

Guide to Appropriate Metric Selection for Calculating the Index of Biotic Integrity (IBI) for Indiana Large and Great Rivers, Inland Lakes, and Great Lakes nearshore



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Guide to Appropriate Metric Selection for Calculating the Index of Biotic Integrity (IBI) for Indiana Large and Great Rivers, Inland Lakes, and Great Lakes Nearshore Habitats

The following documentation is a summary of the appropriate metrics that should be used for assessing anthropogenic influences in the State of Indiana. Information from this document are summarized for simplicity of use, but further reading should be based on information contained in each of the individual biological indicator documents, papers, or reports.

Collection procedures follow the U. S. Environmental Protection Agency (USEPA) Standard Operating Procedures for conducting rapid assessment of ambient surface water quality using fish (1988). All graphs were produced using Statistica (1999). The format for this document is similar to a diagnostic key. For each couplet, choose the appropriate selection and follow the directions. For a detailed list of documents used to create this guide, please refer to the reference section of this paper.

1. Determine waterbody type

- a. Lotic, flowing waters including creeks, streams, large and great rivers, and Ohio Riverstep 2
- b. Lentic, standing waters including wetlands, ponds, inland lakes, Great Lake nearshore habitats step 3

2. Determine drainage area (sq mi)

- a. Less than 1000 square miles*..... step 4
- b. Greater than or equal to 1000 square miles step 5

* If sampling location is a large river (greater than or equal to 1000 square miles) in either the St. Joseph River, St. Mary's River, or Maumee River (Huron Erie Lake Plain), or the St. Joseph River (Lake Michigan drainage), Pigeon River, and Elkhart River (Northern Indiana Till Plain) follow this step. These rivers were included in the calibration for each of these ecoregions.

3. Determine surface area (ha). NOTE: Waterbody biological indicators for lentic systems < 20 ha are described for ponds, pannes, and palustrine wetlands in Simon (1998) and for vernal ponds and wetlands in Simon et al. (2000). These waterbody types are not covered further in this document.

- a. Less than 20 ha (vernal pond, wetland, pond)..... see Simon 1998, Simon et al. 2000
- b. Greater than 20 ha (inland lake, Great Lakes nearshore).... step 6, see Simon 2001, 2004, Simon & Stewart 2006

4. Determine the ecoregion that your stream is located or drains. If your sampling location occurs on or near an ecoregion boundary line, select the ecoregion that the stream drains, see map next page (Fig. 5.1). These stream sizes are summarized in Dufour (2002) and has been described in detail in the information contained below. Consult Dufour (2002) to determine guidance or refer to appropriate Ecoregion document.

- a. Central Corn Belt Plain see Simon 1991
- b. Eastern Corn Belt Plain see Simon & Dufour 1998
- c. Northern Indiana Till Plain see Simon 1998
- d. Huron Erie Lake Plain see Simon 1994
- e. Interior River Lowland see Dufour 2002, page 28
- f. Interior Plateausee Simon 1997

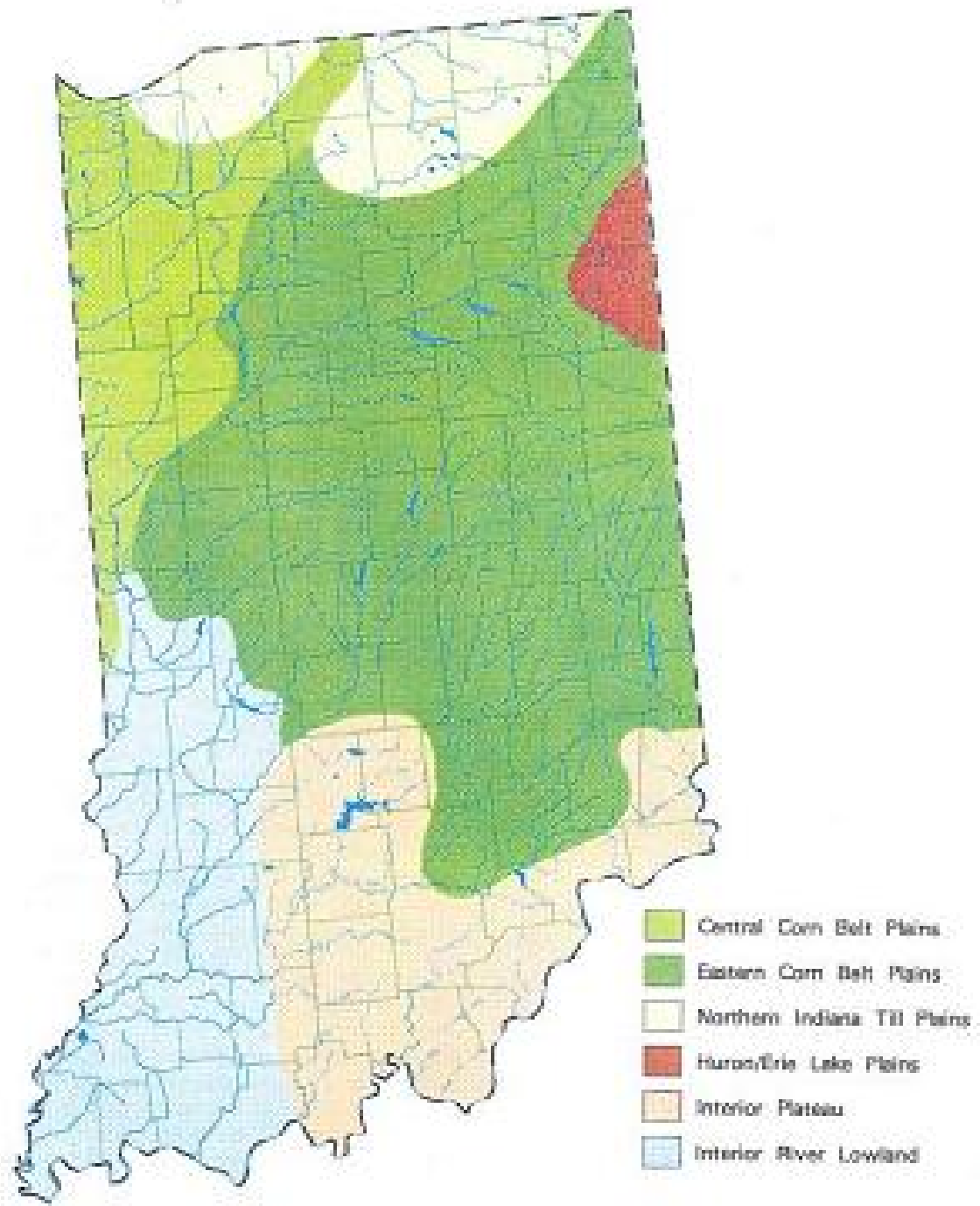


Fig. 5.1. Ecoregions of Indiana (Omernik and Gallant 1988).

5. Determine appropriate category

- a. Drainage area (sq mi) is greater than or equal to 1000, (large river includes Wabash and White rivers).....page 4 (White River) or page 12 (Wabash River) (see Simon 1992 or Simon & Stahl 1998). NOTE:

Calibrations for these two rivers are revised and include additional information not previously available. Consult Simon (1992) or Simon & Stahl (1998) for metric explanation and metric species membership.

- b. Drainage area (sq mi) is greater than or equal to 2000 (sq. mi), mainstem Wabash River or Ohio River.....page 12 (Wabash River) or page 19 (Ohio River) (see Simon & Stahl 1998, Emery et al. 2003).

NOTE: Calibration for the lower Wabash River is based on original information. Consult Simon & Stahl (1998) for information on metrics and metric species membership.

6. Determine appropriate category or Ecoregion based on location of waterbody. NOTE: Lake Michigan nearshore requires use of Great Lake calibrations for Lake Michigan coastal wetlands. Harbor and embayment criteria are in preparation by Simon & Morris (in preparation).

- a. Great Lakes nearshore see Simon & Stewart 2006, page 21
- b. Natural lakes and reservoirs of the Central Corn Belt Plain, Northern Indiana Till Plain, and Eastern Corn Belt Plain Ecoregionssee Simon 2001, page 23
- c. Reservoirs and oxbow lakes Interior River Lowland and Interior Plateau Ecoregions..... see Simon 2002, page 25

White River Metrics

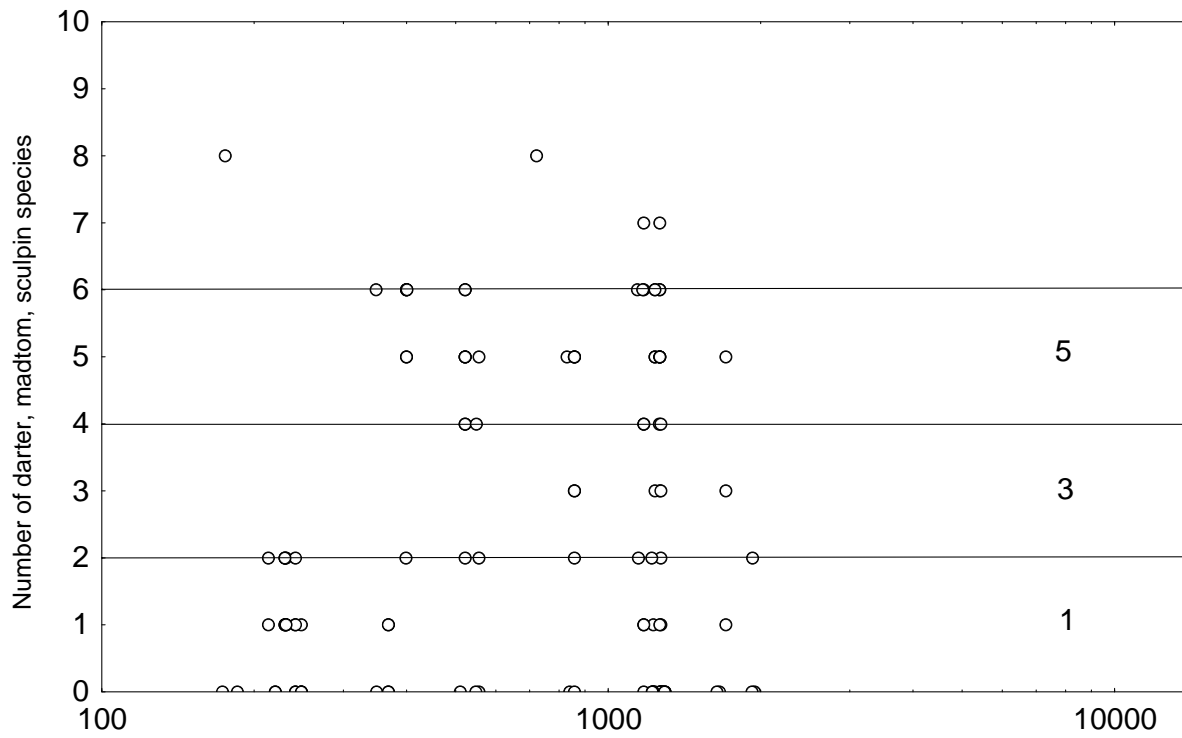
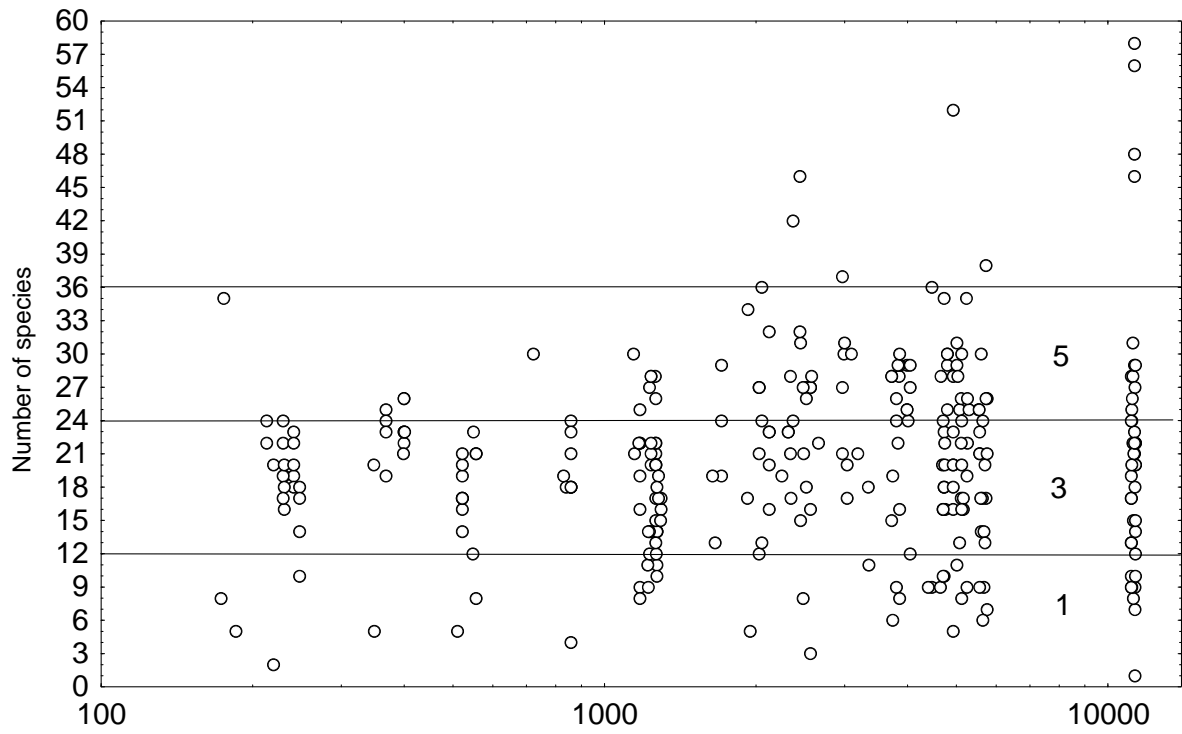
Determine the appropriate stream category to use:

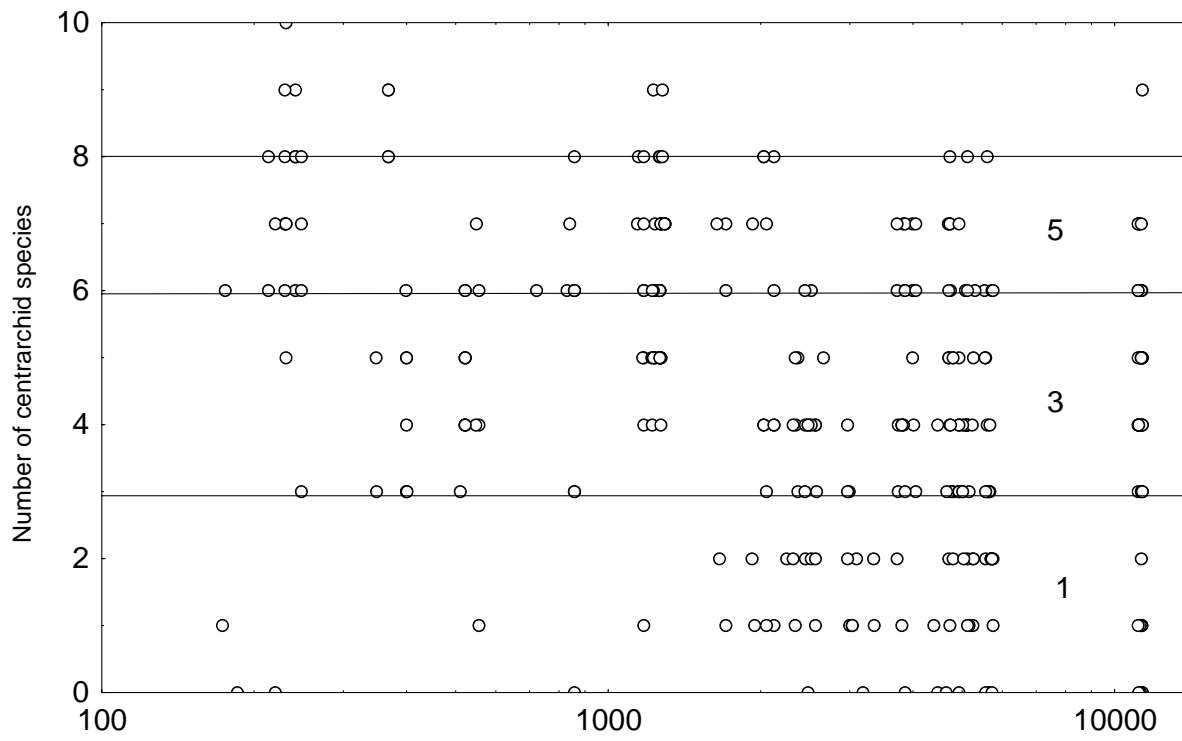
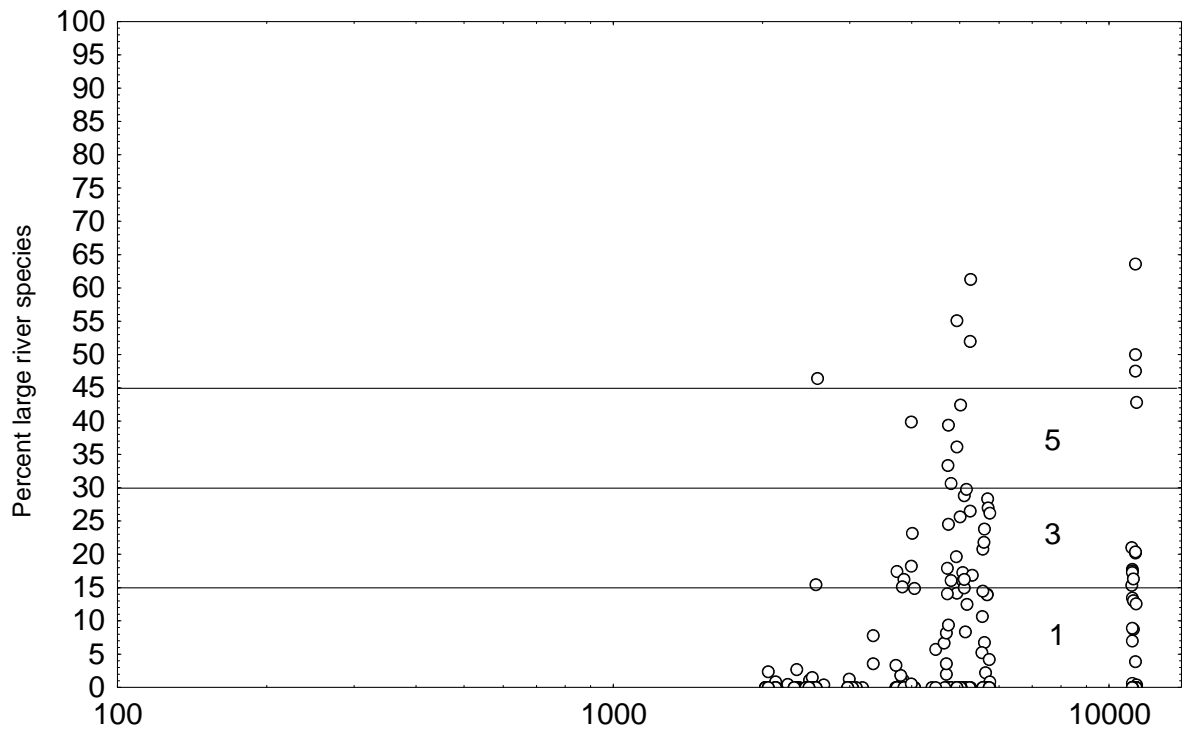
- a. Greater than or equal to 1000 (sq mi),
but less than 2000 (sq mi) use B, and LR metrics
- b. Great river (larger than or equal to 2000 sq mi)..... use B, and GR metrics

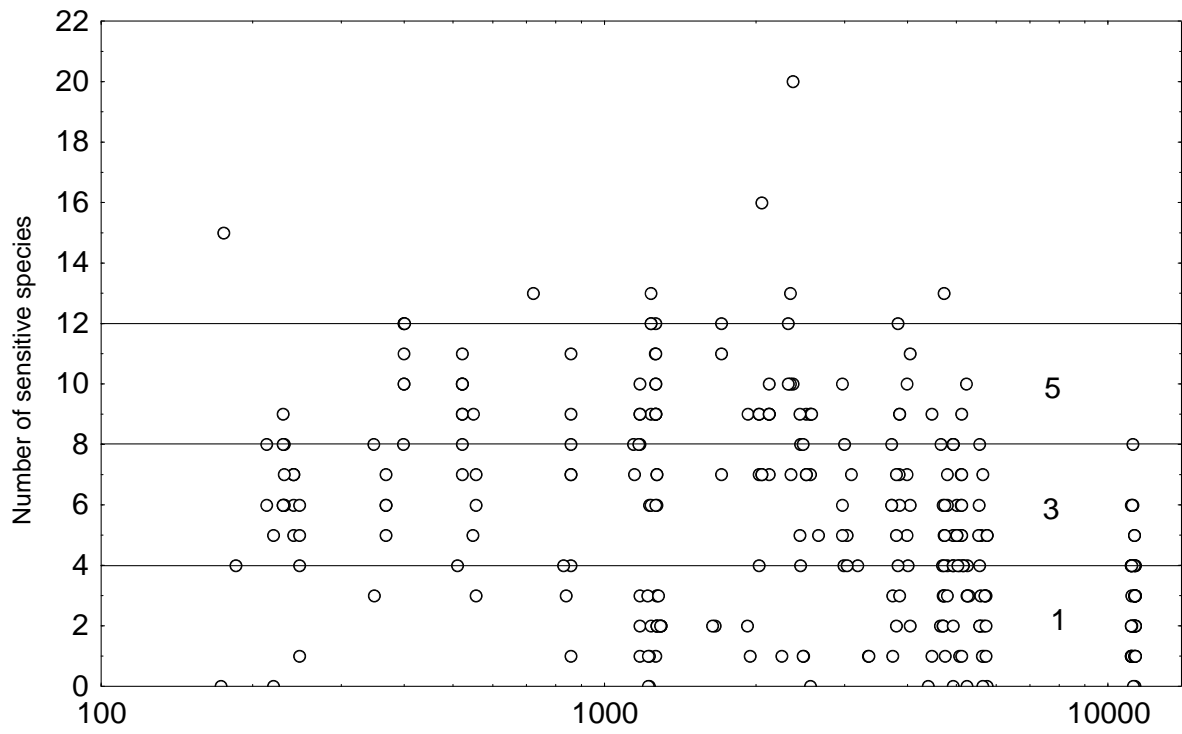
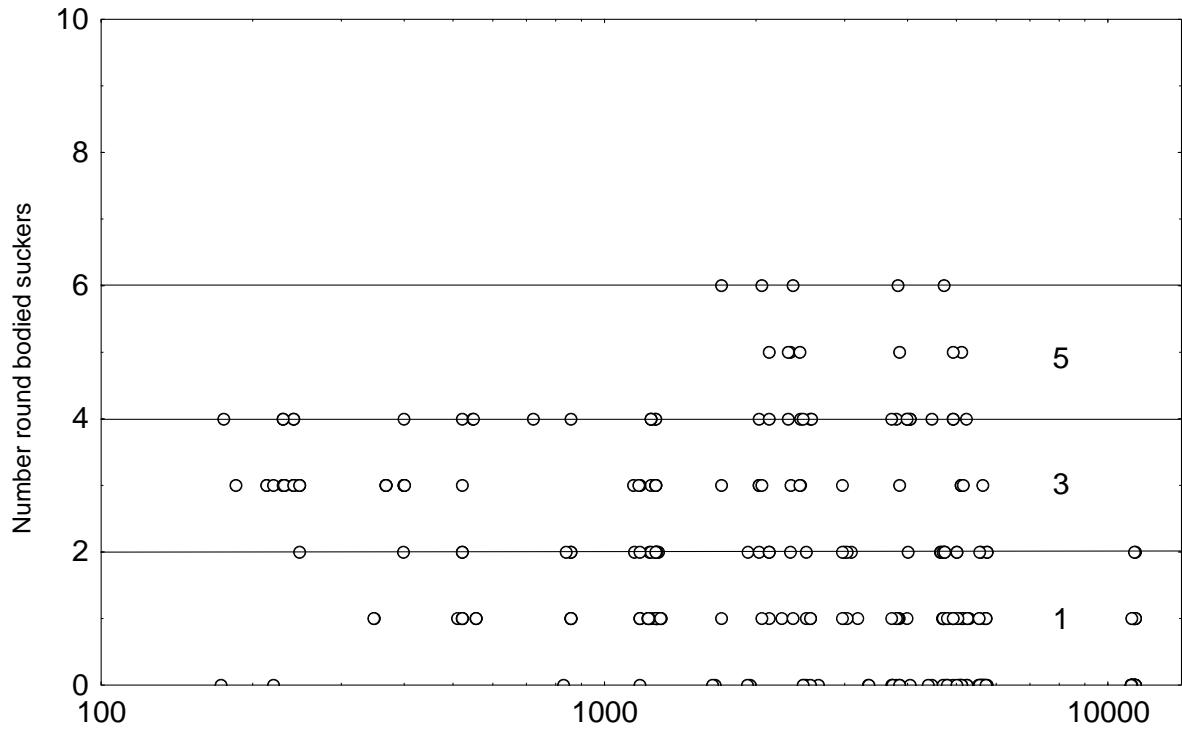
NOTE: Large numbers of a single species can often “swamp” certain metrics making it difficult to assess site status. Therefore, it is essential to remove gizzard shad (*Dorosoma cepedianum*) from this particular set of data prior to IBI calculations (see metric CPUE – gizzard shad).

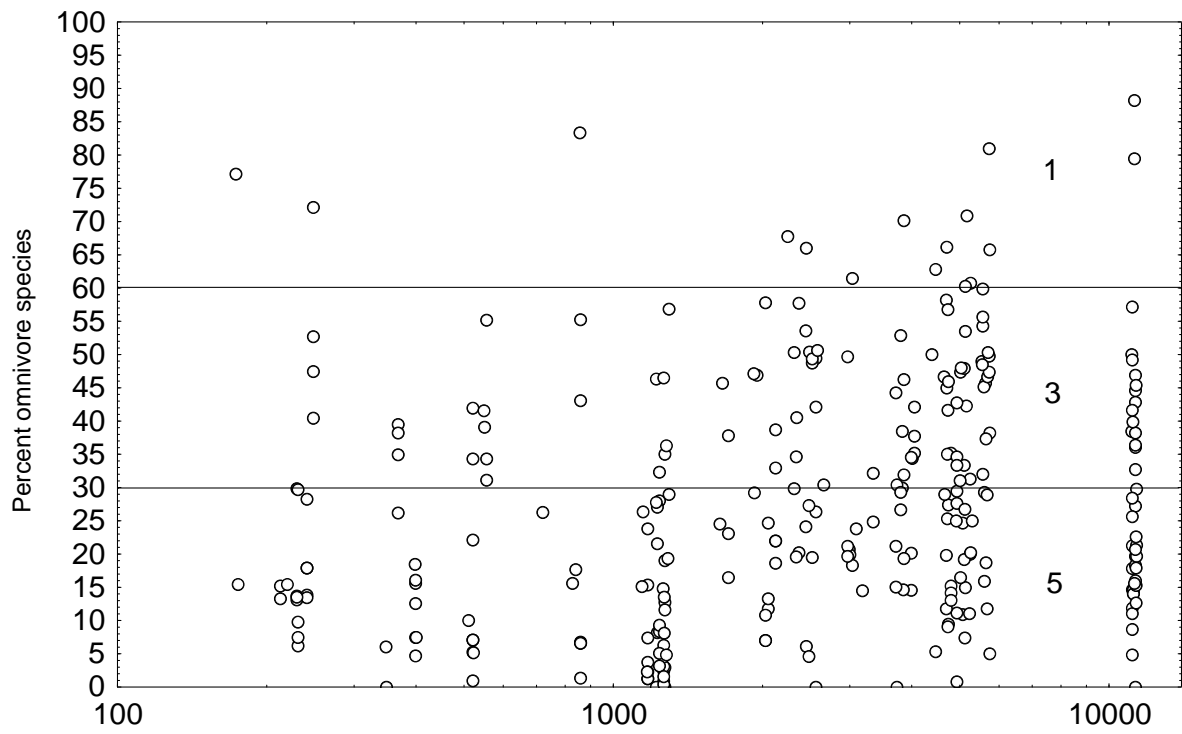
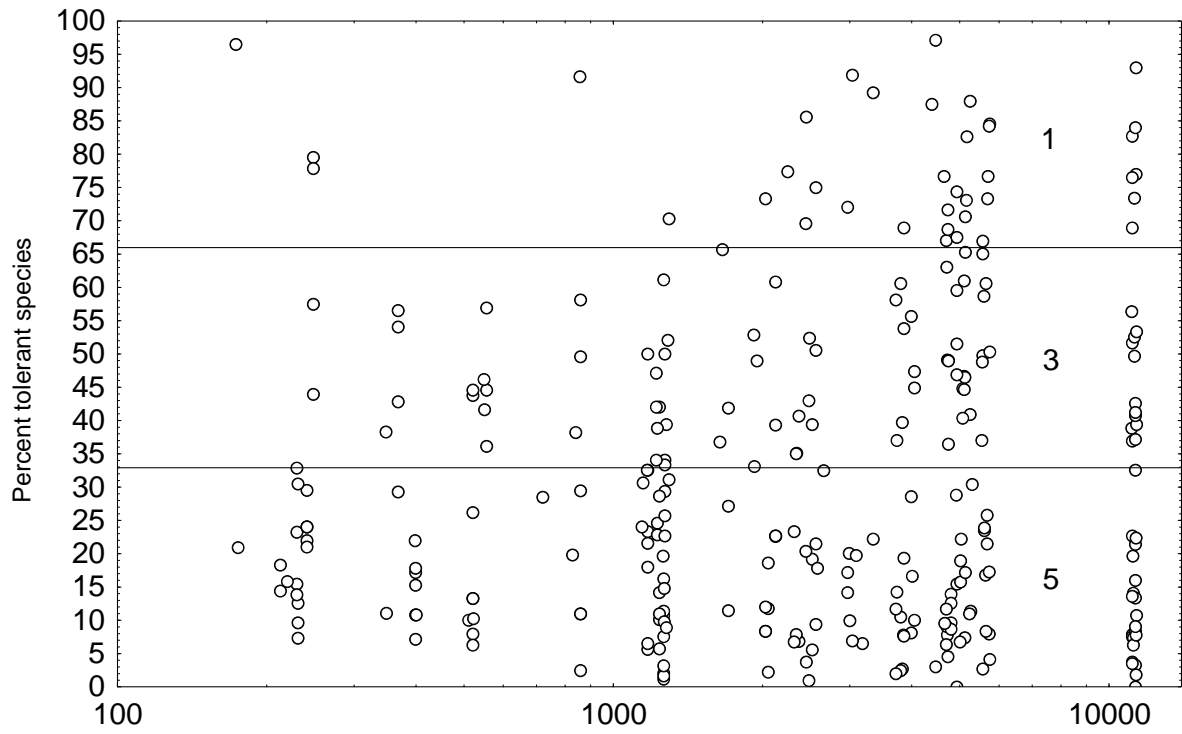
Stream Category	Metric	5	3	1
B	Total number of species	≥ 24	12-23	<12
LR	Number of darter, madtom, and sculpin spp.	≥ 4	2-3	< 2
GR	Percent large river species as individuals	>30%	15-30%	<15%
B	Number of centrarchid species	≥ 6	3-5	≤ 2
B	Number of round-bodied sucker species	≥ 4	2-3	< 2
B	Number of sensitive species	≥ 8	4-7	< 4
B	Percent tolerant species as individuals	< 33%	33-66%	> 66%
B	Percent omnivore species as individuals	< 30%	30-60%	>60%
B	Percent insectivore species as individuals	> 66%	33-66%	< 33%
B	Percent carnivore species as individuals	> 30%	15-30%	< 15%
B	Catch Per Unit Effort (number of individuals)	>1,000	500-1,000	< 500
B	Percent simple lithophilic spawning as individuals	> 33.4%	16.7-33.4%	<16.7%
B	Percent DELT anomalies as individuals	< 0.1%	0.1-1.3%	> 1.3%

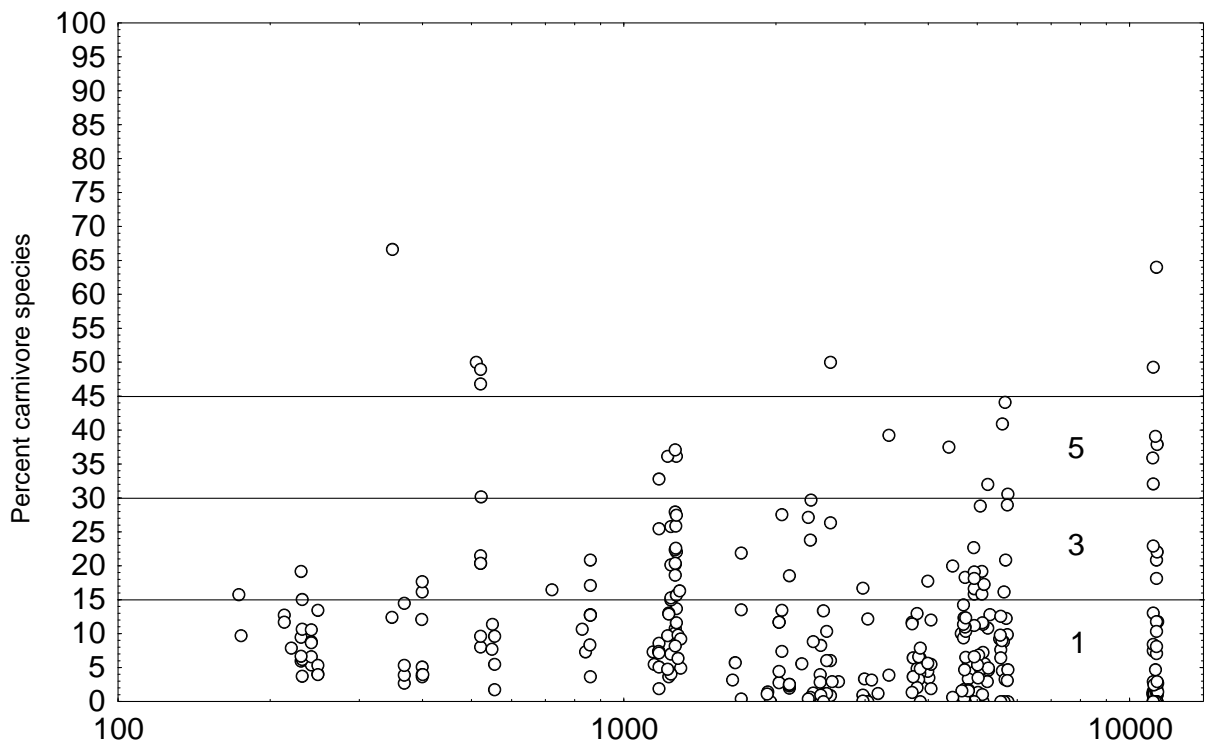
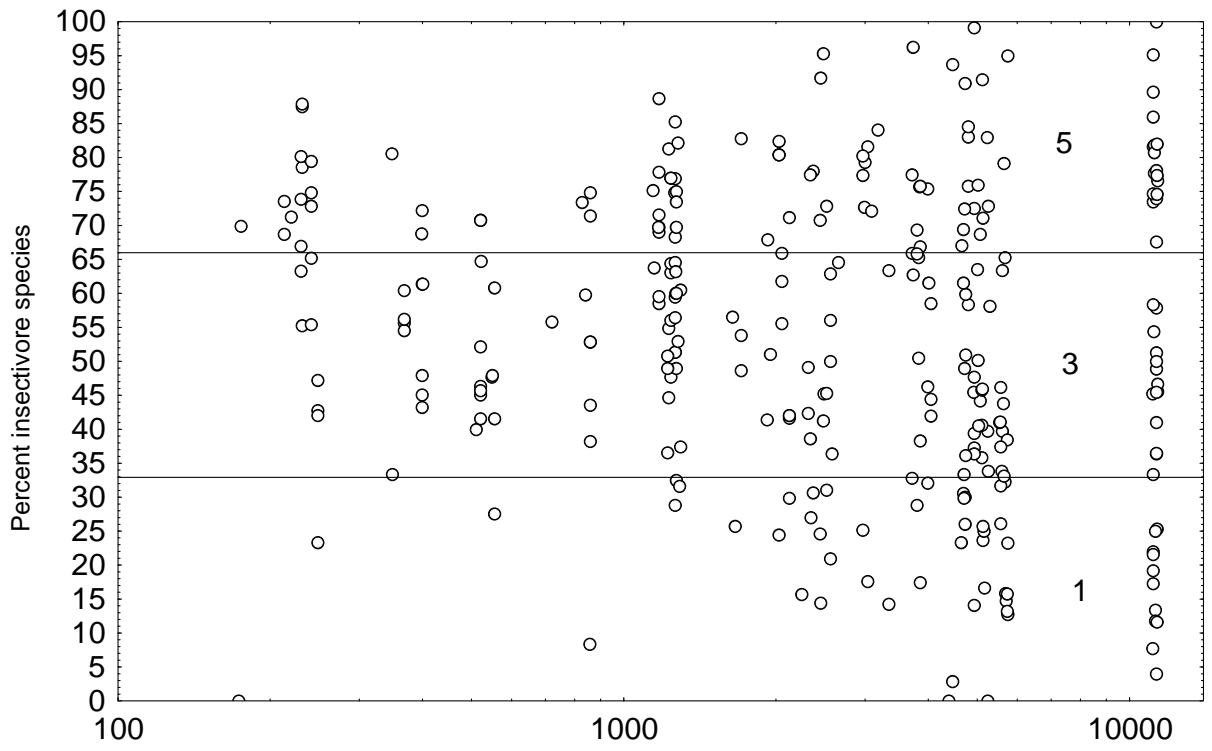
NOTE: Scoring modifications are made when CPUE is <100 individuals (with gizzard shad) or <50 (without gizzard shad) in a 500 m zone. Scoring modifications include scoring all percentage metrics “1”.

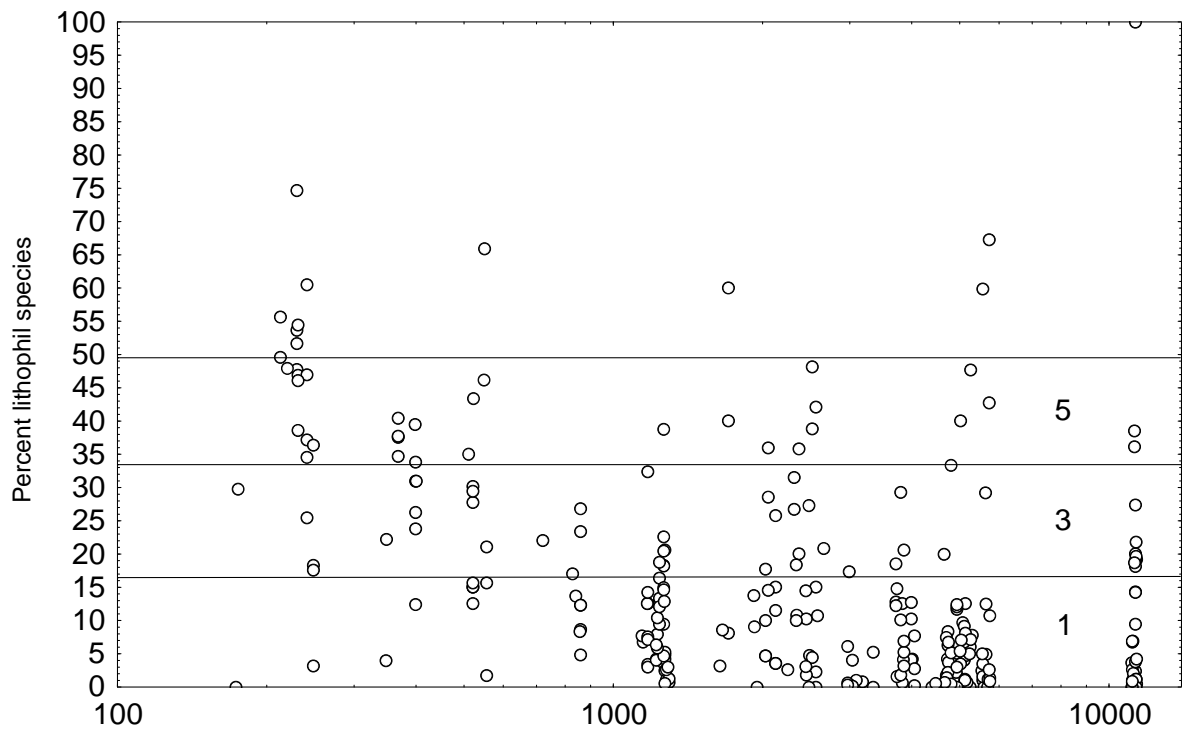
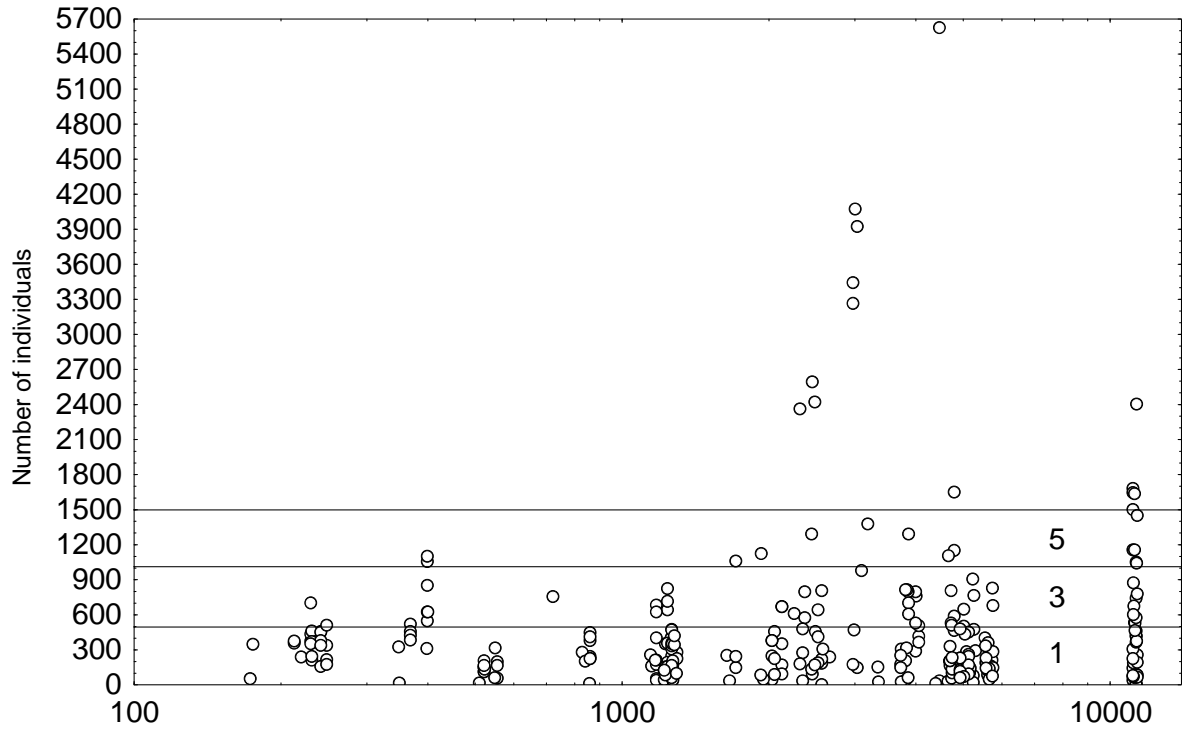


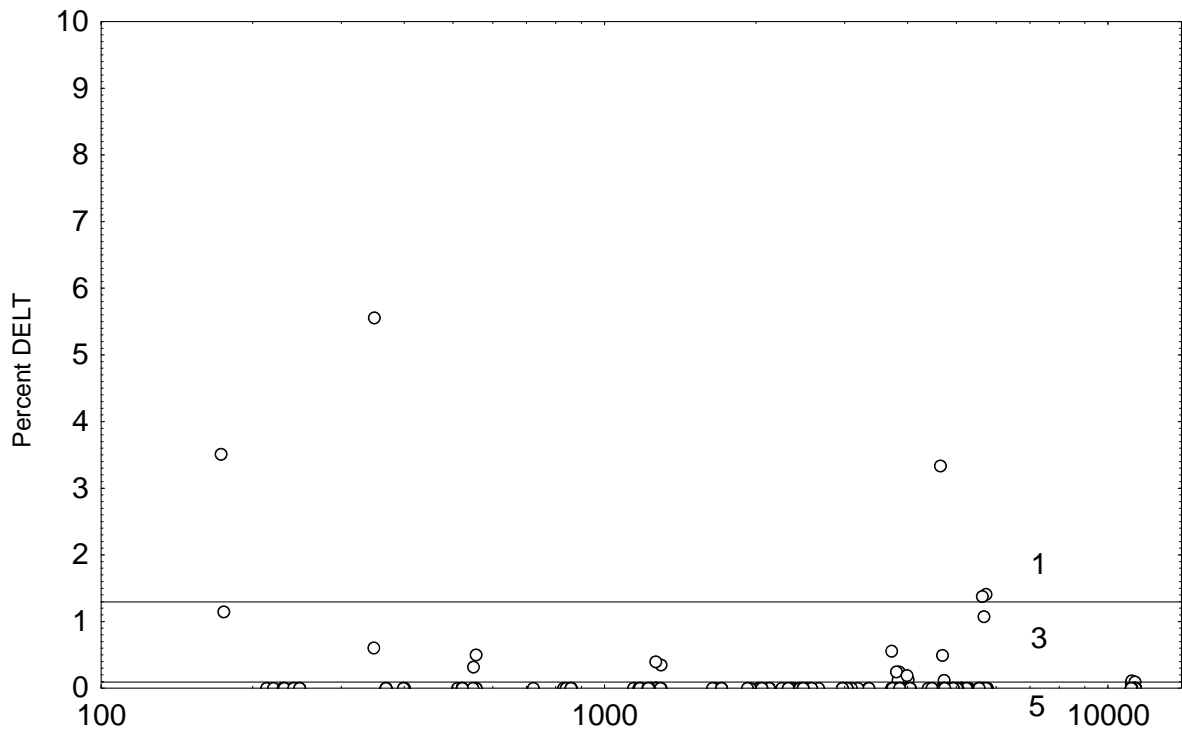












Wabash River Metrics

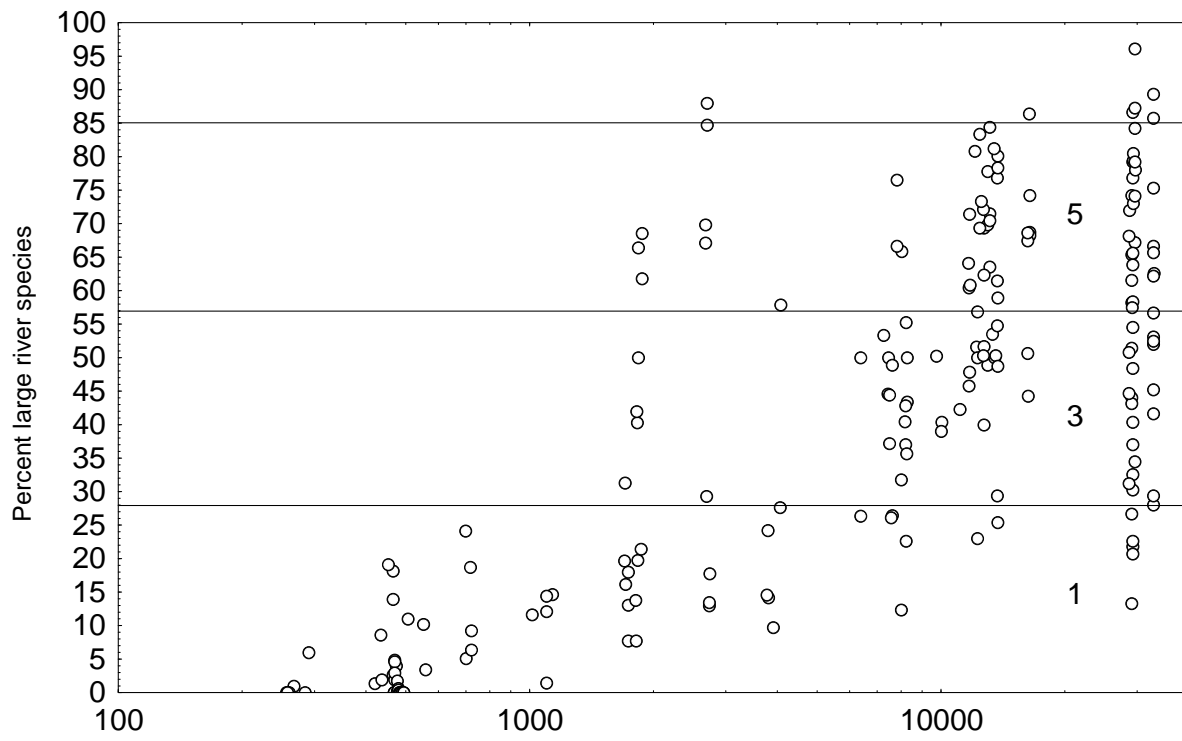
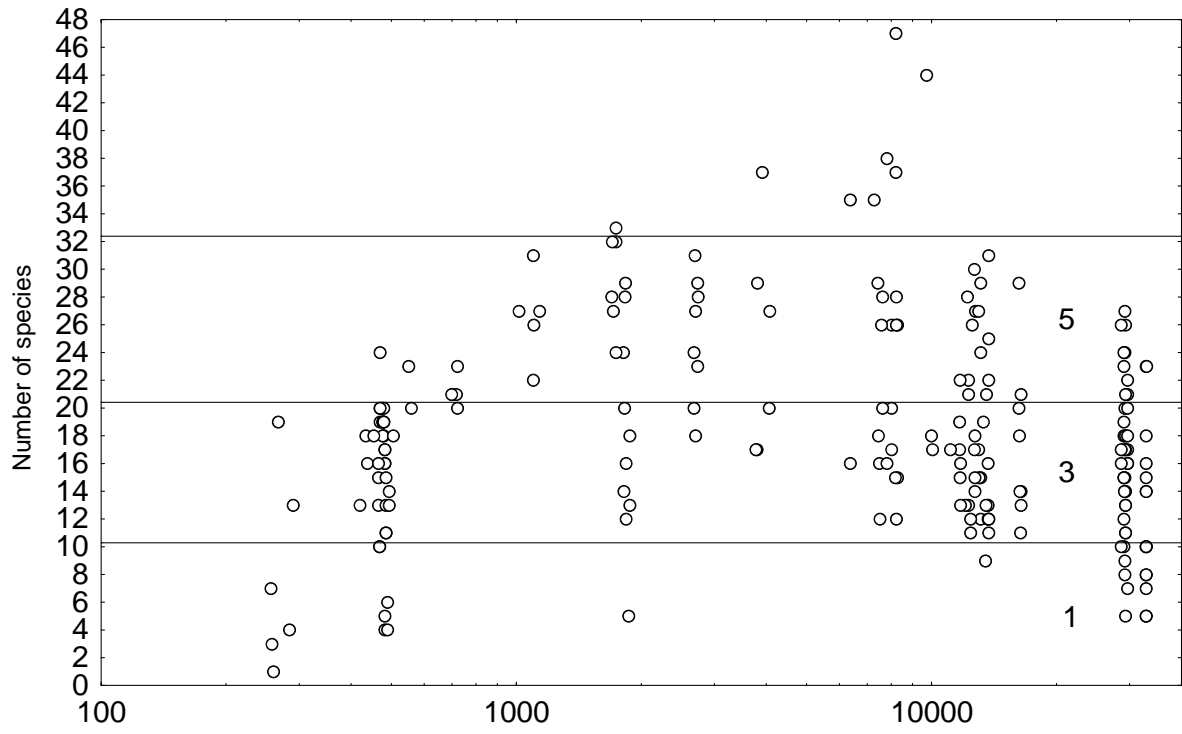
Determine the appropriate stream category to use:

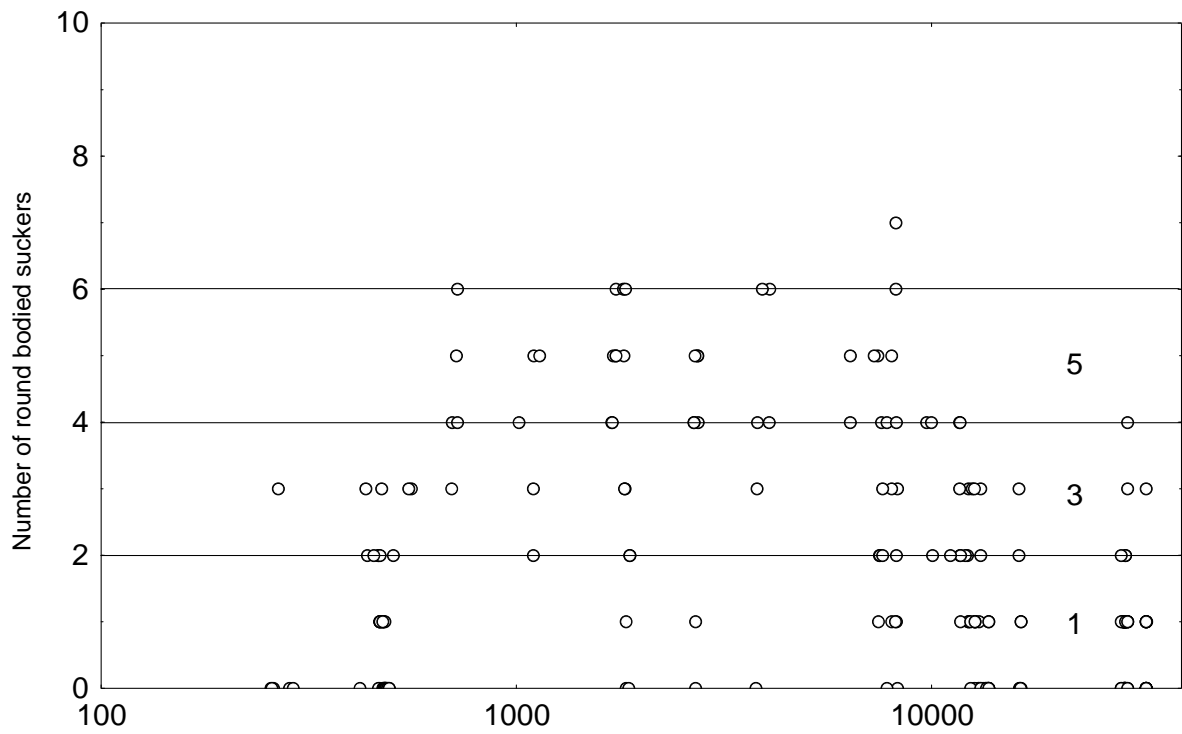
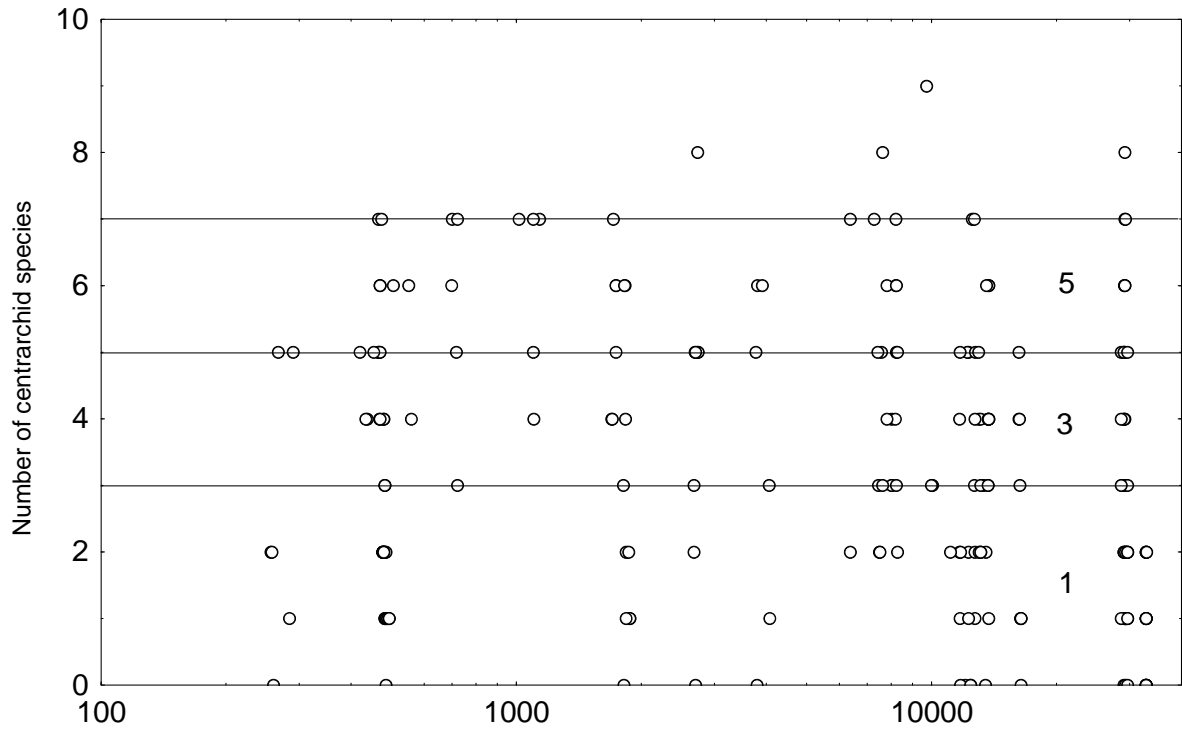
- b. Greater than or equal to 1000 (sq mi),
but less than 2000 (sq mi) use B, and LR metrics
- b. Great river (larger than or equal to 2000 sq mi)..... use B, and GR metrics

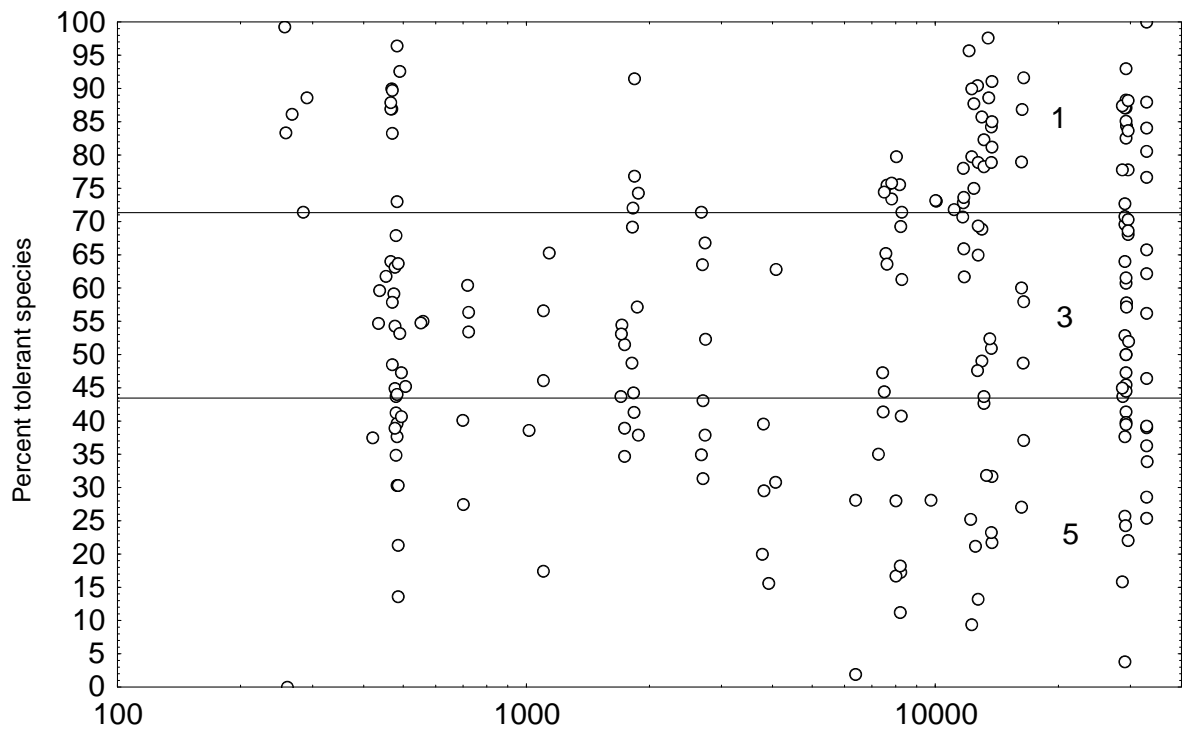
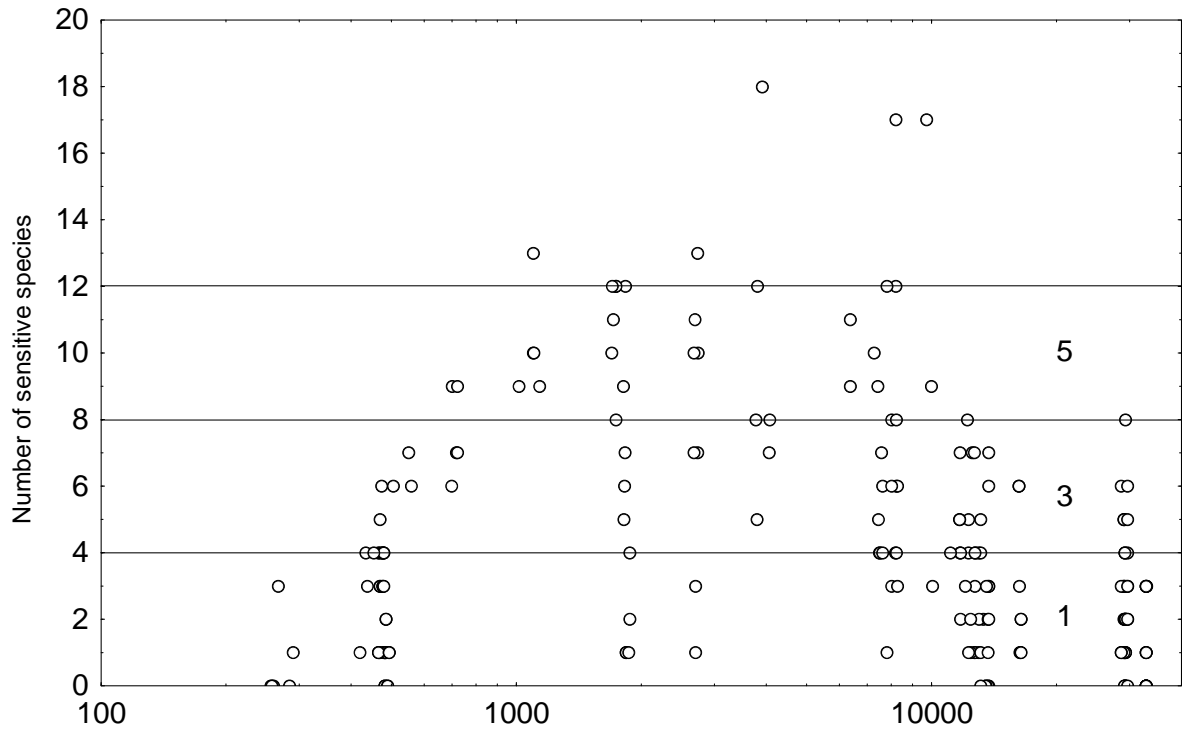
NOTE: Large numbers of a single species can often “swamp” certain metrics making it difficult to assess site status. Therefore, it is essential to remove gizzard shad (*Dorosoma cepedianum*) from this particular set of data prior to IBI calculations (see metric CPUE – gizzard shad).

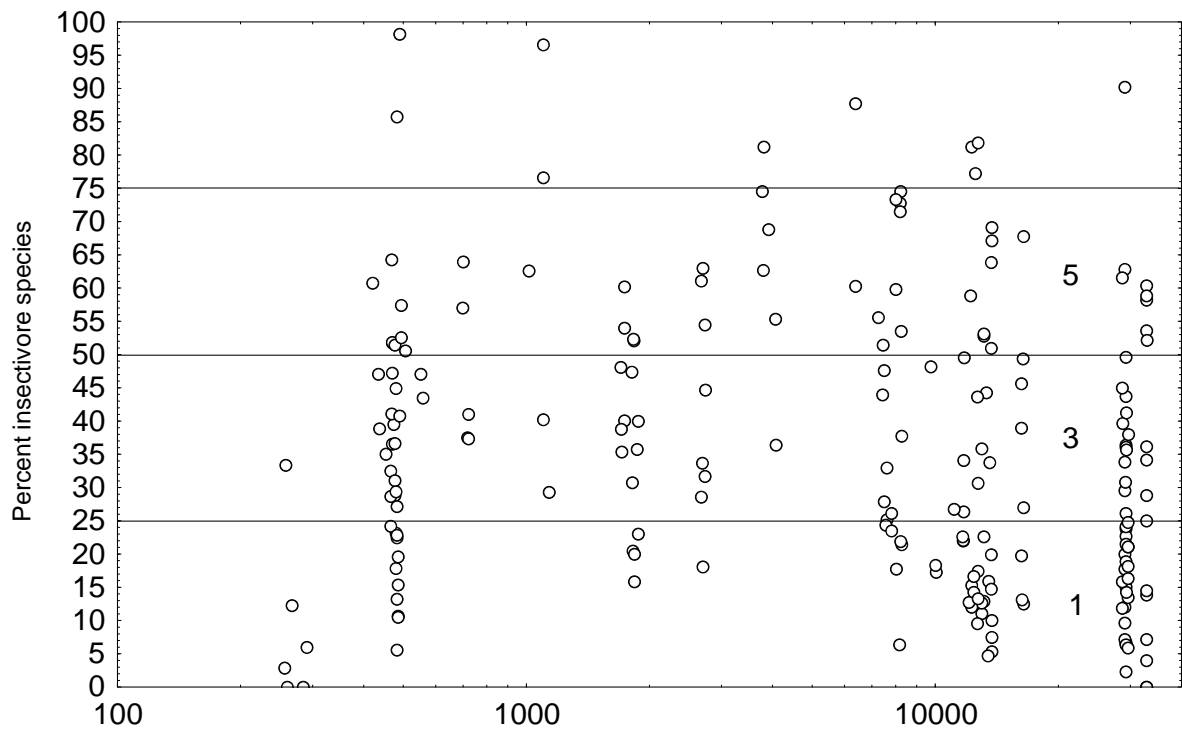
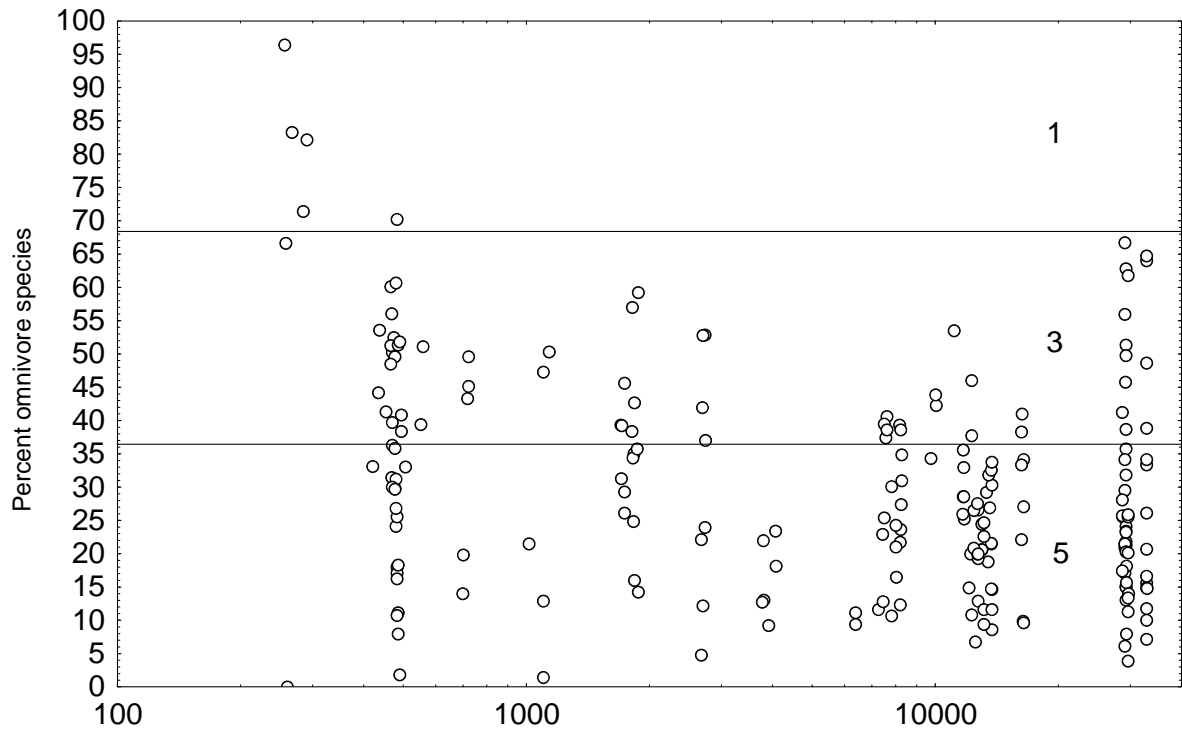
Stream Category	Metric	5	3	1
B	Total number of species	> 20	10-20	<10
LR	Number of darter, madtom, and sculpin spp.	≥ 4	2-3	< 2
GR	Percent large river species as individuals	> 56.6%	28.3-56.6%	<28.3%
B	Number of centrarchid species	≥ 5	3-4	≤ 2
B	Number of round-bodied sucker species	≥ 5	2-4	< 2
B	Number of sensitive species	≥ 8	4-7	≤ 3
B	Percent tolerant species as individuals	< 43.3%	43.3-71.6%	> 71.6%
B	Percent omnivore species as individuals	< 36.7%	36.7-68.3%	>68.3%
B	Percent insectivore species as individuals	> 50%	25-50%	< 25%
B	Percent carnivore species as individuals	20-30%	10-20 and 30-40%	< 10% or >40%
B	Catch Per Unit Effort- gizzard shad (=number of individuals)	>1,200	600-1,200	< 600
B	Percent simple lithophilic spawning as individuals	> 30%	15-30%	<15%
B	Percent DELT anomalies as individuals	< 0.1%	0.1-1.3%	> 1.3%

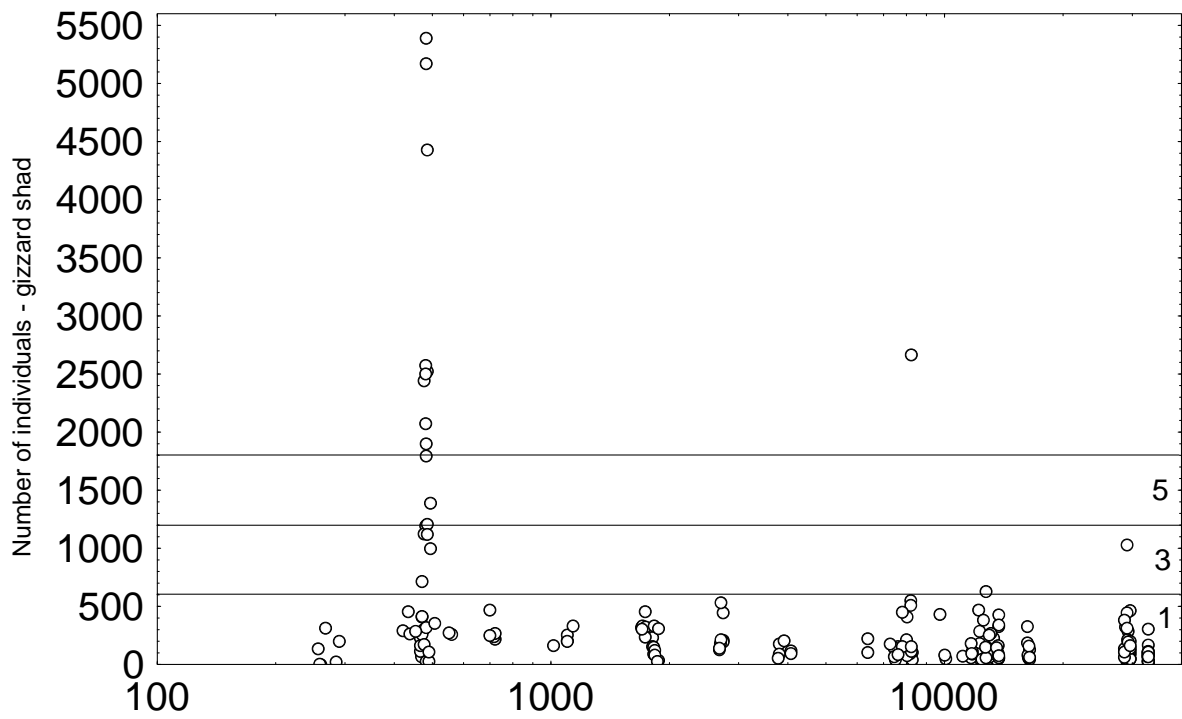
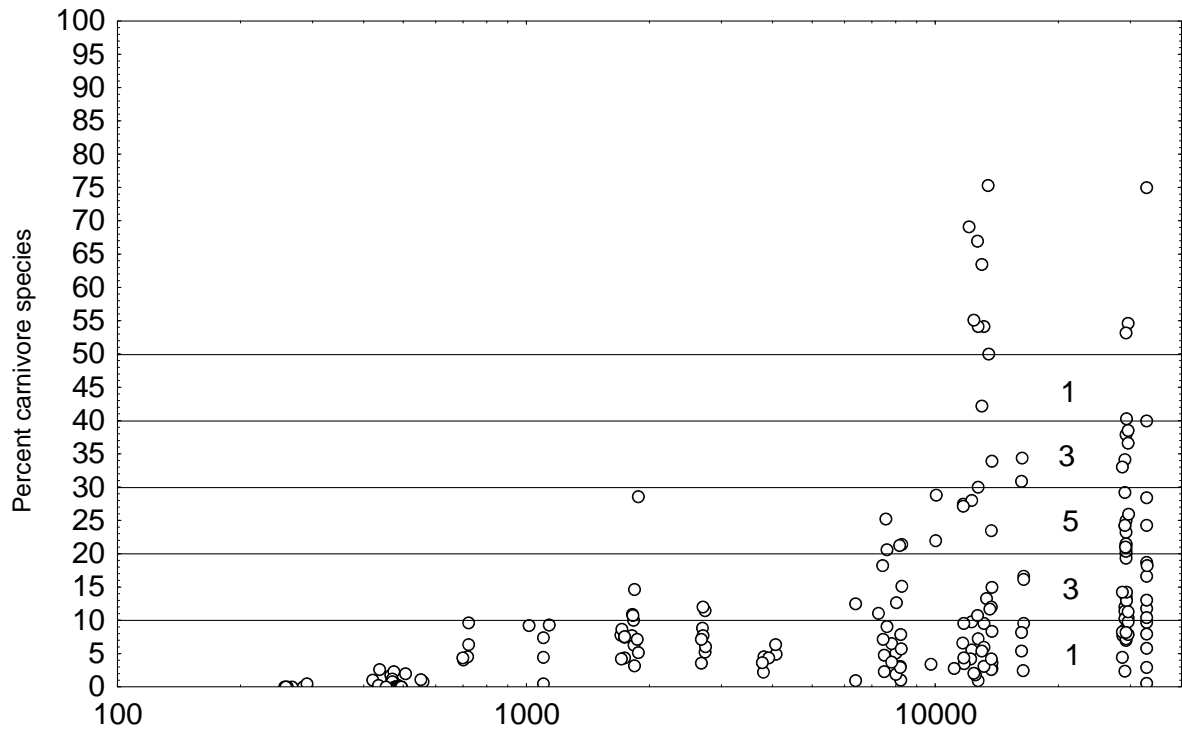
Scoring modification are made when less than 50 (without gizzard shad) or 100 (with gizzard shad) individuals are collected. NOTE: Scoring modifications include scoring all percentage metrics “1”.

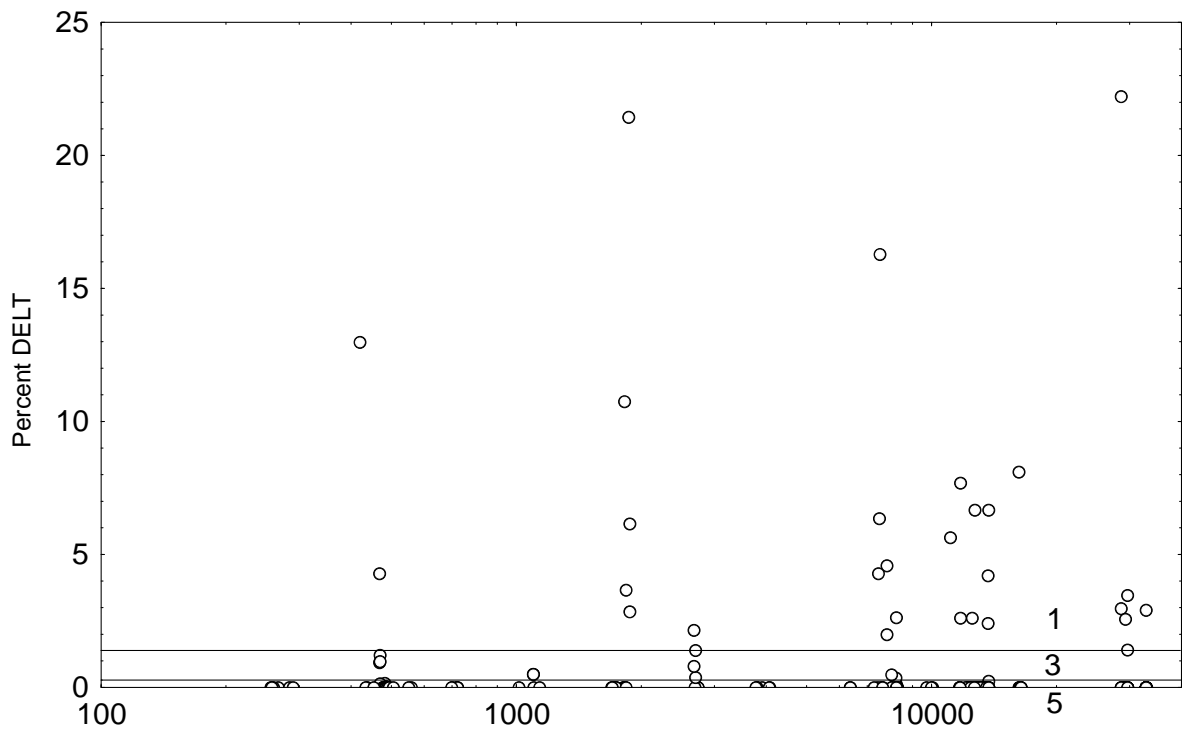
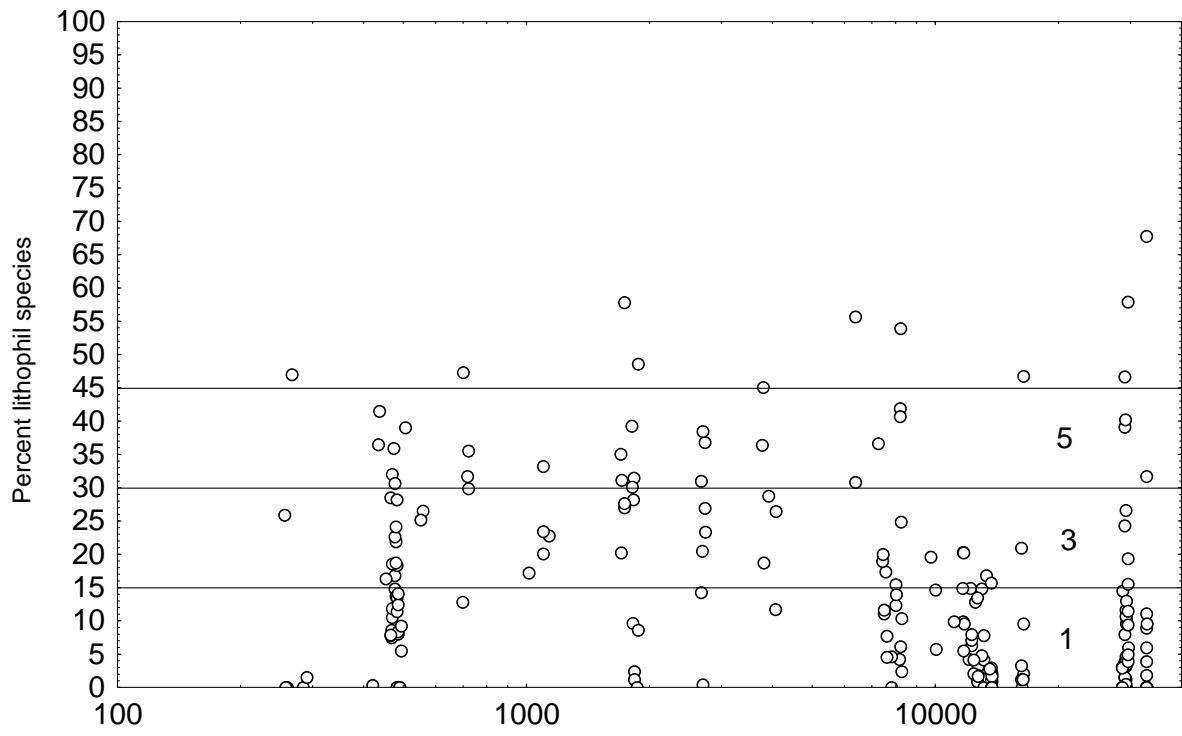












Ohio River Metrics

These series of metrics are developed for use on Great Rivers and is based on the study by Emery *et al.*, 2003 (see pg 801). This index can be applied to all Ohio River sites along the Indiana shoreline. Rkm = Ohio River kilometer. Guild assignments for the ORFiN are included in Appendix 1.

Stream Category	Metric	1	3	5
B	Total number of species (excludes nonindigenous species & hybrids)	$X \leq (-0.0046 * \text{rkm}) + 48.28 * 0.33$	$(-0.0046 * \text{rkm}) + 48.28 * 0.33 < X < (-0.0046 * (\text{rkm}) + 48.28) * 0.66$	$X \geq (-0.0046 * (\text{rkm}) + 48.28) * 0.66$
B	Number of sucker spp.	$X \leq (-0.0035 * (\text{rkm}) + 14.48) * 0.33$	$(-0.0035 * (\text{rkm}) + 14.48) * 0.33 < X < (-0.0035 * (\text{rkm}) + 14.48) * 0.66$	$X \geq (-0.0035 * (\text{rkm}) + 14.48) * 0.66$
B	Number of centrarchid species	$X < 3$	$3 \leq X < 6$	$X \geq 6$
B	Number of great river species	$X < 2$	$2 \leq X < 3$	$X \geq 3$
B	Number of intolerant species	$X \leq (-0.004 * (\text{rkm}) + 12.87) * 0.33$	$(-0.004 * (\text{rkm}) + 12.87) * 0.33 < X < (-0.004 * (\text{rkm}) + 12.87) * 0.66$	$X \geq (-0.004 * (\text{rkm}) + 12.87) * 0.66$
B	Percent tolerant species as individuals	$X > 6.66$	$3.33 < X \leq 6.66$	$X \leq 3.33$
B	Percent simple lithophilic spawning as individuals	$X \leq (-0.0237 * (\text{rkm}) + 105.09) * 0.33$	$(-0.0237 * (\text{rkm}) + 105.09) * 0.33 < X < (-0.0237 * (\text{rkm}) + 105.09) * 0.66$	$X \geq (-0.0237 * (\text{rkm}) + 105.09) * 0.66$
B	Percent Nonnative species as individuals	$X > 8.58$	$4.3 < X \leq 8.58$	$X \leq 4.3$
B	Percent detritivore species as individuals	$X \geq (-0.006 * (\text{rkm}) + 51.49) * 0.66$	$(-0.006 * (\text{rkm}) + 51.49) * 0.33 < X < (-0.006 * (\text{rkm}) + 51.49) * 0.66$	$X \leq (-0.006 * (\text{rkm}) + 51.49) * 0.33$
B	Percent invertivore species as individuals	$X \leq (-0.0335 * (\text{rkm}) + 138.4) * 0.33$	$(-0.0335 * (\text{rkm}) + 138.4) * 0.33 < X < (-0.0335 * (\text{rkm}) + 138.4) * 0.66$	$X \geq (-0.0335 * (\text{rkm}) + 138.4) * 0.66$
B	Percent piscivore species as individuals	$X \leq (-0.0047 * (\text{rkm}) + 96.56) * 0.33$	$(-0.0047 * (\text{rkm}) + 96.56) * 0.33 < X < (-0.0047 * (\text{rkm}) + 96.56) * 0.66$	$X \geq (-0.0047 * (\text{rkm}) + 96.56) * 0.66$
B	Number of DELT anomalies	$X \geq 4$	$2 \leq X < 4$	$X < 2$
B	Catch Per Unit Effort *	$X \leq (-0.018 * (\text{rkm}) + 740.29) * 0.33$	$(-0.018 * (\text{rkm}) + 740.29) * 0.33 < X < (-0.018 * (\text{rkm}) + 740.29) * 0.66$	$X \geq (-0.018 * (\text{rkm}) + 740.29) * 0.66$

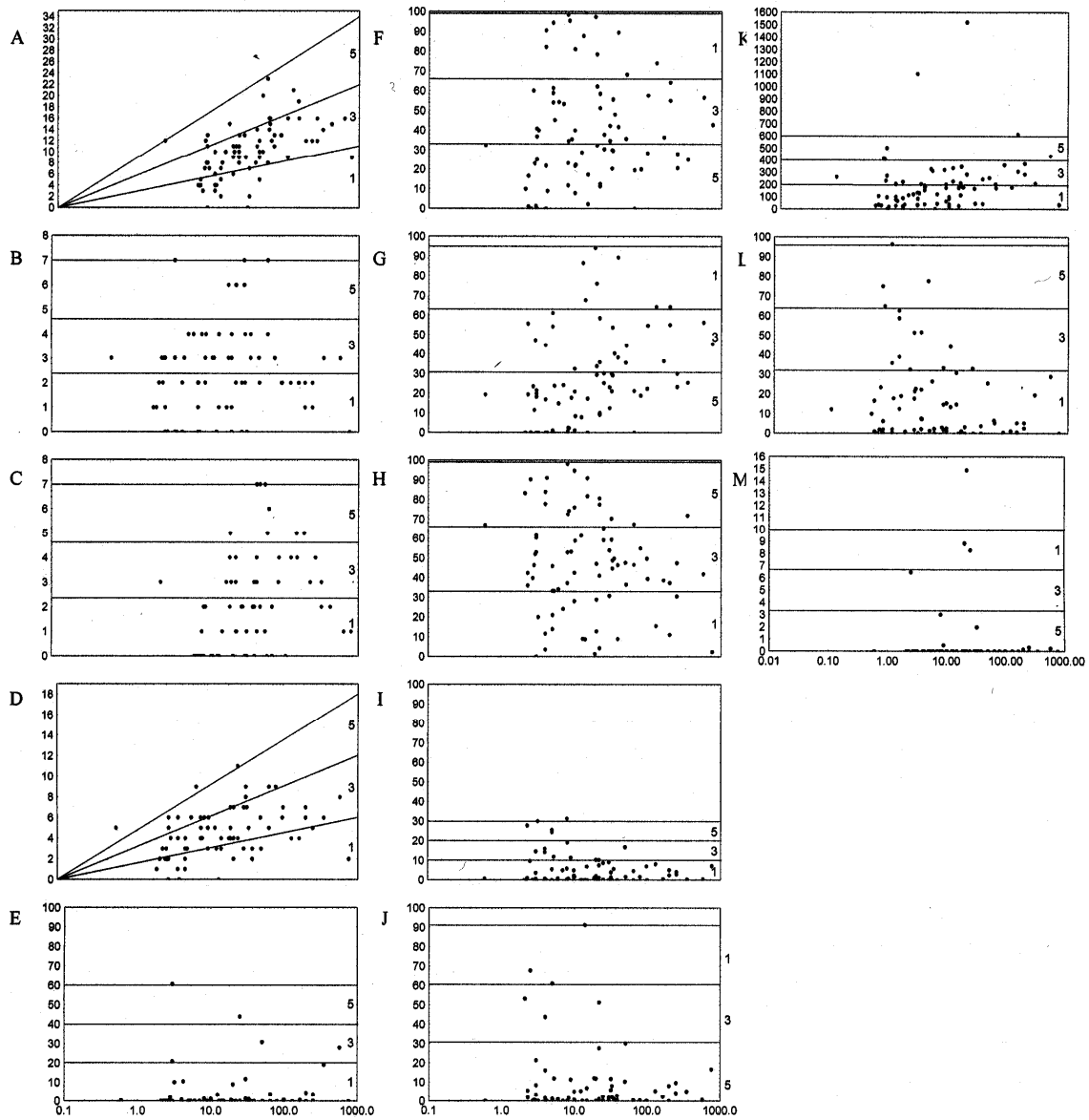
NOTE: Large numbers of a single species can often “swamp” certain metrics making it difficult to assess site status. Therefore, it is essential to remove gizzard shad (*Dorosoma cepedianum*) from this particular set of data prior to IBI calculations (see metric CPUE – gizzard shad). CPUE is based on the relative number of individuals collected using a standard sampling technique removing species designated as tolerant, non-indigenous (including both alien and non-indigenous species), and hybrids. Scoring modification are made when less than 50 (without gizzard shad, non-indigenous species, and hybrids) or 100 (with gizzard shad) individuals are collected. NOTE: Scoring modifications include scoring all percentage metrics “1”.

Lake Michigan Nearshore Metrics

These series of metrics are developed for use on Lake Michigan nearshore habitats and is based on the study by Simon 2004 (see Appendix II). This index can be applied to all Lake Michigan nearshore sites along the Indiana shoreline.

Stream Category	Metric	5	3	1
B	Total number of species	See	Fig A	
B	Number of centrarchid species (Fig B)	≥ 5	3-4	≤ 2
B	Number Great Lake obligate species (Fig C)	≥ 5	3-4	≤ 2
B	Number lake habitat species	See	Fig D	
B	Percent individuals intolerant species (Fig E)	< 20%	20-40%	> 40%
B	Percent individuals tolerant species (Fig F)	≤ 33%	34-66%	≥ 67%
B	Percent individuals as detritivores (Fig G)	≤ 33%	34-66%	≥ 67%
B	Percent individuals as insectivores (Fig H)	≥ 67%	34-66%	≤ 33%
B	Percent individuals as carnivores (Fig I)	> 20%	10-20%	< 10%
B	Percent individuals as exotic or non-native species (Fig J)	≤ 32%	33-61%	≥ 62%
B	Catch Per Unit Effort (=number of individuals) (Fig K)	≥ 401	201-400	≤ 200
B	Percent individuals as phytophils (Fig L)	≥ 67%	34-66%	≤ 33%
B	Percent individuals with DELT anomalies (Fig M)	≤ 3.2%	3.3-6.9%	≥ 7%

NOTE: Large numbers of a single species can often “swamp” certain metrics making it difficult to assess site status. Therefore, it is essential to remove gizzard shad (*Dorosoma cepedianum*) from this particular set of data prior to IBI calculations (see metric CPUE – gizzard shad). Scoring modifications are made when less than 50 (without gizzard shad) or 100 (with gizzard shad) individuals are collected. Scoring modifications include scoring all percentage metrics “1”.



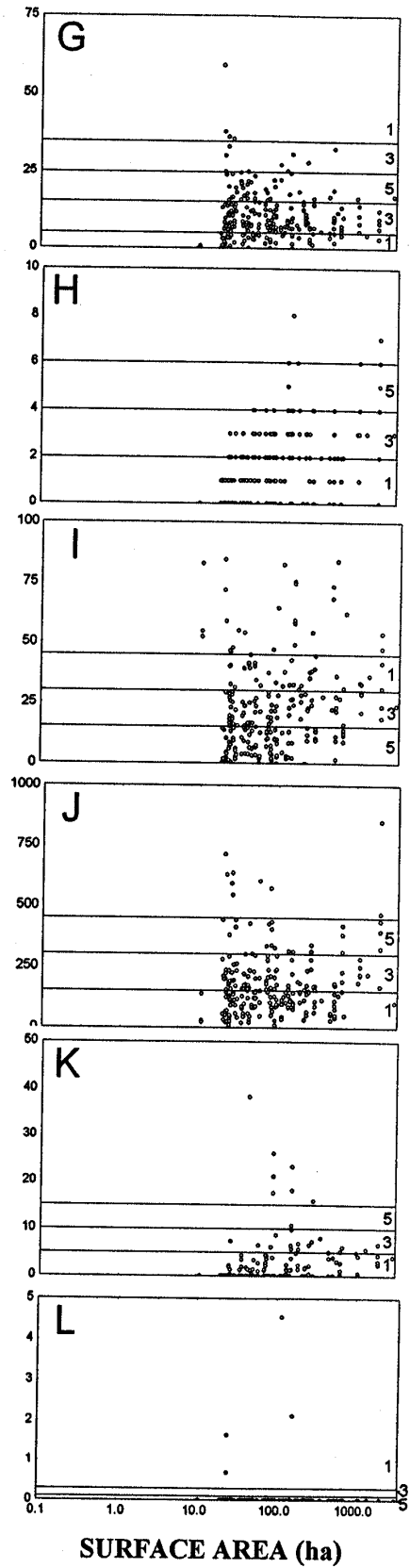
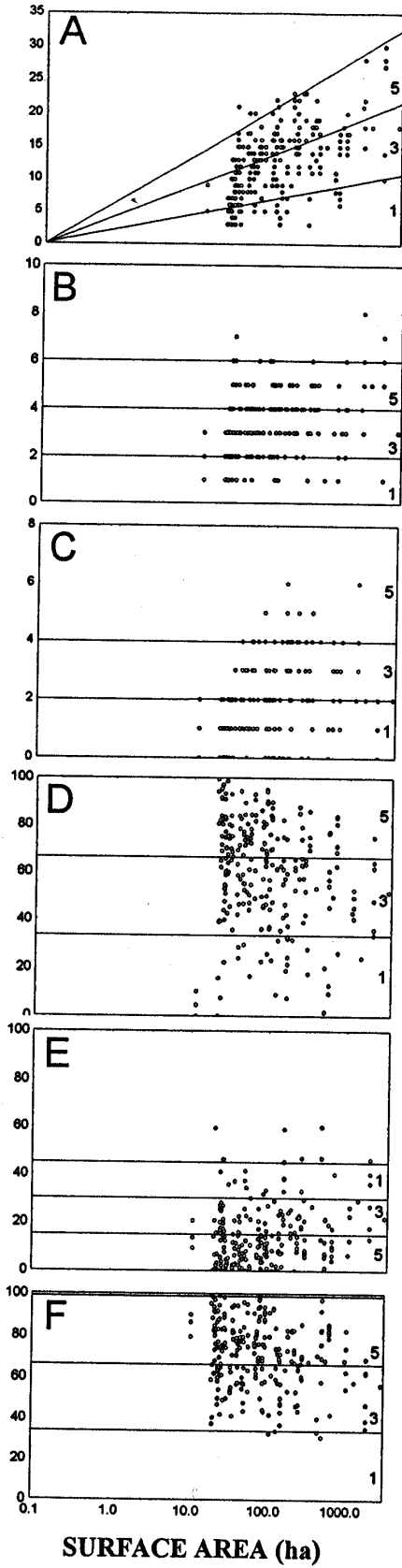
WETTED WETLAND WIDTH (m)

**Natural Lake and Reservoir Metrics
(Central Corn Belt Plain, Northern Indiana Till Plain,
Huron-Erie Lake Plain, Eastern Corn Belt Plain Ecoregions)**

These series of metrics are developed for use on natural lake and reservoir metrics in four ecoregions in northern Indiana. These metrics are based on the study by Simon, 2001. This index can be applied to all lake sites (> 20 ha) in the four Indiana ecoregions.

Stream Category	Metric	5	3	1
B	Total number of species	See	Fig A	
B	Number of centrarchid species (Fig B)	≥ 5	3-4	≤ 2
B	Number of native minnow species (Fig C)	≥ 5	3-4	≤ 2
B	Percent individuals as lake obligate species (Fig D)	≥ 67%	34-66%	≤ 33%
B	Percent individuals as omnivores (Fig E)	< 15%	15-30%	> 30%
B	Percent individuals as insectivores (Fig F)	≥ 67%	33-66%	< 33%
B	Percent individuals as carnivores (Fig G)	>15%- 25%	> 5-15% or >25-≤35%	≤5% or > 35%
B	Number of sensitive species (Fig H)	≥ 5	3-4	≤ 2
B	Percent individuals as tolerant species (Fig I)	< 15%	15-30%	> 30%
B	Catch Per Unit Effort (=number of individuals) (Fig J)	> 300	150-300	<150
B	Percent individuals simple lithophils (Fig K)	>10%	5-10%	<5%
B	Percent individuals DELT anomalies (Fig L)	< 0.1%	0.1-0.3%	> 0.3%

NOTE: Large numbers of a single species can often “swamp” certain metrics making it difficult to assess site status. Therefore, it is essential to remove gizzard shad (*Dorosoma cepedianum*) from this particular set of data prior to IBI calculations (see metric CPUE – gizzard shad). Scoring modifications are made when less than 50 (without gizzard shad) or 100 (with gizzard shad) individuals are collected. Scoring modifications include scoring all percentage metrics “1”.

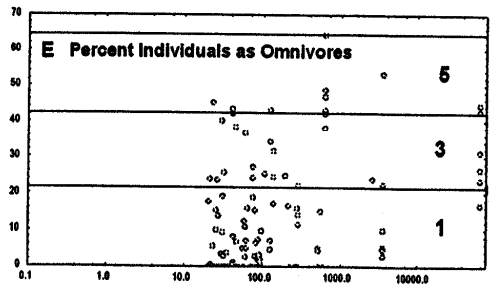
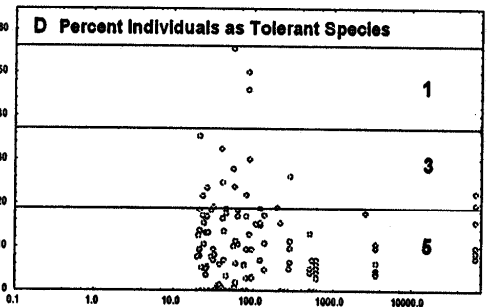
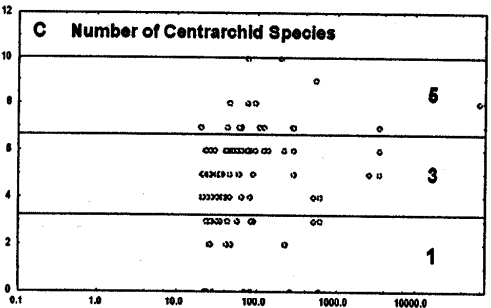
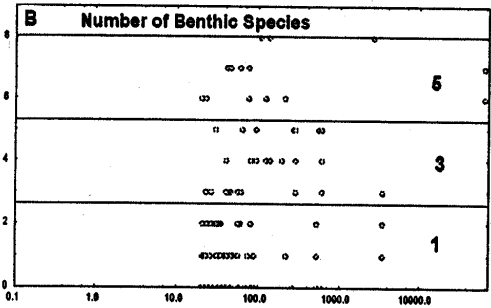
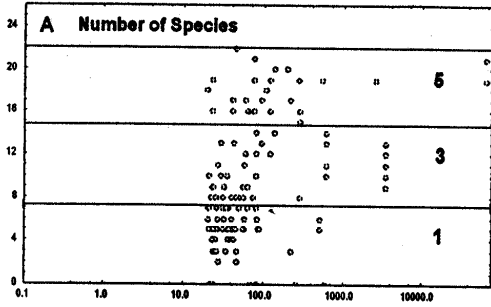


Oxbow Lake and Reservoir Metrics (Interior River Lowland and Interior Plateau)

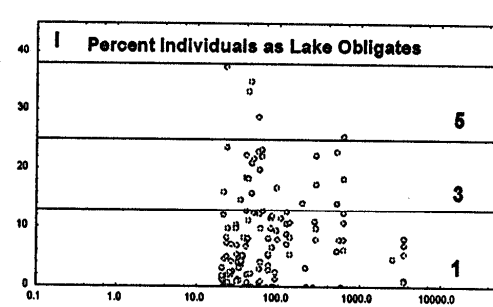
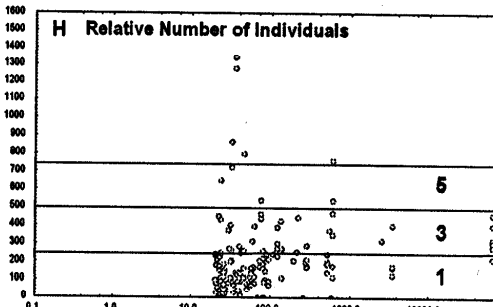
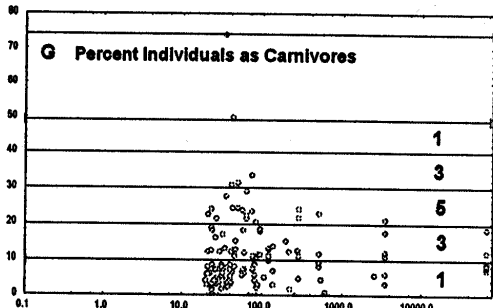
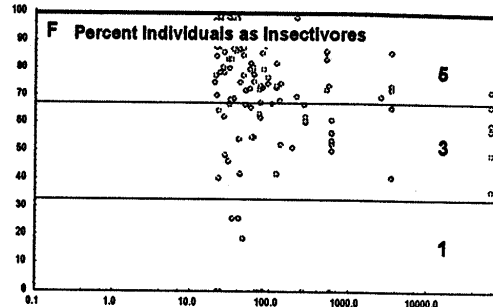
These series of metrics are developed for use on lakes larger than 20 ha surface area and are based on the study by Simon, 2002. This index can be applied to all Interior River Lowland and Interior Plateau lakes within these Ecoregions.

Stream Category	Metric	5	3	1
B	Total number of species (Fig A)	≥ 15	8-14	≤ 7
B	Number of benthic species (Fig B)	≥ 6	3-5	≤ 2
B	Number of centrarchid species (Fig C)	≥ 7	4-6	≤ 3
B	Percent individuals as tolerant species (Fig D)	≤ 19	20-37%	> 37%
B	Percent individuals as detritivores (Fig E)	< 22%	22-42%	> 42%
B	Percent individuals as insectivores (Fig F)	> 66%	33-66%	< 33%
B	Percent individuals as carnivores (Fig G)	> 20- < 30%	10-20 or 30-40%	< 10% or > 40%
B	Catch Per Unit Effort (=number of individuals) (Fig H)	> 500	250-500	< 250
B	Percent individuals as lake obligate species (Fig I)	> 24%	12-24%	< 12%
B	Percent individuals with DELT anomalies	< 0.1%	0.1-0.3%	> 0.3%

NOTE: Large numbers of a single species can often “swamp” certain metrics making it difficult to assess site status. Therefore, it is essential to remove gizzard shad (*Dorosoma cepedianum*) from this particular set of data prior to IBI calculations (see metric CPUE – gizzard shad). Scoring modifications are made when less than 50 (without gizzard shad) or 100 (with gizzard shad) individuals are collected. Scoring modifications include scoring all percentage metrics “1”.



SURFACE AREA (ha)



SURFACE AREA (ha)

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Appendix I

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Appendix II.

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