua	Ian
	ATG4-(2018-II)-NL	Antigua	Ian
11/5/18	ATG1-(2018-III)-CSIC	Spain	Ian
	ATG3-(2018-III)-CSIC	Spain	Ian
	ATG5-(2018-III))-CSIC	Spain	Ian
	ATG9-(2018-III)-CSIC	Spain	Ian
	ATG11-(2018-III)-MTM	Sweden	Ian
	ATG2-(2018-III)-NL	Antigua	Ian
	ATG4-(2018-III)-NL	Antigua	Ian
	ATG1-(2018-IV)-CSIC	Spain	Ian
	ATG3-(2018-IV)-CSIC	Spain	Ian
	ATG5-(2018-IV)-CSIC	Spain	Ian
	ATG9-(2018-IV)-CSIC	Spain	Ian
	ATG11-(2018-IV)-MTM	Sweden	Ian
	ATG2-(2018-IV)-NL	Antigua	Ian
	ATG4-(2018-IV)-NL	Antigua	Ian

See Annex 1 for more information.

Passive Air Sampling Results

Data and results of the comparison of the concentration levels for the St. Phillip's site, for the years 2017 and 2018 are presented in Mosaic Table 3. Each campaign, except for ATG (2017-II), was compared to the campaign which occurred immediately prior.

Table 3: Mosaic Table showing Comparison of Concentration Levels

Group	Parameter	Unit	ATG (2017-II)	ATG (2017-III)	ATG (2017-IV)	ATG (2018-I)	ATG (2018-II)	ATG (2018-III)	ATG (2018-IV)
Cyclodiene	Aldrin + unknown peak	ng/PUF	<0.20	0.31	0.20	<0.20	0.24	<0.20	<0.20
	cis-Chlordane	ng/PUF	0.94	0.79	0.61	1.2	1.9	2.1	1.6
	trans-Chlordane	ng/PUF	<0.40	0.44	<0.40	0.89	0.75	1.4	1.1
	cis-Nonachlor + Chlordecone	ng/PUF	<0.40	<0.40	<0.40	<0.40	0.69	0.53	0.42
	trans-Nonachlor	ng/PUF	2.7	1.7	1.7	3.5	5.7	4.1	3.1
	Oxychlordane	ng/PUF	<0.40	<0.40	<0.40	<0.40	<0.40	<0.40	<0.40
	Dieldrin	ng/PUF	1.4	2.5	1.1	1.8	5.5	3.0	2.5
	a-Endosulfan	ng/PUF	<1.00	1.3	1.3	<1.00	<1.00	<1.00	1.2
	b-Endosulfan	ng/PUF	<1.00	<1.00	n.q.	n.q.	<1.00	<1.00	<1.00
	Endosulfan sulfate	ng/PUF	<0.20	<0.20	n.q.	n.q.	<0.20	<0.20	<0.20
	Endrin	ng/PUF	0.43	3.1	0.51	0.98	1.1	1.2	1.1
	Heptachlor	ng/PUF	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20
	cis-Heptachlor Epoxide	ng/PUF	0.41	<0.40	<0.40	<0.40	<0.40	<0.40	<0.40
	trans-Heptachlor Epoxide	ng/PUF	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00
	Mirex	ng/PUF	0.19	0.15	0.12	0.15	0.24	0.12	0.14
DDT	o,p'-DDD	ng/PUF	0.14	0.24	<0.08	0.08	0.24	0.11	<0.08
	o,p'-DDE	ng/PUF	0.12	0.24	0.11	0.15	0.41	0.34	0.21
	o,p'-DDT	ng/PUF	0.42	1.5	0.30	0.59	1.6	1.3	0.75
	p,p'-DDD	ng/PUF	0.48	0.59	0.20	0.21	0.54	0.14	0.16
	p,p'-DDE	ng/PUF	9.6	8.1	4.6	8.7	26	12	7.9
	p,p'-DDT	ng/PUF	4.8	4.6	1.0	1.5	2.8	2.9	1.7
HCB	HCB	ng/PUF	3.7	1.9	2.5	3.6	2.8	1.1	3.5
PeCB	PeCB	ng/PUF	42	4.4	3.5	54	35	3.9	40
HCH	a-HCH	ng/PUF	0.33	<0.20	<0.20	0.95	0.64	<0.20	0.40
	b-HCH	ng/PUF	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20
	d-HCH	ng/PUF	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20
	g-HCH (lindane)	ng/PUF	0.72	<0.20	0.50	1.4	2.4	<0.20	1.0
BDE	BDE-17	ng/PUF	<0.03	<0.03	<0.03	<0.03	<0.03	<0.03	<0.03
	BDE-28	ng/PUF	0.02	0.03	0.03	0.03	<0.02	0.03	<0.02
	BDE-47	ng/PUF	0.33	0.39	0.50	0.32	0.35	0.37	<0.25
	BDE-66	ng/PUF	<0.20	<0.20	0.20	<0.20	0.20	<0.20	<0.20
	BDE-100	ng/PUF	0.04	0.04	0.05	0.03	0.04	0.04	<0.03j
	BDE-99	ng/PUF	0.15	0.17	0.18	<0.14	0.17	<0.14	<0.14
	BDE-85	ng/PUF	<0.07	<0.07	<0.07	<0.07	<0.07	<0.07	<0.07
	BDE-154	ng/PUF	<0.16	<0.16	<0.16	<0.16	<0.16	<0.16	<0.16
	BDE-153	ng/PUF	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50
	BDE-183	ng/PUF	<1.00	<1.00	<1.00	3.04	<1.00	<1.00	<1.00
PBB	PBB-153	ng/PUF	<0.03	<0.03	<0.03	<0.03	<0.03	<0.03	<0.03
HBCD	a-HBCD	ng/PUF	0.19	1.4	0.79	1.1	<0.03	NA	0.04
	b-HBCD	ng/PUF	<0.03	0.76	0.22	0.36	<0.03	NA	<0.03
	g-HBCD	ng/PUF	0.77	1.6	0.21	1.5	<0.03	NA	<0.03
PFAS	PFHxS	pg/PUF	12	12	12	51	54	40	47
	PFOA	pg/PUF	375	224	194	371	472	374	230
	br-PFOS	pg/PUF	21	5	38	5	NR	NR	NR
	L-PFOS	pg/PUF	90	12	58	115	NR	NR	NR
	ΣPFOS	pg/PUF	111	12	96	115	NR	NR	NR

Increased Concentration
Decreased Concentration
Without Changes
Below the Limit of Quantification (LOQ)

n.q. Not Quantifiable
NR Not Reported
NA Not Analyzed

*Note: Where the campaign immediately prior was not quantified/reported/analyzed, the value was compared to the most recent campaign which was quantified/ reported/ analyzed.

In the case of the Cyclodiene group, it was shown that the concentration of majority of the parameters, 49%, fell below their respective limit of quantifications (LOQs). There was a 22% increase in the concentration of the parameters with only an 18% decrease observed.

The concentration of the parameters in the Dichlorodiphenyltrichloroethane (DDT) group showed an increase, 43%, throughout 2017 and 2018. This was mainly observed within the first and second quarter of 2018 where an increase was observed for all the parameters.

A 43% increase concentration is shown for the parameters of the Hexachlorobenzene (HCB) group with an equal number of decreases, 43%, observed.

An overall decrease of 57% was observed for Pentachlorobenzene (PeCB). However, a 27% increase was shown; this was observed in the first and last quarter of 2018.

Hexachlorocyclohexanes (HCHs) show a decrease or values below the LOQ for 72% of the parameters in the group. An increase, 21%, was observed for only lindane and a-HCH.

The concentration of the parameters of the Bromine Diphenyl Ether (BDE) group increased by 14%. Most of the concentrations were shown to be below their respective LOQs. It was observed that for the last quarter of 2018, the concentrations for all the parameters were below the LOQ.

Hexabromocyclododecanes (HBCDs) show a 43% decrease or values below the LOQ. Overall, an increase of 33% was shown.

Per- and polyfluoroalkyl substances (PFAS) show a decrease in 23% of the parameters and an increase of 31%. 26% of the results for were not reported; this was observed in the last three quarters of 2018.

Initial POPs

The average yearly concentrations[1] of the initial POPs, except for toxaphene, can be seen in Table 4. The behavior of the data is shown in Figure 4 where it is observed that the concentration for most of the POPs increased from 2017 to 2018, except for Aldrin, Endrin and Heptachlor where decreases were observed. A significant increase was shown in the case of Chlordane and Dieldrin where increases of 145% and 92% were observed respectively.

[1] For passive air data, all subsequent yearly averages for 2017 were calculated from Campaigns II-IV.

Table 4- Average Yearly Concentrations of the Initial POPs

	Average Concentration (ng/PUF)	
Initial POPs	2017	2018
Aldrin	0.1700	0.0600
Chlordane	0.5920	1.4490
DDT	2.0578	2.9304
Dieldrin	1.6667	3.2000
Endrin	1.3467	1.0950
Heptachlor	0.0456	0.0000
HCB	2.7000	2.7500
Mirex	0.1533	0.1625
PCB	0.0083	0.0091
PCDD/PCDF	0.0007	0.0008

Note: When calculating the yearly average, the contribution of those compounds with values lower than the LOQ was equal to 0.

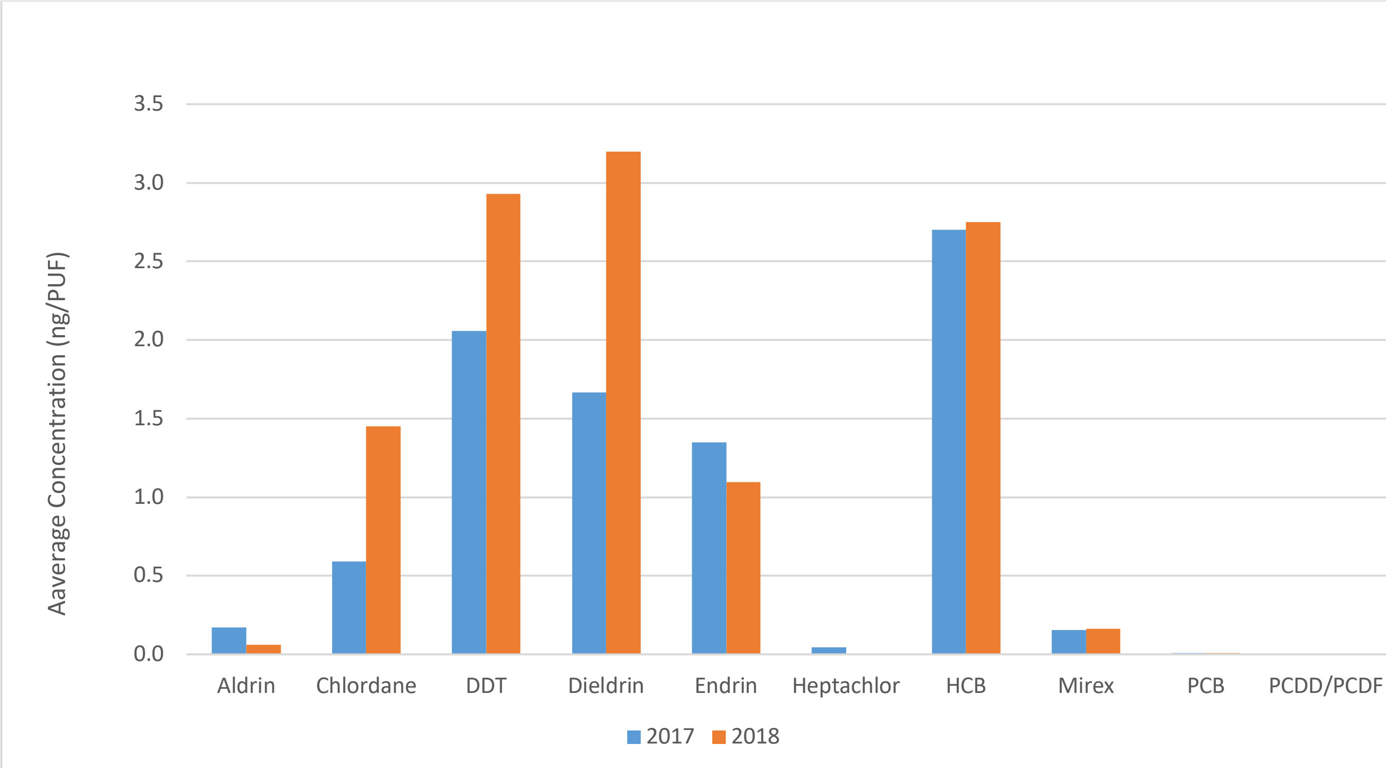

Figure 4- Comparison of the Annual Concentrations of Initial POPs for 2017 and 2018

Organochlorine Insecticides, Cyclodiene Subgroup

The yearly average concentrations and the behavior of the data for the Cyclodiene subgroup of the OCPs are shown in Table 5 and Figure 5. It is observed that while most of the average concentrations for the parameters are above their respective LOQs, the average concentrations of Oxychlordane, b-Endosulfan, Endosulfan sulfate, Heptachlor and trans-Heptachlor Epoxide are below their LOQs for both 2017 and 2018. Major increases were observed for cis-Chlordan, 118%, trans-Nonachlor, 102%, Dieldrin, 92%, and most significantly trans-Chlordane, 604%.

Table 5-Average Yearly Concentration of Cyclodienes

	Average Concentration (ng/PUF)	
Parameter	2017	2018
Aldrin + unknown peak	0.170	0.060
cis-Chlordane	0.780	1.700
trans-Chlordane	0.147	1.035
cis-Nonachlor + Chlordecone	<0.40	0.410
trans-Nonachlor	2.033	4.100
Oxychlordane	<0.40	<0.40
Dieldrin	1.667	3.200
a-Endosulfan	0.867	0.300
b-Endosulfan	<1.00	<1.00
Endosulfan sulfate	<0.20	<0.20
Endrin	1.203	1.095
Heptachlor	<0.20	<0.20
cis-Heptachlor Epoxide	0.137	<0.40
trans-Heptachlor Epoxide	<1.00	<1.00
Mirex	0.153	0.163

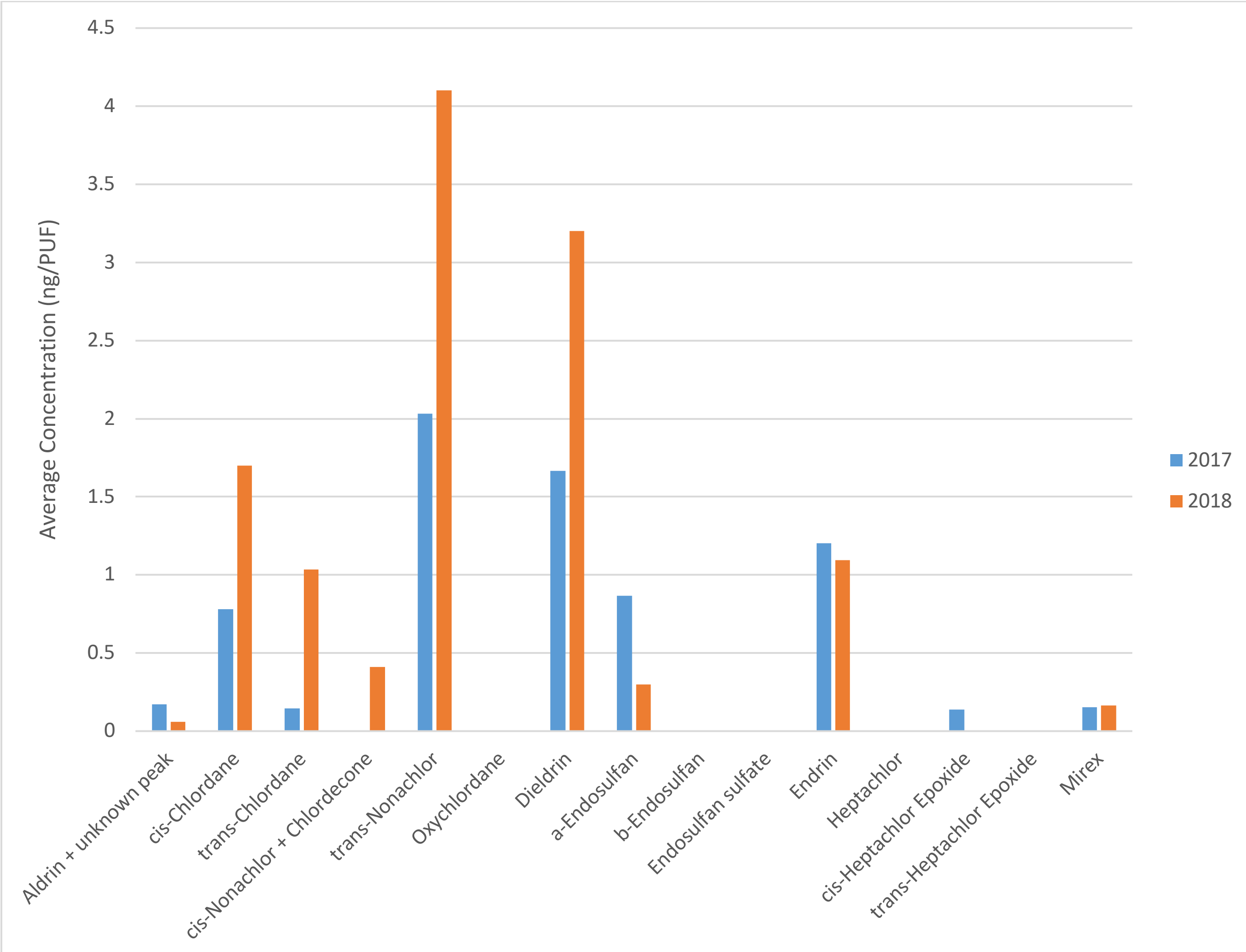

Figure 5- Comparison of the Annual Concentrations of Cyclodienes for 2017 and 2018

Dichlorodiphenyltrichloroethane and its isomers

The average yearly concentration Dichlorodiphenyltrichloroethane (DDT) and its isomers is shown in Table 6 and Figure 6 shows the behavior of the data. All data is above the LOQ. It is observed that 50% of the parameters showed an increase in average concentration between 2017 and 2018. A 77% increase was observed for the isomer o,p'-DDE and 84% with respect to p,p'-DDE.

Table 6-Average Yearly Concentration for DDT and its Isomers

	Average Concentration (ng/PUF)	
Parameter	2017	2018
o,p'-DDD	0.127	0.108
o,p'-DDE	0.157	0.278
o,p'-DDT	0.740	1.060
p,p'-DDD	0.423	0.263
p,p'-DDE	7.433	13.650
p,p'-DDT	3.467	2.225

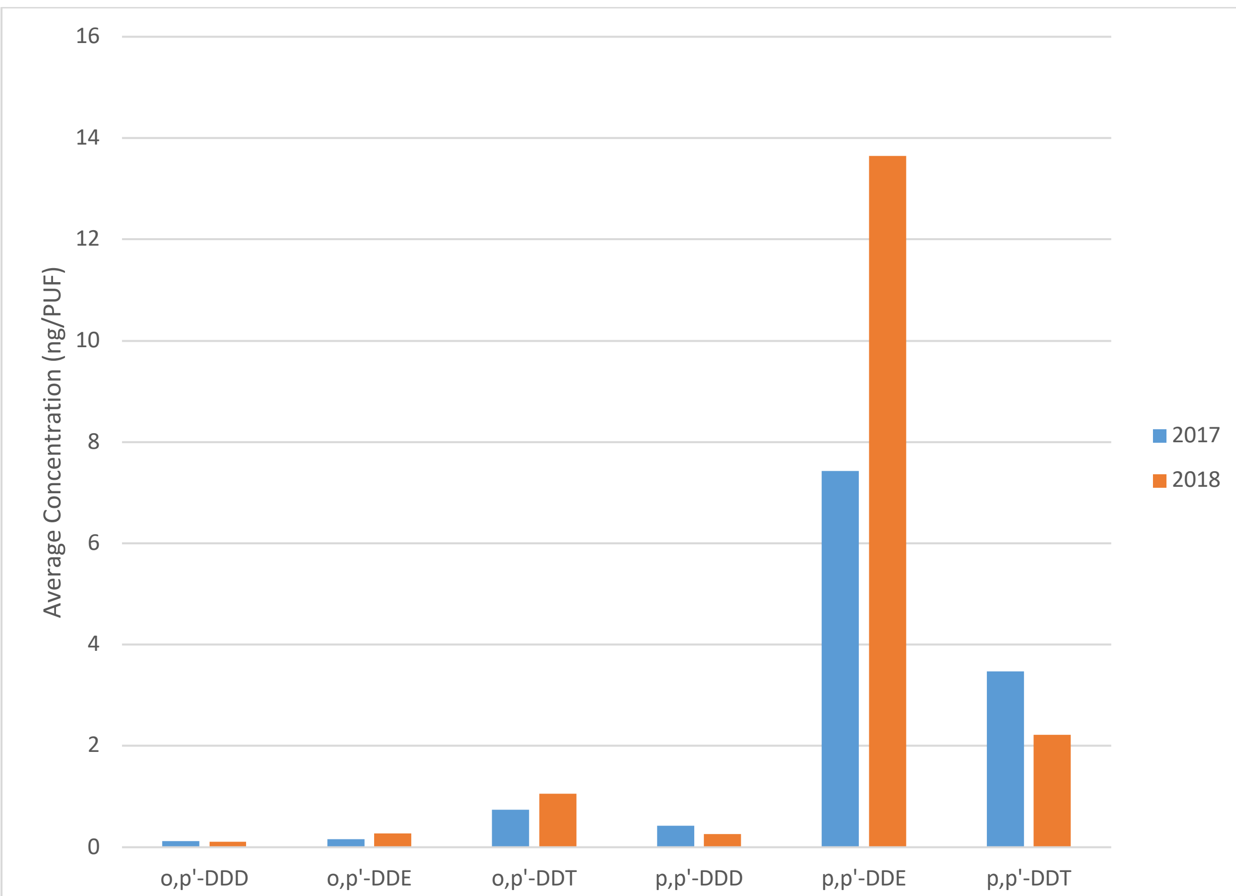

Figure 6-Comparison of the Annual Concentrations of DDT and its Isomers for 2017 and 2018

Hexachlorobenzene

The average yearly concentration of the POP Hexachlorobenzene (HCB) and the behavior of the data is shown in Table 7 and Figure 7 respectively. It observed that there is a slight increase of 1.9% between 2017 and 2018.

Table 7-Average Yearly Concentration of HCB

	Average Concentration (ng/PUF)	
Parameter	2017	2018
HCB	2.70	2.75

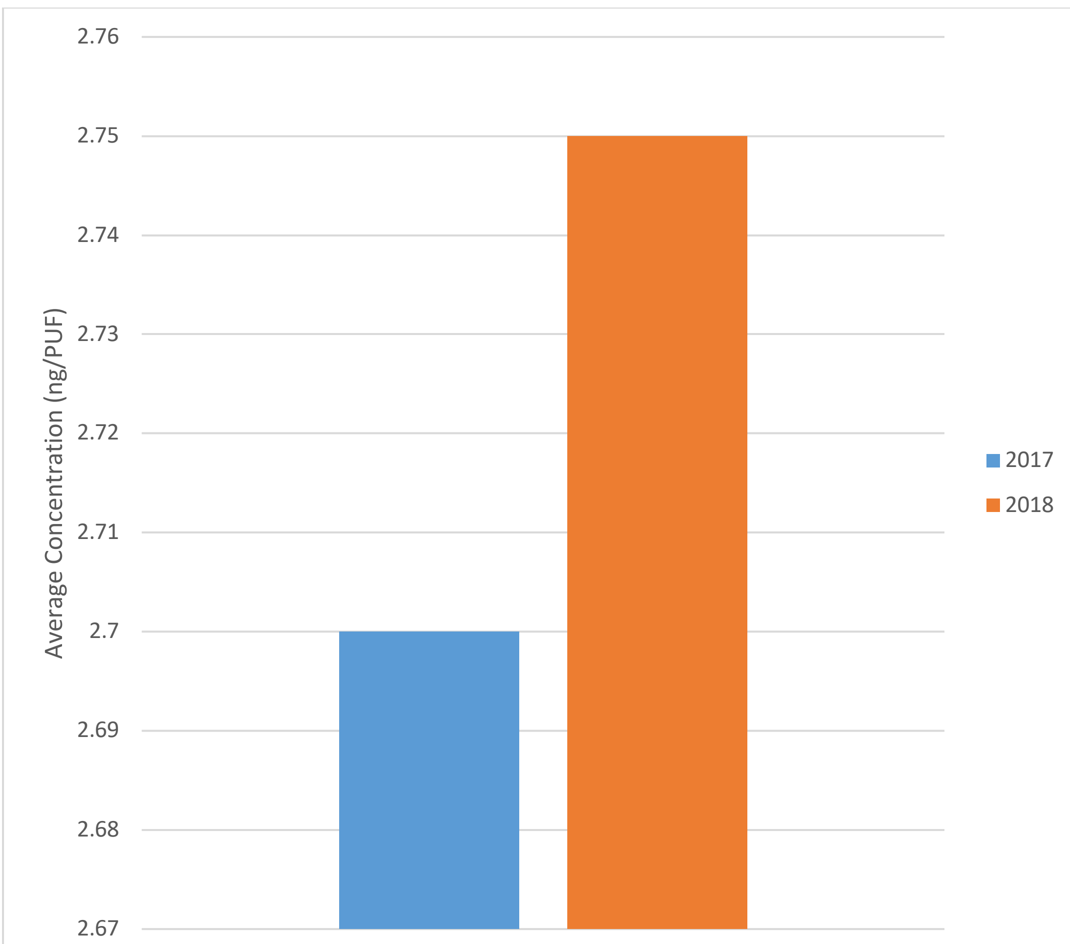

Figure 7-Behavior of HCBs for 2017 and 2018

Polychlorinated biphenyls and congeners

All indicator Polychlorinated biphenyls (PCBs) concentrations for each campaign conducted within the years 2017 and 2018 were below their respective LOQs. Refer to Table 2a in Annex 2.

The average yearly concentration of dioxin like- PCBs (dl-PCBs) is shown in Table 8 and Figure 8 shows the behavior of the data. Most of the average concentrations for the parameters are above their respective LOQs. Most of the parameters showed a slight increase in the average concentration between 2017 and 2018 with the most significant being 13% for PCB 156. Refer to Table 2b Annex 2 for the annual sum concentration of dl-PCBs for 2017 and 2018 respectively.

Table 8-Average Yearly Concentration of dl-PCBs and Congeners

	Average Concentration (pg/PUF)	
Parameter	2017	2018
PCB 77	7.3	7.3
PCB 81	0.8	1.0
PCB 126	2.3	2.5
PCB 169	0.8	<0.3653
PCB 105	22.2	24.5
PCB 114	2.1	1.8
PCB 118	52.2	59.9
PCB 123	1.8	<1.1557
PCB 156	5.5	6.2
PCB 157	1.6	1.9
PCB 167	3.4	3.8
PCB 189	<0.765	<0.8699

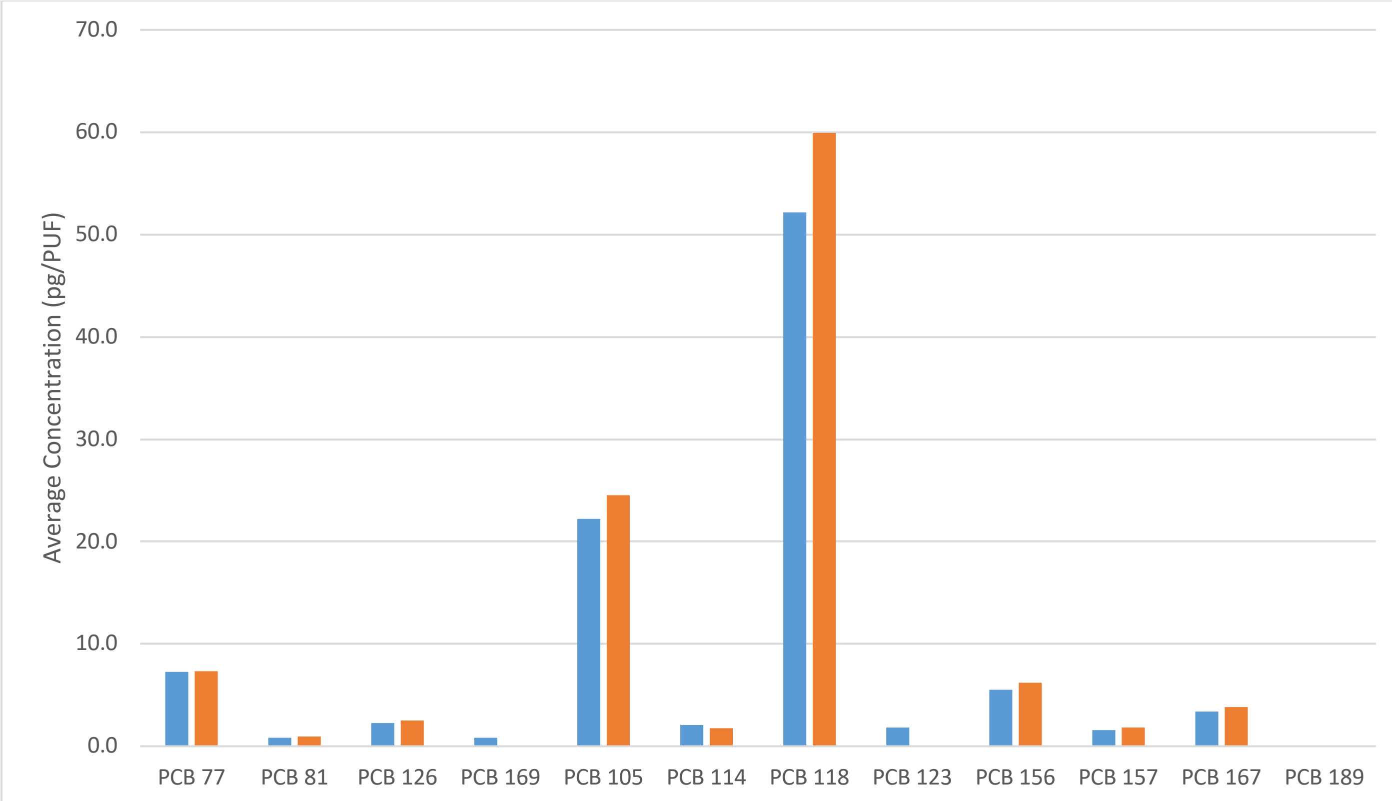

Figure 8-Comparison of dl-PCBs for 2017 and 2018

Polychlorinated Dibenzodioxins and Dibenzofurans and congeners

Most of the data for the Polychlorinated Dibenzodioxins/ Polychlorinated Dibenzofurans (PCDDs/PCDFs) and their congeners are relatively low or below the LOQ. Refer to Table 2c in Annex 2 which shows the sum for each PCDD/PCDF for 2017 and 2018.

Toxic Equivalence (TEQs) - Dioxins and Furans and PCBs similar to Dioxins

The calculated TEQ values for PCDD/PCDFs and dl-PCBs are shown in Table 9 and the behavior is shown in Figure 9. With reference to TEQ PCDD/PCDFs, a significant increase of 233% between 2017 and 2018 observed. Regarding TEQ PCBs, compared to the increase TEQ PCDD/PCDFs, there was a less significant increase of 30% between 2017 and 2018. An overall, TEQ total, increase of 100% was observed.

Table 9-TEQ values for PCDD/PCDFs and dl-PCBs

	ATG(2017-II+III+IV)	ATG(2018-I+II+III+IV)
WHO_{2005}-$TEQ_{PCDD/PCDF}$	0.42	1.4
WHO_{2005}-TEQ_{PCB}	0.77	1.0
WHO_{2005}-TEQ_{total}	1.2	2.4

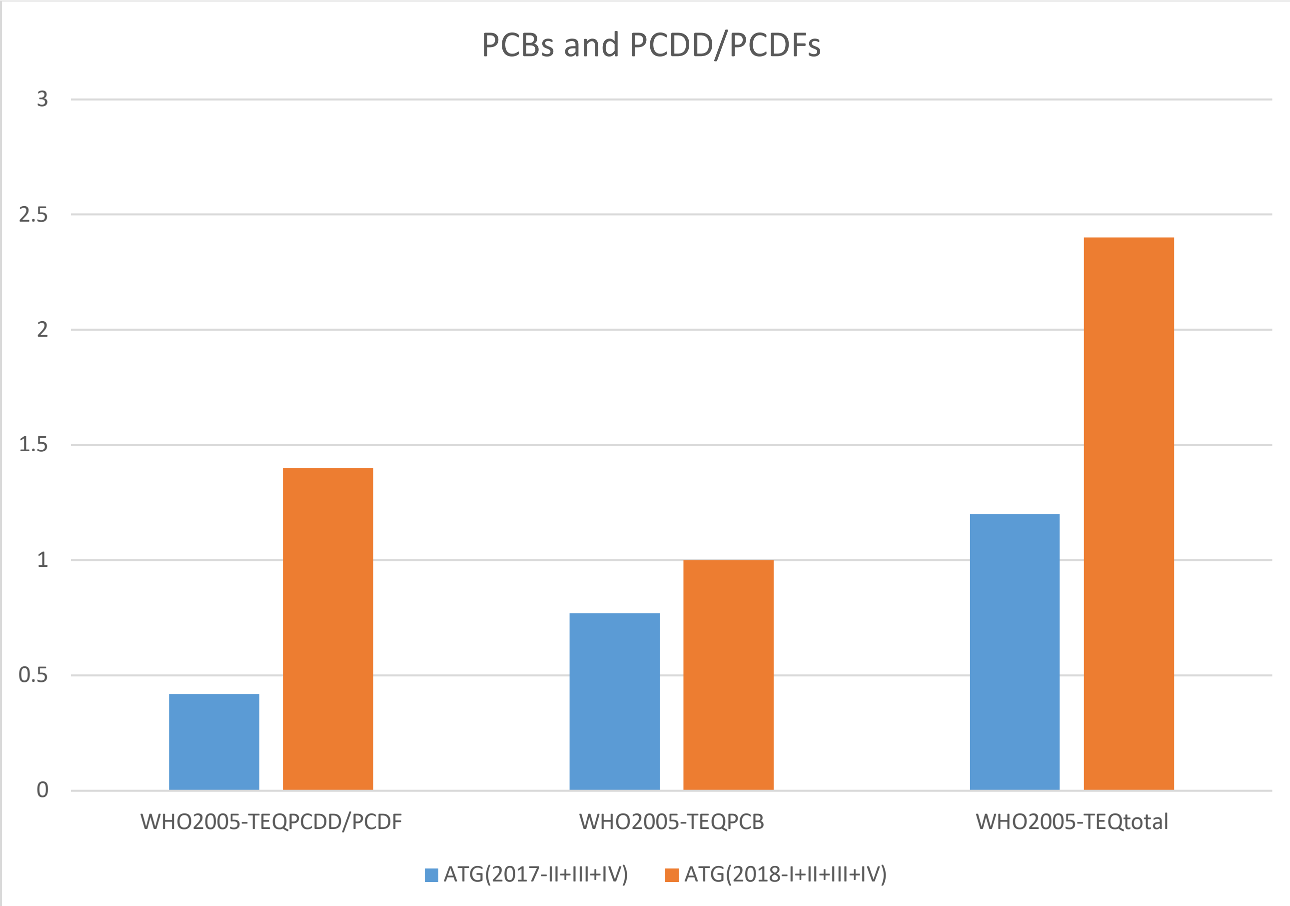

Figure 9-Behavior of PCDD/PCDFs and PCBs for 2017 and 2018

Hexachlorocyclohexane and its isomers

The average yearly concentration for Hexachlorocyclohexane (HCH) is shown in Table 10 and the behavior of the data is shown in Figure 10. While 50% of the data is below the LOQ, the other half of the data showed significant increases between 2017 and 2018. A significant increase of 353% was observed for the isomer a-HCH and a major increase of 195% was also observed for lindane.

Table 10-Average Yearly Concentration of HCH and its Isomers

	Average Concentration (ng/PUF)	
Parameter	2017	2018
a-HCH	0.110	0.498
b-HCH	<0.20	<0.20
d-HCH	<0.20	<0.20
g-HCH (lindane)	0.407	1.200

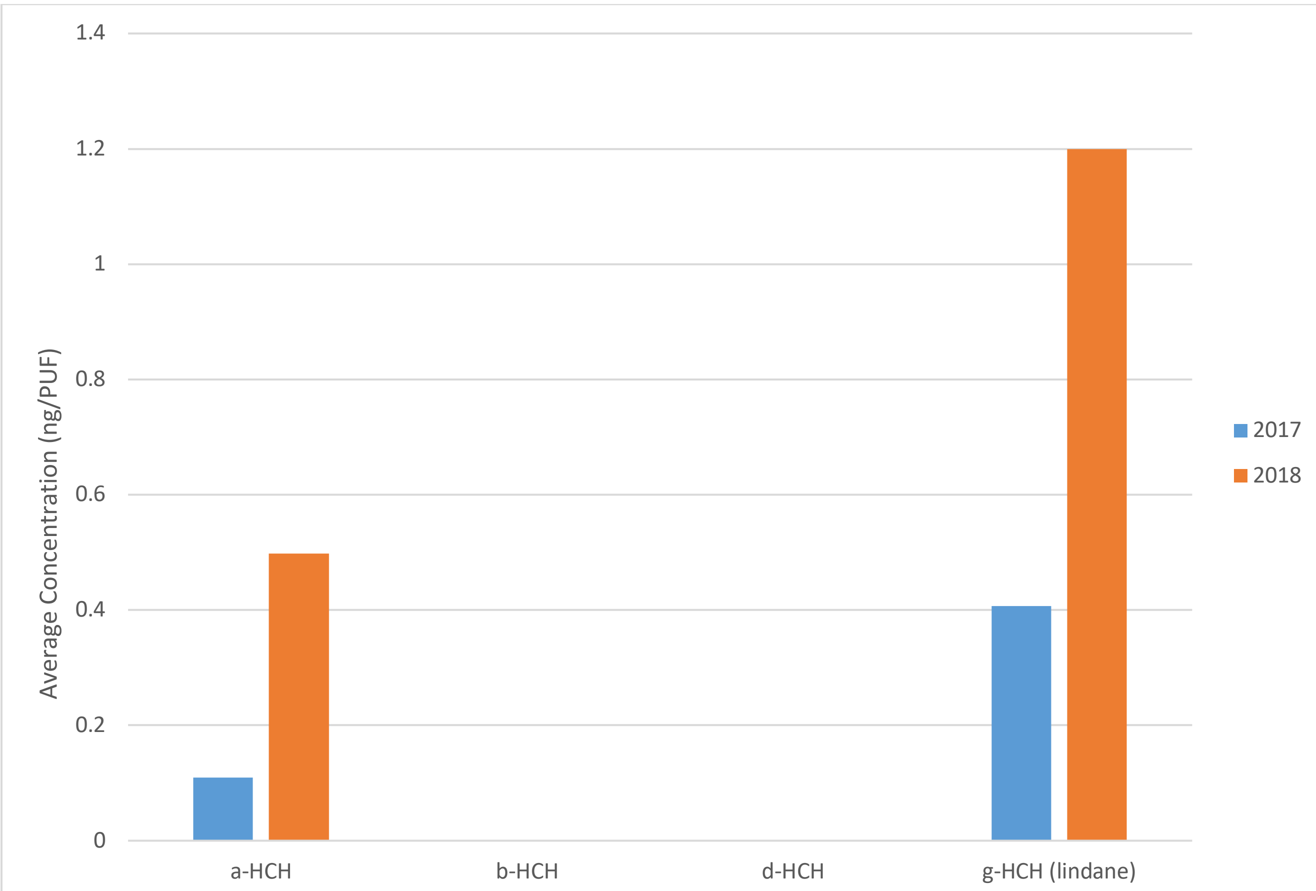

Figure 10-Comparison of the Annual Concentrations of HCHs for 2017 and 2018

Bromine Diphenyl Ethers and their isomers

The average yearly concentration of Bromine Diphenyl Ether (BDE) and its isomers is shown in Table 11 and Figure 11 shows the behavior of the data. The average concentrations of the isomers BDE- 17, 85, 154, and 153 are below their LOQs for both 2017 and 2018. A decrease was observed for the remaining isomers except for BDE-183 where an increase is observed. This increase was attributed to the value of 3.04 ng/PUF which was observed in quarter one of 2018; the remaining three quarters showed values below the LOQ. Refer to Table 2d in Annex 2.

Table 11-Average Yearly Concentration of BDE and its Isomers

	Average Concentration (ng/PUF)	
Parameter	2017	2018
BDE-17	<0.03	<0.03
BDE-28	0.027	0.020
BDE-47	0.407	0.260
BDE-66	0.100	0.050
BDE-100	0.043	0.028
BDE-99	0.167	0.043
BDE-85	<0.07	<0.07
BDE-154	<0.16	<0.16
BDE-153	<0.50	<0.50
BDE-183	<1.00	<1.00

*Note: Value for quarter one was above the LOQ.

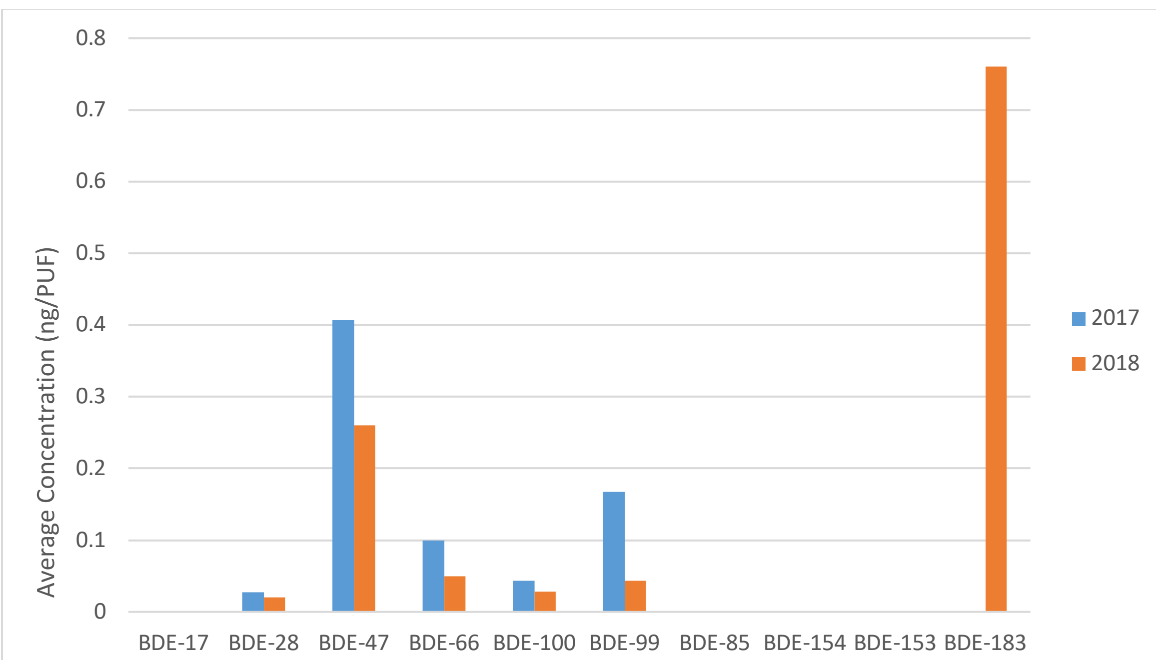

Figure 11-Comparison of the Annual Concentrations of BDEs for 2017 and 2018

Pentachlorobenzene

The average yearly concentration for Pentachlorobenzene (PeCB) is shown in Table 12 and the behavior of the data is shown in Figure 12. A significant increase of 353% was observed between 2017 and 2018.

Table 12-Average Yearly Concentration of PeCB

	Average Concentration (ng/PUF)	
Parameter	2017	2018
PeCB	0.110	0.498

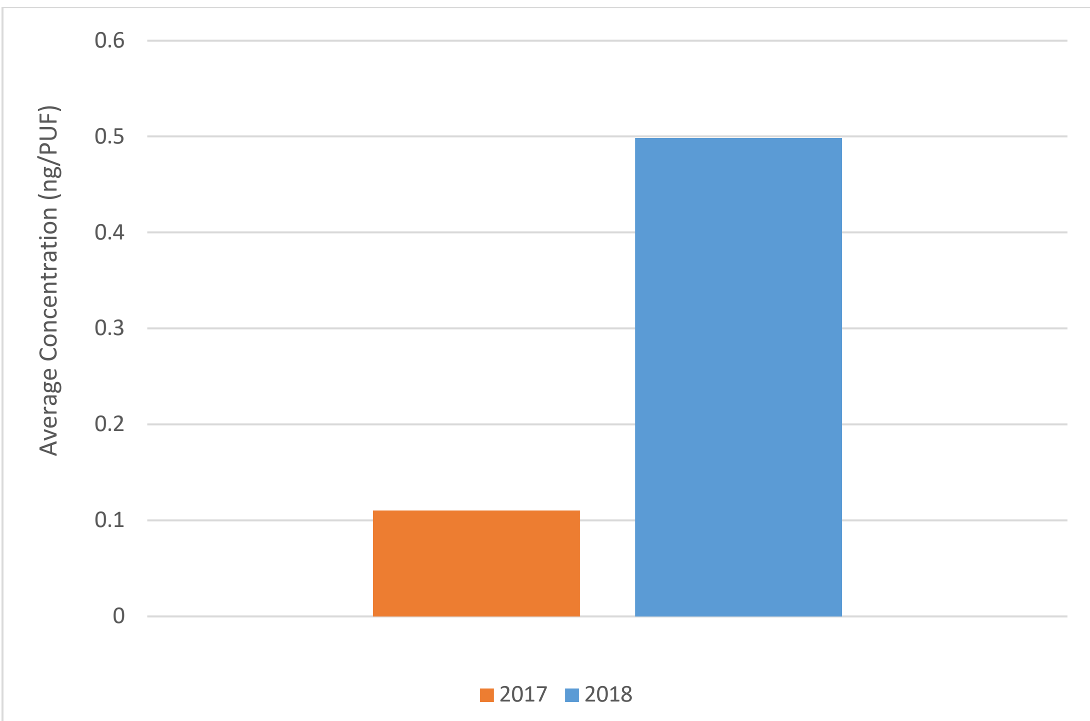

Figure 12-Comparison of the Annual Concentrations of PeCBs for 2017 and 2018

Hexabromocyclododecane and its Isomers

The average yearly concentrations of Hexabromocyclododecane (HBCD)and its isomers is shown in Table 13 and the behavior of the data is shown in Figure 13. All data is above the LOQ. A decrease was observed for all the isomers. A 52% decrease was observed for a-HBCD, 63% for b-HBCD and 42% for g-HBCD.

Table 13-Average Yearly Concentrations for HBCDs for 2017 and 2018

	Average Concentration (ng/PUF)	
Parameter	2017	2018
a-HBCD	0.793	0.380
b-HBCD	0.327	0.120
g-HBCD	0.860	0.500

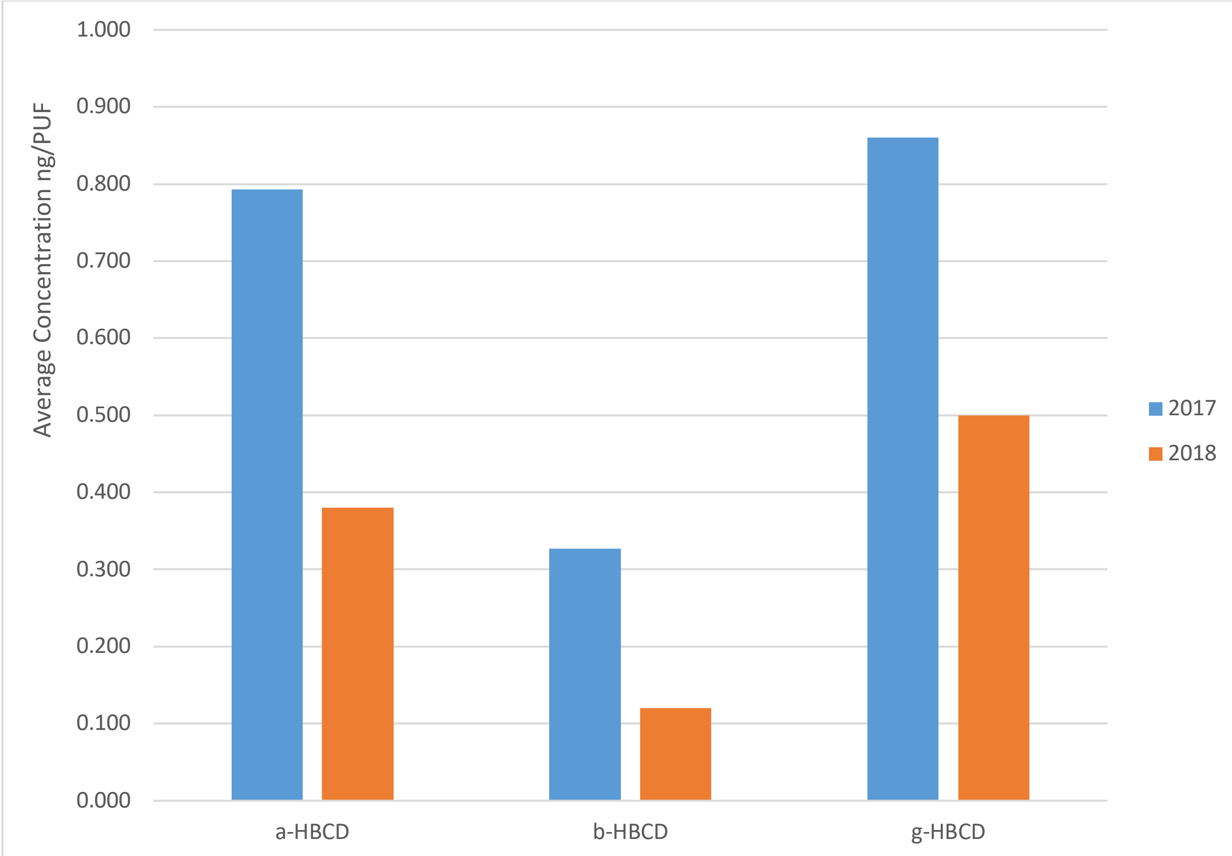

Figure 13-Comparison of the Annual Concentrations of HBCDs for 2017 and 2018

Per- and Polyfluorinated Substances

With regards to Perfluorooctane sulfonic acid (PFOS), there is no reported data for the last three quarters of 2018. An upwards trend is observed for the last two reported data values, ATG (2017-IV) and ATG (2018-I), for ΣPFOS. Refer to Table 2e in Annex 2 for further data regarding PFOS.

Shown in Figure 14 and Figure 15 respectively, is the trend in the concentration of Perfluorohexane sulfonate (PFHxS) and Perfluorooctanoic acid (PFOA) between 2017 and 2018. Regarding PFHxS, although there was a slight decrease in concentration between the second and third quarters of 2018, based on the trendline, there is an evident upwards trend observed. For PFOA, although there is a notable decline in concentration observed from the second quarter of 2018, based on the trendline, there is still a slight upwards trend being observed.

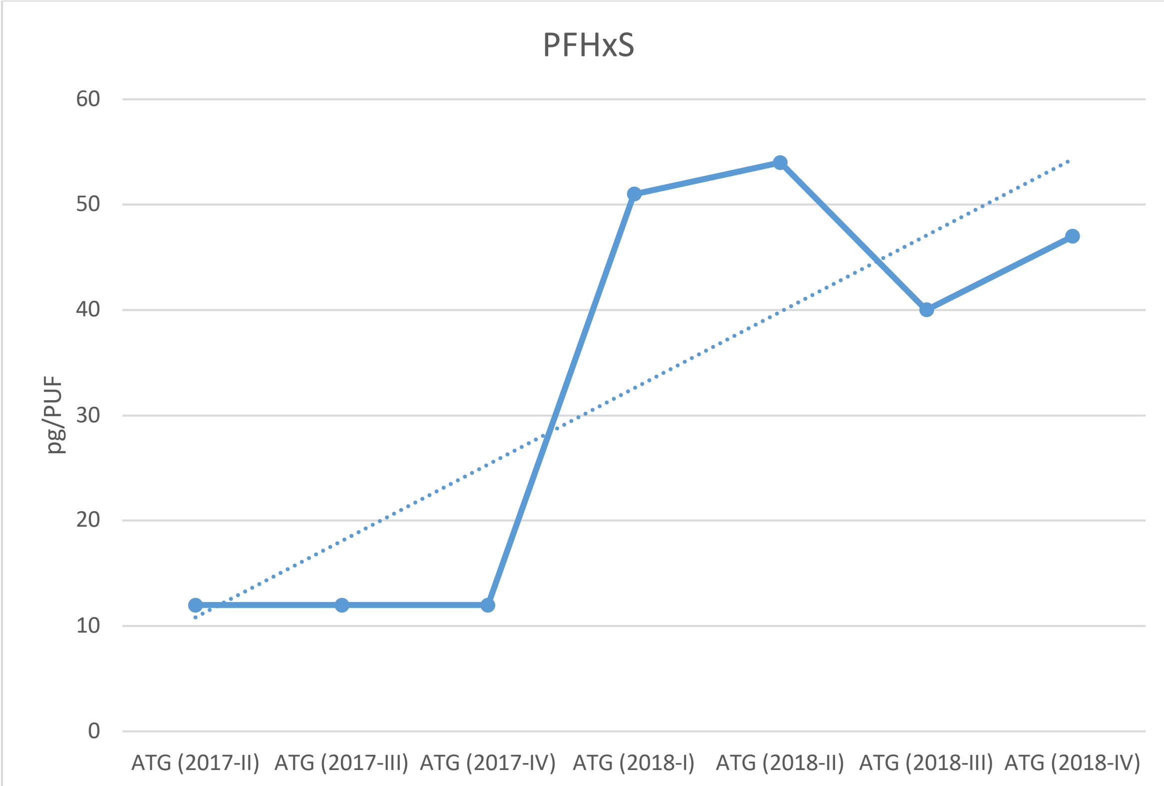

Figure 14-Concentration of PFHxS for the period of 2017 and 2018

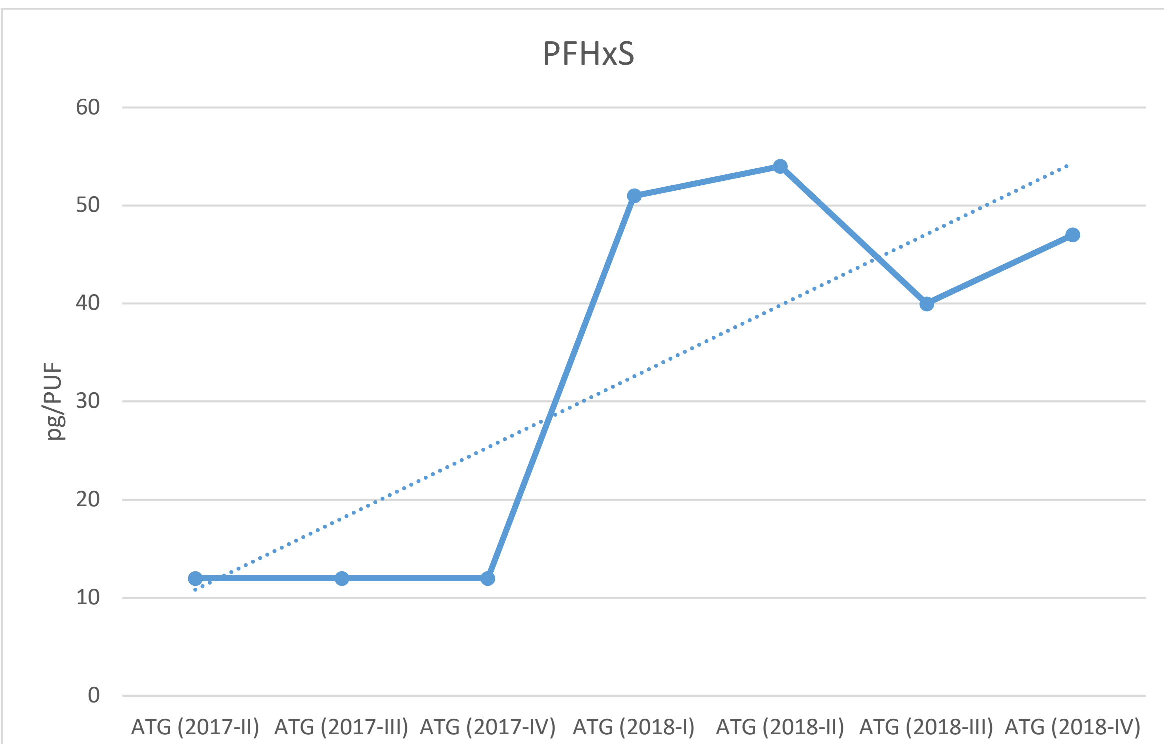

Figure 15-Concentration of PFOA for the period of 2017 and 2018

HUMAN MILK SURVEY

Persistent Organic Pollutants' nature to dissolve in and bioaccumulate in fatty tissue, allowed for the monitoring of human milk to assess both maternal and infantile health risks.

Coordination:

The Human Milk Survey was co-coordinated by Mrs. Andrea Marshall with the assistance of Mr. Ian Francis, who conducted interviews and facilitated the collection of samples from candidates.

A total of 97 candidates were identified and interviewed. Of the mothers initially committing to providing a sample, 25 samples were successfully collected and the pool consisting of 25 ml each, was shipped for analysis to CVVA, Freiburg, Germany on 27 April 2018.

Methodology:

The Sir Lester Bird Medical Centre hospital administration was formally approached to obtain consent and aid in the selection of new mothers based on the stipulated criteria:

1. First-time mothers between the ages of 18 and 40 years old.
2. Supplied milk must be extracted within the first six (6) weeks of confinement.

A list of prospective participants was obtained by the co-ordinators. The prospective participants were contacted to sensitise them as to the purpose of the study and to ascertain their interest in participation. Interviews were set up to issue the questionnaires, consent forms and the sample bottles. Follow- up interviews were conducted to obtain the requisite information and the samples. 50mL samples were obtained from each eligible mother. 25mL aliquots were pooled to obtain an overall national sample, which was sent for testing. The remaining 25mL aliquots were retained for testing at the Department of Analytical Services.

Results

In 2008 the sum of dioxins and dioxin-like PCBs was 7.14 pg TEQ/g fat[2]. Dioxin-like PCBs had lower levels (2.87 pg TEQ/g fat) compared to dioxins (4.27 pg TEQ/g fat). In 2018 the sum of dioxins and dioxin-like PCBs was 2.92 pg TEQ/g fat and the level of dioxin-like PCBs was much lower (0.55 pg TEQ/g fat) compared to dioxins (2.37 pg

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[2] 1 pg = 1 picogram = a trillionth of gram = 10^{-12} g

TEQ/g fat). The 2018 human milk data indicate that levels have considerably decreased for total TEQ by more than 65% including a decrease for PCDD/F by 45% and for PCBs by more 80%.

The level of the sum of non-dioxin-like PCBs (PCB #28, 52, 101, 138, 153, 180) in breast milk was 28.9 ng/g fat[3] in 2008 and decreased by more than 60% to 11.08 ng/g fat in 2018.

The concentration for DDT, DDE, and DDD in human milk from Antigua and Barbuda was 193.3 ng/g fat in 2008 and has decreased by 67% to 63.14 ng/g fat in 2018. This indicates that DDT concentration in human milk and exposure of breastfed infant have decreased by more than 65% within the 10 years.

In 2008 the concentrations of dieldrin, chlordane, heptachlor, hexachlorobenzene (HCB) and toxaphene in human breast milk samples from Antigua and Barbuda were 2.6, 4.4, 1.4, 5.3, and 1.3 ng/g fat. respectively, and have dropped until 2018 to 1.86, 1.36, 1.02, 4.50, and 0.71 ng/g fat, respectively.
The concentrations of lindane (γ-HCH) and β-HCH in human milk have declined from 1.1 and 3.9 ng/g fat, respectively, in 2008 to 0.8 and 1.29 ng/g fat, respectively, in 2018.

Both in 2008 and in 2018 the concentrations of α-HCH, aldrin, endrin, and mirex were below the detection limit of 0.5 ng/g fat.

In 2018 the sum of 25 PBDE congeners (without PBDE 209) was 15.49 ng/g fat. The highest levels were measured for BDE-47 (7.24 ng/g fat), BDE-153 (3.12 ng/g fat), BDE-99 (1.67 ng/g fat), and BDE-100 (1.51 ng/g fat). Levels were only slightly lower (18%) compared to 2008, when the sum of 6 PBDE congeners had been measured and was about 19 ng/g fat.

Newly listed POPs in human milk that were analyzed in 2018, but not in 2008.

The pooled human milk samples from 2018 were also analyzed for the newly listed POPs and related substances: Hexabromocyclododecane (HBCD), short-chained chlorinated paraffins (SCCPs), medium-chained chlorinated paraffins (MCCPs), polychlorinated naphthalenes (PCNs), perfluorooctanesulfonic acid (PFOS), perfluorooctanoic acid (PFOA), perfluorohexanesulfonic acid (PFHxS), endosulfan, hexabromobiphenyl (HBB), pentachlorobenzene (PeCB), pentachlorophenol (PCP), pentachloroanisole, hexachlorobutadiene (HCBD), p,p'-dicofol, and chlordecone.

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[3] 1 ng = 1 nanogram = a billionth of gram = 10^{-9} g

In 2018 the concentration of α-HBCD was 0.30 ng/g fat, and β- and γ-HBCD were below the detection limit of 0.1 ng/g fat.

Levels of PFOS, PFOA, and PFHxS in human milk are given on a wet weight basis. The concentrations of (linear) PFOS, PFOA, and PFHxS were 11.0, 18.5 und <5.5 pg/g wet weight, respectively. Branched PFOS were also analyzed, and a concentration of 2.5 pg/g wet weight was determined. The concentration of short-chained chlorinated paraffins (SCCPs) in human milk of Antigua and Barbuda was 31 ng/g fat in 2018. The level of medium-chained chlorinated paraffins (MCCPs) was 56 ng/g fat, higher than for SCCPs. The sum of SCCP and MCCP (87 ng/g) (See Annex 3 for more information)

Also, levels of 26 PCN congeners were measured in breast milk from Antigua and Barbuda. Levels ranged from <0.035 pg/g fat to 15.25 pg/g fat (PCN 52/60). The PCN-TEQ was determined and was between 0.007 pg TEQ/g fat (lower bound) and 0.05 pg TEQ/g fat (upper bound).

Endosulfan, hexabromobiphenyl, pentachlorobenzene, pentachlorophenol (PCP), and chlordecone were below the detection limit of 0.5 ng/g fat, and pentachloroanisole, hexachlorobutadiene (HCBD) and p,p'-dicofol were below 1 ng/g fat.

NATIONAL SAMPLES

National samples were prepared in accordance with the Standard Operating Procedures (SOPs) as outlined in the UNEP document entitled "Protocol for the Sampling and Pre-treatment of National Samples within the UNEP/GEF Projects to Support the Global Monitoring Plan of POPs 2016-2019". Several matrices of national interest were sampled to determine the potential Persistent Organics Pollutants exposure and to provide baseline data. These matrices were:

- Water (from a national surface water source- Potworks Dam)
- Sediment (from a national surface water source- Potworks Dam)
- Soil- Cattle wash-Paynter's
- Fish
- Eggs
- Vegetables

Coordination:

Coordination of the National samples was executed by the Department of Analytical Services. The matrices were water, sediment, soil, fish, eggs, and vegetable matter. For the timely and efficient collection of samples, the aid of additional government agencies was employed. These include The Sir Lester Bird Medical Center, The Antigua Fisheries Limited, and Point Wharf Fisheries.

Methodology:

Pretreatment of samples

This includes the homogenization and subsequent splitting into equal parts, from which a portion was sent to the reference laboratory and the other was retained by The Department of Analytical Services. The utmost care was taken to avoid contamination through the thorough cleaning of workstations, equipment, and apparatus between each sample type.

Pretreatment of equipment and apparatus

The equipment and apparatus utilized were washed with detergent, rinsed with warm water, ethanol, and hexane, and then allowed to dry before use.

Equipment and Apparatus:

- Glass sample bottles (1L)
- Sample rod
- Cooler with Ice packs
- forceps
- knives
- shovels
- 2 mm sieves
- blender
- aluminum bowl
- glass jars
- stainless steel buckets
- Soil Auger

Personal Protection:

The following Personal Protective Equipment were utilised in the acquisition of samples:

- Gloves
- Rubber boots
- Long sleeve lab coats
- safety goggles.

Transportation:

The Department vehicle, devoid of additional personal or extraneous matter.

Geo-referencing or photographic registers:

GPS coordinates were taken at all sample sites.

Standardized protocol:

Laboratory protocol for sampling surface water, soil, and sediment was observed in addition to general laboratory work instructions and Standard Operation Procedures (SOPs).

Labeling:

Clear-defined labels were placed on each bottle/jar containing a sample.

Sampling

Abiotic samples (Water, Soil and Sediment)

Water Sampling

As with the passive air sampling, it was important to assess the water quality of a major water source for POPS in a bid to ascertain the human health and environmental health impacts. The Pot Works Dam was chosen as it is the largest surface water source providing the island with potable water. It was thought that such an assessment would give a representative perspective of the quality of water reaching any resident.

Water grab samples were collected at the Potworks Dam as summarized below:

1. Two precleaned glass sample bottles (1L) were attached to a sample rod and submerged below the surface of the water.
2. Once full the glass jars were removed from the sample rod and covered with their cap.
3. The samples were adequately labeled and refrigerated until time for the shipment to the reference laboratory.
4. GPS coordinates for the location of water sampling were recorded. See Annex 2.

Soil & Sediment Sampling:

Soil samples were collected from the cattle wash station located in Paynter's Antigua. Care was taken to avoid sandy soil as sufficient organic carbon is needed for the analysis of POPs.

1. The area was cleared with a machete to remove grass and debris.
2. A precleaned soil auger was used to dig the soil to the 30cm mark.
3. The soil was then placed into a precleaned aluminum bucket and transported back to the laboratory.
4. The soil was then allowed to air dry and homogenized and split into equal parts for shipment to the reference laboratory and retention by the department of analytical services.
5. The same procedure was followed for the sampling of sediment at the Potworks Dam.

Biotic Samples (Eggs, Fish, Vegetable Matter)

Eggs:

The Wadadli Eggs brand was chosen and purchased at Billy's supermarket.

1. Three dozen eggs were homogenized in a precleaned blender and mixed thoroughly.
2. The egg mixture was then divided into three 1kg portions and poured into large glass jars.
3. Each glass jar containing 1kg of egg mixture was then deep frozen, and two were shipped to reference laboratories while one was retained by the Department of Analytical Services.

Fish:

Fish species of interest (traditionally eaten locally) for sampling were wild caught off the coast of Antigua. All fish sampled were purchased from the Point Wharf Fisheries Complex.

1. The fish was filleted using precleaned knives and scalpels.
2. Blood, scales, and any other extraneous matter were washed away from the fillet using distilled water.
3. Samples were then homogenized and put in a glass jar (1kg).
4. The sample was deep-frozen and shipped to the reference laboratory in the frozen state.

Vegetables:

Vegetable Samples were purchased at the local market and were in a freshly harvested state when sampled. These samples were a composite of produce acquired from different vendors.

1. A pre-cleaned knife or scalpel was used to remove the peel or other inedible parts of the vegetable.
2. The vegetable samples were then homogenized in a precleaned mixer and split into three equal parts, 500g per portion.
3. The samples were then deep frozen and two were sent to reference laboratories while the other was retained by the Department of Analytical Services.

Antigua and Barbuda facilitated two shipments of national samples to the expert laboratories in Spain and Sweden. The first shipment of national samples, comprising of the aforementioned matrices, were sent to Spain. However, owing to customs restrictions in Barcelona, Spain the samples were rejected. A second shipment, comprising of fish, sediment, soil, eggs, and water, was subsequently sent to Sweden. Tables 14-16 highlight the information for the first shipment. A repeat sampling was prepared for shipment to Orebro University, Sweden for onward submission to CSIC Spain. Table 17 and 18 highlight the information for the second shipment.

Table 14-First Shipment: Samples Shipped to CSIC Barcelona, Spain

Sample no.	Sample type	Parameter
001A	Butter Nut Squash	OCPs
002A	Pumpkin	OCPs
003A	Sweet Potato	OCPs
004A	Conch	OCPs and Indicator PCB
004D	Conch	dl-POP
004E	Conch	PBDE
005A	Marlin	OCPs and Indicator PCB
005E	Marlin	dl-POP
005F	Marlin	PBDE
006A	Reef Snapper	OCPs and Indicator PCB
007B	Potworks water	OCP and Indicator PCB
008A	Potworks Sediment	OCP and Indicator PCB
008B	Potworks Sediment	dl-POP
009C	Eggs	OCP
009D	Eggs	PBDE
010A	Soil	OCP and Indicator PCB
010B	Soil	dl-POP
010D	Soil	Toxaphene

Table 15-First Shipment: Samples Shipped to Orebro University (First Shipment)

Sample No.	Sample Type	Parameter
004B	Conch	PFOs
005B	Marlin	PFOs
006B	Reef Snapper	PFOs
007A	Potworks Water	PFOs
008C	Potworks Sediment	PFOs
009A	Eggs	PFOs
010C	Soil	PFOs

Table 16-First Shipment: Samples Shipped to VU Amsterdam

Sample No.	Sample Type	Parameter
005D	Marlin	HBCD Isomers
009B	Eggs	HBCD Isomers
006C	Reef Snapper	HBCD Isomers

Table 17-Second Shipment: Samples Shipped to Barcelona, Spain (via Sweden)

Sample no.	Sample type	Parameter
001A	Trigger Fish	Indicator PCBs
001B	Trigger Fish	dl-POP, PCDD and dl PCB
002B	Parrot Fish	dl-POP and Indicator PCB
003A	Potworks Sediment	dl-POP and Indicator PCB
003B	Potworks Sediment	dl-POP and Indicator PCB
004A	Wadadli Eggs	dl-POP and Indicator PCB
005A	Livestock Wash Soil	dl-POP and Indicator PCB

Table 18-Second Shipment: Samples Shipped to Sweden

Sample no.	Sample type	Parameter
001C	Trigger Fish	PFOS
002C	Parrot Fish	PFOS
003C	Potworks Sediment	PFOS
004C	Wadadli Eggs	PFOS
005B	Livestock Wash Soil	PFOS
006A	Potworks Water	PFOS

Table 19-Samples Retained in Antigua and Barbuda

Sample no.	Sample type	Parameter
001B	Butternut Squash	OCPs
002B	Pumpkin	OCPs
003B	Sweet Potato	OCPs
004C	Conch	OPCs
005C	Marlin	OCPs
007C	Potworks Water	OCPs
008D	Potworks Sediment	OCPs
009E	Egg	OCPs
010E	Soil	OCPs

Results

Dioxin-like POPs

The TEQ values of dioxin-like POPs, found in both biotic and abiotic samples, are shown in Table 20. In terms of the biotic samples, it was observed that PCDDs/PCDFs had lower TEQs when compared to the values observed for the PCBs. It was also observed that fish sample 001B has the highest total TEQ in terms of the total mass. Fish samples had higher TEQ values overall amongst the biotic samples.

For the abiotic samples, it was observed that the soil sample, 005A, had higher TEQ values for both types of POPs and in total. See Tables 4a, 4b, 4c and 4d in Annex 4 for further information.

Table 20 – Sum TEQ of Dioxin-like POPs in National Samples

	Matrix	Sample-ID	Units	WHO_{2005}-$TEQ_{PCDD/PCDF}$	WHO_{2005}-TEQ_{PCB}	WHO_{2005}-TEQ_{total}
Biotic	Eggs	004A	pg total	0.87	0.28	1.15
			pg / g fresh	0.03	0.01	0.04
			pg / g fat	0.15	0.04	0.20
	Fish	002B	pg total	0.59	0.36	0.95
			pg / g fresh	0.01	0.01	0.01
			pg / g fat	2.94	1.82	4.76
		001B	pg total	0.92	0.38	1.30
			pg / g fresh	0.01	0.01	0.02
			pg / g fat	3.07	1.28	4.34
Abiotic	Soil	005A	pg / g dry	2.64	0.13	2.77
	Sediment	008A(*)		1.46	0.05	1.51
		008B(*)		0.67	0.05	0.72

Note: (*) Same sample in different jar

Non-Dioxin-like Polychlorinated Biphenyls and their Congeners

Table 21 shows the sum of non-dioxin-like PCBs found in biotic and abiotic national samples. It was observed that the eggs, sample 004A, had the highest sum for the biotic sample in terms of total mass. However, it must be noted that two of the fish samples, samples 002B and 001B, had high sum values of 15479 pg/g fat and 14434 pg/g fat, respectively. The soil sample, 005A, had the highest sum value, 2017 pg/ g dry amongst the abiotic samples. See Table 4e, 4f, 4g and 4h in Annex 4 for further information.

Table 21-Sum non-Dioxin-like PCB Congeners in National Samples

	Matrix	Sample-ID	Units	Sum Indicator PCB
Biotic	Eggs	004A	pg total	1037
			pg / g fresh	162
			pg / g fat	819
	Fish	002B	pg total	640
			pg / g fresh	47
			pg / g fat	15479
		001B(*)	pg total	627
			pg / g fresh	65
			pg / g fat	14434
		001A(*)	pg total	645
			pg / g fresh	66
			pg / g fat	<LOQ
Abiotic	Soil	005A	pg / g dry	207
	Sediment	008A(*)		140
		008B(*)		198

Note: (*) Same sample in different jar

Organochlorine POPs

For the analyzed biotic and abiotic samples, most results for the Organochlorine POPs were below their respective LOQs. It must be noted that while the OCP concentrations for the fish samples were below the LOQ, or not analyzed in some cases, there were notable concentrations of p-p' DDE (1717 pg total and 212 pg/ g fresh), and p-p' DDT (84 pg total and 10 pg/ g fresh) were observed for the egg sample 004A.

For the abiotic samples, while majority of the results were below their respective LOQs or not analyzed, there were notable concentrations observed for several OCPs. Organochlorine POPs p-p' DDE and p-p' DDT were found in the analyzed soil and sediment samples. It was observed that the soil sample, 005A, had the highest concentration of p-p' DDE, >25598 pg/ g dry, and p-p' DDT, >15060 pg/ g dry, amongst the abiotic samples. For the soil sample, other DDT isomers were found to have concentrations above their respective LOQs. Other than the aforementioned DDT isomers, lindane, at a concentration of 307 pg/ g dry, was found in sediment sample 008B. Refer to Tables 4i, 4j and 4k in Annex 4 for additional information.

Polybrominated Diphenyl Ethers and their Congeners

Table 22 shows the sum of PBDEs found in biotic and abiotic national samples. It was observed that for the biotic samples, the fish samples had sum values that were more than three (3) times that of the eggs sample. When comparing the biotic samples, it was observed that the soil sample, 005A, had a higher sum, 317 pg/g dry, than the sediment samples. See Tables 4l, 4m and 4n in Annex 4 for additional information.

Table 22-Detection of PBDE Congeners in National Samples

	Matrix	Sample-ID	Units	Sum Indicator PBDEs
Biotic	Eggs	004A	pg total	648
			pg / g fresh	80
	Fish	002B	pg total	2229
			pg / g fresh	371
		001B(*)	pg total	2350
			pg / g fresh	346
		001A(*)	pg total	2748
			pg / g fresh	309
Abiotic	Soil	005A	pg / g dry	317
	Sediment	008A(*)		272
		008B(*)		246

Note: (*) Same sample in different jar

Per- and Polyfluorinated Substances

Shown in Table 23 are concentrations of PFOS, PFOA and PFHxS, found in biotic and abiotic national samples. Fish sample, 005B, was observed to have the highest concentrations PFOS, PFOA and PFHxS amongst the biotic samples. For the biotic samples, L-PFOS, when compared to br-PFOS, was observed to have a higher concentration regardless of the matrix for the biotic samples; sample 005B had a L-PFOS concentration of 1269 pg/g.

The soil samples were observed to have lower concentrations of PFOS, PFOA and PFHxS when compared to the sediment samples. Like the biotic samples, the sediment and the soil samples were observed to have higher concentrations L-PFOS compared to br-PFOS. Further, for all the abiotic samples, L-PFOS was also observed to have the highest concentration amongst all the analyzed per- and polyfluorinated substances.

Table 23-Detection of PFOS, PFOA and PFHxS in National Samples

	Matrix	Sample-ID	Unit	L-PFOS	br-PFOS	ΣPFOS	PFOA	PFHxS
Biotic	Egg	004C	pg/g	33.60	14.14	47.74	14.07	6.88
	Fish Egg	009A	pg/g	10.29	4.84	15.13	<6.2	<5.6
	Fish	001C	pg/g	6.20	<1.2	6.20	13.06	<5.6
		002C	pg/g	8.40	2.43	10.83	9.66	<5.6
		004B	pg/g	8.00	3.22	11.22	16.43	<5.6
		005B	pg/g	1269	206	1475	160	13.02
		006B	pg/g	6.20	<1.2	6.20	9.19	<5.6
Abiotic	Sediment	008B	pg/g	433	24.76	458	45.45	49.52
		003C	pg/g	186	27.76	213	33.07	6.94
	Soil	005C	pg/g	170	24.18	194	61.13	33.6
		010C	pg/g	143	25.30	168	43.77	<5.6
	Water	006A	ng/L	1.48	1.15	2.63	2.01	0.48
		007A	ng/L	0.56	0.31	0.87	2.2	0.74

Hexabromocyclododecane Analysis

HBCD was undetectable in the three (3) samples indicated in Table 16 above.

Comparative Analysis of National Samples

The samples outlined in Table 19 were analyses at the national laboratory for organochlorine pesticides with specific emphasis on Heptachlor and Endosulfan. These analytes were below the level of detection for all samples. This was in line with results obtained from national samples analysed at the expert laboratory for these analytes that were generally below the limit of quantitation.

INTERNATIONAL INTER-CALIBRATION STUDY

The interlaboratory assessment was conducted to obtain information on the performance of labs to detect POPS in a standardized solution and matrices of choice. Labs are expected to quantify analyte within a variance of 25%. A z-score is assigned based on the 25% error and labs are required to obtain a z-score of 2 or higher.

Antigua and Barbuda participated in the third and fourth rounds of the interlaboratory assessment and focused on the quantitation of OCPs based on the equipment configuration (GC-ECD).

During the third round, the laboratory produced unsatisfactory results for the two (2) analytes reported. During the fourth round, four (4) results were reported with one (1) satisfactory result, one (1) questionable result, and two (2) unsatisfactory results.

Overview

National Capacity

The Department of Analytical Services, the nation's sole analytical laboratory, has the capacity to conduct POPs analysis.

During the course of the project, there were two (2) technical staff, trained to carry out analytical chemistry tests, inclusive of screening for POPs.

The laboratory was furnished with a Gas Chromatograph- Agilent 7890A (ECD-FID). Analogic Solutions, the supplier located in Trinidad and Tobago, conducted the installation in 2016 and provides the annual maintenance.

Constraints

The laboratory was plagued with equipment failure and unavailability of analysts. Retaining analysts during the course of the project proved challenging and led to a limited testing scope. The governance structure of the laboratory was a significant constraint as it relates to the hiring of new staff.

Addressing Constraints and Sustainability:

The following capacity constraints have been addresses:

1. Governance structure – Draft legislation has been developed to transition the Department of Analytical Services to Statutory body that would be responsible for national testing and research.
2. Staffing – Three additional Chemists have been hired to enhance the technical capacity to analyse for POPs and other contaminants.
3. Test equipment – GC-MSD was acquired with the assistance of the International Atomic Energy Agency to execute national project "Using nuclear technology to assess pollution of the marine and terrestrial environment and impact on human health". This allows to expanded capacity to analyse for POPs.

Capacity Building Activities

a. Trainings

   CSIC facilitated POPs analysis training in 2019 to include:

   - Extraction and purification of POPS from biotic and abiotic samples
   - Review of QA/QC

   Pesticides Research Laboratory, UWI Mona, Jamaica

   - POPs identification in various media
   - PCB analysis
   - Review of QA/QC

CONCLUSION AND RECOMMENDATIONS

The execution of the GMP project provided an opportunity to expand the analytical capacity of the Department of Analytical Services (DAS) to provide POPs regional data towards the assessment of the global levels of POPs.

The equipment configuration of the DAS restricted the analytical scope to OCPs and PCBs and excludes analysis of newly listed POPs fluorinated compounds. Additionally, the staffing capacity was inadequate in the area of POPs analysis during the period of the project.

The training received was beneficial in ensuring that standardized procedures are fully utilized and understood and was likely contributed to the improvement seen in interlaboratory assessment in fourth round compared to the second round.

The results obtained necessitate that a national study is required to determine potential source of POPs in breastmilk, with specific emphasis on brominated flame retardants. Also, the presence of elevated levels of fluorinated POPs in fish requires further investigation.

The following measures are recommended to improve the monitoring of POPs in Antigua and Barbuda:

1. Address governance and institutional arrangements to upgrade the DAS to a statutory entity to ensure investment in analytical capacity and human resource.
2. Improve laboratory infrastructure to support the acquired improved POPS analysis equipment (GC-MS) that was obtained.
3. Increase engagement on capacity building projects to continue addressing analytical capacity constraints.
4. Improve staffing arrangements at the DAS to ensure sustainability of POPs analysis programme.
5. Improve training regime to ensure enhanced technical capacity of analysts.
6. Identify POPs of greatest concern to ensure that the required analytical capacity is developed nationally.
7. Strengthen collaboration and coordination with agencies such as the IAEA to build national capacity.

8. Explore the need for national long-term studies to assess risk to human and environmental health relating to exposure to POPs.
9. Review current air monitoring site to improve data collection in future rounds of the GMP.
10. Commence preparatory steps for participation in the next round of the GMP.

ANNEXES:

Annex 1: Passive Air Sampling Campaigns Data

Table 1a: showing information regarding 2017 Campaign II, the period of exposure and transmission to the Expert Labs

PUF Code	Year-Season	Country of origin, ISO-3 code	PAS site name	GPS coordinates of site	Sampler No.	Destination lab for analysis	Analytes	Name of person who deployed the PUF	Actual exposure start date (dd-mm-yyyy)	Actual exposure end date (dd-mm-yyyy)	Name of person who collected the PUF	Effective days of exposure	Date the PUF was sent to expert lab
ATG-1 (2017-II)	2017-II	ATG	ADC	17°4´37.26"N, 61°45´36.84"W	1	CSIC	OCPs	L Christian	3-Apr-2017	3-Jul-2017	L Christian	91	10-Jul-2017
ATG-2 (2017-II)	2017-II	ATG		17°4´37.26"N, 61°45´36.84"W	2	National Laboratory	OCPs	L Christian	**3-Apr-2017**	**3-Jul-2017**	L Christian	91	10-Jul-2017
ATG-3 (2017-II)	2017-II	ATG	ADC	17°4´37.26"N, 61°45´36.84"W	3	CSIC	PCB (6)	L Christian	3-Apr-2017	3-Jul-2017	L Christian	91	10-Jul-2017
ATG-4 (2017-II)	2017-II	ATG		17°4´37.26"N61° 45´36.84"W	4	National Laboratory	PCB (6)	L Christian	**3-Apr-2017**	**3-Jul-2017**	L Christian	91	10-Jul-2017
ATG-5 (2017-II)	2017-II	ATG	ADC	17°4´37.26"N, 61° 45´36.84"W	5	CSIC	dl-POPs	L Christian	3-Apr-2017	3-Jul-2017	L Christian	91	10-Jul-2017
ATG-9 (2017-II)	2017-II	ATG	ADC	17°4´37.26"N, 61° 45´36.84"W	9	CSIC	PBDE, HBCD, HxBB	L Christian	3-Apr-2017	3-Jul-2017	L Christian	91	10-Jul-2017
ATG-11 (2017-II)	2017-II	ATG	ADC	17°4´37.26"N, 61° 45´36.84"W	11	MTM	PFOS	L Christian	3-Apr-2017	3-Jul-2017	L Christian	91	10-Jul-2017

Table 1b: showing information regarding 2017 Campaign III, the period of exposure and transmission to the Expert Labs

PUF Code	Year-Season	Country of origin, ISO-3 code	PAS site name	GPS coordinates of site	Sampler No.	Destination lab for analysis	Analytes	Name of person who deployed the PUF	Actual exposure starts date (dd-mm-yyyy)	Actual exposure end date (dd-mm-yyyy)	Name of person who collected the PUF	Effective days of exposure	Date the PUF was sent to expert lab
ATG-1 (2017-III)	2017-III	ATG	ADC	17°4´37.26"N, 61°45´36.84"W	1	CSIC	OCPs	L Christian	3-Jul-2017	2-Oct-2017	L Christian	91	13-Oct-2017
ATG-2 (2017-III)	2017-III	ATG	ADC	17°4´37.26"N, 61°45´36.84"W	2	National Laboratory	OCPs	L Christian	**1-Jul-2017**	2-Oct-2017	L Christian	91	13-Oct-2017
ATG-3 (2017-III)	2017-III	ATG	ADC	17°4´37.26"N, 61°45´36.84"W	3	CSIC	PCB (6)	L Christian	3-Jul-2017	2-Oct-2017	L Christian	91	13-Oct-2017
ATG-4 (2017-III)	2017-III	ATG	ADC	17°4´37.26"N, 61°45´36.84"W	4	National Laboratory	PCB (6)	L Christian	**1-Jul-2017**	2-Oct-2017	L Christian	91	13-Oct-2017
ATG-5 (2017-III)	2017-III	ATG	ADC	17°4´37.26"N, 61°45´36.84"W	5	CSIC	dl-POPs	L Christian	3-Jul-2017	2-Oct-2017	L Christian	91	13-Oct-2017
ATG-9 (2017-III)	2017-III	ATG	ADC	17°4´37.26"N, 61°45´36.84"W	9	CSIC	PBDE, HBCD, HxBB	L Christian	3-Jul-2017	2-Oct-2017	L Christian	91	13-Oct-2017
ATG-11 (2017-III)	2017-III	ATG	ADC	17°4´37.26"N, 61°45´36.84"W	11	MTM	PFOS	L Christian	3-Jul-2017	2-Oct-2017	L Christian	91	13-Oct-2017

Table 1c: showing information regarding 2017 Campaign IV, the period of exposure and transmission to the Expert Labs

PUF Code	Year-Season	Country of origin, ISO-3 code	PAS site name	GPS coordinates of site	Sampler No.	Destination lab for analysis	Analytes	Name of person who deployed the PUF	Actual exposure start date (dd-mm-yyyy)	Actual exposure end date (dd-mm-yyyy)	Name of person who collected the PUF	Effective days of exposure	Date the PUF was sent to expert lab
ATG-1 (2017-IV)	2017-IV	ATG	ADC	17°4´37.26"N, 61°45´36.84"W	1	CSIC	OCPs	A Ogunbiyi	2-Oct-2017	2-Jan-2018	A Ogunbiyi	92	2-Jan-2018
ATG-2 (2017-IV)	2017-IV	ATG		17°4´37.26"N, 61° 45´36.84"W	2	National Laboratory	OCPs	A Ogunbiyi	2-Oct-2017	2-Jan-2018	A Ogunbiyi	92	2-Jan-2018
ATG-3 (2017-IV)	2017-IV	ATG	ADC	17°4´37.26"N, 61° 45´36.84"W	3	CSIC	PCB (6)	A Ogunbiyi	2-Oct-2017	2-Jan-2018	A Ogunbiyi	92	2-Jan-2018
ATG-4 (2017-IV)	2017-IV	ATG		17°4´37.26"N, 61° 45´36.84"W	4	National Laboratory	PCB (6)	A Ogunbiyi	2-Oct-2017	2-Jan-2018	A Ogunbiyi	92	2-Jan-2018
ATG-5 (2017-IV)	2017-IV	ATG	ADC	17°4´37.26"N, 61° 45´36.84"W	5	CSIC	dl-POPs	A Ogunbiyi	2-Oct-2017	2-Jan-2018	A Ogunbiyi	92	2-Jan-2018
ATG-9 (2017-IV)	2017-IV	ATG	ADC	17°4´37.26"N, 61° 45´36.84"W	9	CSIC	PBDE, HBCD, HxBB	A Ogunbiyi	2-Oct-2017	2-Jan-2018	A Ogunbiyi	92	2-Jan-2018
ATG-11(2017-IV)	2017-IV	ATG	ADC	17°4´37.26"N, 61° 45´36.84"W	11	MTM	PFOS	A Ogunbiyi	2-Oct-2017	2-Jan-2018	A Ogunbiyi	92	2-Jan-2018

Table 1d: showing information regarding 2018 Campaign I, the period of exposure and transmission to the Expert Labs

PUF Code	Year-Season	Country of origin, ISO-3 code	PAS site name	GPS coordinates of site	Sampler No.	Destination lab for analysis	Analytes	Name of person who deployed the PUF	Actual exposure start date (dd-mm-yyyy)	Actual exposure end date (dd-mm-yyyy)	Name of person who collected the PUF	Effective days of exposure	Date the PUF was sent to expert lab
ATG-1 (2018-I)	2018-I	ATG	ADC	17°4´37.26"N, 61° 45´36.84"W	1	CSIC	OCPs	I Francis	2-Jan-2018	2-Apr-2018	I Francis	90	11-Apr-2018
ATG-2 (2018-I)	2018-I	ATG	ADC	17°4´37.26"N, 61° 45´36.84"W	2	National Laboratory	OCPs	I Francis	2-Jan-2018	2-Apr-2018	I Francis	90	11-Apr-2018
ATG-3 (2018-I)	2018-I	ATG	ADC	17°4´37.26"N, 61° 45´36.84"W	3	CSIC	PCB (6)	I Francis	2-Jan-2018	2-Apr-2018	I Francis	90	11-Apr-2018
ATG-4 (2018-I)	2018-I	ATG	ADC	17°4´37.26"N, 61° 45´36.84"W	4	National Laboratory	PCB (6)	I Francis	2-Jan-2018	2-Apr-2018	I Francis	90	11-Apr-2018
ATG-5 (2018-I)	2018-I	ATG	ADC	17°4´37.26"N, 61° 45´36.84"W	5	CSIC	dl-POPs	I Francis	2-Jan-2018	2-Apr-2018	I Francis	90	11-Apr-2018
ATG-9 (2018-I)	2018-I	ATG	ADC	17°4´37.26"N, 61° 45´36.84"W	9	CSIC	PBDE, HBCD, HxBB	I Francis	2-Jan-2018	2-Apr-2018	I Francis	90	11-Apr-2018
ATG-11 (2018-I)	2018-I	ATG	ADC	17°4´37.26"N, 61° 45´36.84"W	11	MTM	PFOS	I Francis	2-Jan-2018	2-Apr-2018	I Francis	90	11-Apr-2018

Table 1e: showing information regarding 2018 Campaign II, the period of exposure and transmission to the Expert Labs

PUF Code	Year-Season	Country of origin, ISO-3 code	PAS site name	GPS coordinates of site	Sampler No.	Destination lab for analysis	Analytes	Name of person who deployed the PUF	Actual exposure start date (dd-mm-yyyy)	Actual exposure end date (dd-mm-yyyy)	Name of person who collected the PUF	Effective days of exposure	Date the PUF was sent to expert lab
ATG-1 (2018-II)	2018-II	ATG	ADC	17°4´37.26"N, 61° 45´36.84"W	1	CSIC	OCPs	I Francis	2-Apr-2018	1-Jul-2018	I Francis	90	12-Jul-2018
ATG-2 (2018-II)	2018-II	ATG	ADC	17°4´37.26"N, 61° 45´36.84"W	2	National Laboratory	OCPs	I Francis	2-Apr-2018	1-Jul-2018	I Francis	90	12-Jul-2018
ATG-3 (2018-II)	2018-II	ATG	ADC	17°4´37.26"N, 61° 45´36.84"W	3	CSIC	PCB (6)	I Francis	2-Apr-2018	1-Jul-2018	I Francis	90	12-Jul-2018
ATG-4 (2018-II)	2018-II	ATG	ADC	17°4´37.26"N, 61° 45´36.84"W	4	National Laboratory	PCB (6)	I Francis	2-Apr-2018	1-Jul-2018	I Francis	90	12-Jul-2018
ATG-5 (2018-II)	2018-II	ATG	ADC	17°4´37.26"N, 61° 45´36.84"W	5	CSIC	dl-POPs	I Francis	2-Apr-2018	1-Jul-2018	I Francis	90	12-Jul-2018
ATG-9 (2018-II)	2018-II	ATG	ADC	17°4´37.26"N, 61° 45´36.84"W	9	CSIC	PBDE, HBCD, HxBB	I Francis	2-Apr-2018	1-Jul-2018	I Francis	90	12-Jul-2018
ATG-11 (2018-II)	2018-II	ATG	ADC	17°4´37.26"N, 61° 45´36.84"W	11	MTM	PFOS	I Francis	2-Apr-2018	1-Jul-2018	I Francis	90	12-Jul-2018

Table 1f: showing information regarding 2018 Campaign III, the period of exposure and transmission to the Expert Labs

PUF Code	Year-Season	Country of origin, ISO-3 code	PAS site name	GPS coordinates of site	Sampler No.	Destination lab for analysis	Analytes	Name of person who deployed the PUF	Actual exposure start date (dd-mm-yyyy)	Actual exposure end date (dd-mm-yyyy)	Name of person who collected the PUF	Effective days of exposure	Date the PUF was sent to expert lab
ATG-1 (2018-III)	2018-III	ATG	ADC	17°4´37.26"N, 61° 45´36.84"W	1	CSIC	OCPs	I Francis	1-Jul-2018	1-Oct-2018	I Francis	92	5-Nov-2018
ATG-2 (2018-III)	2018-III	ATG	ADC	17°4´37.26"N, 61° 45´36.84"W	2	National Laboratory	OCPs	I Francis	**1-Jul-2018**	1-Oct-2018	I Francis	92	5-Nov-2018
ATG-3 (2018-III)	2018-III	ATG	ADC	17°4´37.26"N, 61° 45´36.84"W	3	CSIC	PCB (6)	I Francis	1-Jul-2018	1-Oct-2018	I Francis	92	5-Nov-2018
ATG-4 (2018-III)	2018-III	ATG	ADC	17°4´37.26"N, 61° 45´36.84"W	4	National Laboratory	PCB (6)	I Francis	**1-Jul-2018**	1-Oct-2018	I Francis	92	5-Nov-2018
ATG-5 (2018-III)	2018-III	ATG	ADC	17°4´37.26"N, 61° 45´36.84"W	5	CSIC	dl-POPs	I Francis	1-Jul-2018	1-Oct-2018	I Francis	92	5-Nov-2018
ATG-9 (2018-III)	2018-III	ATG	ADC	17°4´37.26"N, 61° 45´36.84"W	9	CSIC	PBDE, HBCD, HxBB	I Francis	1-Jul-2018	1-Oct-2018	I Francis	92	5-Nov-2018
ATG-11 (2018-III)	2018-III	ATG	ADC	17°4´37.26"N, 61° 45´36.84"W	11	MTM	PFOS	I Francis	1-Jul-2018	1-Oct-2018	I Francis	92	5-Nov-2018

Table 1g: showing information regarding 2018 Campaign IV, the period of exposure and transmission to the Expert Labs

PUF Code	Year-Season	Country of origin, ISO-3 code	PAS site name	GPS coordinates of site	Sampler No.	Destination lab for analysis	Analytes	Name of person who deployed the PUF	Actual exposure start date (dd-mm-yyyy)	Actual exposure end date (dd-mm-yyyy)	Name of person who collected the PUF	Effective days of exposure	Date the PUF was sent to expert lab
ATG-1 (2018-IV)	2018-IV	ATG	ADC	17°4´37.26"N, 61° 45´36.84"W	1	CSIC	OCPs	I Francis	1-Oct-2018	2-Jan-2019	I Francis	93	22-Feb-2019
ATG-2 (2018-IV)	2018-IV	ATG	ADC	17°4´37.26"N, 61° 45´36.84"W	2	National Laboratory	OCPs	I Francis	**1-Oct-2018**	2-Jan-2019	I Francis	93	22-Feb-2019
ATG-3 (2018-IV)	2018-IV	ATG	ADC	17°4´37.26"N, 61° 45´36.84"W	3	CSIC	PCB (6)	I Francis	1-Oct-2018	2-Jan-2019	I Francis	93	22-Feb-2019
ATG-4 (2018-IV)	2018-IV	ATG	ADC	17°4´37.26"N, 61° 45´36.84"W	4	National Laboratory	PCB (6)	I Francis	**1-Oct-2018**	2-Jan-2019	I Francis	93	22-Feb-2019
ATG-5 (2018-IV)	2018-IV	ATG	ADC	17°4´37.26"N, 61° 45´36.84"W	5	CSIC	dl-POPs	I Francis	1-Oct-2018	2-Jan-2019	I Francis	93	22-Feb-2019
ATG-9 (2018-IV)	2018-IV	ATG	ADC	17°4´37.26"N, 61° 45´36.84"W	9	CSIC	PBDE, HBCD, HxBB	I Francis	1-Oct-2018	2-Jan-2019	I Francis	93	22-Feb-2019
ATG-11 (2018-IV)	2018-IV	ATG	ADC	17°4´37.26"N, 61° 45´36.84"W	11	MTM	PFOS	I Francis	1-Oct-2018	2-Jan-2019	I Francis	93	22-Feb-2019

Annex 2: Passive Air Sampling Results

Table 2a: showing results of indicator PCBs in ambient air samples in the 8 campaigns carried out between 2017 and 2018.

Region	GRULAC	GRULAC	GRULAC	GRULAC	GRULAC	GRULAC	GRULAC	GRULAC
Matrix	PUF	PUF	PUF	PUF	PUF	PUF	PUF	PUF
Sampler	3	3	3	3	3	3	3	3
Lab	CSIC	CSIC	CSIC	CSIC	CSIC	CSIC	CSIC	CSIC
Sampling year	2017	2017	2017	2017	2018	2018	2018	2018
Season code	I	II	III	IV	I	II	III	IV
Year-season	2017-I	2017-II	2017-III	2017-IV	2018-I	2018-II	2018-III	2018-IV
Exposure time	quarterly	quarterly	quarterly	quarterly	quarterly	quarterly	quarterly	quarterly
Original Sample-ID	ATG-3 (2017-I)	ATG-3 (2017-II)	ATG-3 (2017-III)	ATG-3 (2017-IV)	ATG-3 (2018-I)	ATG-3 (2018-II)	ATG-3 (2018-III)	ATG-3 (2018-IV)
Full country name	Antigua and Barbuda	Antigua and Barbuda	Antigua and Barbuda	Antigua and Barbuda	Antigua and Barbuda	Antigua and Barbuda	Antigua and Barbuda	Antigua and Barbuda
Country ISO-3	ATG	ATG	ATG	ATG	ATG	ATG	ATG	ATG
Sample ID	ATG (2017-I)	ATG (2017-II)	ATG (2017-III)	ATG (2017-IV)	ATG (2018-I)	ATG (2018-II)	ATG (2018-III)	ATG (2018-IV)
Unit	ng / PUF	ng / PUF	ng / PUF	ng / PUF	ng / PUF	ng / PUF	ng / PUF	ng / PUF
Indicator PCB								
PCB 28	No sample	<0,20	<0,20	<0,20	<0,20	<0,20	<0,20	<0,20
PCB 52	No sample	<0,20	<0,20	<0,20	<0,20	<0,20	<0,20	<0,20
PCB 101	No sample	<0,25	<0,25	<0,25	<0,25	<0,25	<0,25	<0,25
PCB 153	No sample	<0,25	<0,25	<0,25	<0,25	<0,25	<0,25	<0,25
PCB 138	No sample	<0,25	<0,25	<0,25	<0,25	<0,25	<0,25	<0,25
PCB 180	No sample	<0,20	<0,20	<0,20	<0,20	<0,20	<0,20	<0,20
Sum Indicator PCB (LB)	No sample	0,00	0,00	0,00	0,00	0,00	0,00	0,00

Table 2b: showing results of dl-PCBs in ambient air annual samples corresponding to 2017 and 2018.

Region	GRULAC	GRULAC
Matrix	PUF	PUF
Sampler and nº of PUFs	5 (3 PUFs)	5 (4 PUFs)
Lab	CSIC	CSIC
Sampling year	2017	2018
Season code	II+III+IV	I+II+III+IV
Year-season	2017-II+III+IV	2018-I+II+III+IV
Exposure time	quarterly x 3	quarterly x 4
Original Sample-ID	ATG-5 (3 PUFs) (2017- II+III+IV)	ATG-5 (4 PUFs) (2018- I+II+III+IV)
Full country name	Antigua and Barbuda	Antigua and Barbuda
Country ISO-3	ATG	ATG
Sample ID	ATG (2017-II+III+IV)	ATG (2018-I+II+III+IV)
	pg / 3 PUF	pg / 4 PUF
PCB 77	21,9	29,3
PCB 81	2,4	3,8
PCB 126	6,8	10,0
PCB 169	2,4	<1.4611
PCB 105	66,7	98,1
PCB 114	6,2	7,0
PCB 118	156,5	239,6
PCB 123	5,5	<4.6226
PCB 156	16,6	24,9
PCB 157	4,7	7,4
PCB 167	10,2	15,2
PCB 189	<2.295	<3.4795

Table 2c: showing results of PCDD / PCDFs in ambient air annual samples corresponding to 2017 and 2018.

Region	GRULAC	GRULAC
Matrix	PUF	PUF
Sampler and no. of PUFs	5 (3 PUFs)	5 (4 PUFs)
Lab	CSIC	CSIC
Sampling year	2017	2018
Season code	II+III+IV	I+II+III+IV
Year-season	2017-II+III+IV	2018-I+II+III+IV
Exposure time	quarterly x 3	quarterly x 4
Original Sample-ID	ATG-5 (3 PUFs) (2017- II+III+IV)	ATG-5 (4 PUFs) (2018- I+II+III+IV)
Full country name	Antigua and Barbuda	Antigua and Barbuda
Country ISO-3	ATG	ATG
Sample ID	ATG (2017-II+III+IV)	ATG (2018-I+II+III+IV)
	pg / 3 PUF	pg / 4 PUF
PCDD/PCDF		
2378-Cl_4DD	<0.4845	<0.7881
12378-Cl_5DD	<1.8253	<1.4435
123478-Cl_6DD	<1.2402	<1.1349
123678-Cl_6DD	<1.3321	1,8
123789-Cl_6DD	1,7	1,5
1234678-Cl_7DD	8,1	5,0
Cl_8DD	18,9	27,9
2378-Cl_4DF	1,4	1,2
12378-Cl_5DF	<0.7298	1,6
23478-Cl_5DF	<0.7025	1,8
123478-Cl_6DF	<0.9709	2,0
123678-Cl_6DF	<0.9928	<1.2058
123789-Cl_6DF	<1.3342	<3.5925
234678-Cl_6DF	<1.1078	<2.9564
1234678-Cl_7DF	2,9	4,8
1234789-Cl_7DF	<0.9673	<1.947
Cl_8DF	3,3	6,4

Table 2d: showing results of PBDEs in ambient air samples in the 8 campaigns carried out between 2017 and 2018.

Region	GRULAC	GRULAC	GRULAC	GRULAC	GRULAC	GRULAC	GRULAC	GRULAC
Matrix	PUF	PUF	PUF	PUF	PUF	PUF	PUF	PUF
Sampler	9	9	9	9	9	9	9	9
Lab	CSIC	CSIC	CSIC	CSIC	CSIC	CSIC	CSIC	CSIC
Sampling year	2017	2017	2017	2017	2018	2018	2018	2018
Season code	I	II	III	IV	I	II	III	IV
Year-season	2017-I	2017-II	2017-III	2017-IV	2018-I	2018-II	2018-III	2018-IV
Exposure time	quarterly	quarterly	quarterly	quarterly	quarterly	quarterly	quarterly	quarterly
Original Sample-ID	ATG-9 (2017-I)	ATG-9 (2017-II)	ATG-9 (2017-III)	ATG-9 (2017-IV)	ATG-9 (2018-I)	ATG-9 (2018-II)	ATG-9 (2018-III)	ATG-9 (2018-IV)
Full country name	Antigua and Barbuda	Antigua and Barbuda	Antigua and Barbuda	Antigua and Barbuda	Antigua and Barbuda	Antigua and Barbuda	Antigua and Barbuda	Antigua and Barbuda
Country ISO-3	ATG	ATG	ATG	ATG	ATG	ATG	ATG	ATG
Sample ID	ATG (2017-I)	ATG (2017-II)	ATG (2017-III)	ATG (2017-IV)	ATG (2018-I)	ATG (2018-II)	ATG (2018-III)	ATG (2018-IV)
Unit	ng / PUF	ng / PUF	ng / PUF	ng / PUF	ng / PUF	ng / PUF	ng / PUF	ng / PUF
BDE-17	No sample	<0,03	<0,03	<0,03	<0,03	<0,03	<0,03	<0,03
BDE-28	No sample	0,02	0,03	0,03	0,03	<0,02	0,03	<0,02
BDE-47	No sample	0,33	0,39	0,50	0,32	0,35	0,37	<0,25
BDE-66	No sample	<0,02	<0,02	0,02	<0,02	0,02	<0,02	<0,02
BDE-100	No sample	0,04	0,04	0,05	0,03	0,04	0,04	<0,03
BDE-99	No sample	0,15	0,17	0,18	<0,14	0,17	<0,14	<0,14
BDE-85	No sample	<0,07	<0,07	<0,07	<0,07	<0,07	<0,07	<0,07
BDE-154	No sample	<0,16	<0,16	<0,16	<0,16	<0,16	<0,16	<0,16
BDE-153	No sample	<0,50	<0,50	<0,50	<0,50	<0,50	<0,50	<0,50
BDE-183	No sample	<1,00	<1,00	<1,00	3,04	<1,00	<1,00	<1,00

Table 2e: showing results of PFOS, PFOA, PFHxS, and PFOS precursors in ambient air samples in the 7 campaigns carried out between 2017 and 2018.

Sample ID	Unit	L-PFOS	br-PFOS	SPFOS	PFOA	PFHxS	FOSA	NMeFOSA	NEtFOSA	NMeFOSE	NEtFOSE
ATG (2017-II)	pg/1 PUF	90	21	111	375	12	NR	NR	NR	NR	NR
ATG (2017-II+III+IV)	pg/3 PUF	205	128	334	730	12	149.8	NR	NR	NR	NR
ATG (2017-III)	pg/1 PUF	12	5	12	224	12	NR	NR	NR	NR	NR
ATG (2017-IV)	pg/1 PUF	58	38	96	194	12	NR	<200	<200	<200	<200
ATG (2018-I)	pg/1 PUF	115	5	115	371	51	NR	NR	NR	NR	NR
ATG (2018-II)	pg/1 PUF	NR	NR	NR	472	54	NR	NR	NR	<200	NR
ATG (2018-II+III+IV)	pg/4 PUF	NR	NR	NR	1561	12	NR	NR	NR	<200	NR
ATG (2018-III)	pg/1 PUF	NR	NR	NR	374	40	NR	NR	NR	<200	NR
ATG (2018-IV)	pg/1 PUF	NR	NR	NR	230	47	NR	NR	NR	<200	NR

*Note: NR- not reported

Annex 3: Human Milk Results

Lipid content [%]: 3

		Concentration ng/g lipid weight
Aldrin		nd
Chlordane group	1)	1,36
alpha-chlordane		nd
gamma-chlordane		nd
oxy-chlordane		1,40
Dieldrin		1,86
DDT group	2)	63,14
o,p'-DDD		nd
p,p'-DDD		nd
o,p'-DDE		nd
p,p'-DDE		54,54
o,p'-DDT		nd
p,p'-DDT		2,32
Endrin group	3)	nd
Endrin		nd
Endrin ketone		nd
Heptachlor group	4)	1,02
Heptachlor		nd
Heptachlor-epoxide cis		1,07
Heptachlor-epoxide trans		nd
Hexachlorobenzene		4,50
Hexachlorocyclohexane (HCH) group		
alpha-HCH		nd
beta-HCH		1,29
gamma-HCH		0,80
Endosulfan group	5)	nd
alpha-endosulfan		nd
beta-endosulfan		nd
Endosulfan sulfat		nd
Parlar (toxaphene) group	6)	0,71
Parlar 26		nd
Parlar 50		0,71
Parlar 62		nd
Mirex		nd

		Concentration ng/g lipid weight
Chlorinated paraffins	1)	87
short-chained chlorinated paraffins (SCCPs)		31
medium-chained chlorinated paraffins (MCCPs)		56

Lipid content [%]: 3

		Concentration ng/g lipid weight
Chlordecone	1)	nd
Hexabromocyclododecane (HBCD) group	2)	0,30
alpha-HBCD		0,30
beta-HBCD		nd
gamma-HBCD		nd

Lipid content [%]: 3

		Concentration ng/g lipid weight
Hexabrombiphenyl	1)	nd
Pentachlorobenzene	1)	nd
Pentachlorophenol	1)	nd
Pentachloroanisole	2)	nd
Hexachlorobutadiene	2)	nd
p,p-Dicofol	2)	nd

Fat content [%] 3.0

Mean values of multiple analyses

Congeneres	Concentration [ng/g fat]
BDE 15	0.07
BDE 17	0.003
BDE 28	0.34
BDE 47	7.24
BDE 49	0.06
BDE 66	0.07
BDE 75	0.01
BDE 77	0.001
BDE 85	0.12
BDE 99	1.67
BDE 100	1.61
BDE 119	< 0.001
BDE 126	< 0.007
BDE 138	0.02
BDE 153	3.12
BDE 154	0.12
BDE 183	0.04
BDE 190	0.005
BDE 196	0.02
BDE 197	0.24
BDE 203	0.04
BDE 206	0.14
BDE 207	0.39
BDE 208	0.16
BDE 209	-
Sum of PBDE (without BDE 209)	15.49

Fat content [%] 3.0

Mean values of multiple analyses

2,3,7,8-substituted PCDF/PCDD	Concentration [pg/g fat]	MU
2,3,7,8-TeCDF	0.34	
1,2,3,7,8-PeCDF	0.18	
2,3,4,7,8-PeCDF	1.32	
1,2,3,4,7,8-HxCDF	0.58	
1,2,3,6,7,8-HxCDF	0.54	
2,3,4,6,7,8-HxCDF	0.26	
1,2,3,7,8,9-HxCDF	<0.016	
1,2,3,4,6,7,8-HpCDF	0.53	
1,2,3,4,7,8,9-HpCDF	<0.008	
OCDF	0.099	
2,3,7,8-TeCDD	0.29	
1,2,3,7,8-PeCDD	1.11	
1,2,3,4,7,8-HxCDD	0.43	
1,2,3,6,7,8-HxCDD	2.25	
1,2,3,7,8,9-HxCDD	0.68	
1,2,3,4,6,7,8-HpCDD	4.04	
OCDD	24.4	
WHO-PCDD/F-TEQ (upperbound)	2.37	± 0.49
WHO-PCDD/F-TEQ (mediumbound)	2.37	± 0.49
WHO-PCDD/F-TEQ (lowerbound)	2.37	± 0.49

Lipid content [%]: 3

PCN	Concentration [pg/g fat]
PCN 27	n.d. < 0.069
PCN 28/36	13.90
PCN 31	n.d. < 0.096
PCN 42	2.61
PCN 46	1.02
PCN 48	0.64
PCN 49	n.d. < 0.087
PCN 50	0.08
PCN 52/60	15.25
PCN 53	0.33
PCN 59	0.90
PCN 63	0.24
PCN 64/68	0.09
PCN 65	0.12
PCN 66/67	11.42
PCN 69	1.68
PCN 70	n.d. < 0.064
PCN 71/72	0.18
PCN 73	0.33
PCN 74	n.d. < 0.035
PCN 75	n.d. < 0.061

PCN-TEQ (Lowerbound)	0.007
PCN-TEQ (Upperbound)	0.05

Full Country Name	Sample ID	Unit	L-PFOS	br-PFOS	ΣPFOS	L-PFOA	L-PFHxS
Antigua and Barbuda	ATG (2018)	pg/g	11.0	2.5	13.5	18.8	<5.5
Median of 44 samples		pg/g	12	3	15	16	13
Number of results above LOQ		pg/g	37	30	37	44	4

Annex 4: National Sample Results

Table 4a: showing results of dl-POPs (pg total) in biotic National Samples

Region	GRULAC	GRULAC	GRULAC
Full country name	A&B	A&B	A&B
Country ISO-3	ATG	ATG	ATG
Lab	Ministry of Agriculture	Ministry of Agriculture	Ministry of Agriculture
Matrix	Eggs	Fish	Fish
Original Sample-ID	Eggs 004A	Fish 002B	Fish 001B
CSIC-Reference	0157/2020-AV	0159/2020-AV	0158/2020-AV
Units	pg total	pg total	pg total
PCDD/PCDF			
2378-Cl_4DD	0.1	0.1	0.2
12378-Cl_5DD	0.3	0.2	0.4
123478-Cl_6DD	0.3	0.2	0.4
123678-Cl_6DD	0.4	0.2	0.4
123789-Cl_6DD	0.4	0.2	0.4
1234678-Cl_7DD	2.8	0.6	0.5
Cl_8DD	9.7	2.6	1.5
2378-Cl_4DF	0.4	0.2	0.1
12378-Cl_5DF	0.4	0.2	0.3
23478-Cl_5DF	0.5	0.2	0.2
123478-Cl_6DF	0.4	0.2	0.3
123678-Cl_6DF	0.4	0.2	0.3
123789-Cl_6DF	0.3	0.3	0.4
234678-Cl_6DF	0.3	0.2	0.3
1234678-Cl_7DF	0.7	0.2	0.3
1234789-Cl_7DF	0.3	0.3	0.4
Cl_8DF	1.5	0.6	0.8
WHO_{2005}-$TEQ_{PCDD/PCDF}$	0.87	0.59	0.92
dl-PCB			
PCB 77	15.4	14.7	15.2
PCB 81	1.7	1.2	0.8
PCB 126	2.3	3.1	3.3
PCB 169	1	1.4	1.4
PCB 105	62.9	81.8	86.2
PCB 114	5.7	5.3	7.3
PCB 118	213	270.1	277.1
PCB 123	4.6	6.7	6.7
PCB 156	23.3	33.5	34.9
PCB 157	5	8	8.4
PCB 167	14	24.6	25.2
PCB 189	3.6	7.1	7.1
WHO_{2005}-TEQ_{PCB}	0.28	0.4	0.4
WHO_{2005}-TEQ_{total}	1.15	1	1.3

Table 4b: showing results of dl-POPs (pg/g fresh) in biotic National Samples

Fresh weight (g)	28.8	66.3	66.3

Region	GRULAC	GRULAC	GRULAC
Full country name	A&B	A&B	A&B
Country ISO-3	ATG	ATG	ATG
Lab	Ministry of Agriculture	Ministry of Agriculture	Ministry of Agriculture
Matrix	Eggs	Fish	Fish
Original Sample-ID	Eggs 004A	Fish 002B	Fish 001B
CSIC-Reference	0157/2020-AV	0159/2020-AV	0158/2020-AV
Units	pg / g fresh	pg / g fresh	pg / g fresh
PCDD/PCDF			
2378-Cl_4DD	0.0047	0.0019	0.0035
12378-Cl_5DD	0.0087	0.0034	0.0054
123478-Cl_6DD	0.0092	0.0031	0.0053
123678-Cl_6DD	0.0156	0.0033	0.0054
123789-Cl_6DD	0.0142	0.0032	0.0061
1234678-Cl_7DD	0.0983	0.0089	0.0077
Cl_8DD	0.3366	0.0397	0.0227
2378-Cl_4DF	0.0138	0.0026	0.0022
12378-Cl_5DF	0.0146	0.0037	0.0044
23478-Cl_5DF	0.0171	0.0025	0.0025
123478-Cl_6DF	0.0126	0.0033	0.0046
123678-Cl_6DF	0.0123	0.0034	0.005
123789-Cl_6DF	0.0098	0.0041	0.0055
234678-Cl_6DF	0.0104	0.0026	0.0043
1234678-Cl_7DF	0.025	0.0032	0.0051
1234789-Cl_7DF	0.0118	0.0041	0.0066
Cl_8DF	0.0506	0.0092	0.0119
WHO_{2005}-$TEQ_{PCDD/PCDF}$	0.03	0.01	0.01
dl-PCB			
PCB 77	0.535	0.2224	0.2285
PCB 81	0.0606	0.0187	0.0122
PCB 126	0.0811	0.0463	0.0492
PCB 169	0.0347	0.0214	0.021
PCB 105	2.1847	1.2331	1.2998
PCB 114	0.1978	0.0797	0.1097
PCB 118	7.397	4.0743	4.1791
PCB 123	0.1596	0.1006	0.1011
PCB 156	0.809	0.5058	0.5258
PCB 157	0.1733	0.1213	0.1263
PCB 167	0.4851	0.3706	0.3798
PCB 189	0.1261	0.1069	0.107
WHO_{2005}-TEQ_{PCB}	0.01	0.01	0.01
WHO_{2005}-TEQ_{total}	0.04	0.01	0.02

Table 4c: showing results of dl-POPs (pg/g fat) in biotic National Samples

Fat weight (g)	5.7	0.2	0.3
Region	GRULAC	GRULAC	GRULAC
Full country name	A&B	A&B	A&B
Country ISO-3	ATG	ATG	ATG
Lab	Ministry of Agriculture	Ministry of Agriculture	Ministry of Agriculture
Matrix	Eggs	Fish	Fish
Original Sample-ID	Eggs 004A	Fish 002B	Fish 001B
CSIC-Reference	0157/2020-AV	0159/2020-AV	0158/2020-AV
Units	pg / g fat	pg / g fat	pg / g fat
PCDD/PCDF			
2378-Cl_4DD	0.0238	0.6285	0.7843
12378-Cl_5DD	0.0442	1.1185	1.1897
123478-Cl_6DD	0.0464	1.03	1.1817
123678-Cl_6DD	0.0787	1.0945	1.1997
123789-Cl_6DD	0.0716	1.0645	1.339
1234678-Cl_7DD	0.4966	2.96	1.709
Cl_8DD	1.7009	13.173	5.0153
2378-Cl_4DF	0.0699	0.8775	0.4903
12378-Cl_5DF	0.0739	1.214	0.969
23478-Cl_5DF	0.0862	0.839	0.5483
123478-Cl_6DF	0.0637	1.087	1.027
123678-Cl_6DF	0.0623	1.1275	1.1057
123789-Cl_6DF	0.0496	1.3495	1.2247
234678-Cl_6DF	0.0526	0.8595	0.961
1234678-Cl_7DF	0.1265	1.053	1.1257
1234789-Cl_7DF	0.0597	1.3665	1.4523
Cl_8DF	0.2557	3.0475	2.6233
WHO_{2005}-$TEQ_{PCDD/PCDF}$	0.15	2.9	3.1
dl-PCB			
PCB 77	2.7032	73.7	50.5
PCB 81	0.3061	6.2	2.7
PCB 126	0.4098	15.3	10.9
PCB 169	0.1756	7.1	4.6
PCB 105	11.0385	408.8	287.2
PCB 114	0.9992	26.4	24.3
PCB 118	37.3744	1350.6	923.6
PCB 123	0.8063	33.3	22.3
PCB 156	4.0876	167.7	116.2
PCB 157	0.8755	40.2	27.9
PCB 167	2.4511	122.9	83.9
PCB 189	0.6373	35.4	23.6
WHO_{2005}-TEQ_{PCB}	0.05	1.8	1.28
WHO_{2005}-TEQ_{total}	0.2	4.8	4.3

Table 4d: showing results of dl-POPs (pg/g dry) in abiotic National Samples

Dry weight (g)	7.1	7.9	7.1
Region	GRULAC	GRULAC	GRULAC
Full country name	A&B	A&B	A&B
Country ISO-3	ATG	ATG	ATG
Lab	Ministry of Agriculture	Ministry of Agriculture	Ministry of Agriculture
Matrix	Soil	Sediment	Sediment
Original Sample-ID	Soil 005A	Sediment 003A(*)	Sediment 003B(*)
CSIC-Reference	0156/2020-SV	0154/2020-SV	0155/2020-SV
Units	**pg / g dry**	**pg / g dry**	**pg / g dry**
PCDD/PCDF			
2378-Cl_4DD	0.1	0.02	0.02
12378-Cl_5DD	0.5	0.3	0.2
123478-Cl_6DD	0.8	0.5	0.3
123678-Cl_6DD	2	0.7	0.4
123789-Cl_6DD	1.5	0.8	0.5
1234678-Cl_7DD	40	4.6	3.5
Cl_8DD	354.5	11.5	19.3
2378-Cl_4DF	1	0.2	0.2
12378-Cl_5DF	0.3	0.5	0.3
23478-Cl_5DF	2.2	0.8	0.3
123478-Cl_6DF	0.8	1.5	0.5
123678-Cl_6DF	0.9	1.7	0.5
123789-Cl_6DF	0.1	0.1	0.1
234678-Cl_6DF	1.1	1.8	0.5
1234678-Cl_7DF	8.5	7	2.1
1234789-Cl_7DF	0.3	1	0.3
Cl_8DF	14.1	5.6	1.7
WHO_{2005}-$TEQ_{PCDD/PCDF}$	2.64	1.46	0.67
dl-PCB			
PCB 77	3.9	1.2	1.3
PCB 81	1.1	0.2	0.4
PCB 126	1	0.5	0.4
PCB 169	0.8	0.3	0.2
PCB 105	79.3	6.2	6.6
PCB 114	1.9	0.3	0.5
PCB 118	35.9	15.2	17.1
PCB 123	1.5	0.3	0.3
PCB 156	10.5	2.3	2.1
PCB 157	3.7	0.3	0.7
PCB 167	6.2	1	0.9
PCB 189	1.8	0.2	0.3
WHO_{2005}-TEQ_{PCB}	0.13	0.05	0.05
WHO_{2005}-TEQ_{total}	2.77	1.51	0.72

Table 4e: showing results of non-dioxin-like POPs (pg total) in biotic National Samples

Region	GRULAC	GRULAC	GRULAC	GRULAC
Full country name	A&B	A&B	A&B	A&B
Country ISO-3	ATG	ATG	ATG	ATG
Lab	Ministry of Agriculture	Ministry of Agriculture	Ministry of Agriculture	Ministry of Agriculture
Matrix	Eggs	Fish	Fish	Fish
Original Sample-ID	Eggs 004A	Fish 002B	Fish 001B(*)	Fish 001A(*)
CSIC-Reference	0157/2020-AV	0159/2020-AV	0158/2020-AV	0160/2020-AV
Units	pg total	pg total	pg total	pg total
Indicator PCB				
PCB 28	148	19	14	14
PCB 52	207	36	33	32
PCB 101	240	95	102	105
PCB 153	237	213	217	209
PCB 138	141	171	160	175
PCB 180	64	107	101	110
Sum Indicator PCB	1037	640	627	645

Table 4f: showing results of non-dioxin-like POPs (pg/g fresh) in biotic National Samples

Fresh weight (g)	6.4	13.7	9.6	9.8
Region	GRULAC	GRULAC	GRULAC	GRULAC
Full country name	A&B	A&B	A&B	A&B
Country ISO-3	ATG	ATG	ATG	ATG
Lab	Ministry of Agriculture	Ministry of Agriculture	Ministry of Agriculture	Ministry of Agriculture
Matrix	Eggs	Fish	Fish	Fish
Original Sample-ID	Eggs 004A	Fish 002B	Fish 001B(*)	Fish 001A(*)
CSIC-Reference	0157/2020-AV	0159/2020-AV	0158/2020-AV	0160/2020-AV
Units	pg / g fresh	pg / g fresh	pg / g fresh	pg / g fresh
Indicator PCB				
PCB 28	23	1	1	1
PCB 52	32	3	3	3
PCB 101	37	7	11	11
PCB 153	37	16	23	21
PCB 138	22	12	17	18
PCB 180	10	8	11	11
Sum Indicator PCB	162	47	65	66

Table 4g: showing results of non-dioxin-like POPs (pg/g fat) in biotic National Samples

Fat weight (g)	1.27	0.04	0.04	**0**
Region	GRULAC	GRULAC	GRULAC	GRULAC
Full country name	A&B	A&B	A&B	A&B
Country ISO-3	ATG	ATG	ATG	ATG
Lab	Ministry of Agriculture	Ministry of Agriculture	Ministry of Agriculture	Ministry of Agriculture
Matrix	Eggs	Fish	Fish	Fish
Original Sample-ID	Eggs 004A	Fish 002B	Fish 001B(*)	Fish 001A(*)
CSIC-Reference	0157/2020-AV	0159/2020-AV	0158/2020-AV	0160/2020-AV
Units	pg / g fat	pg / g fat	pg / g fat	pg / g fat
Indicator PCB				
PCB 28	117	468	315	<LOQ
PCB 52	163	866	758	<LOQ
PCB 101	189	2294	2344	<LOQ
PCB 153	187	5145	5000	<LOQ
PCB 138	112	4126	3685	<LOQ
PCB 180	51	2579	2333	<LOQ
Sum Indicator PCB	819	15479	14434	<LOQ

Table 4h: showing results of non-dioxin-like POPs (pg/g dry) in abiotic National Samples

Dry weight (g)	**2.3**	**2.5**	**2.2**
Region	GRULAC	GRULAC	GRULAC
Full country name	A&B	A&B	A&B
Country ISO-3	ATG	ATG	ATG
Lab	Ministry of Agriculture	Ministry of Agriculture	Ministry of Agriculture
Matrix	Soil	Sediment	Sediment
Original Sample-ID	Soil 005A	Sediment 003A(*)	Sediment 003B(*)
CSIC-Reference	0156/2020-SV	0154/2020-SV	0155/2020-SV
Units	**pg / g dry**	**pg / g dry**	**pg / g dry**
Indicator PCB			
PCB 28	15	71	61
PCB 52	19	24	55
PCB 101	18	16	38
PCB 153	26	11	17
PCB 138	37	13	19
PCB 180	92	5	8
Sum Indicator PCB	207	140	198

Table 4i: showing results of Organochlorine POPs (pg total) in biotic National Samples

Region	GRULAC	GRULAC	GRULAC	GRULAC
Full Country Name	Antigua and Barbuda	Antigua and Barbuda	Antigua and Barbuda	Antigua and Barbuda

Country ISO-3	ATG	ATG	ATG	ATG
Lab	Ministry of Agriculture	Ministry of Agriculture	Ministry of Agriculture	Ministry of Agriculture
Matrix	Eggs	Fish	Fish	Fish
Original Sample-ID	Eggs 004A	Fish 002B	Fish 001B(*)	Fish 001A(*)
CSIC Reference	0157/2020-AV	0159/2020-AV	0158/2020-AV	0160/2020-AV
Units	pg total	pg total	pg total	pg total
Pentachlorobenzene	<1000	n.a.	n.a.	<200
a-HCH	<200	n.a.	n.a.	<500
Hexachlorobenzene	<200	n.a.	n.a.	<200
g-HCH (lindane)	<200	n.a.	<200	<200
b-HCH	<200	<200	<200	<200
d-HCH	<200	<200	<200	<200
Heptachlor	<200	<200	<200	<200
Aldrin + unknown peak	<200	<200	<200	<200
Oxychlordane	<400	<400	<400	<400
cis-Heptachlor Epoxide	<400	<400	<400	<400
trans-Heptachlor Epoxide	<1000	<1000	<1000	<1000
o,p'-DDE	<80	<80	<80	<80
p,p'-DDE	1717	<80	<80	<80
trans-Chlordane	<400	<400	<400	<400
cis-Chlordane	<400	<400	<400	<400
a-Endosulfan	<1000	<1000	<1000	<1000
trans-Nonachlor	<400	<400	<400	<400
Dieldrin	n.a.	<400	<400	<400
Endrin	n.a.	<400	<400	<400
o,p'-DDD	<80	<80	<80	<80
o,p'-DDT	<80	<80	<80	<80
p,p'-DDD	<80	<80	<80	<80
p,p'-DDT	84	<80	<80	<80
cis-Nonachlor + Chlordecone	<400	<400	<400	<400
b-Endosulfan	n.a.	n.a.	n.a.	n.a.
Endosulfan sulfate	n.a.	n.a.	n.a.	n.a.
Mirex	<80	<80	<80	<80

**Note: n.a.- not analyzed*

Table 4j: showing results of Organochlorine POPs (pg/g fresh) in biotic National Samples

Fresh weight (g)	8.1	6.8	6.9	5.9
Region	GRULAC	GRULAC	GRULAC	GRULAC
Full country name	A&B	A&B	A&B	A&B
Country ISO-3	ATG	ATG	ATG	ATG

Lab	Ministry of Agriculture	Ministry of Agriculture	Ministry of Agriculture	Ministry of Agriculture
Matrix	Eggs	Fish	Fish	Fish
Original Sample-ID	Eggs 004A	Fish 002B	Fish 001B(*)	Fish 001A(*)
CSIC-Reference	0157/2020-AV	0159/2020-AV	0158/2020-AV	0160/2020-AV
Units	pg / g fresh	pg / g fresh	pg / g fresh	pg / g fresh
OCPs				
Pentachlorobenzene	<123	n.a.	n.a.	n.a.
a-HCH	<25	n.a.	n.a.	<34
Hexachlorobenzene	<62	n.a.	n.a.	<34
g-HCH (lindane)	<25	n.a.	<29	<34
b-HCH	<25	<29	<29	<34
d-HCH	<25	<29	<29	<34
Heptachlor	<25	<29	<29	<34
Aldrin + unknown peak	<25	<29	<29	<34
Oxychlordane	<49	<59	<58	<68
cis-Heptachlor Epoxide	<49	<59	<58	<68
trans-Heptachlor Epoxide	<123	<147	<145	<169
o,p'-DDE	<10	<12	<12	<14
p,p'-DDE	212	<12	<12	<14
trans-Chlordane	<49	<59	<58	<68
cis-Chlordane	<49	<59	<58	<68
a-Endosulfan	<123	147	145	169
trans-Nonachlor	<49	<59	<58	<68
Dieldrin	n.a.	<59	<58	<68
Endrin	n.a.	<59	<58	<68
o,p'-DDD	<10	<12	<12	<14
o,p'-DDT	<10	<12	<12	<14
p,p'-DDD	<10	<12	<12	<14
p,p'-DDT	10	<12	<12	<14
cis-Nonachlor + Chlordecone	<49	<59	<58	<68
b-Endosulfan	n.a.	n.a.	n.a.	n.a.
Endosulfan sulfate	n.a.	n.a.	n.a.	n.a.
Mirex	<10	<12	<12	<14

**Note: n.a.- not analyzed*

Table 4k: showing results of Organochlorine POPs (pg/g dry) in abiotic National Samples

Dry weight (g)	2.4	2.5	2.6
Region	GRULAC	GRULAC	GRULAC
Full country name	A&B	A&B	A&B
Country ISO-3	ATG	ATG	ATG
Lab	Ministry of Agriculture	Ministry of Agriculture	Ministry of Agriculture
Matrix	Soil	Sediment	Sediment

Original Sample-ID	Soil 005A	Sediment 003A(*)	Sediment 003B(*)
CSIC-Reference	0156/2020-SV	0154/2020-SV	0155/2020-SV
Units	**pg / g dry**	**pg / g dry**	**pg / g dry**
OCPs			
Pentachlorobenzene	n.a.	n.a.	n.a.
a-HCH	n.a.	n.a.	<77
Hexachlorobenzene	n.a.	n.a.	<192
g-HCH (lindane)	n.a.	n.a.	**307**
b-HCH	n.a.	n.a.	<77
d-HCH	n.a.	n.a.	<77
Heptachlor	n.a.	n.a.	<77
Aldrin + unknown peak	n.a.	n.a.	<77
Oxychlordane	n.a.	n.a.	<154
cis-Heptachlor Epoxide	n.a.	n.a.	<154
trans-Heptachlor Epoxide	n.a.	n.a.	<385
o,p'-DDE	**1100**	n.a.	<31
p,p'-DDE	**25598**	**89**	**93**
trans-Chlordane	n.a.	n.a.	<154
cis-Chlordane	n.a.	n.a.	<154
a-Endosulfan	n.a.	n.a.	<385
trans-Nonachlor	n.a.	n.a.	<154
Dieldrin	n.a.	n.a.	n.a.
Endrin	n.a.	n.a.	154
o,p'-DDD	**4001**	<32	<31
o,p'-DDT	**11471**	<32	<31
p,p'-DDD	**3857**	<32	<31
p,p'-DDT	**15060**	**80**	**75**
cis-Nonachlor + Chlordecone	**86**	<160	<154
b-Endosulfan	n.a.	n.a.	n.a.
Endosulfan sulfate	n.a.	n.a.	n.a.
Mirex	<33	<32	<31

**Note: n.a.- not analyzed*

Table 4l: showing results of PBDEs (pg total) in biotic National Samples

Region	GRULAC	GRULAC	GRULAC	GRULAC
Full country name	A&B	A&B	A&B	A&B
Country ISO-3	ATG	ATG	ATG	ATG
Lab	Ministry of Agriculture	Ministry of Agriculture	Ministry of Agriculture	Ministry of Agriculture
Matrix	Eggs	Fish	Fish	Fish
Original Sample-ID	Eggs 004A	Fish 002B	Fish 001B(*)	Fish 001A(*)
CSIC-Reference	0157/2020-AV	0159/2020-AV	0158/2020-AV	0160/2020-AV
Units	pg total	pg total	pg total	pg total
PBDEs				
BDE-28	2	3	5	8
BDE-47	103	245	259	342
BDE-100	43	245	251	63
BDE-99	143	988	1045	210
BDE-154	38	143	156	295
BDE-153	110	235	251	684
BDE-183	209	369	384	1145
Sum PBDEs	648	2229	2350	2748

Table 4m: showing results of PBDEs (pg/g fresh) in biotic National Samples

Fresh weight (g)	8.1	6	6.8	8.9
Region	GRULAC	GRULAC	GRULAC	GRULAC
Full country name	A&B	A&B	A&B	A&B
Country ISO-3	ATG	ATG	ATG	ATG
Lab	Ministry of Agriculture	Ministry of Agriculture	Ministry of Agriculture	Ministry of Agriculture
Matrix	Eggs	Fish	Fish	Fish
Original Sample-ID	Eggs 004A	Fish 002B	Fish 001B(*)	Fish 001A(*)
CSIC-Reference	0157/2020-AV	0159/2020-AV	0158/2020-AV	0160/2020-AV
Units	pg / g fresh	pg / g fresh	pg / g fresh	pg / g fresh
PBDEs				
BDE-28	0.3	0.6	0.7	0.8
BDE-47	13	41	38	38
BDE-100	5	41	37	7
BDE-99	18	165	154	24
BDE-154	5	24	23	33
BDE-153	14	39	37	77
BDE-183	26	61	57	129
Sum PBDEs	80	371	346	309

Table 4n: showing results of PBDEs (pg/g dry) in abiotic National Samples

Dry weight (g)	**2.1**	**2.3**	**2.5**
Region	GRULAC	GRULAC	GRULAC
Full country name	A&B	A&B	A&B
Country ISO-3	ATG	ATG	ATG
Lab	Ministry of Agriculture	Ministry of Agriculture	Ministry of Agriculture
Matrix	Soil	Sediment	Sediment
Original Sample-ID	Soil 005A	Sediment 003A(*)	Sediment 003B(*)
CSIC-Reference	0156/2020-SV	0154/2020-SV	0155/2020-SV
Units	**pg / g dry**	**pg / g dry**	**pg / g dry**
PBDEs			
BDE-28	5	2	17
BDE-47	125	58	45
BDE-100	30	7	5
BDE-99	67	22	13
BDE-154	14	10	6
BDE-153	23	30	28
BDE-183	52	142	131
Sum PBDEs	317	272	246

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