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Review of PCB Data From Badin Lake

This report summarizes our analysis and evaluation of the recent Polychlorinated Biphenyl (PCB) data from Badin Lake in Stanly County, NC. As you know, fish from Badin Lake were sampled in 2008 and fish tissue was analyzed for PCBs using a modern congener-specific analysis (for all 209 congeners). Based on the results from these analyses, the NC Department of Health and Human Services issued a fish consumption advisory for Badin Lake (February 11, 2009). Subsequently, we participated in a sampling event in Badin Lake (April 2, 2009) concurrent with the NC Division of Water Quality (DWQ) and collected sediment samples for analysis of PCB congeners as well as several other analytes. We were also provided information from the NC Division of Waste Management (McDaniel 2009) regarding the PCBs that were used at the Alcoa Badin Works Plant in Stanly County. Based upon the specific Aroclors or commercial blends of PCB congeners used at the Alcoa facility, we could analyze the congener-specific data for relationships between the PCBs in the fish tissue, sediments and those associated with the Alcoa facility.

PCBs are a family of industrial chlorinated chemical compounds that include 209 possible forms, or "congeners". Commercial PCBs are usually a mixture of 50 or more congeners. The laboratory methods for analyzing specific congeners require very sensitive techniques, and therefore laboratories often "qualify" data as estimated concentrations for various reasons. These reasons can include values that are higher or lower than the calibration range of the analytical instrument, concentrations that are below method reporting limits but above detection limits, quantitative interference, and detection of the compound in laboratory method blanks. Although data may be qualified for these various reasons, they represent detected chemicals at estimated concentrations and can be useful for interpreting general trends or patterns in environmental samples, such as fish tissue and sediments. Data that require no laboratory qualification (or are "unqualified") are those that can be clearly quantified by the laboratory (not estimated) and meet all quality assurance/quality control standards set by the laboratory without reservation. In this analysis of the Badin Lake fish tissue and sediment data, we initially considered unqualified PCB congener data separately, and then included the qualified data in our assessment to be thorough in our analysis since the data were limited (7 sediment samples and 30 fish samples).

Initially, we (Dr. Matt Huddleston and I) compared the PCB congeners and concentrations in the fish tissue with those in sediment samples from the southwest arm (near the Alcoa facility), the northwest arm, and the northeast arm of Badin Lake. Based upon our analysis, we reached the following conclusions.

When considering the unqualified congener data only (these are data that met all laboratory QA/QC standards without reservation):

1. **There is a relationship between PCB congeners in sediments from the southwest arm of the lake and PCBs in fish from Badin Lake.** All PCB congeners detected in the

sediments from the southwest arm of Badin Lake, with the exception of congener no. 2, were also detected in fish tissues regardless of the collection location for the fish. Even the fish collected outside of the southwest arm of Badin Lake contained PCB congeners found in the sediments from the southwest arm.

When considering all of the congener data (actual and estimated concentrations):

2. **Congeners detected in the fish tissue provided further evidence of sediments as a source of PCBs.** The PCB congeners measured in the sediments of Badin Lake are essentially the same congeners measured in the fish tissue collected throughout the lake. Many congeners not detected in sediments were also not detected in fish tissues. This is additional information implicating sediments as a source of PCBs in fish tissues.

3. **PCB congeners detected in sediments from the southwest arm of the lake (near the Alcoa facility) have concentrations significantly greater (on the order of 10 to 100 times greater) than sediments from other parts of the lake.** These congeners were also present in fish sampled from the southwest arm. This is the pattern that would be expected if the sediments were a primary source of PCBs in fish tissues. Since sediments and fish do not accumulate or metabolize PCBs or congeners in the same manner, we would expect to find some differences. In other words, PCBs in sediments and fish change and breakdown differently over time, even within different sediment types (mud, sand, etc.) and different fish species. **Despite the expected differences, the pattern of detected PCB congeners common to sediments and fish in Badin Lake is apparent.**

4. **PCB congeners in sediments from the southwest arm of Badin Lake co-occur more frequently with congeners detected in fish sampled throughout the lake than do congeners in sediments from other parts of the lake.** As part of the data analysis, we ranked PCB congener concentrations from high to low for each fish tissue and sediment sample to determine if the congeners measured at the highest concentrations were common to both fish and sediments. Of the ranked PCB congeners measured in sediments from the southwest arm, there were 14 co-occurrences of ranked PCB congeners in each of the fish sampling locations (southwest arm, northwest arm and northeast arm of the lake). Of the ranked PCB congeners measured in sediments collected from near Narrows Dam, 12 congeners also occurred in fish collected from the southwest arm, 11 co-occurred in fish collected from the northwest arm, and 12 co-occurred in fish collected from the northeast arm of the lake. When compared to ranked PCB congeners measured in sediments from the northwest arm of Badin Lake, only 6 congeners co-occurred in fish tissue samples collected from each arm of the Badin Lake. In summary, the PCB congeners with the highest concentrations in sediments from the southwest arm of Badin Lake co-occur more frequently with congeners in fish tissue samples than do congeners measured in sediments from other parts of the lake.

5. **Fish sampled from the southwest arm of Badin Lake were more consistently contaminated by PCBs than fish collected from other parts of the lake.** In the samples from the initial study, the highest PCB concentrations were detected in a few fish from the northwest arm; however, PCB concentrations were more uniform in fish from the southwest arm. PCB concentrations in fish tissue collected from the northeast arm of

Badin Lake were generally lower than concentrations in fish from the southwest and northwest arms.

In summary, there is a close match between PCB congeners detected in the sediments of Badin Lake and those found in fish tissue in this study. The pattern observed between congeners measured in fish tissue collected throughout the lake and those measured in sediments from the southwest arm of the lake would be expected if the sediments were a primary source of PCBs in fish tissues.

Subsequently, we compared the predominant PCB congeners in the sediment and the fish with the congeners present in the Aroclors associated with the Alcoa facility (McDaniel 2009).

When considering the unqualified congener data only:

1. **The Alcoa-related PCB congeners # 3, 4, 8, and 12 occur in sediment from the southwest arm (near the Alcoa facility) and in fish tissue sampled in the southwest, northwest, and northeast arms of the lake.**

When considering all of the congener data (actual and estimated concentrations):

2. **Most of the Alcoa-related PCB congeners were detected in fish tissue and sediment samples in Badin Lake.** Of the 76 PCB congeners associated with Alcoa operations, 18 were either not analyzed in fish tissue or were combined with other congeners for analysis of sediments. Of the remaining 58 congeners that were analyzed individually, 57 occurred in fish tissue, 55 occurred in sediments, and 54 occurred in both fish tissue and sediments (>93% match).

3. **Based on analysis of all of the PCB data, approximately 32 of the congeners associated with Alcoa Aroclors measured in fish tissue also exist at elevated concentrations (on the order of 10 to 100 times greater) in the southwest arm of Badin Lake when compared to concentrations in other parts of the lake.**

4. **When PCB congeners were ranked from highest to lowest concentration as described above, many of the congeners with the highest concentrations are associated with the Alcoa Aroclors and occur in both fish tissue and sediments.** Eleven of the Alcoa-related congeners were detected in more than 60% of the fish tissue samples (Table 1). In sediment samples, approximately 20 of the 53 potentially present congeners (some congeners were analyzed together and not distinguished) are associated with Aroclors used by Alcoa.

Table 1. Occurrence of PCB congeners associated with the Alcoa facility detected in fish tissue samples from Badin Lake.

PCB Congener #	Occurrence in Fish Tissue Samples (n=30)	Aroclors Associated with the Alcoa Facility
187	100%	1260; 1254
153	100%	1260; 1254; 1248
129	100%	1260; 1254; 1248
118	100%	1260; 1254; 1248; 1242
99	100%	1260; 1254; 1248; 1242
110	90%	1260; 1254; 1248; 1242
66	90%	1254; 1248; 1242; 1232; 1221; 1016
52	87%	1254; 1248; 1242; 1232; 1221; 1016
61	83%	1254; 1248; 1242; 1232; 1221; 1016
180	77%	1260; 1254
44	63%	1254; 1248; 1242; 1232; 1221; 1016

In summary, there is a relationship between the PCBs used at the Alcoa facility and the PCBs contained in the sediments and fish in Badin Lake. We have congener specific analytical data for the PCBs in the sediments and the fish. Information regarding the PCBs used at the Alcoa Badin Works Facility was provided by the NC Division of Waste Management.

With more samples and analyses, we could further examine the strength of the relationships apparent in the current data and confirm whether or not there is an ongoing source of PCBs in Badin Lake.

If any questions arise, please contact me.

Sincerely,

John H. Rodgers, Jr.

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