OCPs and PCBs level in commercial fish species (herring, flounder, pollock) from the Sea of Okhotsk

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Introduction

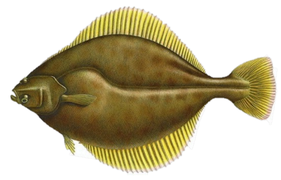
The Sea of Okhotsk is one of the most productive regions in Russia. In recent decades, particular attention has been drawn to studying the levels of pollutants of different origins in marine organisms, including commercial fish. Organochlorine pesticides (OCPs) and polychlorinated biphenyls (PCBs) belong to the group of POPs, the use and production of which are strictly regulated.

Materials and methods

Alaska pollock (*Gadus chalkogrammus*)

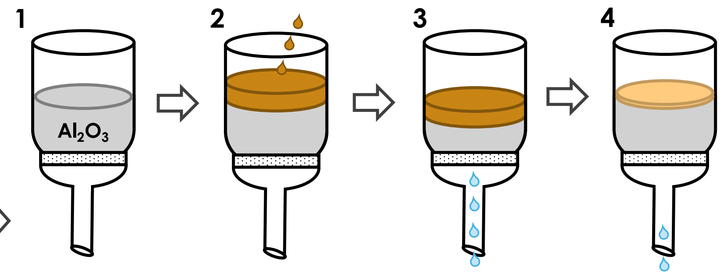
Pacific herring (*Clupea pallasii*)

Alaska plaice (*Pleuronectes quadrituberculatus*)



Yellowfin sole (*Limanda aspera*)

Organ dissection (muscles, liver, eggs, male gonads)
↓
Freeze drying under vacuum
↓
Ultrasonic extraction of lipids



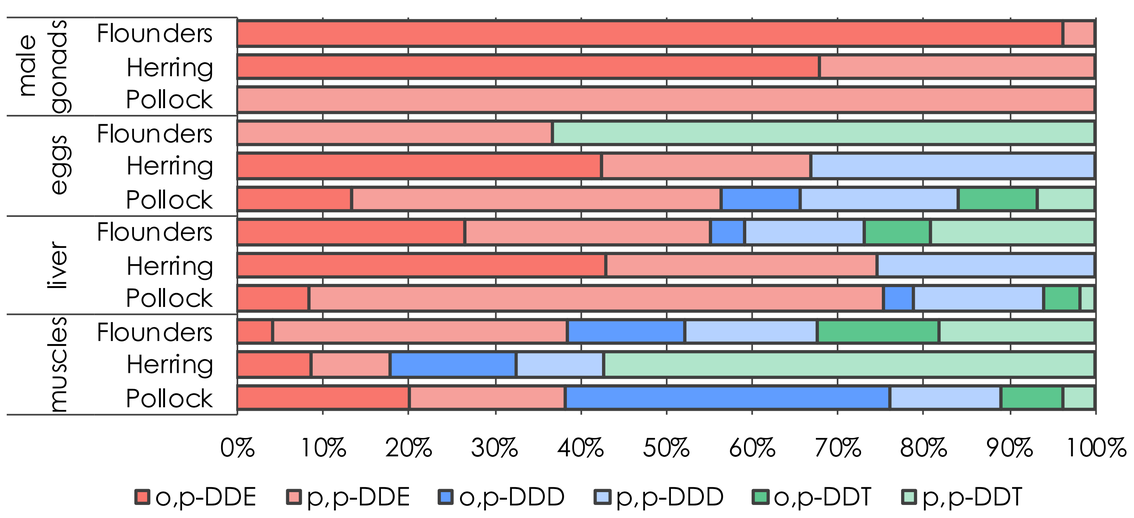
Transferring extracts into vials

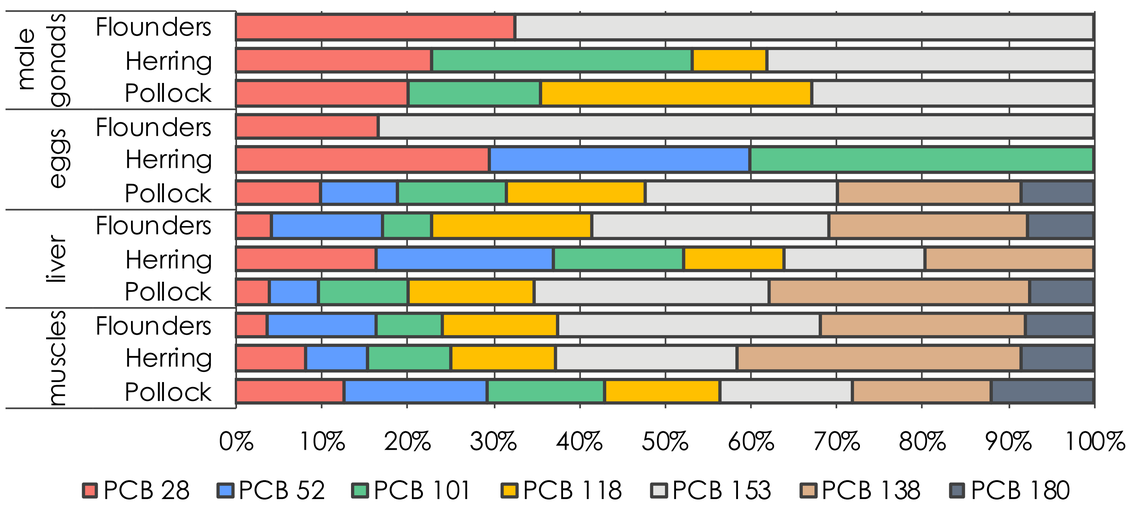
GC MC Shimadzu GCMS-QP2010 Ultra

1. Loading aluminum oxide into Schott filters
2. Lipid extract elution through the column
3. Vacuum-assisted gel filtration
4. Collection of filtered lipid fraction

Results and Discussion

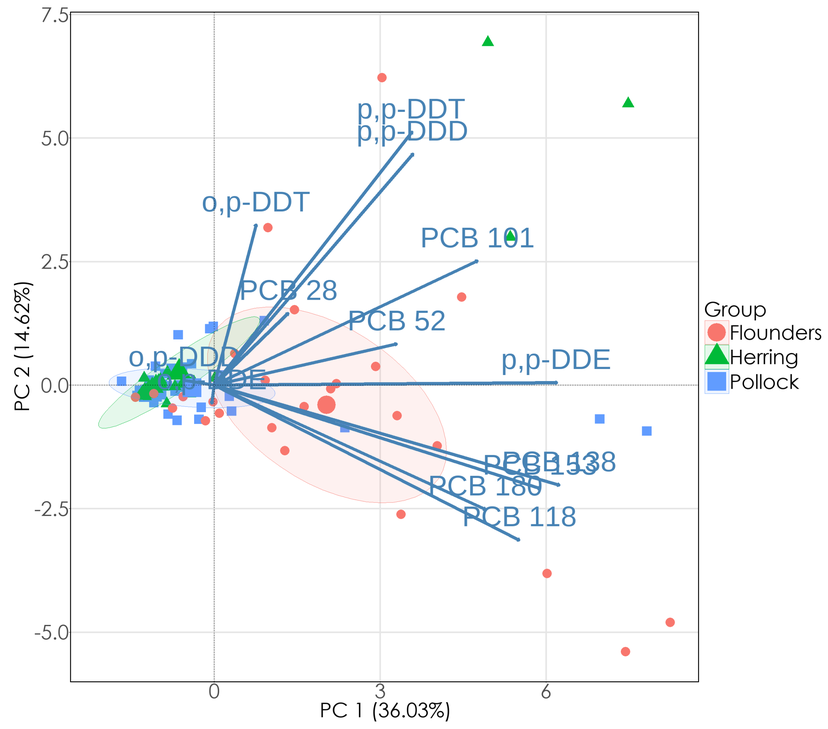
The concentrations of the detected toxicants are presented in Fig. 1. The HCH isomers level was below the detection limit in almost all samples. The ∑DDTs concentration in pollock ranged from 10.3±14.7 ng/g in muscles to 29.2±40.7 ng/g lipid weight in the liver; in herring – from 7.5±19.2 ng/g in muscles to 19.7±28.6 ng/g lipid weight in male gonads; in flounders – from 14.5±7.9 ng/g in eggs to 54±63.3 ng/g lipid weight in male gonads. The ∑PCBs concentration of in pollock ranged from 3.9±5.5 ng/g in muscles to 11.5±11.7 ng/g lipid weight in the liver; in herring – from 2.4±4.5 ng/g in muscles to 7.1±5.4 ng/g lipid weight in the liver; in flounders – from 3.5±2.6 ng/g in eggs to 13.8±11.2 ng/g lipid weight in muscles.



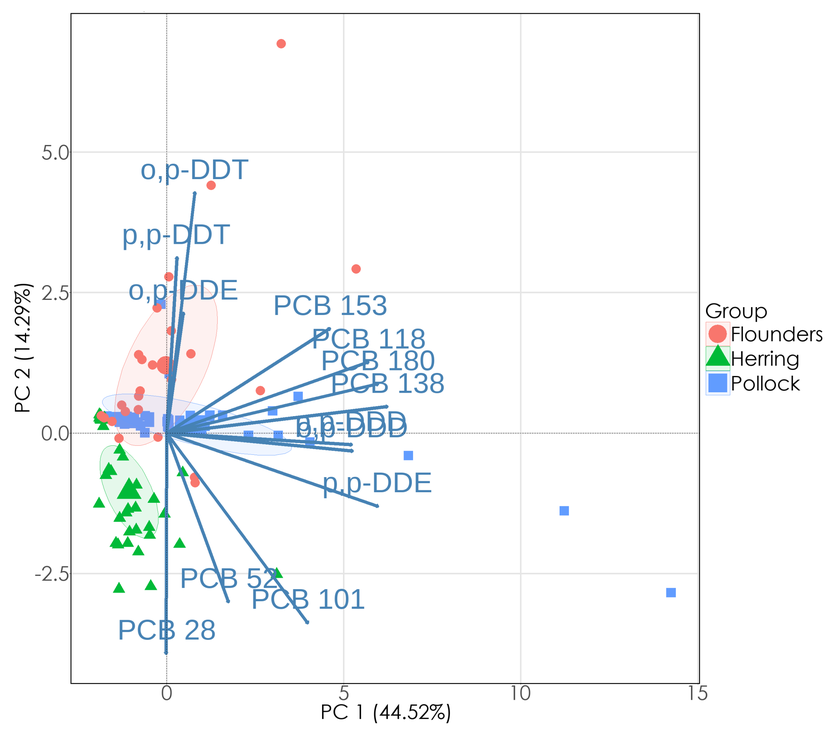


PCA analysis

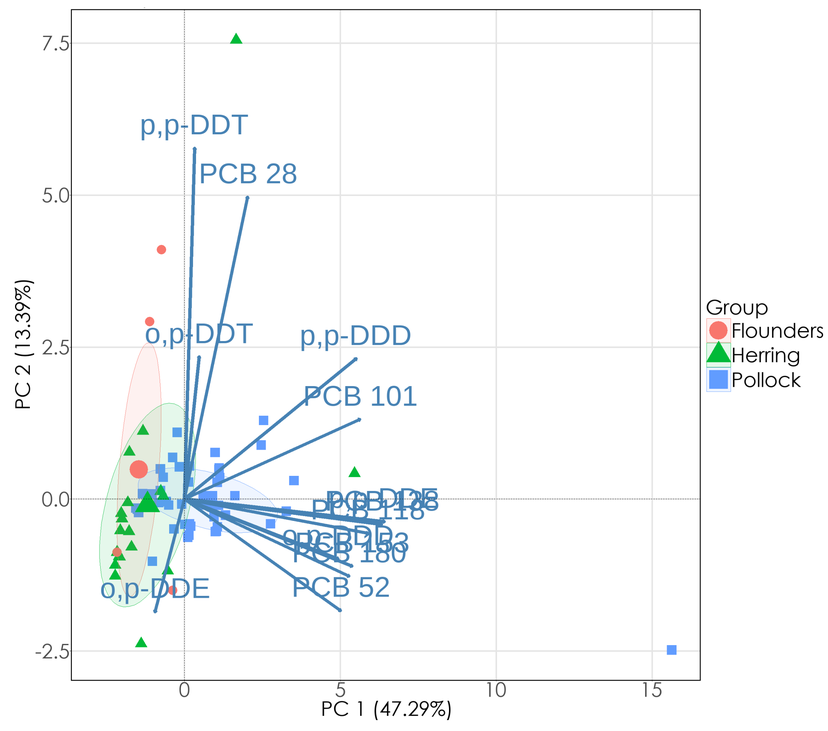
In the PCA plots for **muscles**, a distinct separation of the three fish species according to their ecological groups is observed. Flounder forms a separate cluster, characterized by a higher contribution of PCB 138, 153, 180, p,p'-DDD, and p,p'-DDE. This is consistent with their benthic lifestyle and feeding as benthophagous organisms. Herring, in contrast, groups in another part of the diagram and is associated primarily with PCB 28, 52, 101, and more volatile pesticides. This reflects their pelagic existence and feeding in the upper water layers. Pollock occupies an intermediate position, as it is a semi-pelagic species that performs vertical migrations and can feed both near the bottom and in the water column.



The analysis of data obtained for the **liver** reveals similar patterns of pollutant distribution, analogous to those in the muscles. The PCA results for the liver show that the direction of bioconcentration and distribution of POPs in fish tissues is determined by both the species' ecological niche and the metabolic activity of the tissues. The liver accumulates and processes a wider range of compounds.



In contrast to the muscles and liver, the PCA plot for **eggs** does not show clearly distinct clusters between the species. This indicates similar mechanisms of uptake and redistribution of pollutants in this type of tissue. Reproductive products likely accumulate compounds primarily via a passive pathway—through the bloodstream—without pronounced tissue selectivity.



Conclusions

The levels of POPs in fish are closely linked to their ecology. Bottom-dwelling species (flounders) typically accumulate lipophilic, highly chlorinated compounds such as DDE and PCBs 153, 138, and 180. In contrast, pelagic species (herring) show a higher prevalence of volatile xenobiotics. Species with intermediate habitat preferences (pollock) exhibit a mix of both contaminant profiles.

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