

**CONTAMINANT CONCENTRATIONS IN WATERFOWL
FROM THE SHEBOYGAN RIVER AREA OF CONCERN**

Sean M. Strom
WI Department of Natural Resources
Bureau of Wildlife Management

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INTRODUCTION

Waterfowl consumption advisories have been in place along the Sheboygan River since 1987. These advisories are the result of contamination from persistent, bioaccumulative, and toxic chemicals, primarily polychlorinated biphenyls (PCBs). However, these consumption advisories have not been re-evaluated since their inception. Therefore, we proposed to re-examine the state of the advisories and determine if any of the existing advisories can be removed or if any additional advisories are warranted.

Persistent, bioaccumulative, and toxic (PBT) chemicals are of concern because of evidence that they cause long-term harm to human health and the environment. Examples of PBT chemicals include PCBs, dioxins, organochlorine pesticides, and mercury). Although many chemicals can have toxic effects on humans and the environment, PBTs pose a special challenge primarily because of their unique properties. PBTs do not break down or become diluted in the environment as easily as some chemicals. PBTs also tend to bioaccumulate in the bodies of humans, fish, and other wildlife. As they slowly accumulate through the food chain, PBTs become increasingly concentrated, and may reach very high levels in both humans and wildlife that are at the top of the food chain. Although it may take months or years of regularly eating contaminated waterfowl or fish to build up amounts which are a health concern, the risk should not be ignored. Health problems which may result from the contaminants found in waterfowl range from small changes in health that are hard to detect to birth defects and cancer. Mothers who eat highly contaminated fish for many years before becoming pregnant may have children who are slower to develop and learn.

Polychlorinated biphenyls are considered a PBT chemical which are ubiquitous in the Wisconsin Great Lakes and have been shown to biomagnify up the food chain. PCBs are considered to be probable human carcinogens based on its association with liver tumors of laboratory rats (USEPA 1997). Recent EPA documents have termed the findings of some human studies as “suggestive” of an association between human cancer and PCB exposure (USEPA 1997). PCBs are also associated with immunological effects in animals and some developmental effects in humans. All of the current consumption advisories within the WI AOCs are the direct result of PCB contamination.

Advisories currently in place for the Sheboygan River AOC include an advisory not to eat mallards from the Sheboygan River from Sheboygan Falls downstream to the river’s mouth at Lake Michigan. In addition, an advisory not to eat scaup from Sheboygan Harbor is also in place. The primary objective of this study is to determine whether any existing waterfowl consumption advisories can be removed or if any new advisories are necessary.

METHODS

We focused on collecting samples from waterfowl species which already have an existing consumption advisory. We collected samples from resident mallards along the Sheboygan River as well as scaup from Sheboygan harbor. In addition, we also collected samples from resident Canada geese along the Sheboygan River.

We attempted to collect scaup in late winter. Scaup often overwinter on Lake Michigan and collecting them in the late winter/early spring allowed for the collection of ducks which have been in the area for 4-5 months, therefore better reflecting local contamination.

All carcasses were processed in an identical manner. Briefly, an area (approximately 10 x 12 cm) was plucked from each carcass and a 20 g sample of breast muscle with skin on was dissected. Samples were placed into a labeled plastic bag and submitted to the WI State Lab of Hygiene (WSLH) for analysis. Samples were analyzed for legacy contaminants (PCBs, lead (Pb), mercury (Hg), DDT/DDE, organochlorine pesticides) as well as emerging contaminants such as polybrominated diphenyl ethers (PBDEs), and perfluorinated compounds (PFCs).

Advisories for human consumption (Table 1) were obtained from the Protocol for a Uniform Great Lakes Fish Consumption Advisory (GLSFATF 1993), the Health Guide for People Who Eat Sport Fish from Wisconsin Waters (WDNR and WDH 1994), and Action Levels for Poisonous or Deleterious Substances in Human Food and Animal Feed (USFDA 1994).

Table 1. Human Health Consumption Advisory Critical Concentrations in Fish or Meat Products.

CONTAMINANT	MINIMUM DETECTION LIMIT (µg/g)	ADVISORY CONCENTRATION (µg/g)		
		Unlimited consumption	No more than 1 meal/Week	Do Not Eat
PCB	0.04	<0.05	0.06 - 0.22	>2.0
Mercury (Children under age 15, pregnant women and women of childbearing age)	0.004	<0.05	0.06 - 0.22	>0.95
Lead	0.005	<0.05	n/a	n/a
Cadmium	0.0045	<0.3*	n/a	n/a
PFOS (perfluorooctane sulfonate)	0.12 (ng/g)	<40 (ng/g)	40 - 200 (ng/g)	> 800 (ng/g)

*Level of concern rather than advisory concentration

Wildlife Health staff evaluated and interpreted sample results from the WSLH. Results for each contaminant was compared with the associated critical advisory concentration in food to determine if consumption advisories could be repealed or new advisories are warranted. This process included consultation with the Department of Health Services (DHS) on the interpretation of results.

RESULTS and DISCUSSION

We realize the difficulty regarding the issuance of consumption advisories for waterfowl. Because they are mobile and migratory, it is difficult to pinpoint whether waterfowl have accumulated contaminants from outside WI or the United States or from a location in the state

other than the area where they are harvested. To address this issue, we focused on collecting adult mallards and Canada geese known to be members of a resident flock and/or juvenile birds known to have been hatched in Wisconsin. In addition, scaup often overwinter on Lake Michigan and collecting them in the late winter/early spring would allow for the collection of ducks which have been in the area for 4-5 months, therefore better reflecting local contamination. However, we were only able to collect 3 scaup due to the rapid onset of warm weather and resulting dispersal of the scaup.

PCBs

Detectable levels of PCBs were observed in every resident mallard sample (range 0.91 – 11.0 µg/g) (Table 2). The mean PCB concentration in mallards (4.2 µg/g) was above the “do not eat” advisory concentration. As a result, the existing consumption advisory for mallards within the Sheboygan River will remain in effect. Similarly, PCBs were detected in 10 of 11 samples from resident Canada geese, but at lower levels than observed in resident mallards (range ND – 0.3 µg/g). The mean PCB concentration in resident Canada geese (0.12 µg/g) falls within the restricted consumption advisory concentration range (Table 1). As such, we recommend a consumption advisory of no more than 1 pound/week be placed on Canada geese within the Sheboygan AOC boundary. Only 3 scaup were collected from Sheboygan Harbor, but all 3 had detectable levels of PCBs (range 3.4 – 5.0 µg/g) (Table 2). The mean PCB concentration in scaup (4.0 µg/g) was above the “do not eat” advisory concentration. As a result, the existing consumption advisory for scaup from the Sheboygan Harbor will remain in effect.

METALS

There is no single standard for permissible amounts of lead in food. Furthermore, FDA regulatory standards and guidelines for Pb in food are complicated by the relatively recent recognition (ATSDR 2007, EPA 2007) of Pb as a probable human carcinogen. However, for meat and fat products, an international consensus standard of 0.05 ppm is under discussion (FDA 2000).

Lead was detected in every sample collected from resident mallards (range 0.01 – 0.048 µg/g). However, the mean Pb concentration (0.023 µg/g) was below the advisory concentration of 0.05 µg/g, therefore, an advisory due to Pb contamination is not necessary. Lead was also detected in every sample from resident Canada geese, but 8 of the 11 samples failed quality control standards (matrix duplicate exceeded quality control standards) which was considered during interpretation. However, the observed levels were very low and it is unlikely an advisory for Pb would be necessary. Lead was also detected in every scaup sample (range 0.011 – 0.032 µg/g) but the mean concentration (0.022 µg/g) was below the advisory concentration.

Mercury was also detected in every sample collected from resident mallards (range 0.011 – 0.066 µg/g), but the mean concentration (0.036 µg/g) was below the advisory concentration, so an advisory based on Hg contamination is not necessary. Mercury was detected in only 4 of the 11 samples from resident Canada geese (range ND – 0.018 µg/g) and the mean concentration (0.005 µg/g) was below the advisory concentration. Scaup contained the highest levels of mercury (range 0.085 – 0.23). The mean Hg concentration in scaup (0.15 µg/g) is high enough to warrant a limited consumption advisory for children less than 15 years of age as well as for pregnant

women or women of childbearing years. We recommend an advisory of no more than 1 meal/week for people in these age categories.

Cadmium was detected in only 2 samples from resident mallards and the concentrations observed in these 2 samples were just above the level of detection (0.0045 µg/g). Wisconsin does not routinely test for Cd in fish as part of the fish consumption advisory program and therefore, Wisconsin does not have an advisory concentration for Cd. However, Iowa uses a Cd concentration of 0.3 µg/g as a level of concern. Although, this concentration is not used as an advisory guideline, it does serve as a point of comparison. Cadmium was detected in 7 of the 11 samples from resident Canada geese, but the mean concentration was below the level of concern. Similarly, Cd was detected in 2 of the 3 scaup samples, but concentrations were below the level of concern.

PERFLUORINATED COMPOUNDS (PFCs)

Advisory concentrations only exist for one PFC compound (perfluorooctane sulfonate). As such, only concentrations of this specific compound were able to be interpreted for the purpose of consumption advisories. Perfluorooctane sulfonate (PFOS) was detected in every sample collected from resident mallards (range 6.6 – 49 ppb). While the average PFOS concentration in resident mallards was below the advisory concentration, several individuals had levels that approached or exceeded this concentration. Although a consumption advisory based on PFOS levels is not warranted, we do believe it is an issue worth monitoring in the future. PFOS was also detected in 8 of 11 samples from resident Canada geese (range ND – 10.0 ppb). The average concentration of PFOS in resident geese was below the advisory concentration. Only one sample from scaup had detectable levels of PFOS and the concentration in this sample was below the advisory concentration.

CONCLUSIONS

Based on levels of PCBs observed in both resident mallards and scaup, it is our recommendation that the “do not eat” advisory which is currently in place for the Sheboygan River and Sheboygan Harbor remain in effect. In addition, based on levels of PCBs observed in resident Canada geese, we recommend an advisory of “no more than 1 meal/week” be placed on Canada geese using the Sheboygan River. Comparing results from the current sample collection with samples collected in the mid-1980s for both mallards and scaup indicate PCB levels have decreased only slightly in both species over the last 25 years.

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Table 2: Total PCB, mercury, and lead concentrations (average \pm standard deviation) in waterfowl collected from the Sheboygan River AOC

Species	Sample Size	Collection Date	Total PCBs ($\mu\text{g/g}$)	Hg ($\mu\text{g/g}$)	Pb ($\mu\text{g/g}$)
Mallard	10	07/26/11 – 08/10/11	4.22 \pm 3.6	0.036 \pm 0.02	0.023 \pm 0.13
Canada Geese	11	06/28/2011	0.12 \pm 0.07	0.005 \pm 0.005	0.006* \pm 0.004
Scaup	3	03/07/2012	4.00 \pm 0.9	0.15 \pm 0.07	0.022 \pm 0.01

*Sample results failed QC (matrix duplicate exceeded quality control standards)

Table 3: Concentrations of DDE, cadmium, PFOS, and total PFCs (average \pm standard deviation) in waterfowl collected from the Sheboygan River AOC

Species	Sample Size	DDE ($\mu\text{g/g}$)	Cd ($\mu\text{g/g}$)	PFOS (ng/g)	Total PFCs (ng/g)
Mallard	10	0.24 \pm 0.27	0.003 \pm 0.002	22.8 \pm 16.6	36.5 \pm 21.6
Canada Geese	11	0.06 \pm 0.06	0.008 \pm 0.007	2.8 \pm 3.4	8.7 \pm 5.2
Scaup	3	0.08 \pm 0.02	0.03 \pm 0.07	1.5 \pm 2.5	6.6 \pm 11.3