Ecological Risk Assessment of Dioxins on Common Cormorant Populations

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We estimated the risk of dioxin exposure in Tokyo Bay sediment via fish ingestion onto common cormorant (*Phalacrocorax carbo*) populations, in reference to the egg mortality.

Exposure via contaminated fish was estimated using the next equation.

$$TEQ_{egg} = \sum_{congener} C_{sed} \times BSAF \times BMF \times EBR \times TEF / L_{egg}$$

Where, TEQ_{egg}=Total toxic equivalency quantity in egg (pg TEQ/g egg wet weight basis), C_{sed}=Organic carbon-normalized concentration of each congener (12 congeners; 2378TCDD, 12378PeCDF, 23478PeCDF, 234678HxCDF, PCB81, 77, 126, 104, 105, 118, 156 and 157) in sediment (pg/g sediment OC weight basis), *BSAF*=Lipid- and organic carbon-normalized concentration ratio between fish and sediment, *BMF*=Lipid-normalized concentration ratio between cormorant and fish, *EBR*= Lipid-normalized concentration ratio between egg and parent body, *TEF*=Toxic equivalency factor (WHO-bird), L_{egg}=Lipid content in cormorant egg. The parameters in the right side of the equation, except for TEF, were assigned to probability distributions, respectively. Then, Monte-Carlo simulations were performed using the software package Crystal Ball 4.0 (Decisioneering, Inc., USA). As a result, the probability distribution of TEQ_{egg} was obtained (Fig. 1).

Effects characterization was conducted on the basis of the toxicity data that was derived 2378TCDD egg injection test on double-crested cormorant (*Phalacrocorax auritus*) (Powell *et al*., 1998). On the assumption that the base-10 logarithms of tolerances are assumed to have a normal distribution with parameters: mean=log (LC50); standard deviation=1/slope, from the probit model, a random tolerance is generated as follows (ECOFRAM; USEPA, 1999).

$$\text{Random tolerance} = LD_{50} \times 10^{(Z/slope)} \quad Z = \text{standard normal distribution } (m=0, \delta=1)$$

Risk characterization is a stage where results of exposure and effects analyses are integrated to evaluate the likelihood of adverse effects occurring. The mortality probability function is a quantal response, and for a given exposure and sensitivity, an individual either dies (where the tolerance of the individual is less than the exposure received) or survives.

If exposure>tolerance then morality, if exposure<tolerance then survival

Consequently, the probability distribution of egg morality was estimated (Fig.2).

In the next phase, we will evaluate the risk in terms of population-level effects.

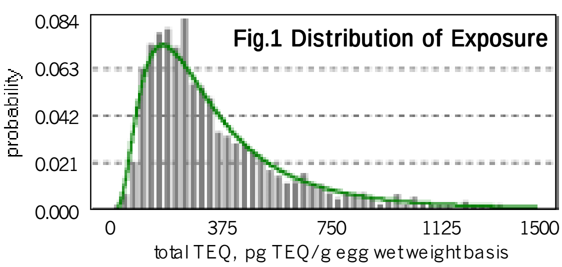

Fig.1 Distribution of Exposure

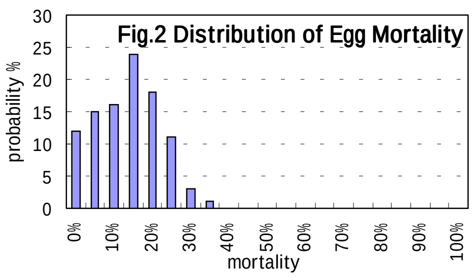

Fig.2 Distribution of Egg Mortality