POPs biotransport by Pacific salmon to the Russian coast of the Northwestern Pacific

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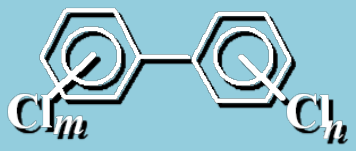
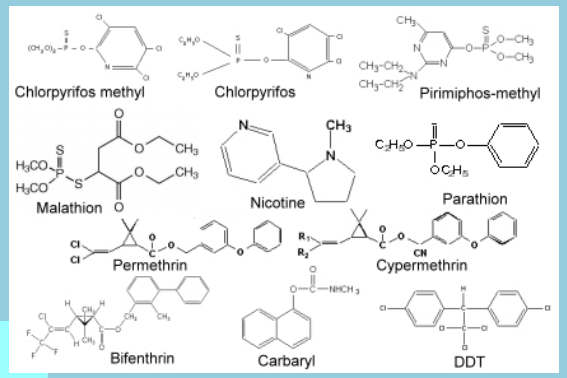
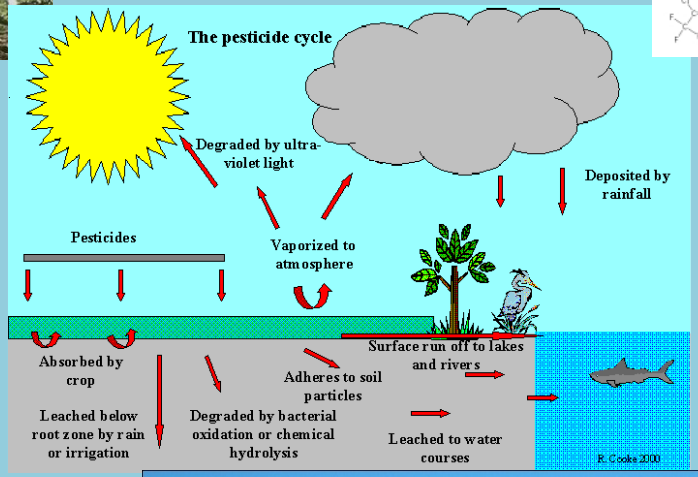
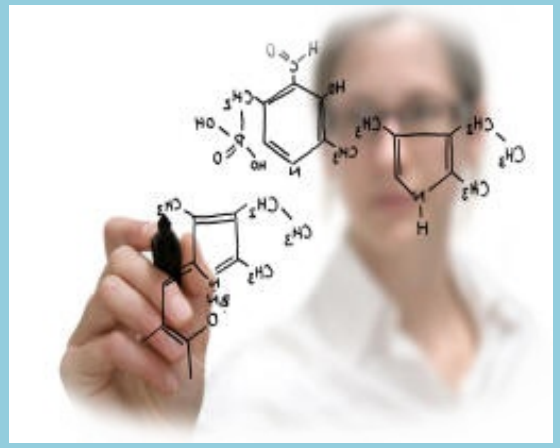
Persistent organic pollutants (POPs) are toxic xenobiotics that circulate in the biosphere over decades

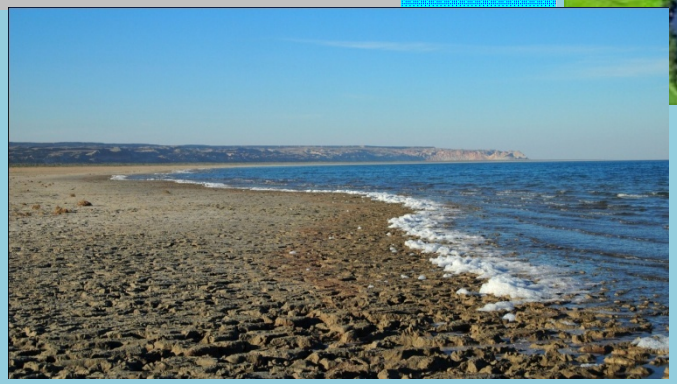


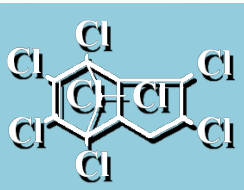
$$m + n = 1 \sim 10$$

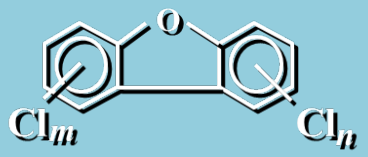






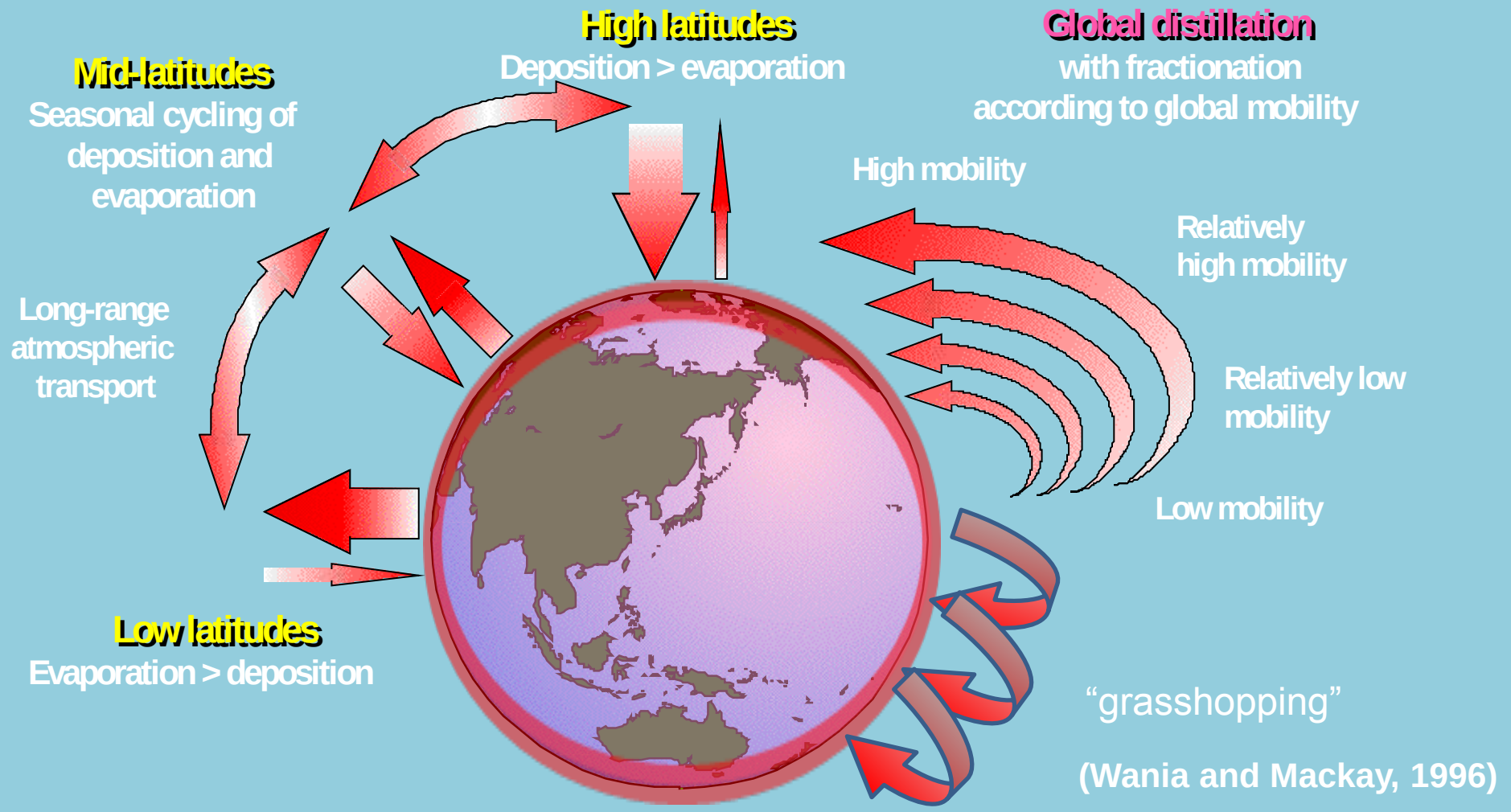






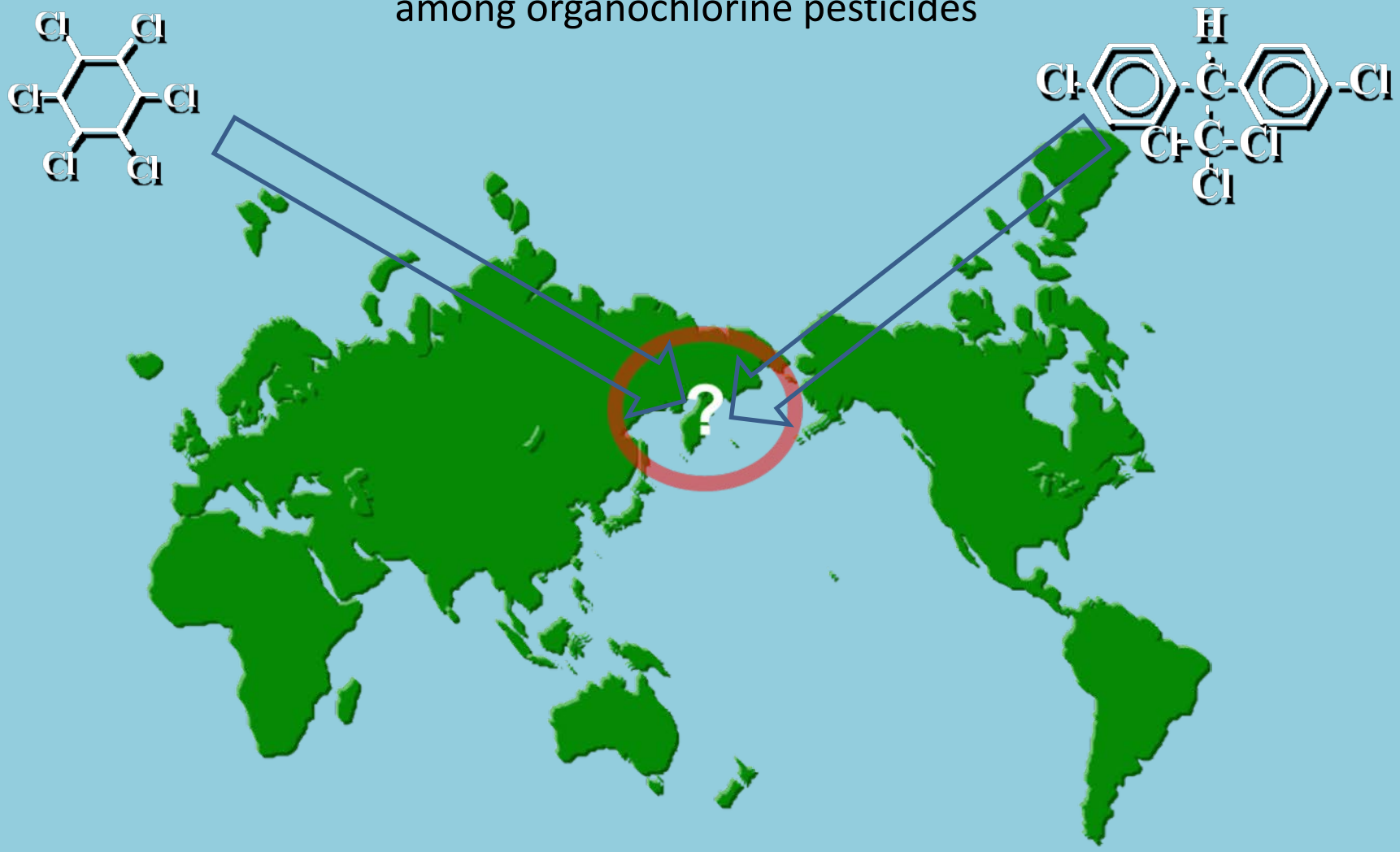
$$m + n = 1 \sim 8$$

Human and industrial activities in tropical and sub-tropical countries may pose serious effect as potential sources of new POPs on global contamination



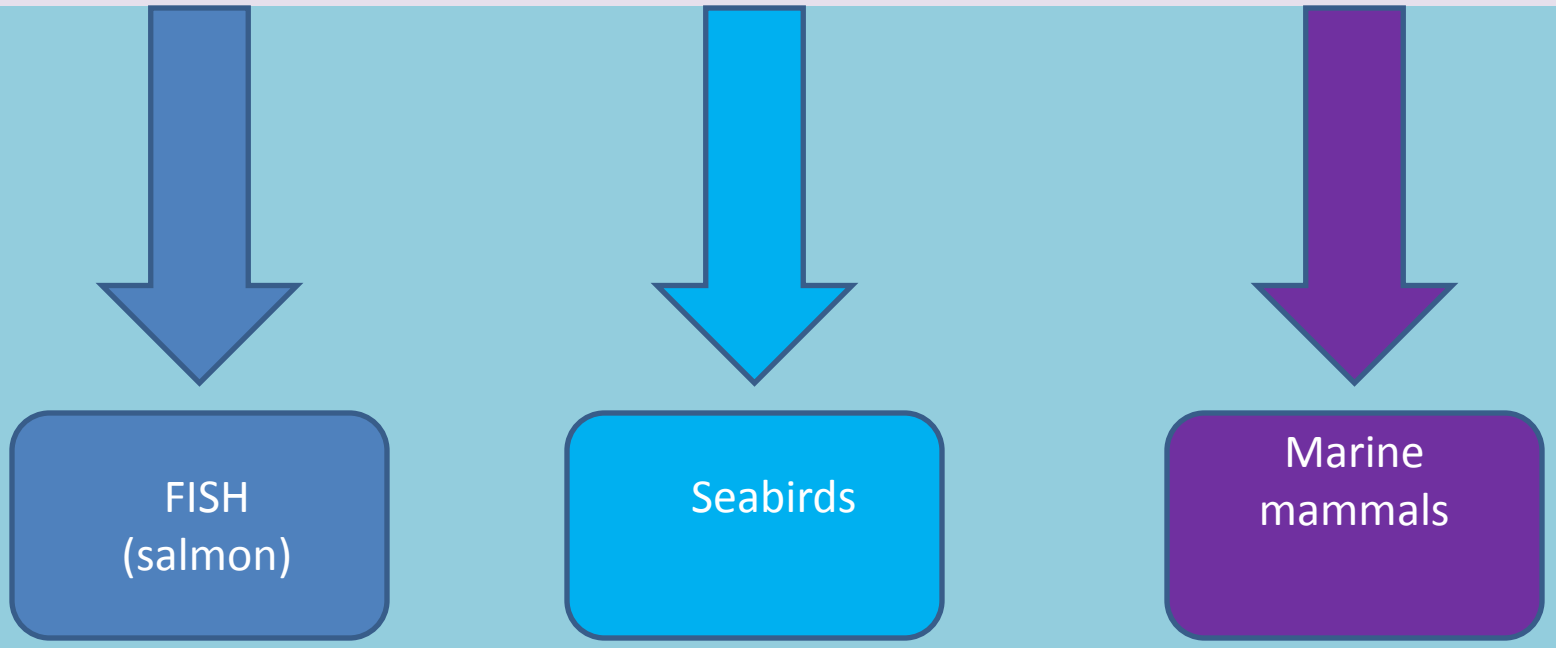
Pesticides evaporate in warm region and spread via the atmosphere as far temperate latitude as Arctic and Antarctica where they cooled and deposited

During the last third of the 20th century, hexachlorocyclohexane (HCH) and dichlorodiphenyltrichloroethane (DDT) have been the most actively used among organochlorine pesticides



These substances are standardized by health regulations in RF.
MPL = 200 mkg/g wet weight (fish, shellfish)

Biotransport of POPs



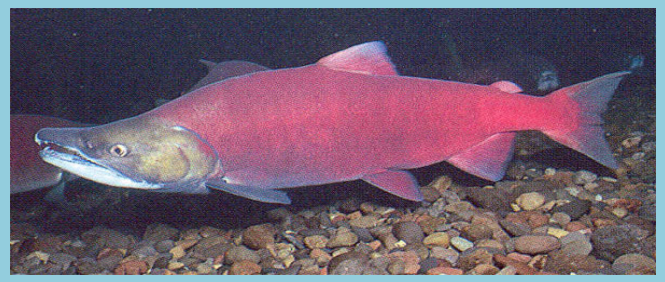
Goals:

- to evaluate the HCH and DDT concentrations in Pacific salmon
- to estimate the role of Pacific salmon in delivery of pesticides during biotransport from the open ocean to the Russian coast of the Northwestern Pacific

Pacific salmon

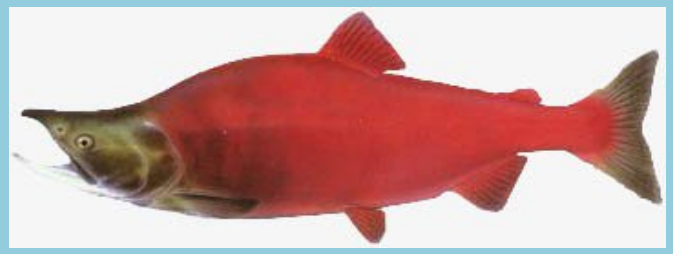
Pink salmon
Oncorhynchus gorbusha

Chum salmon
O. keta

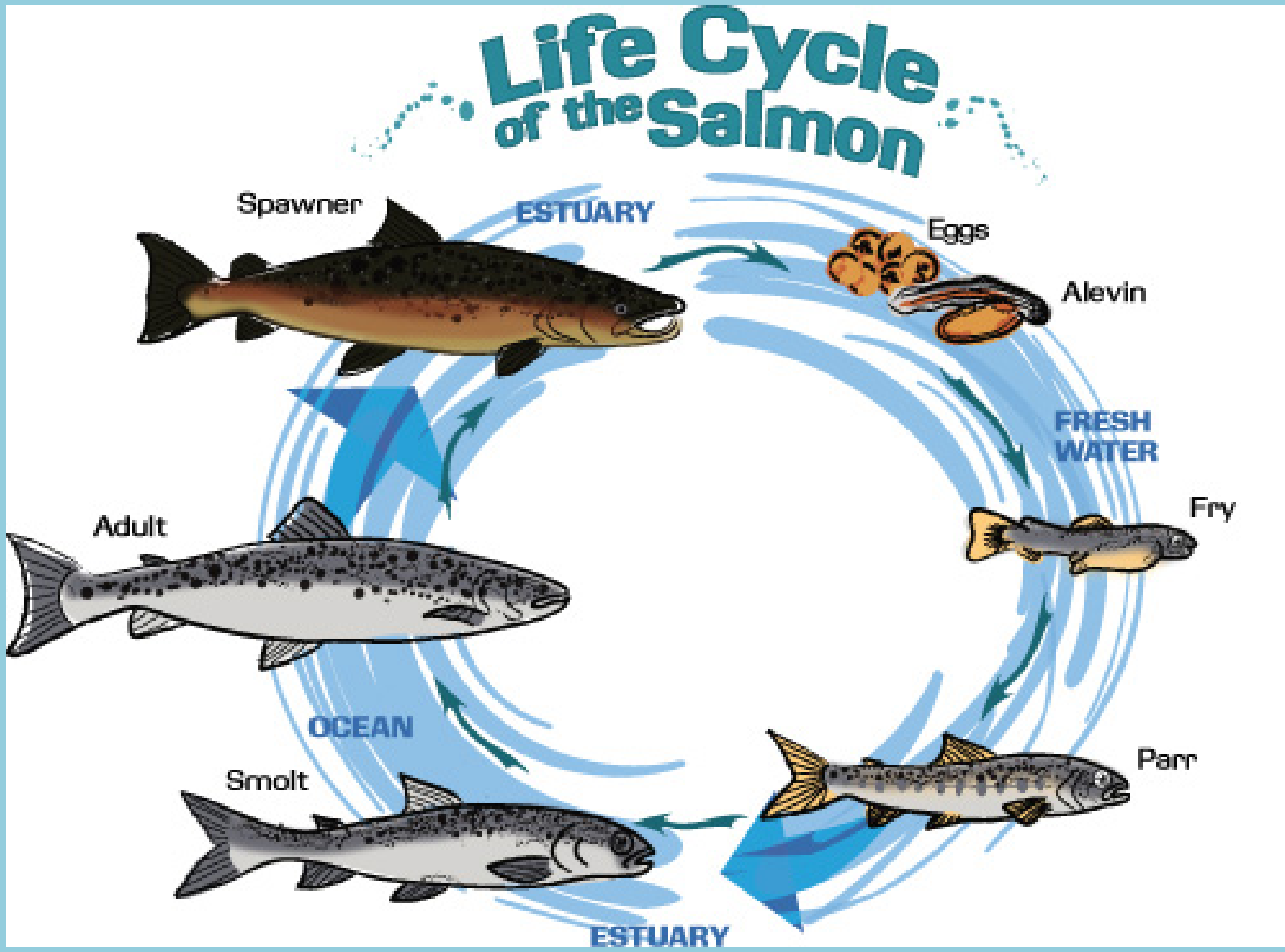


Sockey salmon
***O.nerka* – (redfish)**

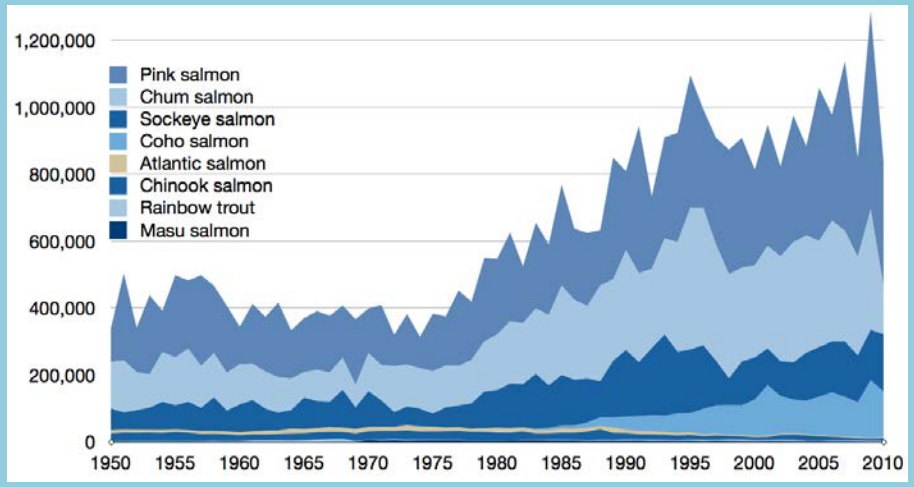
Coho salmon
***O. kisutch* (silver)**



Chinook salmon
O.tschawytscha

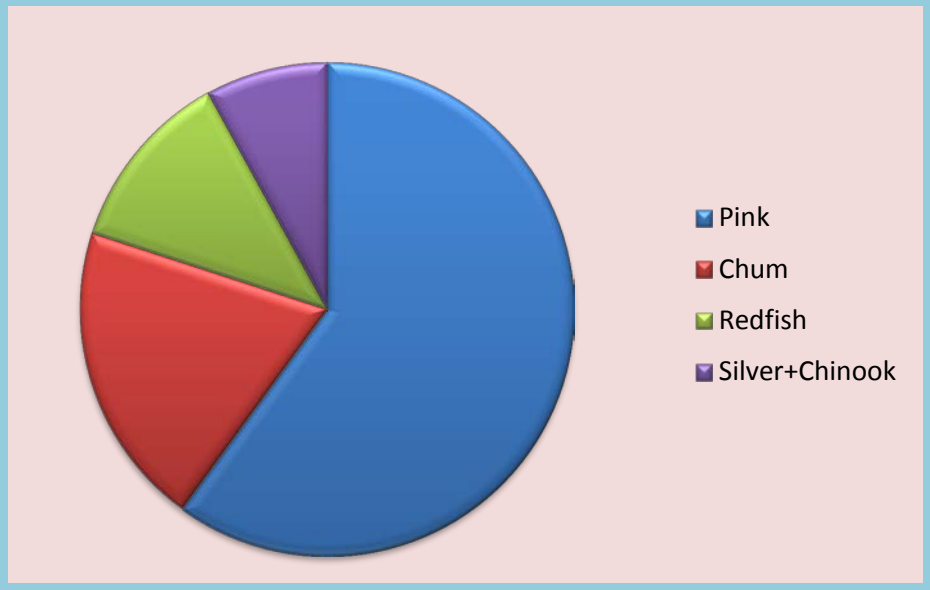

Life Cycle of the Salmon
Spawner
ESTUARY
Eggs
Alevin
FRESH WATER
Fry
Parr
OCEAN
Smolt
ESTUARY
Adult

Wild fisheries – commercial capture of all wild salmon (FAO)

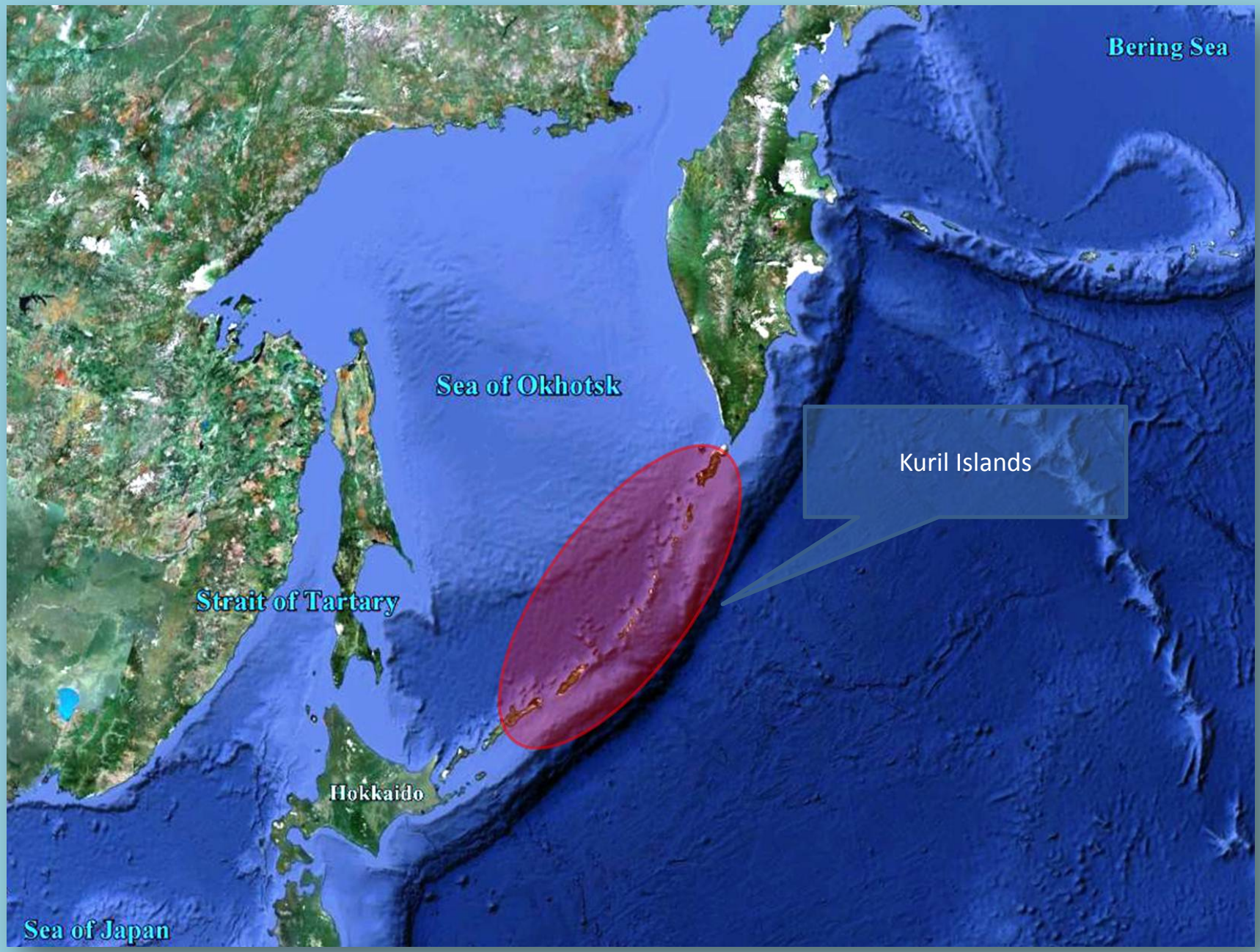


Total catch of Pacific salmon in fishing areas of Russian zone of Far Eastern seas

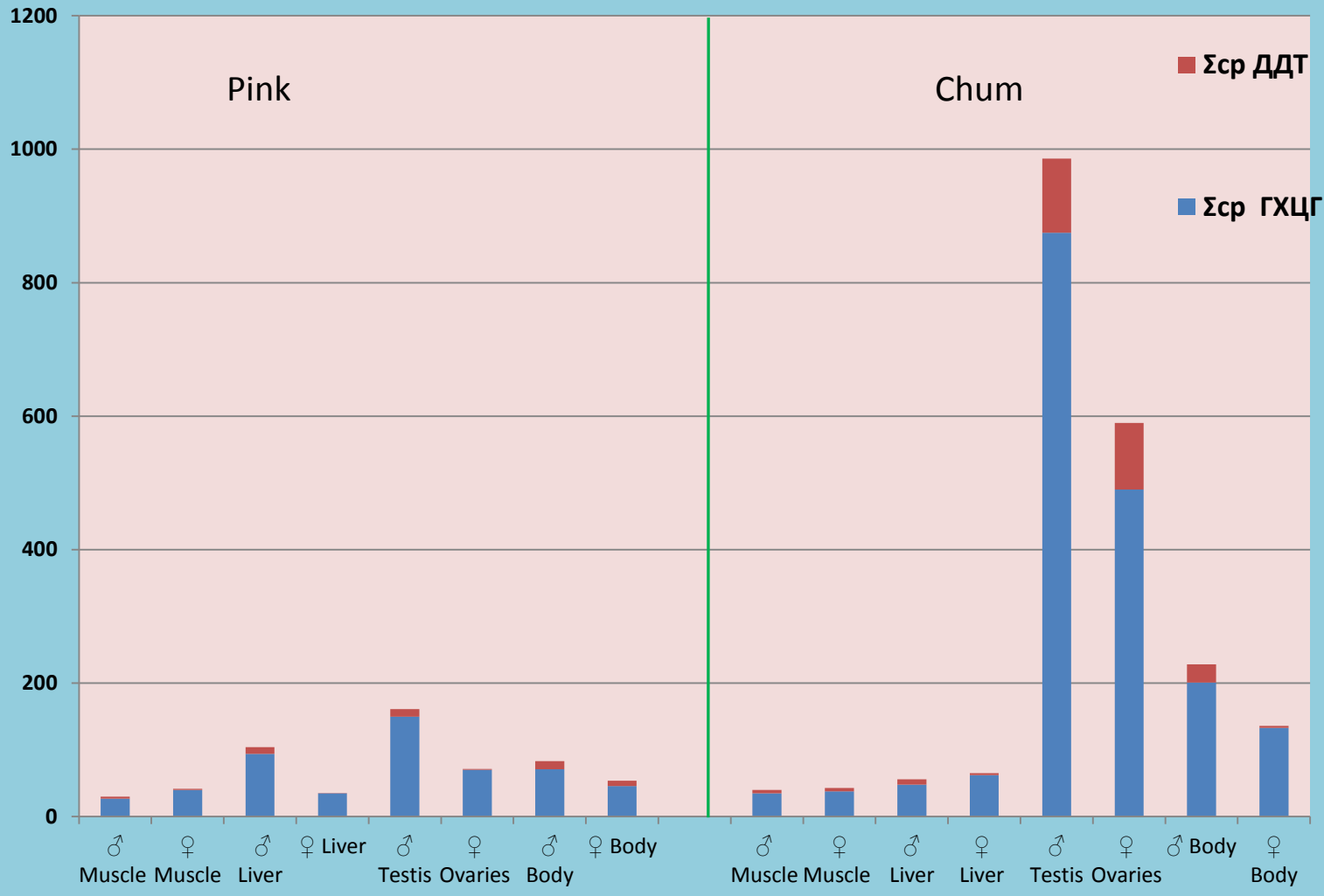
Share of individual species in the overall return and catch salmon in the Russian zone of Far Eastern seas



Map of Pacific salmon sampling



Total concentration (ng/g wet weight) of HCH isomers (α-HCH + β-HCH + γ-HCH), DDT and its metabolites (DDT + DDD + DDE) in pink and chum salmon



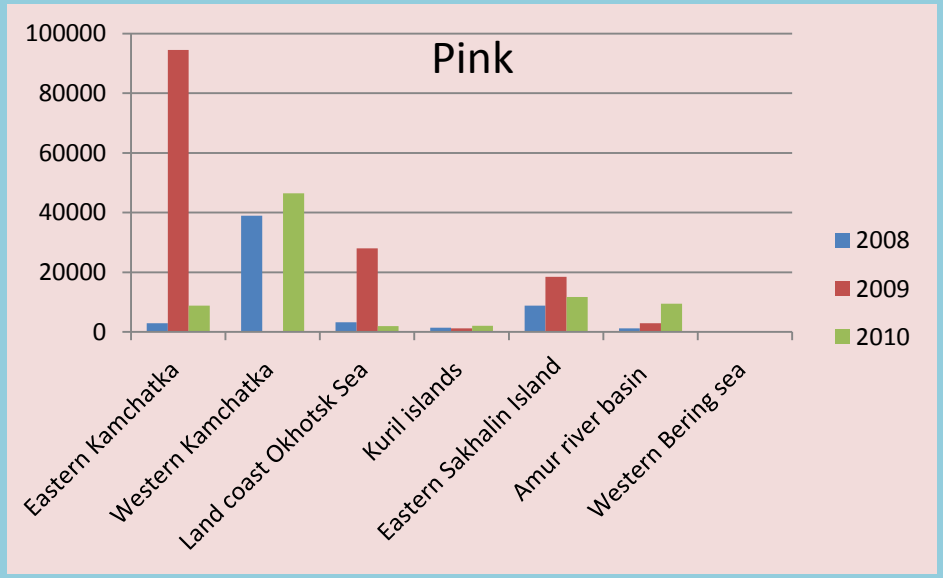
Body weight and total amount of POPs in Pacific salmon migrating to the Russian coast of Northwestern Pacific

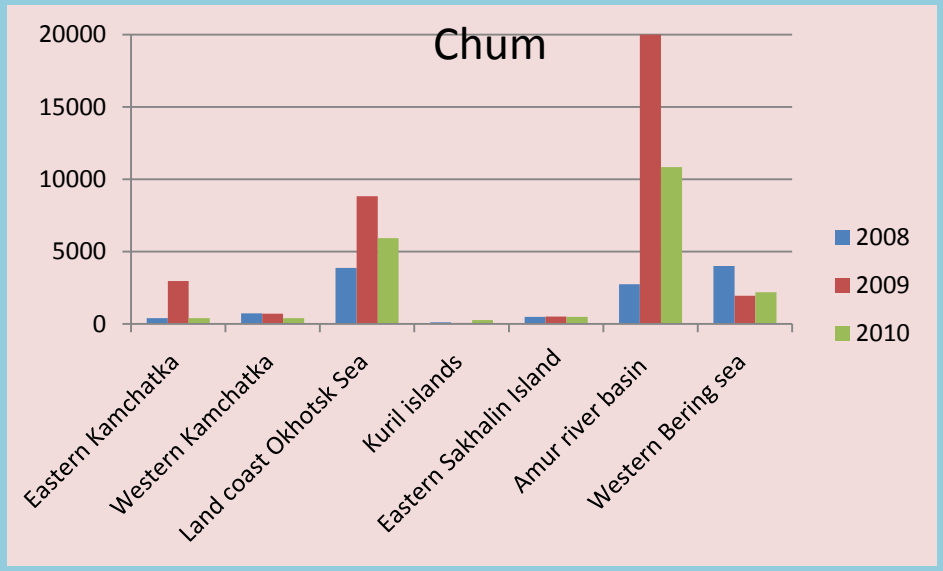
Pink
Average weight – 1,3 kg
Average POPs body burden – 90 mkg

Chum
Average weight – 3,5 kg
Average POPs body burden – 640 mkg

Escapement of Pacific salmon (th. fish) to spawning areas at the Pacific coast of Russia

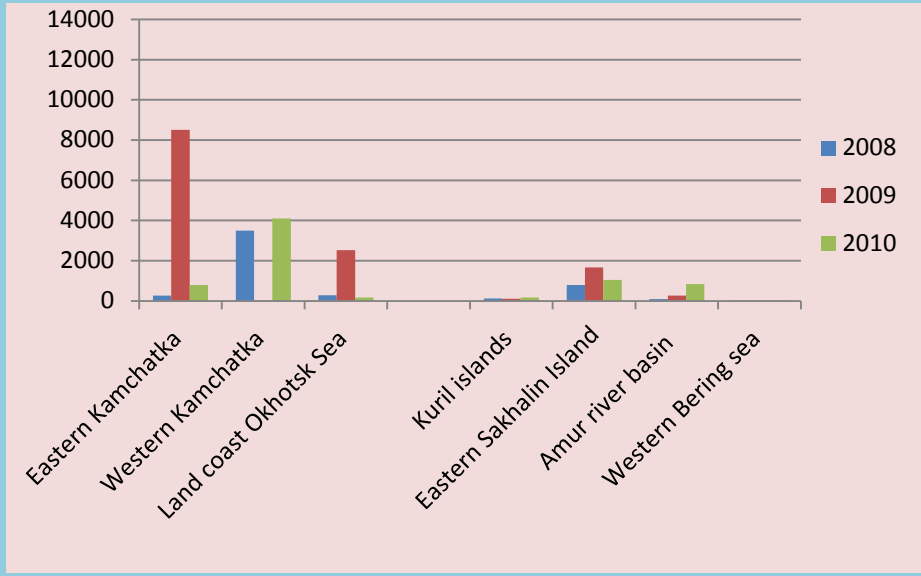
Area	Chum			Pink		
	2008	*2009*	*2010*	*2008*	*2009*	*2010*
Eastern Kamchatka	400	2,954	405	2,915	94,500	8,757
Western Kamchatka	722	716	392	38,949	117	46,441
Continental coast Sea of Okhotsk	3,860	8,827	5,931	3,225	28,042	1926
Kuril islands	105	73	261	1,432	1,216	2,009
Sakhalin Island, eastern coast	478	513	481	8,782	18,478	11,708
Amur river basin	2,747	20,079	10,827	1133	2,927	9,444
Western part Bering sea	4,000	1,943	2,192	70	170	60



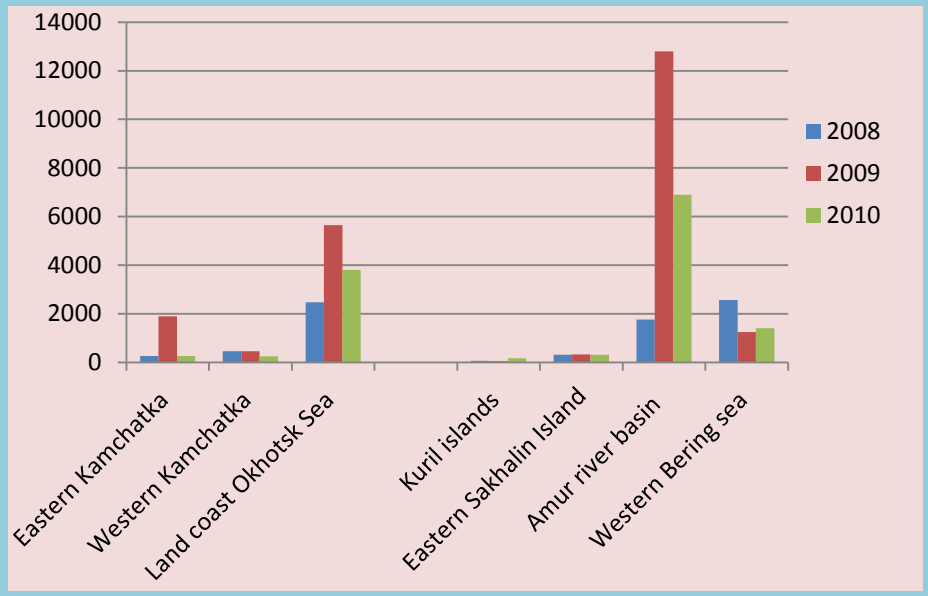


The amount of pesticides (HCH+DDT, g) transported by the Pink and Chum salmon to the spawning areas on the Northwestern Pacific

Pink



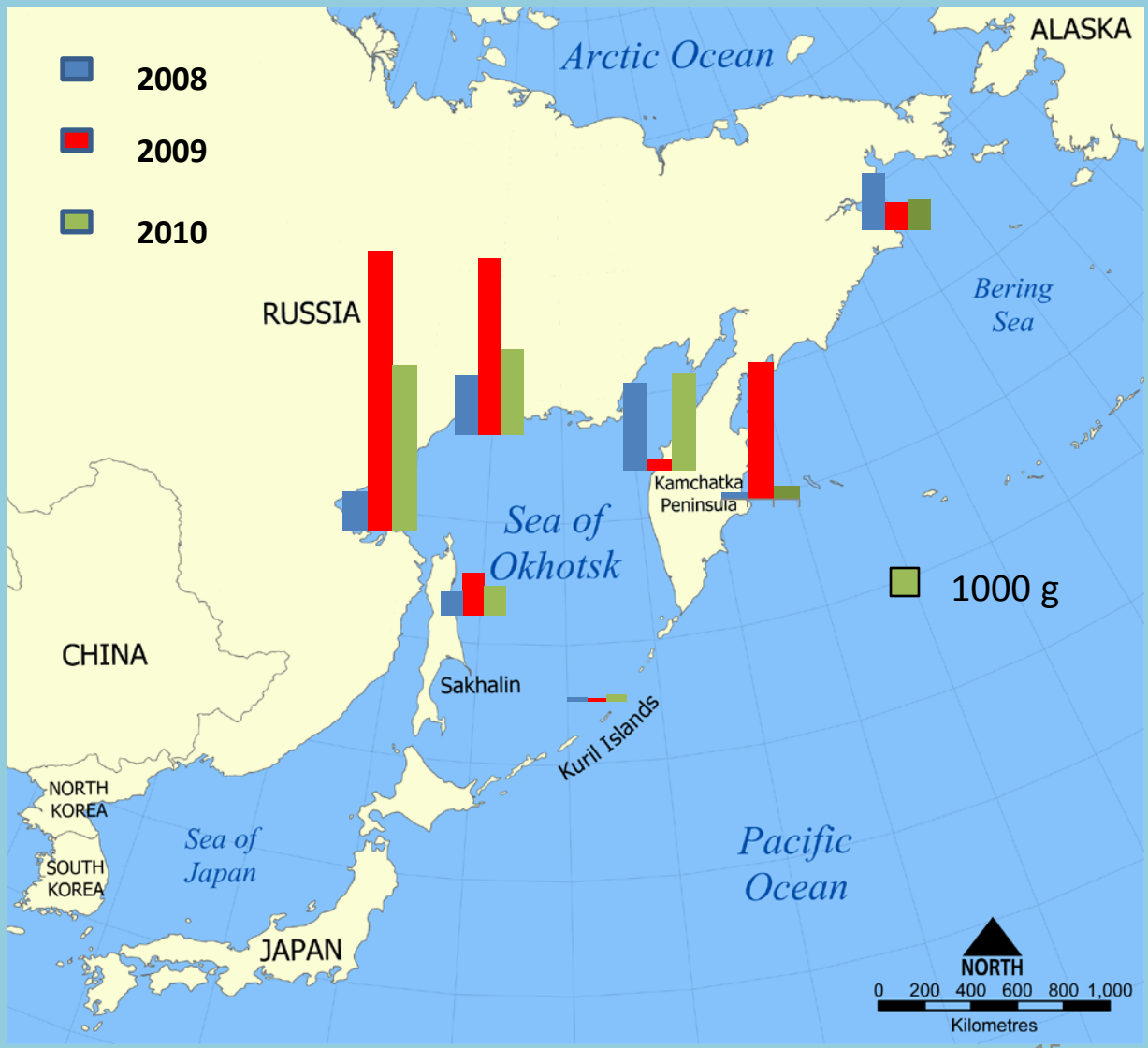
Chum



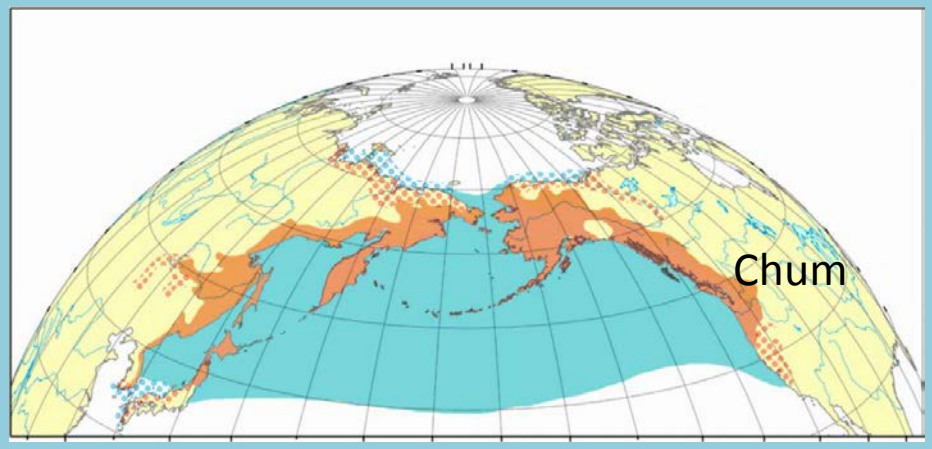
Distribution of pesticides transported by Pacific salmon to Russian coast of Northwestern Pacific

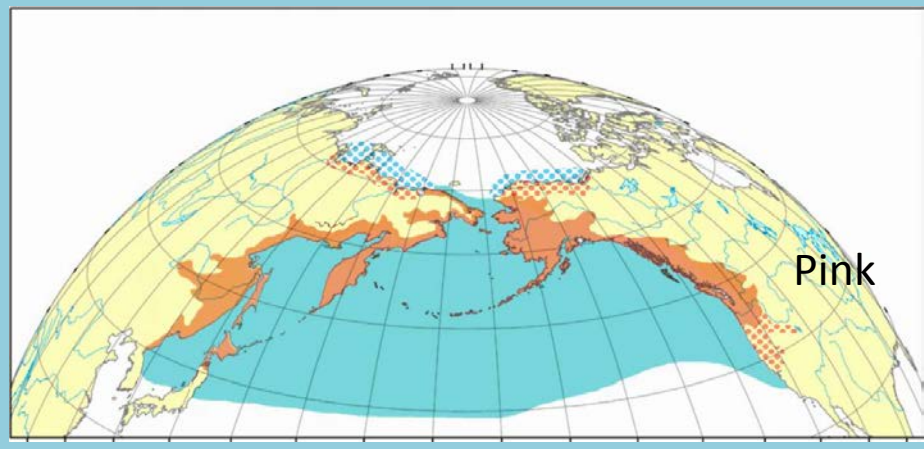
Total Russian coast, Pink+Chum

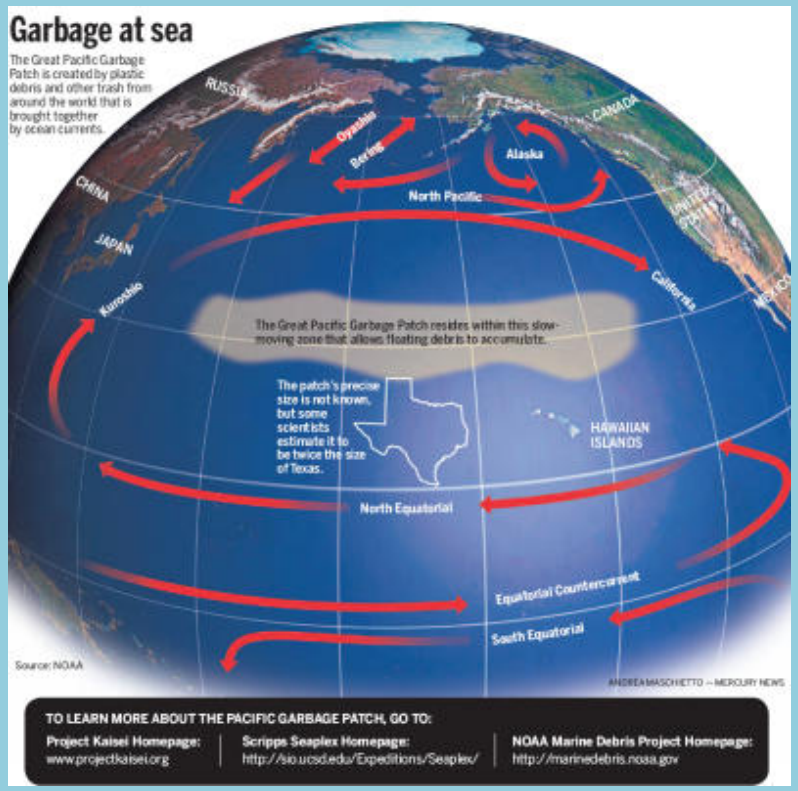
Years	HCH+DDT, g
2008	13000
2009	35500
2010	20200

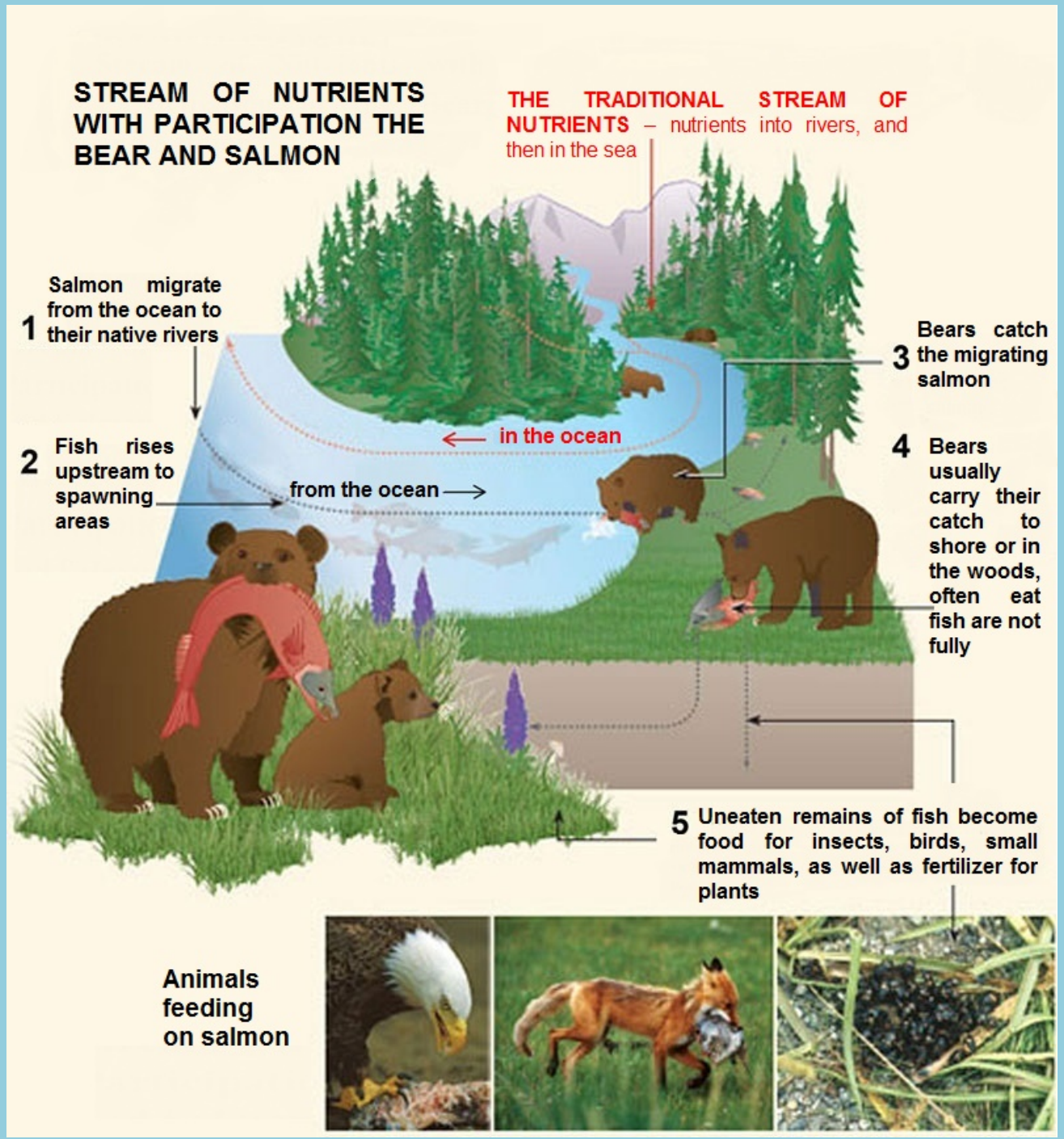


Pink and Chum spawning and ocean distribution









Migratory fish enrich the spawning area with biogenic elements. Now, there is the transport mechanism not only for nutrients, but persistent toxic substances too.

Brown bears consume from 10 000 to 30 000 t of salmon; i.e., they transfer from 1.5 to 4 kg of pesticides to the land

The biotransport of OCPs to spawning grounds depends on the number of migrating salmon, whereas the input of toxicants to the human body with consumed salmon is determined by the amount of caught fish. In recent years, the catches of salmon in Russian waters were high: from 325 000 t to 542 000 t . The amount of pesticides in salmon that were caught during a year was from 40 to 67 kg.

Consumer group	Annual intake of aquatic foods (kg)	Annual intake of POPs (mg)
Average Russian	14	?
Russian Far East	25-30	4,5
Chukotka	60	10,8
Other aboriginal peoples of Russian Far East	50	9

Conclusion

•Salmon are convenient objects for monitoring the circulation of persistent organic pollutants in the biosphere.

•Organic pollutants are firmly embedded in the directed transport of nutrients, carried salmon and linking oceanic and terrestrial ecosystems.

•Annual pesticides reaching the spawning areas and a steady increase in their concentration in the local areas determines the possibility of environmental risk for certain salmon populations.

•It may influence the spawning success of salmon which may be reduced due to the toxicity of the environment.


Thank you for your attention!