Rick Scott
Governor

H. Frank Farmer, Jr., MD, PhD, FACP
State Surgeon General

Toxicology Consult
Florida Department of Health, Division of Environmental Health
Bureau of Environmental Public Health Medicine

Date: February 10, 2012

From: Joseph Mark Higginbotham, MS, PhD, and Kendra F. Goff, PhD

Consult Requested by: Florida Fish and Wildlife Conservation Commission

PURPOSE

The Florida Fish and Wildlife Conservation Commission (FWC) monitors pesticide levels in fish harvested from Lake Apopka, the third largest lake in the state of Florida. Lake Apopka is located in central Florida, northwest of Orlando and is bounded by Lake and Orange counties. One of the concerns for FWC is whether or not the fish from Lake Apopka are safe to eat. Fish sampling data for Lake Apopka spanning from 2004 – 2008 were forwarded to the the Florida Department of Health (FDOH) for review to recommend consumption advisories for recreational fishermen. In addition, FWC requested FDOH review contaminant data to determine whether the fish species could be sold commercially. FWC collected samples based upon feeding habits and trophic levels. Species collected included a bottom feeder (brown bullhead catfish), a lower trophic level (tilapia), two mid-range trophic level (bluegill and redear sunfish), two mid to high trophic level (warmouth and black crappie), and two predator species (largemouth bass and Florida gar). Typically, contaminant concentrations increase up trophic levels. Bottom feeders may be more susceptible to contaminants due to the time spent at the bottom of lakes and streams exposed to potentially contaminated sediment and detritus.

METHODS

Although data provided by FWC included whole body analyses, FDOH chose only to analyze the edible portion of the fish (i.e., fillet) to provide advisory information. A combination of either individual fish analysis data or composite fish data was provided. Generally, composite data were used for advisory determinations because that data set provided the most complete information for all the years observed.

An average tissue value of a contaminant was calculated for individually analyzed fish. For the composite fish samples, this tissue value was considered essentially an “average” for contaminants in the species analyzed. If multiple composites were analyzed for the same species, the composite with the maximum contaminant load was chosen for comparison. The average (individual samples) or maximum (composite samples) value was then compared to FDOH fish tissue action levels for recreational fishermen. FDOH also compared the fish tissue values to US Food and Drug Administration (FDA) action levels for contaminants in fish distributed commercially. Samples were gathered from various locations/stations in Lake Apopka. The data were considered together without specifying separate station locations.

FDOH based recommended advisory levels on sample sizes of n = 8, or greater. If the sample size was not available for a given species (Largemouth bass [LMB], n = 6), FDOH considered an overall advisory based on all years (2004-2008) for which data were available. Redear sunfish, Warmouth, and Florida gar did not meet sample size threshold levels (see Appendix A).

Fish tissues were analyzed for organochlorine pesticides including: [4,4'-DDD, 4,4' DDE, 4,4'-DDT (summed as 4,4'DDTx)], Aldrin, alpha-BHC, beta-BHC, Dieldrin, [Endosulfan I, Endosulfan II, Endosulfan Sulfate (summed as endosulfan sum)], [Endrin, Endrin Aldehyde, Endrin Ketone (summed as endrin sum)], gamma-BHC (also called Lindane), Heptachlor, Heptachlor Epoxide, Methoxychlor, total Chlordane, and Toxaphene. While FDOH has action levels for fish for all pesticides, FDA commercial action levels were only available for DDT, Chlordane, Heptachlor, Heptachlor Epoxide, and Dieldrin.

Both FDOH action levels and monthly/weekly limits were calculated using equations that were obtained from USEPA Guidance for Assessing Chemical Contaminant Data for Use in Fish Advisories, Volume 1 and Volume 2, November 2000. Chemical specific values were obtained from USEPA's IRIS database. For all calculations, a body weight of 70 kilograms, a consumption rate of 0.032 kg/day, a meal size of 0.228 kg (8 ounces) were used. For carcinogens, a target cancer risk (unitless) of 1E-5 was used.

FINDINGS

Recreational Fishing

In general, the contaminant level was low across trophic levels including a predator species, largemouth bass. Most advisory levels were found to be two meals per week (2w) for recreational fishermen, which is the advisory using the lowest contaminant level reviewed by FDOH. The only exception was the brown bullhead catfish (BRBU) which we recommended have a once per week advisory (1w). This fish species spends most of its life as a bottom feeder and may be exposed to higher levels of chemicals in contaminated sediment. This advisory replaces a current DO NOT EAT advisory for brown bullhead catfish. The change is recommended for two reasons: 1) the contaminant levels appear to have decreased since the last data were reviewed 2) the target cancer risk level for carcinogens has been changed from a previous target risk level of 1E-6. FDOH's current risk management consideration is to weigh the documented benefits of fish consumption (high protein, low cost, beneficial fish oils) against a theoretical cancer risk of chemicals in fish. A target risk of 1E-5 for carcinogens still minimizes cancer risks yet brings an increased benefit of fish consumption.

Contaminant levels appeared to increase in 2007 to moderate to high levels (see Appendix A) and were driven by the contaminant Toxaphene. However, the detection limit for tissue analysis of Toxaphene is close to FDOH's target cancer risk level of 1E-5. Although mainly undetected through FWC's current analytical methods, FDOH is unable to suggest an advisory level lower than 1 per week for Toxaphene. Redear sunfish, Warmouth, and Florida gar did not meet sample size thresholds and therefore no advisory was recommended for these three fish species.

FWC also requested comparison for other catfish species (white catfish, channel catfish). The provided data is inadequate for recommendations for these catfish species. Our advisories are completed on a per species basis and FDOH is willing to work with FWC to develop future sampling plans for additional species.

Commercial Fishing

All pesticide levels were below FDA commercial fish tissue action levels for human consumption. The contaminant levels in the fish species analyzed can potentially be sold commercially for human consumption. Although we did not have sufficient sample size for Florida gar (n = 1), we did compare the value to FDA commercial fish action levels for feed. FWC had mentioned a possible used of this species for fish food. Based upon the levels of total DDT in this one sample, Florida gar would be unsuitable for this use. However, we would recommend additional sampling due to the small sample size.

RECOMMENDATIONS

Our recommendations for recreational fishing can be found below:

Table 1. Recreational fish advisory summary for 2004-2008

	2004-2008	
	Overall advisory	Contaminant of concern
Black crappie	2w*	all pesticides
Bluegill	2w	all pesticides
Blue tilapia	2w	all pesticides
Brown bullhead catfish	1w	Toxaphene
Largemouth bass	2w	all pesticides

* 2w = Two meals per week, 1w = 1 meal per week

Our recommendations for commercial fishing are:

- Black crappie, Bluegill, Blue tilapia, Brown bullhead catfish, and Largemouth bass could potentially be sold commercially for human consumption.
- Based upon the single sample of Florida gar, we would not recommend its use for fish food. Additional sampling would be needed to evaluate further.

Appendix A

Table 2. Complete advisory and sample size summary 2004-2008

	2004						2005					
	composite			individual			composite			individual		
	sample number	overall advisory	contaminant of concern	sample number	overall advisory	contaminant of concern	sample number	overall advisory	contaminant of concern	sample number	overall advisory	contaminant of concern
BETI	none			n = 3	2w	all pesticides	n = 9	2w	all pesticides	none		
BRBU	none			n = 4	2w	all pesticides	n = 9	2w	all pesticides	n = 1	2w	all pesticides
BLCR	none			n = 3	2w	all pesticides	n = 9	2w	all pesticides	none		
LMB	none			n = 2	2w	all pesticides	n = 4	2w	all pesticides	none		
RESU	none			n = 1	2w	all pesticides	none			n = 1	2w	all pesticides
BLUE	none			none			none			n = 1	2w	all pesticides
WAR	none			n = 2	2w	all pesticides	none			none		
FGAR	none			none			none			none		

	2006						2007					
	composite			individual			composite			individual		
	sample number	overall advisory	contaminant of concern	sample number	overall advisory	contaminant of concern	sample number	overall advisory	contaminant of concern	sample number	overall advisory	contaminant of concern
BETI	n = 8	2w	all pesticides	none			n = 8	1m	Toxaphene	none		
BRBU	n = 6	2w	all pesticides	n = 4	2w	all pesticides	n = 15	1w	Toxaphene	none		
BLCR	n = 9	2w	all pesticides	none			n = 9	1w	Toxaphene	none		

LMB	n = 3	2w	all pesticides	n = 1	2w	all pesticides	n = 5	1w	4,4'-DDTx	n = 1	1w	4,4'-DDTx, Toxaphene
RESU	none			none			none			none		
BLUE	n = 9	2w	all pesticides	none			n = 9	1w	Toxaphene	none		
WAR	none			none			none			none		
FGAR	none			none			none			none		

	2008					
	composite			individual		
	sample number	overall advisory	contaminant of concern	sample number	overall advisory	contaminant of concern
BETI	n = 3	2w	all pesticides	n = 1	2w	all pesticides
BRBU	n = 2	2w	all pesticides	n = 3	2w	all pesticides
BLCR	n = 8	2w	all pesticides	none		
LMB	n = 6	2w	all pesticides	n = 1	2w	all pesticides
RESU	none			none		
BLUE	n = 9	2w	all pesticides	none		
WAR	none			none		
FGAR	none			n = 1	DNE	4,4'-DDTx

BETI = Blue tilapia

BRBU = Brown bullhead catfish

BLCR = Black crappie

LMB = Largemouth bass

RESU = Redear sunfish

BLUE = Bluegill

WAR = Warmouth

FGAR = Florida gar

Highlighted cells indicate data considered for overall advisory