

# Halogenated Organic Compounds in Endocrine-Disrupted Male Carp from Las Vegas Wash and Lake Mead, Nevada

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## ABSTRACT

Adult common male carp from Las Vegas Wash, Las Vegas Bay, and Callville Bay were collected and tested for the concentration of vitellogenin in blood. The presence of vitellogenin was confirmed in the male carp from Las Vegas Wash and Bay. Extracts of fish tissue of adult male carp were analyzed by capillary gas chromatography/mass spectrometry. The extracts contained low microgram-per-kilogram concentrations of common chlorinated pesticides typically found in the environment. The extracts also contained a series of chlorinated and brominated organic compounds that have not been previously reported in this water system. These compounds range in concentration from low to high micrograms-per-kilogram. Nonyl phenols and nonyl phenol ethoxylates were also detected at hundreds of microgram-per-kilogram concentrations.

## INTRODUCTION

Las Vegas Wasteway is a tributary to Las Vegas Wash and Las Vegas Bay of the Lake Mead National Recreation Area, Nevada. Lake Mead is used for fishing and water sports, public water supply, and habitat for the endangered Razorback Sucker. Vitellogenin, a lipophosphoglycoprotein, -- not normally present in male fish--was confirmed in male carp. Its presence suggests endocrine disruption. Vitellogenin may be produced in male fish after exposure to compounds that may exhibit estrogenic activity. The purpose of this article is to identify and describe the halogenated organic compounds present in whole-body, adult male carp that have been tested for vitellogenin.

## EXPERIMENTAL

Male carp were collected from Las Vegas Wash by seining and from Las Vegas Bay and Callville Bay (reference site) by

electroshocking from a boat. Blood samples were collected and analyzed for vitellogenin (Bevans and others, 1996).

Fish tissue samples then were submitted for chemical analysis. Individual fish samples were prepared for analysis in accordance with the U.S. Geological Survey's approved methods (Leiker and others, 1995). The procedure is as follows: A 10-g (gram) aliquot of homogenized tissue is mixed with  $\text{Na}_2\text{SO}_4$ . The sample and  $\text{Na}_2\text{SO}_4$  mixture is Soxhlet\* extracted with methylene chloride for 24 hours. After extraction, the extract is concentrated by means of Kuderna-Danish to a volume of 5 mL (milliliters). A 1-mL aliquot is removed for lipid determination. A 2-mL aliquot of the remaining extract is passed through a gel permeation chromatographic column to isolate low molecular weight compounds of

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\*The use of brand, firm, and trade names in this article is for identification purposes only and does not constitute endorsement by the U.S. Geological Survey.

interest from endogenous lipid material. The extract is again concentrated by means of Kuderna-Danish to a volume of 1 mL. The 1-mL extract is passed through an adsorption chromatographic column containing 5 g of 8.5 percent water deactivated alumina; 3 g of 2 percent water deactivated silica, and 0.5 cm (centimeter) of sodium sulfate. This column is used to separate the extracts into two fractions. The first fraction is eluted with 30 mL of hexane and contains nonpolar organic compounds, such as, but not limited to, *p,p'*-DDE and polychlorinated biphenyls. The second fraction is eluted with 25 mL of 50 percent (volume/volume) acetone in hexane and contains chlordane components, DDT, DDD, HCH isomers, dieldrin, endrin, toxaphene, and other more polar organic components. After concentrating the extract to about 0.5 mL, each fraction is analyzed twice using capillary gas chromatography/mass spectrometry (GC/MS). All gas chromatographic separations are performed with a 30-m (meter) by 0.25-mm (millimeter) inside diameter capillary column coated with 5 percent diphenyl and 95 percent dimethyl polysiloxane. The first GC/MS analysis is conducted using electron ionization. The second GC/MS analysis is conducted using electron-capture negative ionization, a technique that selects organic compounds that are highly electronegative. These compounds, in many cases, are not detected under normal GC/MS analysis using electron ionization. Quantitation is based on an internal standard.

## RESULTS AND DISCUSSION

The data suggest that Las Vegas Wash and Las Vegas Bay are more highly contaminated than Callville Bay. This result is most likely related to discharge from Las Vegas Wash and entering Las Vegas Bay. Callville Bay seems to be isolated from any significant discharge. Selected compounds that have been identified in whole-body male carp samples from Las Vegas Wash, Las Vegas Bay, and Callville Bay are listed in table 1. Figures 1 and 2 show the mean

concentration of selected organic compounds that have been identified and quantified in individual fish tissue extracts from the three sampling sites. Figure 3 shows the distribution of vitellogenin in fish plasma from the three sampling sites. Nonyl phenols and nonyl phenol ethoxylates are suspected endocrine disrupters. Their detection in these samples was unexpected. The concentration of these compounds is significantly higher than other compounds identified in the extracts. The data suggest that the appearance of vitellogenin might be a result of compounds entering Las Vegas Wash and Las Vegas Bay, because vitellogenin has been detected in male fish from those two sites but has not been detected in male fish from Callville Bay. The data also suggest that discharge from Las Vegas Wash is impacting Las Vegas Bay and potentially might impact Lake Mead.

## SUMMARY

In general, tissue samples from Las Vegas Wash and Las Vegas Bay have higher concentrations of vitellogenin and organic contaminants than samples collected from Callville Bay. The production of vitellogenin in male carp might be related to an individual contaminant or a combination of several contaminants that are present in the water column. Some of the compounds that have been detected in the tissue extracts are suspected endocrine disrupters. Their presence, however, does not imply a direct correlation with vitellogenin. Their presence does suggest that these compounds might be tested to determine if they are related to vitellogenin production in male carp.

## REFERENCES

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