Efforts and Strategies to Deal with the Issue of Endocrine Disruptors in Japan
Results of a Nationwide Survey by the Ministry of the Environment

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I am Shinsuke Tanabe of Ehime University. Now I would like to talk about the results of a nationwide survey conducted by the Ministry of the Environment, Government of Japan concerning the issue on endocrine disrupters.

As you know, the issue of endocrine disrupters gathered interest when the book "Our Stolen Future" by Dr. Theo Colborn and others was published. The book pointed out that man-made chemical substances disrupt the endocrine systems of wild animals and human beings, obstruct reproductive function and produce malignant tumors. The book also points out that such chemical substances could potentially have negative effects such as ataxia of the immune system and/or nervous system. In other words, because of the revelations in the book about new types of toxic effects of these chemical substances, social and scholastic concern for endocrine disrupters has risen both in Japan and overseas.

The Ministry of the Environment of Japan formed a research team headed by Dr. Suzuki in July 1997 to study the problem of endocrine disrupters, which has since expanded it into a nationwide survey. Today I would therefore like to talk about the investigation on the conditions and threat concerning environmental pollution and wild animals conducted by the Ministry of the Environment and would also like to explain, in part, about assessment of environmental risk.

The Ministry of the Environment is simultaneously conducting an investigation on the present status of dioxin pollution. I would also like to talk about the results of the "Simultaneous Nationwide Emergency Study on Dioxins". In other words, I will discuss the results concerning the degree of dioxin contamination in the environment and to what degree animals are contaminated by dioxins.

The Ministry of the Environment has prepared a list of 67 types of endocrine disrupters given in the table. Taking special note on several of these chemicals, the Ministry of the Environment is conducting a survey on wild animals and the environment till present days. The results of this general environmental survey show the general situation during 1998 and 1999. During this 2-year period, the Ministry of the Environment conducted a survey taking samples of air at 218 locations, water at 1347 locations, sediment at 314, soil at 101, and aquatic organisms at 189. The ministry also collected and studied 499 specimens of wildlife. As a result of testing air samples for 11 substances, 10 of those substances were detected. The ministry also tested water, benthic and aquatic organisms for 61 types of substances, and detected anywhere from one-third to one-half of those substances in the specimens. Wild animals were tested for 25 substances, 19 of which were detected.

I would like to talk in detail about the condition of several of these environmental and biological compartments concerning pollution. This is a summary of the substances tested for in the water test and those detected. In the investigations on water, the samples were tested for 61 substances, of which 27 were

detected. Rate of detection was 5% of the total number of samples or higher for 11 of the substances. The concentration range is given here. The vertical axis of the figure represents concentration, and the unit is μg/l. This is the rate of detection, given as percentage on the vertical axis on the right.

The yellow dots represent rate of detection. Rate of detection was relatively high for bisphenol A and polychlorinated biphenyls, indicating that the environment was widely contaminated with these substances. Chemical substances such as nonylphenol, octylphenol and ester phthalates were detected in water samples at relatively high concentrations. The reasons are thought to be the large volume of such substances produced and used, high water solubility of the substances, resulting in easy spreading of these chemicals in aquatic environment.

Next are the results of the sediment analyses. Sediment samples were tested for 61 substances, 26 of which were detected. Rate of detection was 5% or higher for 16 of the substances, so the number of substances was slightly higher than those detected in water. The substances that had a relatively high rate of detection and detected at high concentrations were the chemicals such as ester phthalates, nonylphenols, benzoapyrene and PCBs. These are produced and used in large quantities and present in substances such as particulate matter in the water on which they easily adsorb.

Here are the results of a study on aquatic organisms. Specimens of aquatic organism were also tested for 61 substances, 22 of which were detected. Rate of detection was 5% or higher for 14 of the substances. As you see here, rate of detection and concentration tend to be high for chemical substances such as PCBs, tributyltin and chlordane. A large quantity of substances such as these have been used. They dissolve easily in the fat of organisms and do not easily decompose in the body. This is why they probably exhibit high biological concentration and also why the residual concentrations rose in food web.

Next I would like to talk about the situation of contamination in wild animals. The Ministry of the Environment conducted a survey on fish, amphibians, birds, land-dwelling mammals and marine mammals. Of the 25 substances tested so for, 19 were detected. The range of concentrations are shown here. Here we see the maximum concentration, minimum concentration, mean concentration and limit of detection. “ND” indicates “not detected.”

As you see here, various types of so-called “environmental hormones” were detected in wild animals. The left side of the figure shows concentration of organic chlorine compounds and the right side shows concentration of other chemical substances. As you see here, among these organic chlorine compounds, chemical substances such as PCBs, DDT and chlordane that are extremely stable and easily soluble in fat were detected at high concentrations. Organotin compounds have also been detected in aquatic organisms, such as fish, shellfish and sea mammals. The reason why the substance is detected principally in sea animals may be the fact that the substance is primarily used in the sea. Ester phthalates have also been detected in fish, shellfish and land-dwelling animals. Ester phthalate is not essentially a substance that accumulates in organisms. The reason it is detected in various animals including land-dwelling animals could be because it is produced, used and discharged into the environment in very large quantities.

This figure shows distribution of PCB concentration. As you can see, concentration of PCBs in the water is low, but the substance is detected at relatively high concentrations in soil, sediment and aquatic organisms. As shown here, higher the position of the organism in the ecosystem, greater the concentration

tends to be. As you see here, fluctuation of concentrations of tributyltin, nonyl phenol and ester phthalates among wild animals is slight, and has no tendency to accumulate easily in higher animals such as the one observed in the case of PCBs.

Next I would like to talk briefly about contamination by dioxins. Dioxins is a generic name for polychlorinated dioxin, polychlorinated dibenzofuran and coplanar PCB. This figure shows accumulation of dioxins and PCBs in wild animals. Here we have distribution of dioxin and dibenzofuran concentration and this shows accumulation of coplanar PCB. As you see here, concentration of dioxin and dibenzofuran tends to be higher in terrestrial and marine animals. In the case of coplanar PCBs, however, concentration tends to be higher in sea animals and animals that eat fish than terrestrial animals, and there is a clear difference in the way the substances accumulate in the two.

You can clearly see this fact, when the percentage values of the actual concentrations are expressed as shown here. The red bar represents dioxin and dibenzofuran. The blue bar represents the percentage of coplanar PCBs. As you see here, dioxin and dibenzofuran account for a higher percentage of substances found in land-dwelling animals than coplanar PCBs. The percentage of coplanar PCBs, on the other hand, tends to be higher in birds that feed on fish and sea-dwelling mammals than dioxin and dibenzofuran.

The reason for this is that dioxin and dibenzofuran naturally tend to adhere to aerosols in the atmosphere, and adhere especially well to particulate matter in the water. The substances therefore do not spread far when they enter the environment. In other words, they tend to concentrate near the source of contamination. Coplanar PCB tends to gasify easier than dioxin and does not tend to adhere to particulates in the water, so it tends to travel to remote locations more than dioxin and dibenzofuran. The physical and chemical difference between these substances reflects in the way they are distributed. In other words, studies show that dioxin and dibenzofuran are local contaminants and coplanar PCB is a global contaminant.

This figure shows the residual concentrations of dioxins in wild animals and human beings. These are the results on wild animals. Here we have results for the study conducted in 1998 and these are the results of the study conducted in 1999. Here we have the results of the analyses of dioxins detected in human beings. A distinguishing feature of this figure is the fact that concentration of dioxins is much higher in wild animals than in human beings. You could say therefore that the toxic risk of dioxins is probably higher for wild animals than human beings.

Here we have a summary of reports of abnormalities in wild animals all over the world supposed to be caused by chemical substances including dioxins. As you can see here the abnormalities were observed in some of the wild animals studied in Japan which had approximately the same concentration levels that were seen in some examples cited in the report. The toxic effects of such substances in wild animals containing such high concentrations therefore need to be studied. Taking a note on *Phalacrocorax carbo*, the Ministry of the Environment has been studying toxic effects of so-called “environmental hormones” since 2000. Some of the results have started coming out. As you can see from the figure, the case of *Phalacrocorax carbo* shows that, when the concentration of coplanar PCB is high, the level of thyroid hormones is low, suggesting that coplanar PCB has an effect on thyroid hormones. We have also obtained results in our study suggesting that dioxins also have an effect on immune function, and we are now planning more detailed studies to be conducted in future.

My next slide explains, whether the situation of environmental contamination by dioxins has improved in recent years. In other words the Ministry of the Environment is conducting a study to evaluate past pollution and variation over the passage of time. Here we have the data on variation in air pollution over the years. As you see here, there has been a tendency for the level of contamination to decline since 1999, and you could say that measures to deal with sources of discharge have been effective. The figure at the bottom shows the concentration of dioxin in sediment core samples taken from Tokyo Bay. The highest concentration was observed in 1981. The dioxin concentration level has subsequently declined, but the rate at which it has been declining is very slow. The sediment at the bottom of such seas has not recovered significantly, indicating that measures to reduce and control the discharges to these areas have been ineffective.

As for the future course of environmental studies, the Ministry of the Environment would like to continue studying the condition of environmental pollution, analyzing data, developing screening methods, expanding research on toxic effects using biomarkers. In the course of these studies, we would like to conduct comprehensive risk assessment and take measures to cope with environmental pollution.

These are the documents I referred for my presentation. Information concerning these documents is given in the abstract.

Thank you for your patient listening.