Persistent organic pollutants in bottom and pelagic fish from the Sea of Okhotsk

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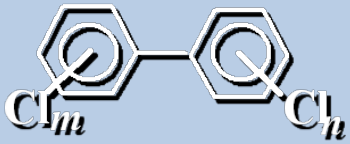
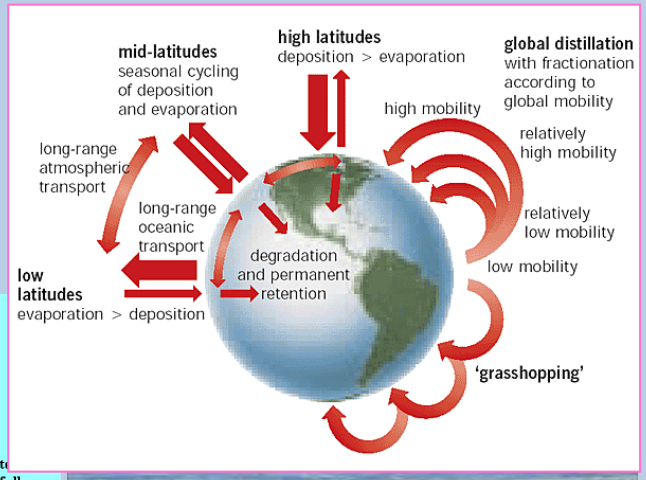
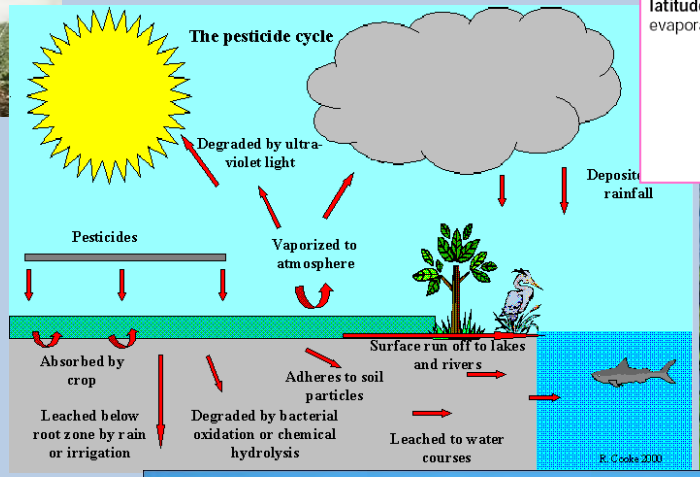
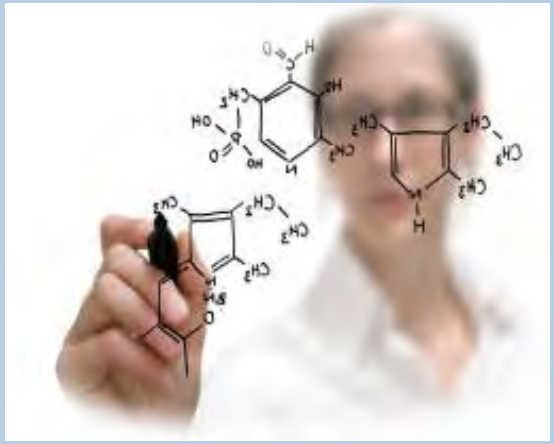
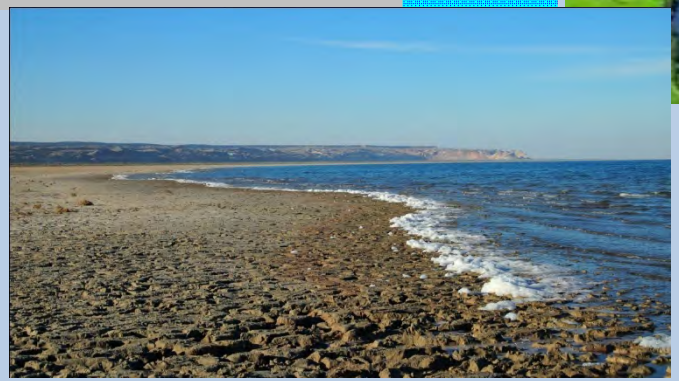
Persistent organic pollutants (POPs) are toxic xenobiotics that circulate in the biosphere over decades. At present, the global background of POPs has been formed on the planet. The pollutants are transported by wind from the regions of their use (tropical and subtropical latitudes) over long distances to middle and polar latitudes

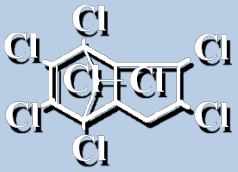


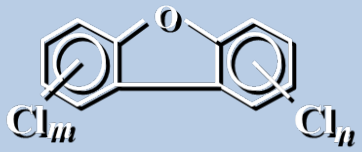




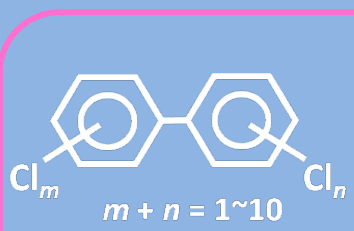




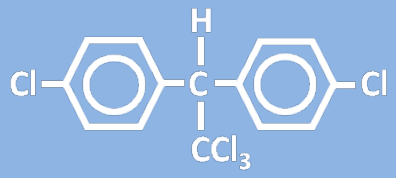




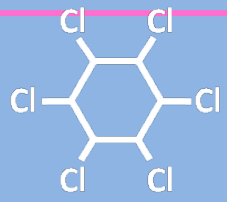
During the last third of the 20th century, hexachlorocyclohexane (HCH) and dichlorodiphenyltrichloroethane (DDT) have been the most actively used among organochlorine pesticides OCPs. At present time organochlorine pesticides (OCP) and polychlorinated biphenyls (PCBs) are the most dangerous among persistent organic pollutants (POPs) in terms of widely distribution and impact on biota.



PCBs



DDTs



HCHs

- **Persistent**
- **Long range transport**
- **Bioaccumulative**
- **Toxic**

The final links in the POPs accumulation are often marine ecosystems.

Fish are able to accumulate POPs in their organs and may be used as indicators of the environment conditions

POPs concentrations in fish from the various regions of the World Ocean were studied actively in last years :

Smalling et al., 2013; East Pacific
Reindl et al., 2013; Baltic Sea
Webster et al., 2009; Coast of Scotland
Sakurai et al., 2009; Sea of Japan
Vuorinen et al., 2017; Gulf of Finland

POPs accumulation was studied in marine mammals and seabirds from the Northwest Pacific

Tsygankov, V.Y., Boyarova, M.D., Lukyanova, O.N., 2016a. Bioaccumulation of organochlorine pesticides (OCPs) in the northern fulmar (Fulmarus glacialis) from the Sea of Okhotsk. Marine Pollution Bulletin 110, 82–85. https://doi.org/10.1016/j.marpolbul.2016.06.084

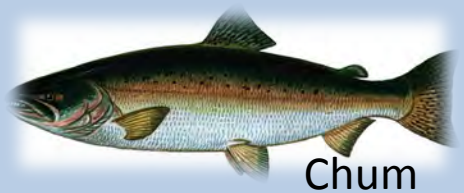
Tsygankov, V.Y., Lukyanova, O.N., Boyarova, M.D., 2018. Organochlorine pesticide accumulation in seabirds and marine mammals from the Northwest Pacific. Marine Pollution Bulletin 128, 208–213. https://doi.org/10.1016/j.marpolbul.2018.01.027

Goal: POPs accumulation in the bottom (flounder) and pelagic fish (Pacific salmon) from the Sea of Okhotsk

Bering flounder
Hipoglossoides robustus

Pacific salmon

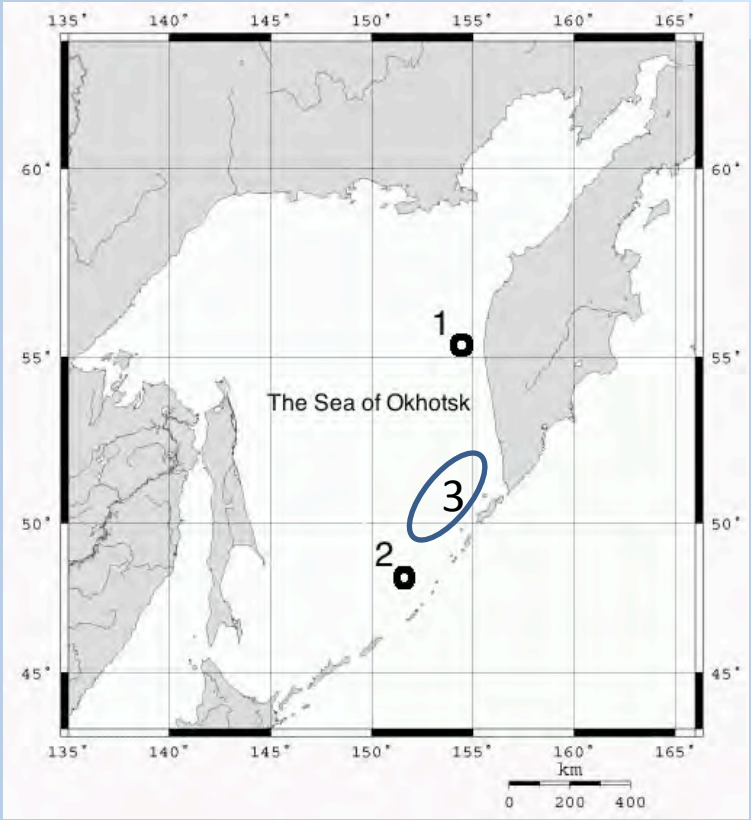
Pink



Chum

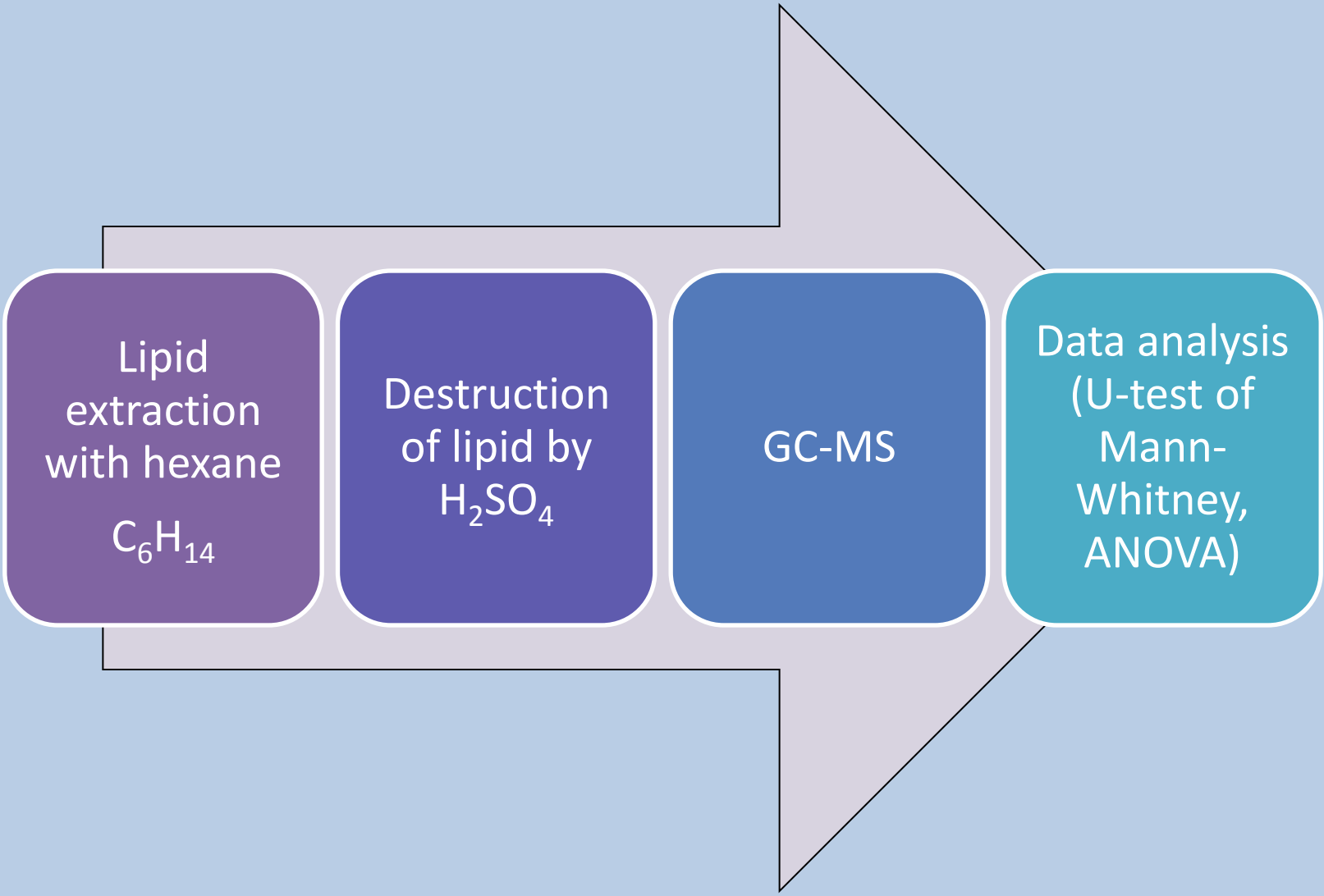
Chinook

Sockeye



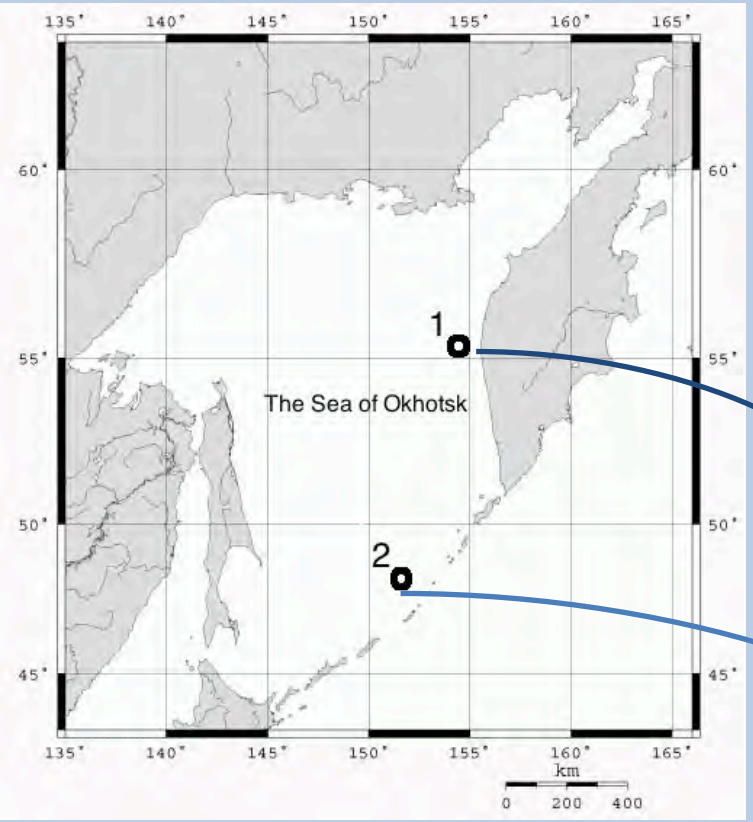
1, 2 – flounder
3- salmon

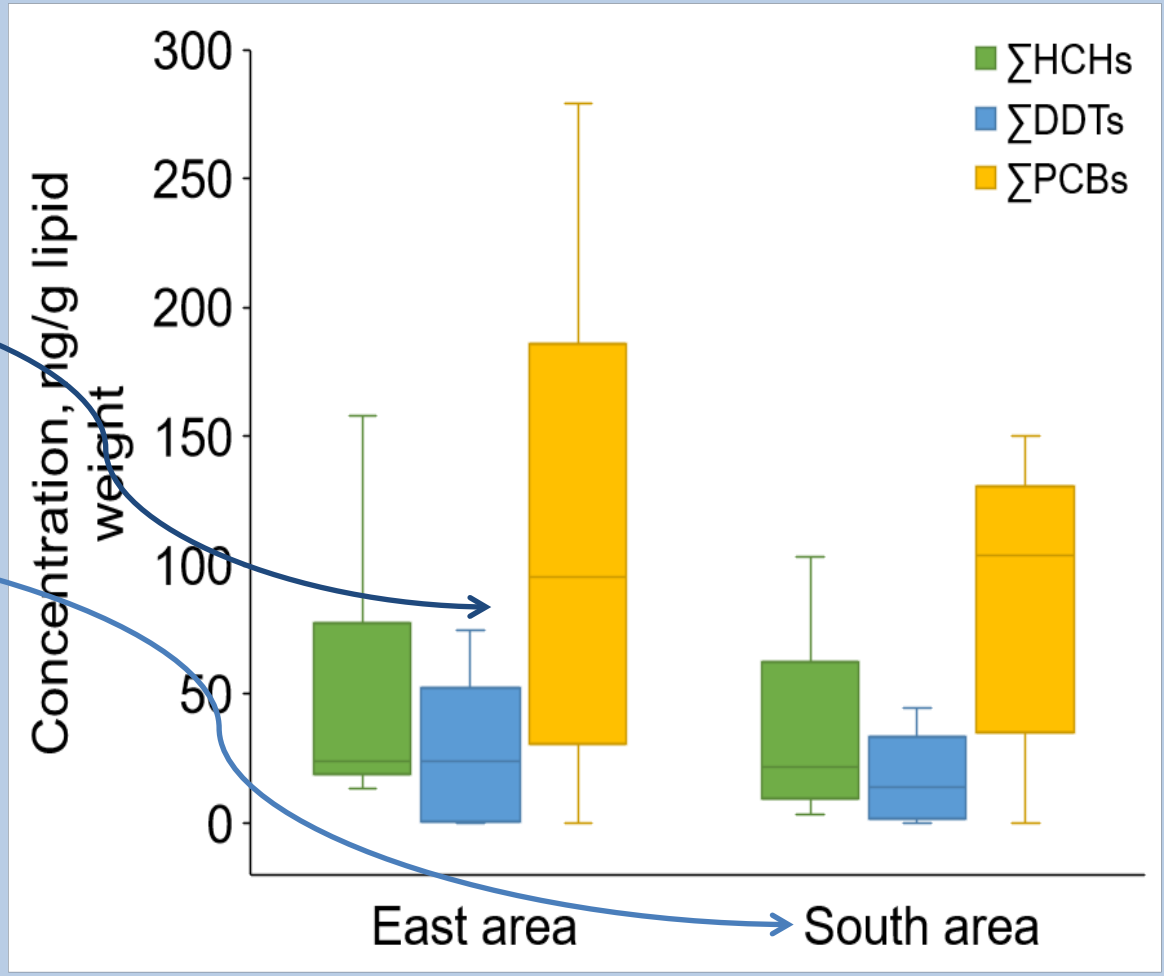
Methods



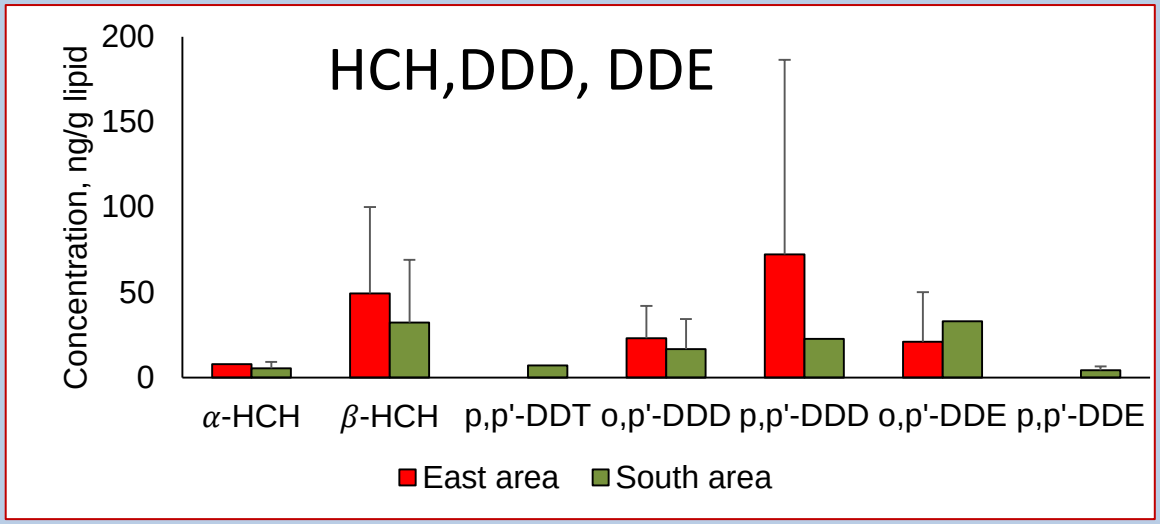
(Tsygankov and Boyarova, *Achievements in the Life Sciences*, 2015)

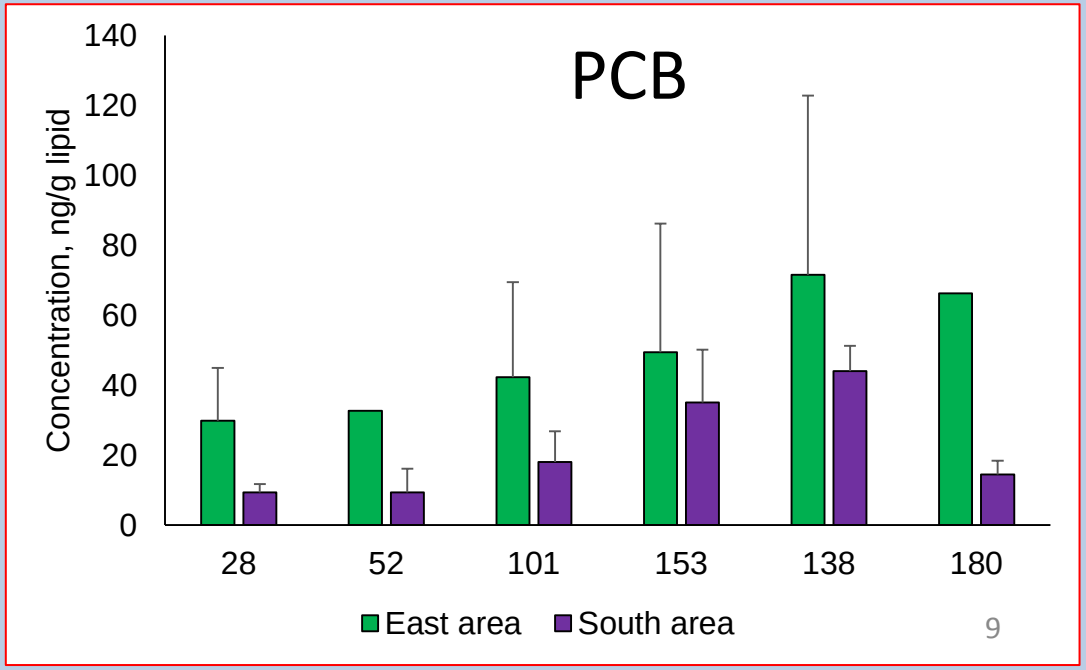
Concentration (ng/g lipid weight) of ΣHCH isomers, ΣDDT and its metabolites and ΣPCB congeners in flounder from the Sea of Okhotsk



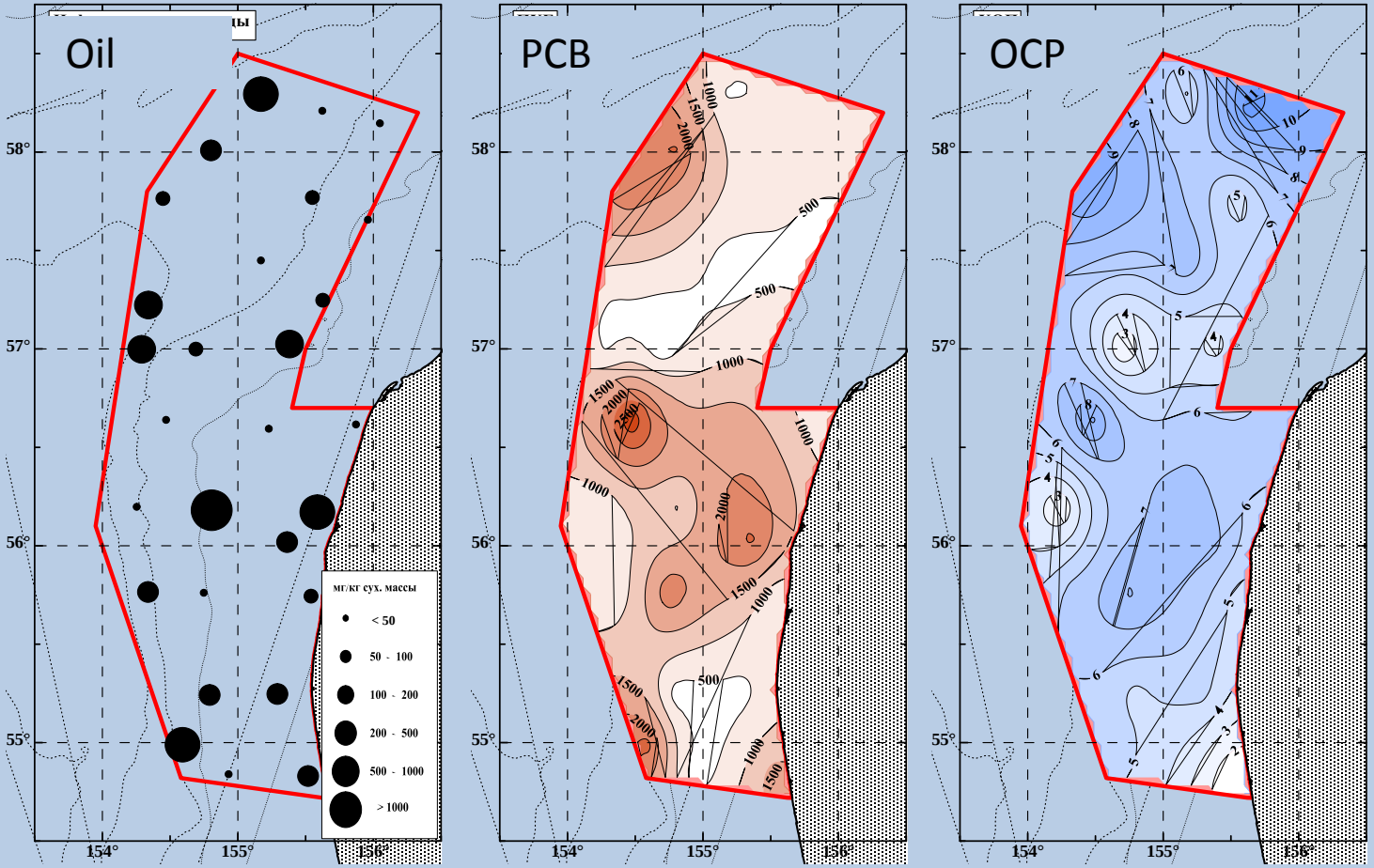


HCH isomers, DDT metabolites and indicator PCB in flounder from the Sea of Okhotsk





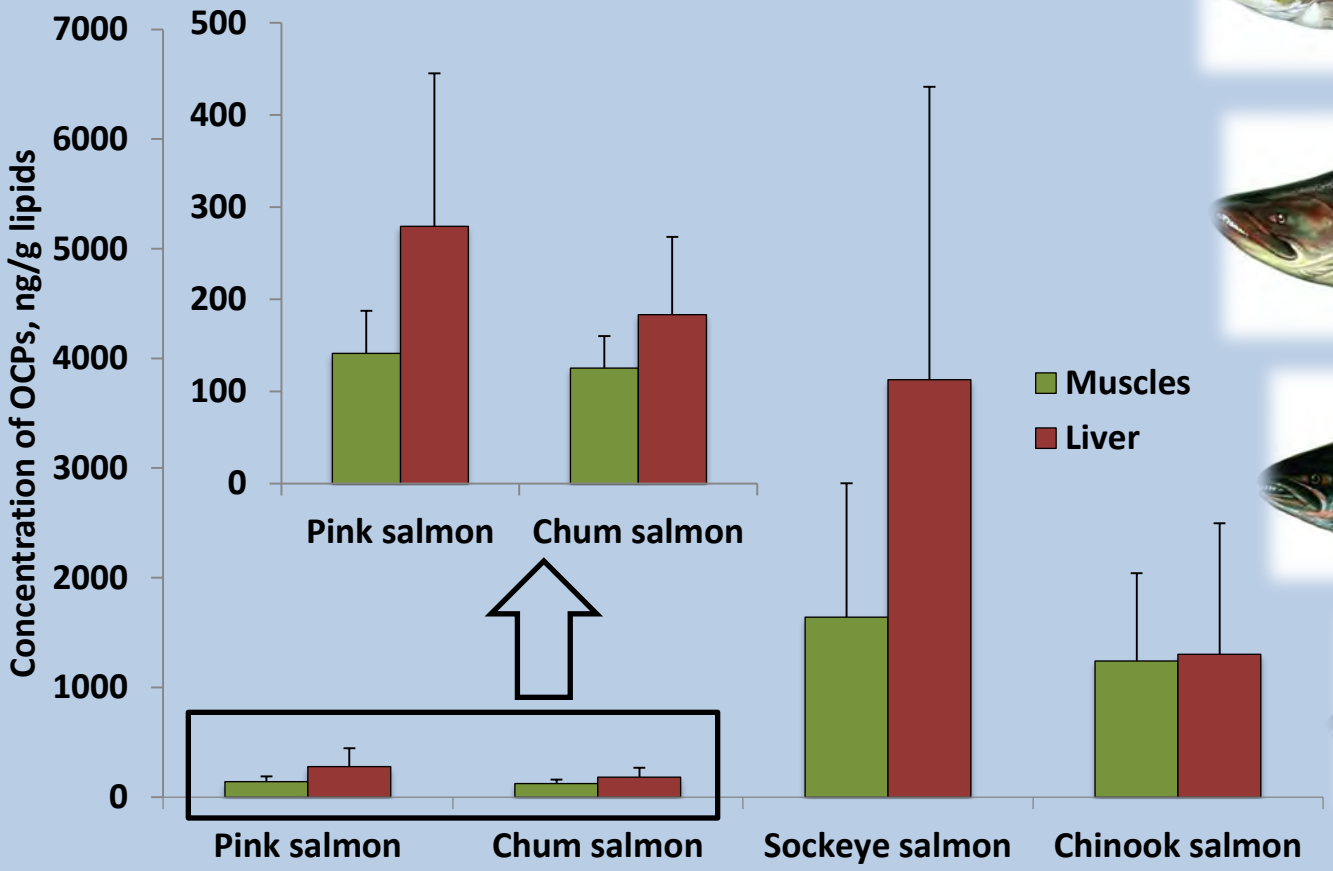
Petroleum hydrocarbons (mg/kg), PCB (ng/kg) and OCP (mkg/kg) in bottom sediments on the western Kamchatka shelf



The use of DDT and HCH in Russia is prohibited under the Stockholm convention (ratified by Russia in 2011).

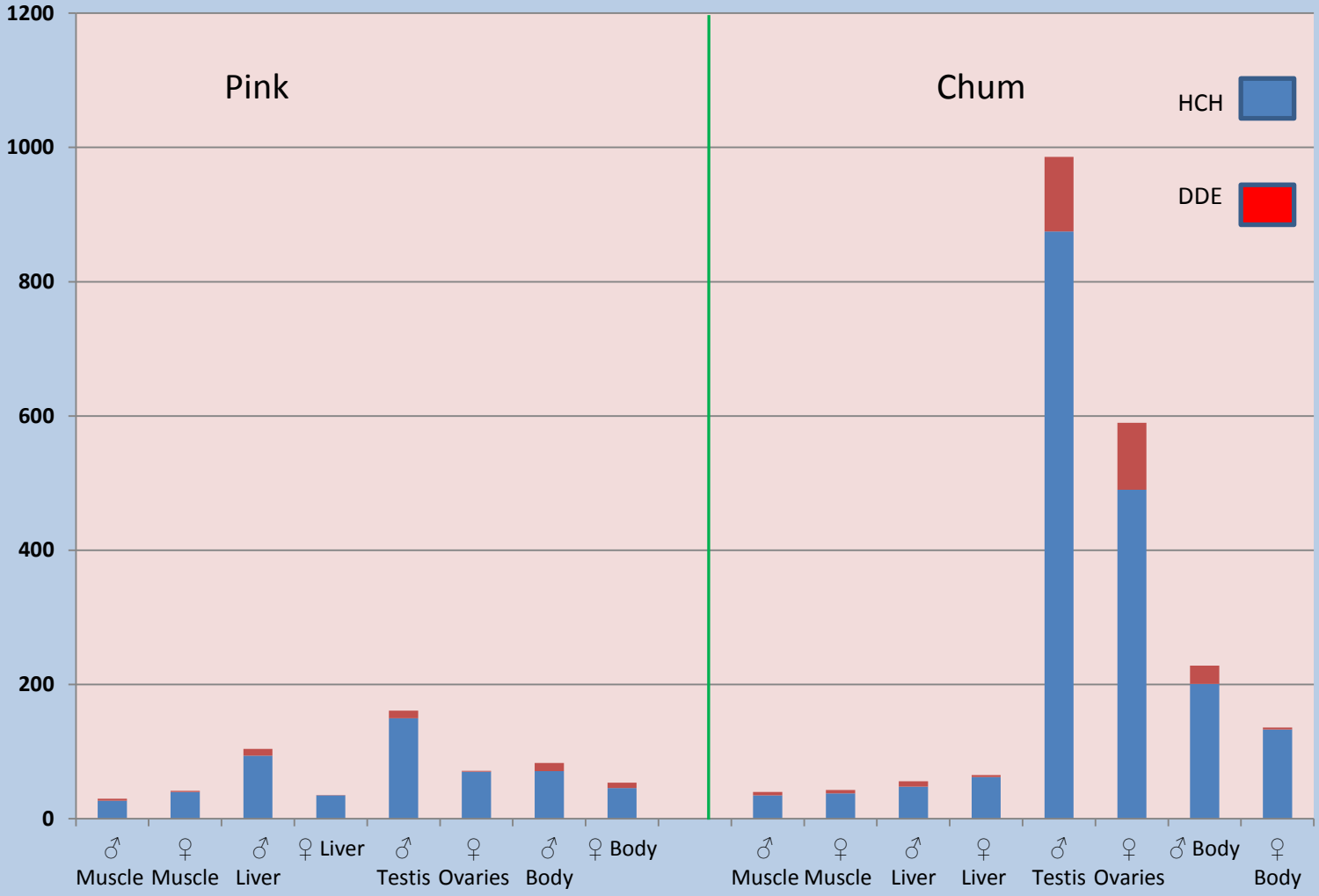
Atmospheric deposition is the principal source of input of these substances to the Sea of Okhotsk.

Pacific salmon

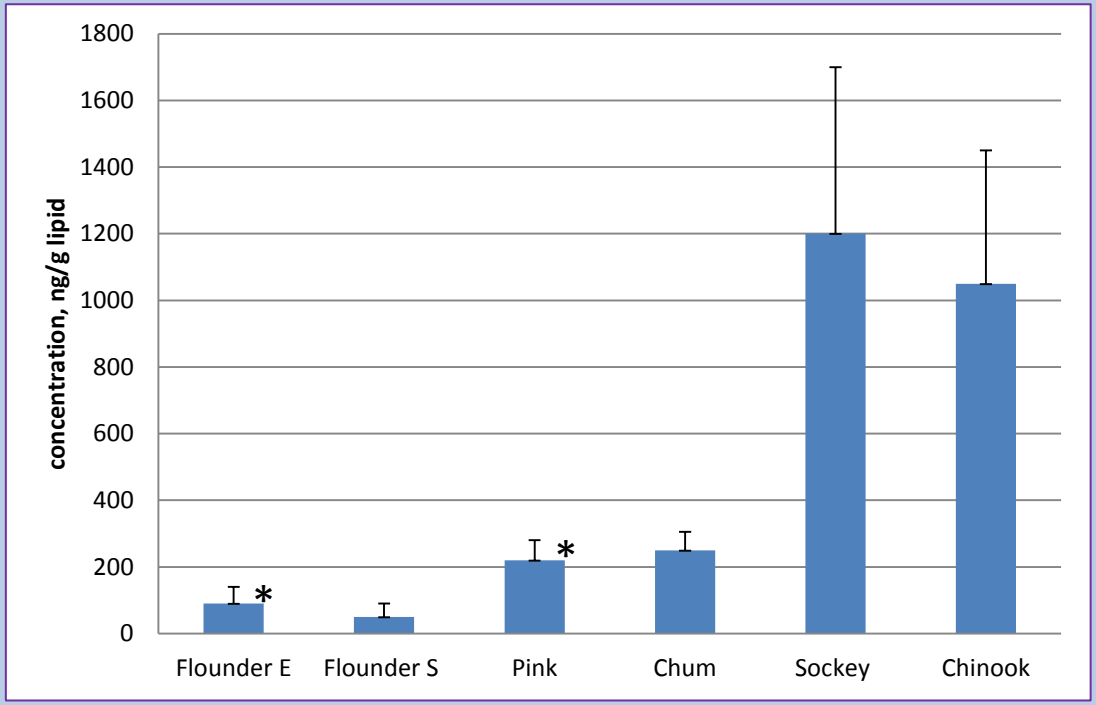


Total OCPs concentration (ΣHCHs + ΣDDE) in salmon organs

Total concentration (ng/g lipid**) of HCH isomers (α-HCH + β-HCH + γ-HCH) and DDE in Pink and Chum organs**



HCH+DDT concentrations in muscle of flounder and salmon from the Sea of Okhotsk



Hygienic requirements (permissible levels) of OCP for the safety of salmon, fish or fish products

OCP concentration (ng/g wet weight) (Mean ± SD) in organs of pink and chum salmon

Species	Organs	α-HCH	β-HCH	γ-HCH	DDE
Pink	Muscle	6.75±4.13	1.27±0.64	0.83±0.37	0.53±0.23
	Liver	11.02±5.51	2.10±1.86	2.11±1.82	1.06±1.21
	Male gonads	20.67±0.25	7.27±0.57	2.69±0.41	2.25±0.06
	Eggs	16.10±7.36	3.06±2.27	2.13±1.37	0.50±0.57
Chum	Muscle	3.49±1.38	2.40±1.69	0.33±0.52	0.77±0.36
	Liver	5.14±3.10	1.95±1.55	2.06±1.84	0.95±0.57
	Male gonads	58.26±7.16	55.89±59.89	24.73±6.14	17.84±2.80
	Eggs	46.68±15.51	12.76±11.06	22.50±21.20	<LOD

Country / Organization	OCP	Permissible levels, ng/g wet weight	Notes	References
Russia	HCHs[1]	200	All products of sea fish and meat of marine mammals (except liver and fish oil); eggs and male gonads; analogues of eggs.	TR CU 021/2011
		100	Fish oil	
		1000	Fish liver and products therefrom	
	DDTs[2]	2000	Sturgeon, salmon, herring fat – all products (except liver, eggs and gonads), including dried, smoked, salted, spiced, marinated, fish cooking and other products, ready-to-eat	
		400	Eggs and male gonads; analogues of eggs.	
		3000	Fish liver and products therefrom	
	HCHs	200	Fish: live, raw, chilled, frozen, minced meat, fillet, meat of marine mammals	SanPin 2.3.2.1078-01
	DDTs	2000	Fish: live, raw, chilled, frozen, minced meat, fillet, meat of marine mammals (sturgeon, salmon, herring)	
	HCHs	200	Eggs and male gonads; analogues of eggs.	
	DDTs	2000	Eggs and male gonads; analogues of eggs.	
	HCHs	1000	Fish liver and products therefrom	
	DDTs	3000	Fish liver and products therefrom	
USA	DDTs[3]	5000	All fish	Compliance Policy Guide. Sec. 575.100
Canada	DDTs	5000	All fish products	Canadian Food Inspection Agency
	HCHs[4]	100	All fish products	
Australia, New Zealand	HCHs[5]	10	All fish	Australia New Zealand Food Standards
	Lindane	1000	All fish	
	DDT[6]	1000	All fish	
Thailand	HCHs	500	All fish	Tanabe, 1991
	DDTs	5000	All fish	
Hong Kong	DDTs	18000	Fish and seafood and their products	Centre for Food Safety, 2014
WHO[7]	HCHs	200		Yahia and Elsharkawy, 2014
Germany	HCHs	500		Kasozi et al., 2008
	DDTs	500		
FAO/WHO[8]	DDTs	200	All fish	Mwevura et al., 2002
CREM/CBI[9]	DDTs	5000		Ogwok et al., 2009
EU[10]	DDTs	100		Daba et al., 2011

Conclusion

•This study provides the baseline information on the occurrence of OCPs and PCBs regulated by the Stockholm convention in the consumed fish from the Sea of Okhotsk.

•Organic contaminants in fish tissue decreased in the order: PCBs> HCHs> DDTs.

•Our results indicate that consumers will have no health problems associated with fish consumption from the Sea of Okhotsk.

•OCP and PCB levels in the Sea of Okhotsk may be considered as background level for the North Pacific.

•However, given that OCPs and PCBs are persistent in the marine environment, their levels should be monitored all the time.