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Organochlorine Pesticides in Fulmar (*Fulmarus glacialis* Linnaeus, 1761) from the Coast of Eastern Kamchatka and the Kuril Islands

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ABSTRACT

Organochlorine pesticides are persistent toxic substances of anthropogenic origin that affect biota. Hexachlorocyclohexane (HCH) isomers (α-, β-, and γ-), DDT and its metabolites (DDD and DDE) were detected in five individuals of fulmars *Fulmarus glacialis* Linnaeus, 1761 from the coast of Eastern Kamchatka and the Kuril Islands. The average amount of HCH isomers in the organs of fulmars ranged from 608 ± 177 ng/g lipids in the total homogenate of the organs to 2093 ± 264 ng/g lipids in the feathers with skin. The average range of the amounts of DDT and its metabolites was from 3606 ± 333 ng/g lipids in the feathers with skin to 4076 ± 1624 ng/g lipids in the feathers. The results are discussed.

Introduction

The 1960s and 1970s were marked by the mass death of wild bird populations in various parts of the world. The reason for this phenomenon turned out to be the use of organochlorine pesticides (OCPs). As a result of endrin intoxication, partridges and pheasants died; dieldrin killed bald eagles and geese. DDT (dichlorodiphenyltrichloroethane) caused the death of cormorants, pelicans, and seagulls; lindane caused the death of starlings (Tanabe et al., 1984; Rovinskii et al., 1990).

After the ban on the use of pesticides was imposed, bird deaths decreased significantly, but deaths caused by OCPs poisoning continued. It is important that in areas contaminated by OCPs, birds are particularly sensitive to other groups of chemical toxicants. Thus, the presence of DDE (dichlorodiphenyldichloroethylene) disguises the effect of the negative effects of mercury on reproduction of birds (Rovinskii et al., 1990; Jorundsdottir et al., 2010).

A number of experiments managed to identify critical concentrations of OCPs in the brain of birds. Lethal doses of pesticides are specific for each species and fall within the range from 4 (for the Japanese quail and yellow cres) to 65 mg/kg (for sparrows) (Tanabe, 2007).

For the first time, a correlation between eggshell thinning and the deterioration of breeding populations of peregrine falcons and sparrow hawk in the field of persistent organochlorine insecticides was revealed in the UK.

Compared with the eggshell thickness in 1940, by the end of 1960s, the eggshell thickness of nine out of the 17 studied species was found to decrease by 5 to 19%. Studies in the U.S. and Canada also revealed a certain degree of thinning of the shell; the shell thickness and the weight of many bird species decreased by 20% (Kunisue et al., 2003; Tanabe and Subramanian, 2006; Tanabe, 2007).

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Birds are useful bioindicators for organochlorine pollutants monitoring because they often are at the apex of the food pyramid. Non-migrating birds can reflect the background contamination of their habitat places. If there are no local pollution sources, birds reflect the global pollution resulting from the trans-boundary transfer of pollutants (Kunisue et al., 2003; Knudsen et al., 2007).

The purpose of this study is to determine the concentration of HCH isomers (hexachlorocyclohexane) (α-, β-, γ-HCH), DDT and its metabolites (DDD (dichlorodiphenyldichloroethane), DDE (dichlorodiphenyldichloroethylene)) in fulmars *Fulmarus glacialis* Linnaeus, 1761, collected in the coastal waters in the Sea of Okhotsk, West Kamchatka and the Kuril Islands.

Materials and Methods

Five studied samples of fulmars *F. glacialis* were collected from the coast of western Kamchatka and the Kuril Islands in June and October 2012 during the TINRO centre expeditions (Fig. 1).

Various organs were scrutinised, depending on the size of birds: feather, feather with skin, and whole carcass (internal organs with feathers). Lipids were extracted from homogenised organs by means of *n*-hexane extraction, with subsequent disintegration of the fat components by concentrated sulphuric acid (Klisenko et al., 1983).

Detection of the mass content of organochlorine pesticides in the biomaterial was performed on a gas chromatograph Shimadzu GC-16A with an ECD electron capture detector (capillary column Shimadzu HiCap CBP5). Column temperature: 210 °C, injector: −250 °C, and detector: −280 °C. Carrier gas: argon, inlet pressure: 2 kg/cm^2, 1:60 flow divider, and flow rate of carrier gas through the column: 0.5 ml/min. To identify individual substances, standard working solutions of OCPs in the concentration range of 1–100 mg/ml were applied.

Results and Discussion

Pesticides were detected in all of the studied birds samples (Table 1). The average amount of HCH isomers in the bodies of fulmars ranged from 608 ± 177 ng/g lipids in the general organ homogenates to 2093 ± 264 ng/g lipids in feathers with skin. α-HCH was found in all the samples of feathers with a maximum value of 1450 ± 186 ng/g lipids. β-Isomer was not detected. γ-HCH was present in samples of feathers and feathers with skin, corresponding to 371 ± 87 and 305 ± 55 ng/g lipids, respectively.

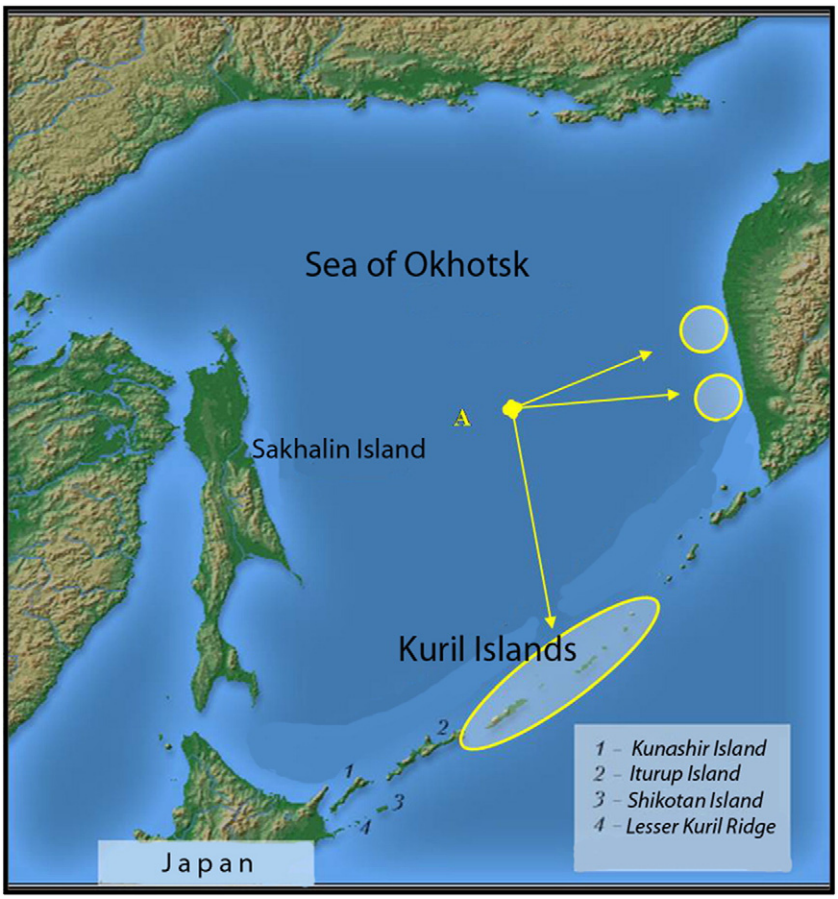

Fig. 1. Map of the work area: A — fulmar sampling locations.