

# Perfluorinated Compounds in Environmental Samples Collected from the Estuarine and Coastal Areas of Korea

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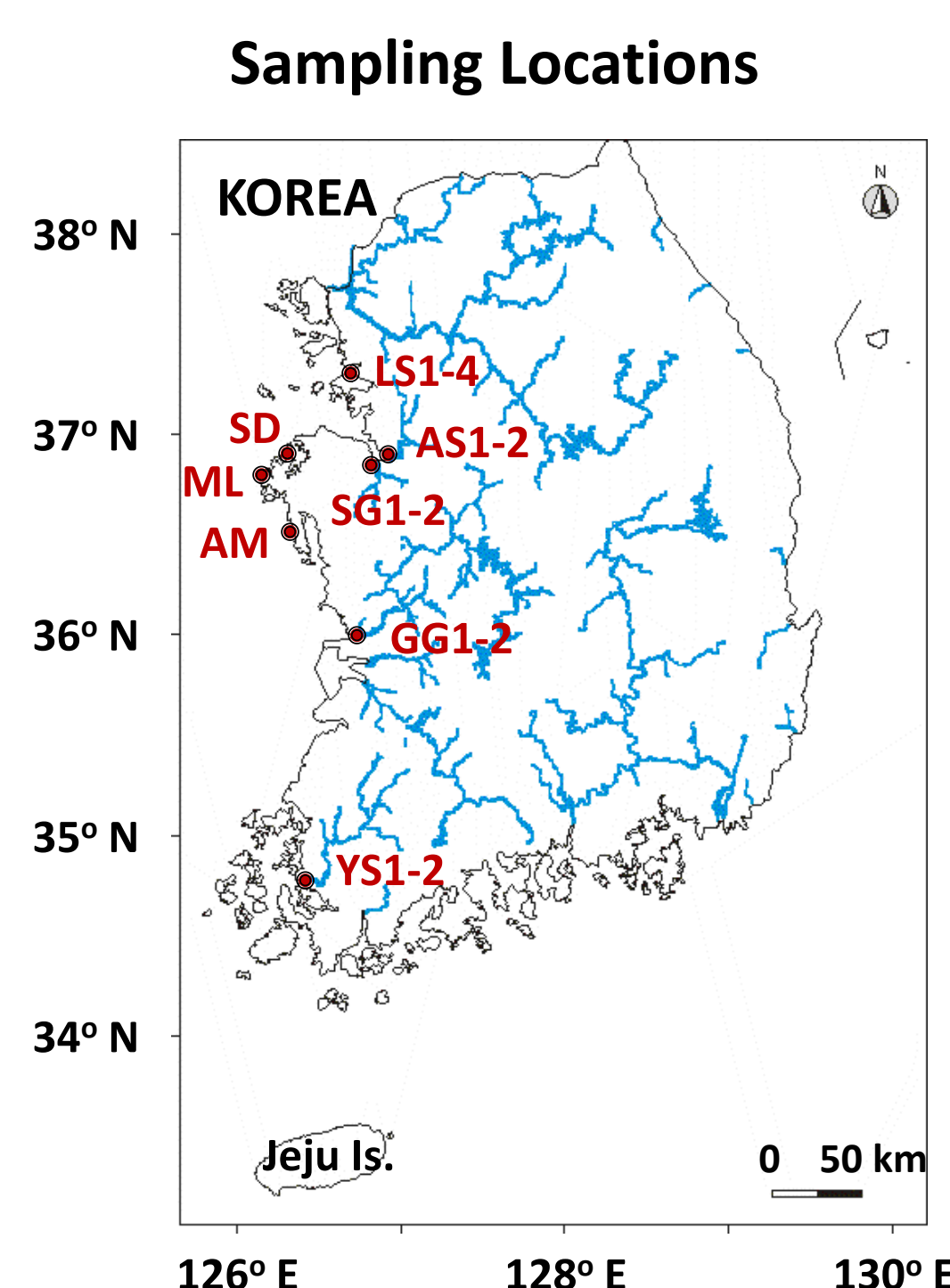
## ABSTRACT

The western coast of Korea is a highly developed region of Asia that is home to millions of people and is vital for both industry and tourism alike. Soil (n=11), sediment (n=12), water (n=15), and biological (n=9) samples were collected from the western coast of Korea to determine the extent of perfluorinated compound (PFC) concentrations in a region that is known to have used PFCs extensively, and to shed light on their sources and transport throughout the region. PFCs were significantly concentrated in some biological and water samples, while concentrations of PFCs in soils and sediments were relatively low. The most widely detected compound for both biological and water samples was found to be perfluorooctanesulfonate (PFOS), with a maximum concentration in fish tissue being 612 ng/g, and a maximum water concentration of 450 ng/L. Concentrations of PFOS detected in biological and aqueous samples were both less than those thought to cause toxicity. However, in both cases concentrations were within a factor of 10 to possible toxicity threshold values. Significant differences in concentrations of PFCs were observed between upstream and downstream locations on the same water system, which suggests point sources. Overall, the detection of PFCs at relatively high concentrations in various environmental matrices from this region of Korea suggests that further study and characterization of these chemicals and their potential risk to both humans and wildlife is needed.

## BACKGROUNDS

- PFCs have been produced and used in large quantities since the 1950s
- PFCs are made up of a carbon-fluorine tail and polar head group
- The C-F covalent bond is very strong and as a result PFCs are resistant to hydrolysis, photolysis, metabolism, and biodegradation
- Wide range of applications from surfactants, to fire-fighting, and pharmaceuticals
- Globally ubiquitous in both remote and urban environments
- Large scale production of PFOS based products in North America were phased out starting in 2000

## INTRODUCTION

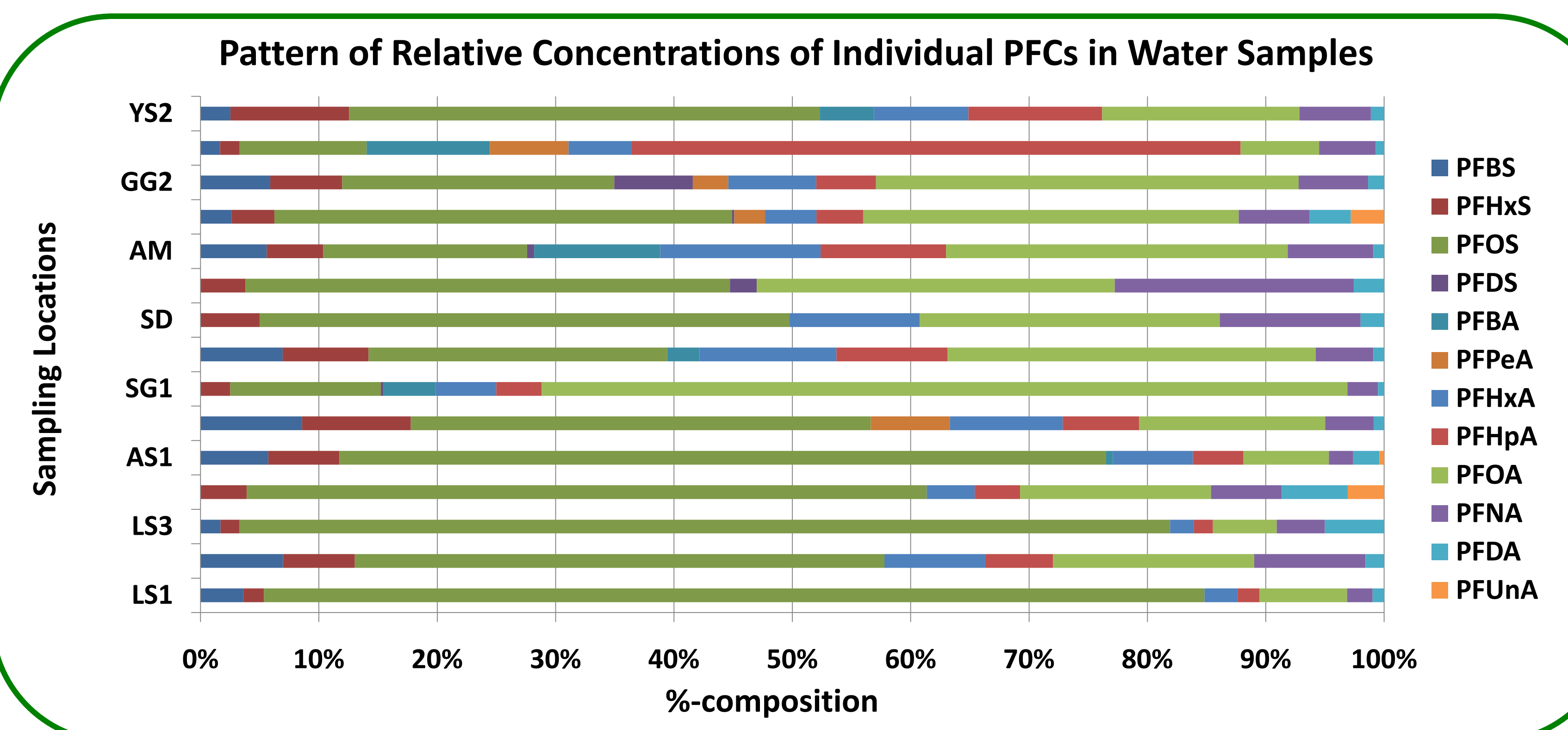


- The western coast of Korea is a highly developed region of Asia that is home to millions of people and is vital for both industry and tourism alike
- Previous studies have shown Korea to relatively high concentrations of PFCs
- Relatively little is known about possible sources, distribution, and fate among environmental matrices
- Locations were chosen based on previous work showing elevated concentrations of PFCs and to detect any possible point-sources
- This study was part of an ongoing study to determine the current status and extent of PFC pollution in the Yellow Sea region of China and Korea

## METHODS & QA/QC

- Water, soil, sediment, and biota samples were collected from 8 estuarine and costal areas along the western coast of South Korea during May of 2008
- Samples were extracted using modified Solid Phase Extraction (SPE) methods to optimize recovery and minimize contamination
- Negative ESI-HPLC-MS/MS operated in MRM was used for data analysis quantification
- The use of Teflon related materials were avoided during all steps of sample collection and analysis
- A second column was inserted directly upstream of the HPLC injector port to separate any possible contamination coming from the eluents or instrument
- Recoveries for all 13 compounds were generally good and greater than 70%, but some poor recoveries were observed for PFBS, PFDS, PFUnA, and PFDoA

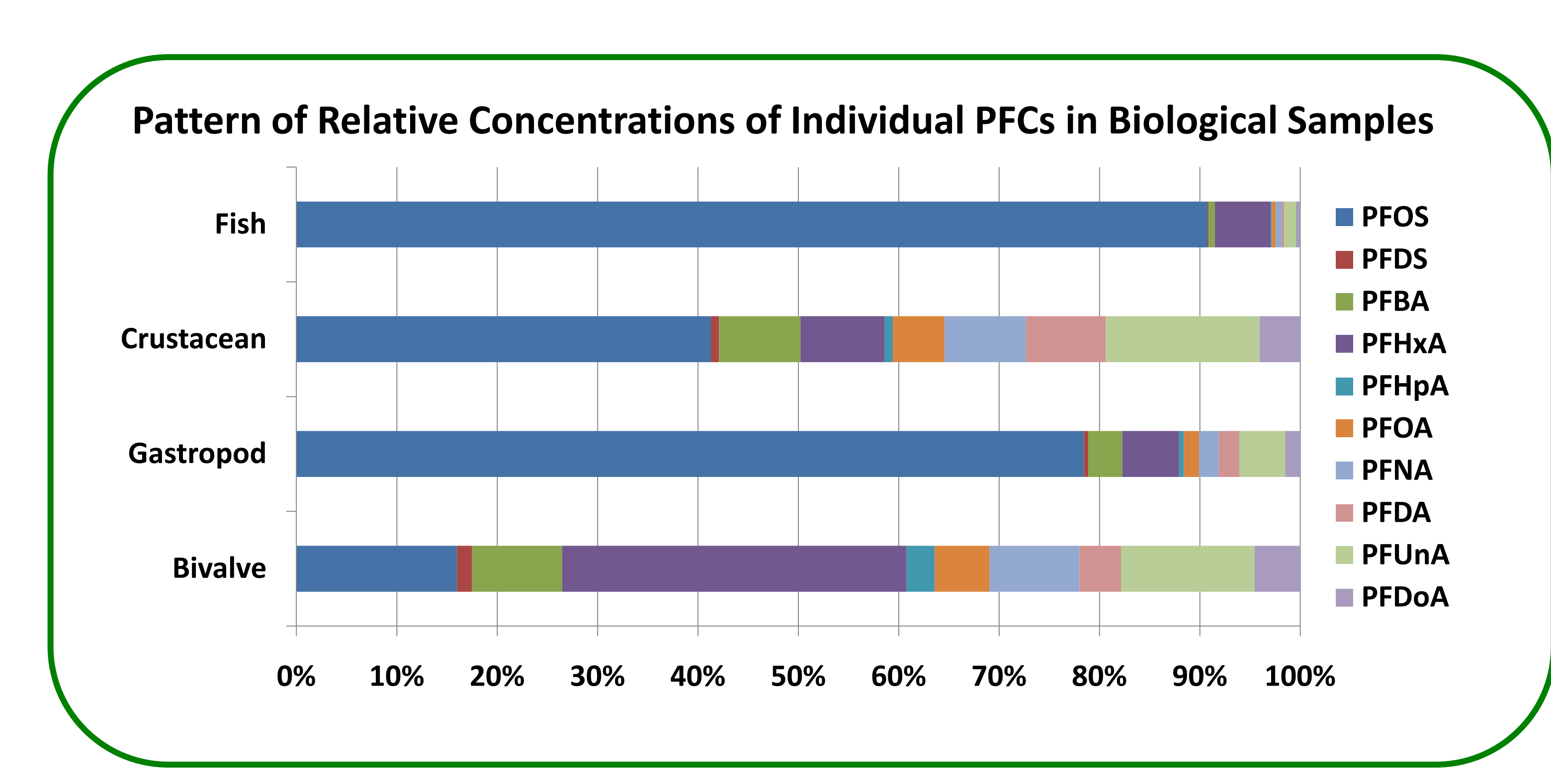
## RESULTS



Concentrations (ng/mL) of PFCs detected in Biological Samples

Location	Species	Samples	PFOS	PFDS	PFBA	PFHxA	PFHpA	PFOA	PFNA	PFDA	PFUnA	PFDoA
LS1	Surf Clam	soft tissue	4.50	0.14		1.52				0.80	2.24	
LS2	Oyster	soft tissue	1.53			5.04						
LS3	Asian Periwinkle	soft tissue	6.50	0.79		1.15		1.45		1.41	2.33	0.75
LS4	Asian Periwinkle	soft tissue	8.40			1.58		1.10	1.27	2.08	3.88	1.58
SG2	Crab	eggs	8.89			1.07		0.51		0.49	1.97	
		shells	1.14							0.32		
		soft tissue	1.30					0.76		1.46	1.81	
SD	Striped Mullet	fillet	8.83							0.13	1.28	
		intestines	266			34.6					1.46	
		liver	612			10.0				0.13	2.38	
ML	Asian Periwinkle	soft tissue	0.26			4.08					1.32	0.99
AM	Mussel	soft tissue	0.77	0.21		4.97	0.96	0.94		0.28	1.61	0.54
	Blue Mussel	soft tissue	0.34	0.22		3.81				0.67	1.09	
	Neritid											
	Gastropod	soft tissue	0.75	0.15		3.75		0.62		1.31	1.31	
	Asian Periwinkle	soft tissue	0.59		5.81	5.01	0.98	0.69		1.02	4.40	
YS1	Rockfish	fillet	2.97	0.44		3.74	0.52	1.46		0.53	1.86	1.78
		intestines	11.2	0.18		2.45				1.27	2.27	
		liver	15.3				0.18			0.19	2.36	
		gills	99.2	0.24		9.43				0.21	1.40	
YS1	Asian Periwinkle	soft tissue	233			2.42				0.56	1.26	
min			0.26	<0.1	<1.0	<1.0	<0.1	<0.5	<1.0	<0.1	<1.0	<0.5
max			612	0.79	5.81	34.6	0.98	1.46	1.27	2.08	4.40	1.78
mean			64.2	0.30	5.81	5.91	0.66	0.94	1.27	0.76	2.01	1.13

## RESULTS (continued)



## CONCLUSIONS

- Concentrations of PFCs in estuarine and coastal areas of South Korea were relatively greater than those reported in other Asian countries,
- Among 13 target PFCs measured, PFOS was consistently found at the greatest concentrations among environmental media
- Some longer-chain PFCs such as PFHxA, PFDA and PFUnA as well as PFOS were concentrated in biota samples, particularly in higher trophic level organisms, supporting bioaccumulation of PFCs
- Occurrence and spatial distribution of detected PFCs in various environmental media between upstream and downstream indicated the continuing input from existing PFCs sources in Korea
- Concentrations of PFOS or PFOA found at some locations were sufficient to potentially cause adverse effects to some wildlife, thus monitoring effort of such PFCs should continued