July 11, 1997

Mark Doolan
U.S. Environmental Protection Agency
726 Minnesota Ave.
Kansas City, Missouri 66101

Dear Mr. Doolan,

As a result of an inadvertent oversight on my part, some invertebrate densities are reported incorrectly in:


The difference in the area covered by the large Hess sampler and of the smaller version of the Hess sampler occasionally used in shallow water was not accounted for in the report. Any densities reported at the following stations should be multiplied by 2.757 to produce the correct density estimate: 1) site 3--station 1 at transects 1 and 3; 2) site 4--station 1 at transects 1, 3, and 5; 3) site 5--stations 2, 3, 4, and 5 on transect 1 and station 1 on transect 3; 4) site 10--station 1 on transect 1; and 5) site 15--site 1 on transect 1.

Sincerely,

Mark L. Wildhaber, Ph.D.
Quantitative Ecologist
July 8, 1997

Mark Doolan  
U.S. Environmental Protection Agency,  
Region VII  
726 Minnesota Ave.  
Kansas City, Kansas 66101

Dear Mr. Doolan:

Enclosed please find a copy of the report summarizing the results of metals analyses of benthic invertebrate samples collected Aug.-Oct., 1994 from the Spring, Neosho, and Cottonwood rivers. We have provided a copy of this report, under separate cover, to Dane Pehrman of Black and Veach for use in the Spring River risk assessment.

Please feel free to call or write if I may be of further assistance.

Sincerely yours,

Christopher J. Schmitt

cc: C. Charbonneau, USFWS
ELEMENTAL CONCENTRATIONS IN BENTHIC INVERTEBRATES COLLECTED FROM THE NEOSHO, COTTONWOOD, AND SPRING RIVERS

Final report to the U.S. Fish and Wildlife, Region 6, Manhattan, Kansas

Mark L. Wildhaber, Christopher J. Schmitt, and Ann L. Allert
U.S. Geological Survey, Biological Resources Division
Midwest Science Center
4200 New Haven Road
Columbia, Missouri 65201

June 2, 1997

Introduction

In 1994, researchers at the Midwest Science Center (MSC) were funded by Region VII of the U.S. Environmental Protection Agency (USEPA) to investigate the potential effects of lead-zinc mining on Neosho madtom (Noturus placidtis), a Federally-listed threatened fish species, populations (Schmitt et al. 1997, Wildhaber et al. 1996). Region 6 of the U.S. Fish and Wildlife Service (USFWS) funded metals analyses of benthic invertebrate tissue collected at the USEPA sites; this report presents the results of the benthic invertebrate tissue analyses.

Methods

Study Area

The study area includes the mainstems of the Neosho, Cottonwood, and Spring Rivers and the lower reaches of several Spring River tributaries in Kansas, Missouri, and Oklahoma; all three rivers are a part of the Arkansas River system (Figure 1, Table 1). The Cottonwood River feeds into the Neosho River just south of Emporia, Kansas. The Neosho river is separated from the Spring River by the Grand Lake of the Cherokees into which both rivers flow.

Sample collection

Collection sites for invertebrates were determined based on the current best information as to the probability that Neosho madtoms would be present. For the Neosho and Cottonwood River from Emporia Kansas to Grand Lake of the Cherokees, 12 gravel bars with know populations of
Neosho madtoms were selected for study (USFWS 1991). For the Spring River from the North Fork of the Spring River to Grand Lake of the Cherokees, 20 gravel bars (the great majority of gravel bars present in the river) were selected for study based on habitat characteristics known to increase the probability for the presence of Neosho madtoms in the Neosho and Cottonwood Rivers (Moss 1983, USFWS 1991, Wenke et al. 1992, Fuselier and Edds 1994). At each site, benthic invertebrates were opportunistically collected from kick seines used for fish collection and dip nets using acid washed forceps and placed in a plastic bag for later metals analyses using ICAP.

Results and Conclusions

For the three primary metals of concern (i.e., Cd, Pb, and Zn) some important patterns were observed (Tables 2 and 3). All three metals were generally found to be higher in all invertebrate classes in the Spring River and its tributaries than in the Neosho/Cottonwood River system. For Cd, the two main invertebrate categories of decapoda (i.e., crayfish) and megaloptera (i.e., dobsonflies) were generally similar in concentration. For Pb and Zn, megaloptera generally had higher concentration than did the decapoda. Within the Spring River drainage: 1) the highest concentrations of Cd were found at sites 17 (i.e., mouth of Center Creek) and 20 (i.e., Shoal Creek); 2) the highest concentrations of Pb were found at sites 17, 20, and 28 (i.e., mouth of Turkey Creek); 3) the highest concentrations of Zn were found at sites 17, 20, 26 (i.e., between Center Creek and Turkey Creek) and 28; and 4) the lowest concentrations of all three metals were found at sites above Center Creek.

The results of the metals analyses of the benthic invertebrate tissues collected in the Neosho, Cottonwood, and Spring Rivers indicate one potential explanation for the previously documented limited distribution of Neosho madtoms in the Spring River (Wilkinsin et al. 1996). The lower concentrations of Cd, Pb, and Zn in benthic invertebrate tissues in the Neosho/Cottonwood River system than in the Spring River parallel the higher density of Neosho madtoms in the Neosho/Cottonwood River system than in the Spring River (Schmitt et al. 1997). Furthermore, lower concentrations of Cd, Pb, and Zn found at sites in the Spring River above Center Creek parallel the fact that, except for site 29 near Baxter Springs, Kansas, Neosho madtoms are generally not collected in the Spring River below Center Creek (Wilkinsin et al. 1996).

Literature Cited


Table 1. Collection sites in the Neosho, Cottonwood, and Spring Rivers, 1994. At sites with letter designations, latitude and longitude were estimated from U.S. Geological Survey 1:100,000 maps.

<table>
<thead>
<tr>
<th>Date sampled</th>
<th>Site number</th>
<th>River (county and state)</th>
<th>Legal description (latitude, longitude)</th>
</tr>
</thead>
<tbody>
<tr>
<td>8/29/94</td>
<td>0A</td>
<td>Neosho River just east of Oswego, Kansas (Cherokee County, Kansas)</td>
<td>SW 1/4, Sec 13, T33S, R21E (37° 09' 56.3&quot; N, 95° 03' 45.8&quot; W)</td>
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<tr>
<td>8/29/94</td>
<td>0B</td>
<td>Neosho River just north of Oswego, Kansas (Labette County, Kansas)</td>
<td>NW 1/4, Sec 15, T33S, R21E (37° 10' 34.1&quot; N, 95° 06' 15.3&quot; W)</td>
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<td>8/30/94</td>
<td>1</td>
<td>Neosho River at Neosho Wildlife Area (Neosho County, Kansas)</td>
<td>NW 1/4, Sec 32, T29S, R21E (37° 28' 33.1&quot; N, 95° 08' 21.1&quot; W)</td>
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<td>8/30/94</td>
<td>2</td>
<td>Neosho River at Neosho Wildlife Area (Neosho County, Kansas)</td>
<td>NE 1/4, Sec 31, T29S, R21E (37° 28' 50.6&quot; N, 95° 08' 35.4&quot; W)</td>
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<tr>
<td>8/31/94</td>
<td>3</td>
<td>Neosho River just northeast of Burlington, Kansas (Coffey County, Kansas)</td>
<td>SW 1/4, Sec 23, T21S, R15E (38° 12' 18.1&quot; N, 95° 43' 47.2&quot; W)</td>
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<tr>
<td>9/1/94</td>
<td>4</td>
<td>Cottonwood River just west of Emporia, Kansas (Chase County, Kansas)</td>
<td>NW 1/4, Sec 26, T19S, R8E (38° 22' 27.3&quot; N, 96° 29' 36.0&quot; W)</td>
</tr>
<tr>
<td>9/1/94</td>
<td>5</td>
<td>Cottonwood River just west of Emporia, Kansas (Chase County, Kansas)</td>
<td>SW 1/4, Sec 25, T19S, R8E (38° 21' 50.6&quot; N, 96° 28' 41.2&quot; W)</td>
</tr>
<tr>
<td>9/7/94</td>
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<td>Neosho River just south of Humbolt, Kansas (Allen County, Kansas)</td>
<td>SW 1/4, Sec 4, T26S, R18E (37° 48' 36.4&quot; N, 95° 26' 50.1&quot; W)</td>
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<td>Neosho River just south of Humbolt, Kansas (Allen County, Kansas)</td>
<td>NW 1/4, Sec 9, T26S, R18E (37° 47' 57.1&quot; N, 95° 26' 48.5&quot; W)</td>
</tr>
<tr>
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<td>7A</td>
<td>Neosho River just east of Emporia, Kansas (Lyon County, Kansas)</td>
<td>NW 1/4, Sec 23, T19S, R12E (38° 23' 27.1&quot; N, 96° 03' 26.0&quot; W)</td>
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<tr>
<td>Date sampled</td>
<td>Site number</td>
<td>River (county and state)</td>
<td>Legal description (latitude, longitude)</td>
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<tr>
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<td>-------------</td>
<td>--------------------------</td>
<td>----------------------------------------</td>
</tr>
<tr>
<td>9/8/94</td>
<td>7B</td>
<td>Neosho River just east of Emporia, Kansas-(Lyon County, Kansas)</td>
<td>NE 1/4, Sec 23, T19S, R12E (38° 23' 12.1&quot; N, 96° 02' 57.6&quot; W)</td>
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<tr>
<td>9/13/94</td>
<td>8</td>
<td>Spring River just downstream of I-44 bridge (Ottawa County, Oklahoma)</td>
<td>NE 1/4, Sec 8, T28N, R24E (36° 55' 27.5&quot; N, 94° 44' 26.0&quot; W)</td>
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<tr>
<td>9/14/94</td>
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<td>Spring River just northeast of Quapaw, Oklahoma (Ottawa County, Oklahoma)</td>
<td>SW 1/4, Sec 28, T29N, R24E (36° 57' 40.3&quot; N, 94° 43' 21.1&quot; W)</td>
</tr>
<tr>
<td>9/15/94</td>
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<td>Spring River just upstream of Oklahoma-Kansas border (Cherokee County, Kansas)</td>
<td>NE 1/4, Sec 18, T35S, R25E (37° 00' 07.4&quot; N, 94° 42' 52.0&quot; W)</td>
</tr>
<tr>
<td>9/20/94</td>
<td>11</td>
<td>Spring River just south of Riverton, Kansas (Cherokee County, Kansas)</td>
<td>SE 1/4, Sec 19, T34S, R25E (37° 03' 54.2&quot; N, 94° 42' 21.7&quot; W)</td>
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<tr>
<td>9/21/94</td>
<td>12</td>
<td>Spring River just upstream State Highway 96 (Cherokee County, Kansas)</td>
<td>SW 1/4, Sec 11, T33S, R25E (37° 10' 52.2&quot; N, 94° 38' 36.0&quot; W)</td>
</tr>
<tr>
<td>9/21/94</td>
<td>13</td>
<td>Spring River just upstream State Highway 96 (Cherokee County, Kansas)</td>
<td>SW 1/4, Sec 11, T33S, R25E (37° 10' 56.7&quot; N, 94° 38' 40.7&quot; W)</td>
</tr>
<tr>
<td>9/22/94</td>
<td>14</td>
<td>Spring River just upstream State Highway 96 (Cherokee County, Kansas)</td>
<td>SW 1/4, Sec 11, T33S, R25E (37° 10' 46.1&quot; N, 94° 38' 32.4&quot; W)</td>
</tr>
<tr>
<td>9/23/94</td>
<td>15</td>
<td>Shoal Creek just upstream State Highway 26 (Cherokee County, Kansas)</td>
<td>NW 1/4, Sec 35, T34S, R25E (37° 02' 30.0&quot; N, 94° 38' 22.0&quot; W)</td>
</tr>
<tr>
<td>9/24/94</td>
<td>16</td>
<td>Spring River just upstream of Oklahoma-Kansas border (Cherokee County, Kansas)</td>
<td>NE 1/4, Sec 18, T35S, R25E (36° 59' 57.3&quot; N, 94° 42' 47.2&quot; W)</td>
</tr>
<tr>
<td>9/26/94</td>
<td>17</td>
<td>Center Creek just upstream of mouth (Jasper County, Missouri)</td>
<td>SW 1/4, Sec 14, T28N, R34W (37° 09' 05.1&quot; N, 94° 36' 59.6&quot; W)</td>
</tr>
<tr>
<td>Date sampled</td>
<td>Site number</td>
<td>River (county and state)</td>
<td>Legal description (latitude, longitude)</td>
</tr>
<tr>
<td>--------------</td>
<td>-------------</td>
<td>--------------------------</td>
<td>----------------------------------------</td>
</tr>
<tr>
<td>9/27/94</td>
<td>18</td>
<td>Spring River just downstream of State Highway 96 (Cherokee County, Kansas)</td>
<td>NW 1/4, Sec 24, T33S, R25E (37° 09' 34.0&quot; N, 94° 37' 47.3&quot; W)</td>
</tr>
<tr>
<td>9/28/94</td>
<td>19</td>
<td>Spring River western channel just downstream of State Highway 96 (Cherokee County, Kansas)</td>
<td>NE 1/4, Sec 14, T33S, R25E (37° 10' 23.7&quot; N, 94° 38' 23.0&quot; W)</td>
</tr>
<tr>
<td>9/29/94</td>
<td>20</td>
<td>Shoal Creek just southwest of Galena, Kansas (Cherokee County, Kansas)</td>
<td>NW 1/4, Sec 34, T34S, R25E (37° 02' 36.8&quot; N, 94° 39' 26.1&quot; W)</td>
</tr>
<tr>
<td>10/1/94</td>
<td>21</td>
<td>Spring River just east of Waco, Missouri (Jasper County, Missouri)</td>
<td>NE 1/4, Sec 18, T29N, R33W (37° 14' 35.4&quot; N, 94° 34' 00.9&quot; W)</td>
</tr>
<tr>
<td>10/2/94</td>
<td>22</td>
<td>Spring River just south of Waco, Missouri (Jasper County, Missouri)</td>
<td>NE 1/4, Sec 35, T29N, R34W (37° 12' 03.8&quot; N, 94° 36' 25.7&quot; W)</td>
</tr>
<tr>
<td>10/3/94</td>
<td>23</td>
<td>Spring River just south of Waco, Missouri (Jasper County, Missouri)</td>
<td>SE 1/4, Sec 23, T29N, R34W (37° 13' 19.9&quot; N, 94° 36' 03.1&quot; W)</td>
</tr>
<tr>
<td>10/4/94</td>
<td>24</td>
<td>Spring River just south of Waco, Missouri (Jasper County, Missouri)</td>
<td>NW 1/4, Sec 26, T29N, R34W (37° 12' 55.2&quot; N, 94° 36' 28.6&quot; W)</td>
</tr>
<tr>
<td>10/4/94</td>
<td>25</td>
<td>Spring River just southeast of Lawton, Kansas (Cherokee County, Kansas)</td>
<td>NE 1/4, Sec 1, T33S, R25E (37° 11' 58.2&quot; N, 94° 37' 32.7&quot; W)</td>
</tr>
<tr>
<td>10/5/94</td>
<td>26</td>
<td>Spring River just southeast of Lawton, Kansas (Cherokee County, Kansas)</td>
<td>SE 1/4, Sec 25, T33S, R25E (37° 08' 17.6&quot; N, 94° 37' 13.2&quot; W)</td>
</tr>
<tr>
<td>10/5/94</td>
<td>27</td>
<td>Spring River just north west of Belleville, Missouri (Cherokee County, Kansas)</td>
<td>NW 1/4, Sec 36, T33S, R25E 37°07'58.8&quot;N 94°37'40.1&quot;W</td>
</tr>
<tr>
<td>Date sampled</td>
<td>Site number</td>
<td>River (county and state)</td>
<td>Legal description (latitude, longitude)</td>
</tr>
<tr>
<td>--------------</td>
<td>-------------</td>
<td>--------------------------</td>
<td>----------------------------------------</td>
</tr>
<tr>
<td>10/6/94</td>
<td>28</td>
<td>Turkey Creek just upstream of mouth (Cherokee County, Kansas)</td>
<td>NW 1/4, Sec 36, T33S, R25E 37°07'44.9&quot;N 94°37'32.5&quot;W</td>
</tr>
<tr>
<td>10/6/94</td>
<td>29</td>
<td>Spring River just north of Baxter, Kansas in western channel (Cherokee County, Kansas)</td>
<td>NE 1/4, Sec 36, T34S, R24E (37° 02' 42.6&quot; N, 94° 43' 35.7&quot; W)</td>
</tr>
</tbody>
</table>
Table 2. First 7 elements determined in the laboratory for benthic invertebrate tissue samples. Samples were collected opportunistically from a site using dip nets and kick seines. For sample composition, ‘decapoda’ represents crayfish, ‘megaloptera’ represent dobsonflies, ‘other’ generally represents molluscs, and ‘all’ represents samples that were too small to be separated in the previous three categories. All elemental measurements are in ug/g wet weight.

<table>
<thead>
<tr>
<th>Site</th>
<th>Sample composition</th>
<th>Wet weight (g)</th>
<th>Percent moisture</th>
<th>Al</th>
<th>B</th>
<th>Ba</th>
<th>Be</th>
<th>Cd</th>
<th>Cr</th>
<th>Cu</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>all</td>
<td>2.34</td>
<td>73.87</td>
<td>177.9</td>
<td>&lt;1.07</td>
<td>9.5</td>
<td>&lt;0.053</td>
<td>0.24</td>
<td>24.02</td>
<td>18.63</td>
</tr>
<tr>
<td>2</td>
<td>Decapoda</td>
<td>3.98</td>
<td>76.13</td>
<td>83.2</td>
<td>0.99</td>
<td>85.6</td>
<td>&lt;0.049</td>
<td>0.12</td>
<td>9.33</td>
<td>56.26</td>
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<tr>
<td>3</td>
<td>Decapoda</td>
<td>17.00</td>
<td>68.82</td>
<td>86.3</td>
<td>&lt;1.01</td>
<td>35.3</td>
<td>&lt;0.051</td>
<td>0.12</td>
<td>1.75</td>
<td>45.86</td>
</tr>
<tr>
<td>3</td>
<td>Megaloptera</td>
<td>17.92</td>
<td>72.32</td>
<td>102.1</td>
<td>&lt;1.06</td>
<td>4.2</td>
<td>&lt;0.053</td>
<td>0.08</td>
<td>22.03</td>
<td>18.03</td>
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<tr>
<td>4</td>
<td>Decapoda</td>
<td>23.25</td>
<td>73.89</td>
<td>103</td>
<td>&lt;1.07</td>
<td>61</td>
<td>&lt;0.107</td>
<td>&lt;0.11</td>
<td>2.49</td>
<td>82.92</td>
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<tr>
<td>4</td>
<td>Megaloptera</td>
<td>5.99</td>
<td>77.80</td>
<td>127</td>
<td>&lt;0.9</td>
<td>3.9</td>
<td>&lt;0.045</td>
<td>0.05</td>
<td>17.75</td>
<td>21.69</td>
</tr>
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<td>5</td>
<td>Decapoda</td>
<td>30.40</td>
<td>73.09</td>
<td>193.6</td>
<td>&lt;1.06</td>
<td>50.6</td>
<td>&lt;0.053</td>
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<td>Megaloptera</td>
<td>4.84</td>
<td>75.20</td>
<td>100.6</td>
<td>&lt;1.04</td>
<td>4</td>
<td>&lt;0.052</td>
<td>0.07</td>
<td>15.7</td>
<td>19.51</td>
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<td>68.05</td>
<td>127</td>
<td>&lt;1.16</td>
<td>73</td>
<td>&lt;0.058</td>
<td>0.08</td>
<td>2.79</td>
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<td>Megaloptera</td>
<td>9.00</td>
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<td>&lt;0.89</td>
<td>4.5</td>
<td>&lt;0.045</td>
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<tr>
<td>8</td>
<td>all</td>
<td>3.43</td>
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<td>136.9</td>
<td>&lt;0.86</td>
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<td>76.13</td>
<td>110.7</td>
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<td>32.8</td>
<td>&lt;0.048</td>
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<td>&lt;0.041</td>
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<td>25.18</td>
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<td>10</td>
<td>Megaloptera</td>
<td>4.69</td>
<td>77.83</td>
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<tr>
<td>Site</td>
<td>Sample composition</td>
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<td>Ba</td>
<td>Be</td>
<td>Cd</td>
<td>Cr</td>
<td>Cu</td>
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</tr>
<tr>
<td>11</td>
<td>Decapoda</td>
<td>32.04</td>
<td>70.59</td>
<td>90.6</td>
<td>&lt;1.04</td>
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<td>&lt;0.052</td>
<td>0.18</td>
<td>1.29</td>
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<td>11</td>
<td>Megaloptera</td>
<td>21.96</td>
<td>74.00</td>
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<td>&lt;0.94</td>
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<td>&lt;0.047</td>
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<td>144.5</td>
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<td>49.8</td>
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<td>&lt;0.11</td>
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<td>94.7</td>
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<td>49.3</td>
<td>&lt;0.118</td>
<td>&lt;0.12</td>
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<td>73.63</td>
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<tr>
<td>14</td>
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Table 3. Last 9 elements determined in the laboratory for benthic invertebrate tissue samples. Samples were collected opportunistically from the site using dip nets and kick seines. For sample composition, 'decapoda' represents crayfish, 'megaloptera' represent dobsonflies, 'other' generally represents molluscs, and 'all' represents samples that were too small to be separated in the previous three categories. All elemental measurements are in ug/g wet weight.

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Figure 1. Map of the Neosho, Cottonwood, and Spring River drainage. Crossed squares indicate location of sites where samples were collected.