

## Elevated Exposures of Polychlorinated Dibenzo-*p*-Dioxins, Dibenzofurans and Dioxin-like Polychlorinated Biphenyls in Livers of Birds from Japan

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### Introduction

Since the late 1940s and the early 1950s, there are a series of avian population collapses. The species that showed signs of declining population was double-crested cormorant, bald eagle, some tern species, heron species and gull species in the Great Lakes, USA and Canada (Postupalsky, 1978) with reproductive and anatomical abnormalities. High correlation has been observed with deformity/anatomical malformations and egg concentrations of polychlorinated dibenzo-*p*-dioxins (PCDDs); polychlorinated dibenzofurans (PCDFs) and dioxin-like polychlorinated biphenyls (PCBs) (for review see Gilbertson *et al.* 1991; Yamashita *et al.* 1993). A few studies have reported the occurrence of dioxin-like PCBs and PCDD/DFs in birds in Japan (Guruge and Tanabe, 1997; Guruge *et al.* 2000; Iseki *et al.* 2000). These studies have suggested greater exposures of PCDDs/DFs and dioxin-like PCBs. Because persistent environmental contaminants are biomagnified in species belongs to top of the food chain. Considering these facts, in the present study, we determined congener-specific accumulation of PCDDs, PCDFs and dioxin-like PCBs in four groups of birds belonging to different habitat and ecology. Toxic equivalencies (TEQs) were estimated using WHO-toxic equivalency factors (TEF) proposed in 1998.

### Materials and Methods

#### Sample collection and Analysis

Bird liver samples were obtained from Gyotoku Birds Observatory located in Chiba Prefecture, Tokyo, Japan, silky chicken was obtained from Nihon University, a few bird liver samples were obtained from fisherman in and around Haneda Airport, Atsugi-city, Tanuma-cho and Tochigi areas. In later dates birds were dissected to separate liver tissue for analysis. Details of the analytical procedures were reported previously (Iseki *et al.* 2000).

### Results and Discussion

Elevated exposures of PCDD/DFs were observed in two species of predator species (mountain hawk eagle) followed by northern goshawk and piscivorous birds such as gray heron (Fig. 1). However, dioxin-like PCBs were greater in sea gulls, mountain hawk eagle, great egret and black-headed gull (Fig. 1). Granivore species showed least concentrations of PCDD/DFs and dioxin-like PCBs. PCDD homologues comprised greater concentration than those of PCDFs in silky chicken, rock pigeon, gray heron, short-tailed shearwater, cattle egret, large-billed crow, sea gull, black-eared kite, northern goshawk and common kestrel. While PCDF homologues were greater in common pheasant, spot-billed duck, whimbrel, great egret, black-headed gull, ural owl and mountain hawk eagle. Collectively, dioxin-like PCBs were several magnitude elevated levels than those of PCDD/DFs depending upon species. The varied accumulation levels in between species and groups suggested different feeding habit and ecology of birds. Further, some species have specific-metabolic/elimination capacity of PCDD/DF homologues.

The congener specific patterns are slightly different in between species. On the whole, 12378-PeCDD and 123678-HxCDD among PCDDs and 23478-PeCDF, 123678-HxCDF among PCDFs were prevalent accumulants in most of birds analyzed. In addition, 12346789-HpCDD, OCDD, 123478-HxCDD among PCDDs and 234678-HxCDF, 12378-PeCDF, 123478-HxCDF, 123789-HxCDF and 2378-TCDF among PCDFs also accumulated in some birds. Similarly, IUPAC Nos. of 77, 126 was most prevalent among non-*ortho* PCBs in many species. Although, some species accumulated greater levels of IUPAC 169 and very few species with IUPAC 81. The mono-*ortho* PCB

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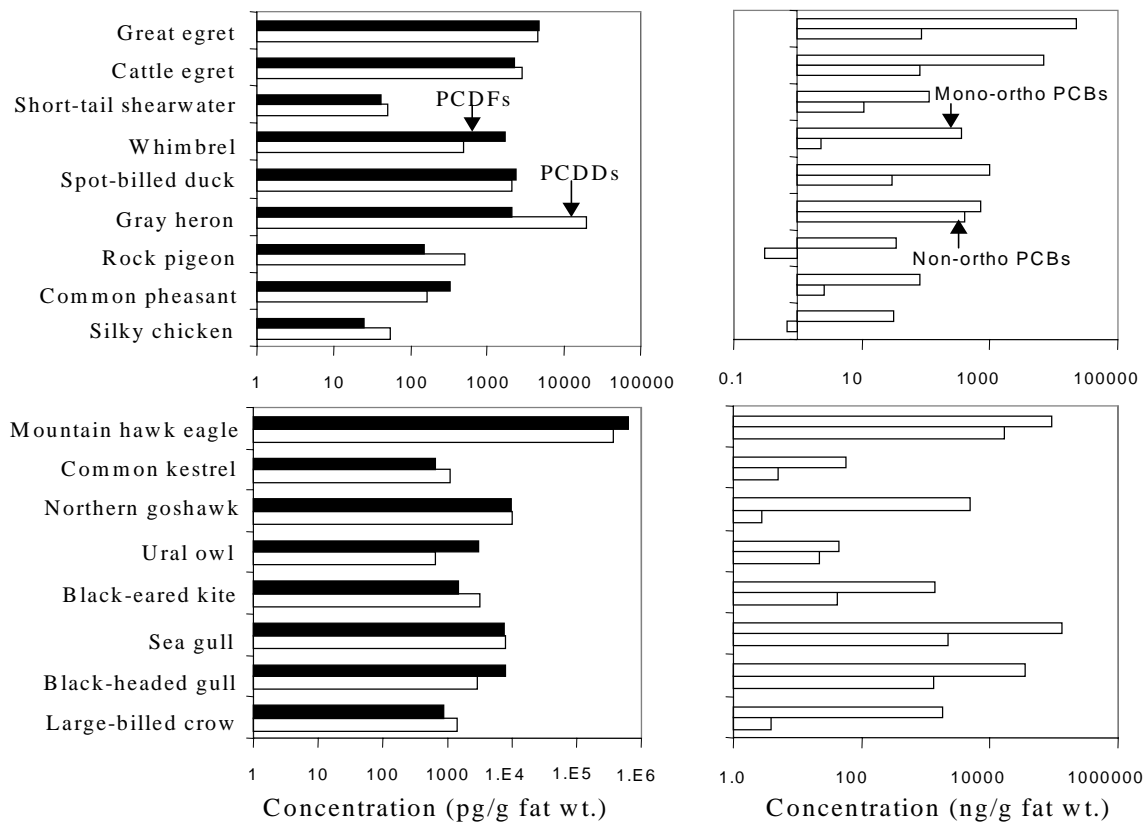
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118, 105 was mostly observed accumulants in many birds apart from 156, 189 and 114. However, mono-*ortho* PCBs were several magnitude higher than non-*ortho* PCBs in all birds analyzed.

The toxic equivalents were in the ranges from 53 to 450000 pgTEQ/g on fat weight after TEF proposed by WHO group in 1998. Granivores showed lower levels followed by most of piscivores, some predators, omnivores and hawk species. In most of birds, dioxin-like PCBs greatly contributed to the toxicity than those of PCDD/DFs. Toxicity contribution by PCDD/DFs was found higher in northern goshawk, ural owl, great egret, spot-billed duck, common pheasant and rock pigeon however, with very low levels. In most of bird species 12378-PeCDD, 2378-TCDD and 123478-HxCDD among PCDDs and 23478-PeCDF, 2378-TCDF, 123478-HxCDF and 123678-HxCDF among PCDFs greatly contributed to toxicity. Among dioxin-like PCBs the toxicity rated in the following order of 126>77>81>169>105>118>156>114>189>157 in most of species analyzed in this study.



**Figure. 1** Concentrations of PCDD/DFs and dioxin-like PCBs in birds of Japan.

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