Human Stressor Index Values for each Aquatic Ecological System in Missouri

	Relative Ranks			
Metric	**1**	**2**	**3**	**4**
Number of Introduced Species	1	2	3	4-5
Percent Urban	0-5	5-10	11-20	>20
Percent Agriculture	0-25	26-50	51-75	>75
Density of Road-Stream Crossings (#/mi²)	0-0.24	0.25-0.49	0.5-0.9	>1
Population Change 1990-2000 (#/mi²)	-42-0	0.1-14	15-45	>45
Degree of Hydrologic Modification and/or Fragmentation by Major Impoundments	1	2 or 3	4 or 5	6
Number of Federally Licensed Dams	0	1-9	10-20	>20
Density of Coal Mines (#/mi²)	0	1-5	6-20	>20
Density of Lead Mines (#/mi²)	0	1-5	6-20	>20
Density of Permitted Discharges (#/mi²)	0	1-5	6-20	>20
Density of Confined Animal Feeding Operations (#/mi²)	0	1-5	5-10	>10

Table 1. The 11 stressor metrics included in the Human Stressor Index (HSI) and the specific criteria used to define the four relative ranking categories for each metric that were used to calculate the HSI for each Aquatic Ecological System.

Description:

There are a multitude of stressors that negatively affect the ecological integrity of riverine ecosystems (Allan and Flecker 1993; Richter et al. 1997). The first step in any effort to account for anthropogenic stressors is developing a list of candidate causes (U.S. EPA 2000). Working in consultation with a team of aquatic resource professionals, a list of the principal human activities known to affect the ecological integrity of streams in Missouri was generated. Then the best available (i.e., highest resolution and most recent) geospatial data that could be found for each of these threats was assembled. Fortunately, and somewhat surprisingly, data were available for most stressors. However, for some, such as channelized stream segments, there were no available geospatial data, and efforts to develop a coverage of such segments using a sinuosity index proved ineffective. Most of the geospatial data were acquired from the U.S. EPA and the Missouri Departments of Conservation and Natural Resources.

We initially generated statistics for 65 individual human threats (e.g., percent urban, lead mine density, degree of fragmentation) for each Aquatic Ecological System in Missouri. We then used correlation analyses to reduce this overall set of metrics into a final set of 11, relatively uncorrelated, measures of human disturbance (Table 1). Relativized rankings (range 1 to 4) were then developed for each of these 11 metrics (Table 1). A rank of 1 is indicative of relatively low disturbance for that particular metric, while a rank of 4 indicates a relatively high level of disturbance. These rankings were based on information contained within the literature or simply quartiles when no empirical evidence on thresholds was available. For instance, rankings for percent urban were; 1: 0-5%, 2: 6-10%, 3: 11-20%, and 4: >20%, were based on the results of various studies that have examined the effects of urban land cover on the ecological integrity of stream ecosystems (Klein 1979; Osborne and Wiley 1988; Limburg et al. 1990; Booth 1991; Weaver and Garmen 1994; Booth and Jackson 1997; Wang et al. 2000). However, existing research for percent agriculture has not identified clear thresholds, suggesting that there is a more or less continual decline in ecological integrity with each added percentage of agriculture in the watershed. For this measure of human threat we simply used quartiles, 1: 0-25%, 2: 26-50%, 3: 51-75%, and 4: >75%.

The relativized rankings for each of these 11 metrics were then combined into a three number Human Stressor Index (HSI). The first number reflects the highest ranking across all 11 metrics (range 1 to 4) (Inset Map A and B). The last two numbers reflect the sum of the 11 metrics (range 11 to 44) (Inset Map C). This index allows you to evaluate both individual and cumulative impacts. For instance, a value of 418, indicates relatively low cumulative impacts (i.e., last two digits = 18 out of a possible 44), however, the first number is a 4, which indicates that one of the stressors is relatively high and potentially acting as a major human disturbance within the ecosystem.

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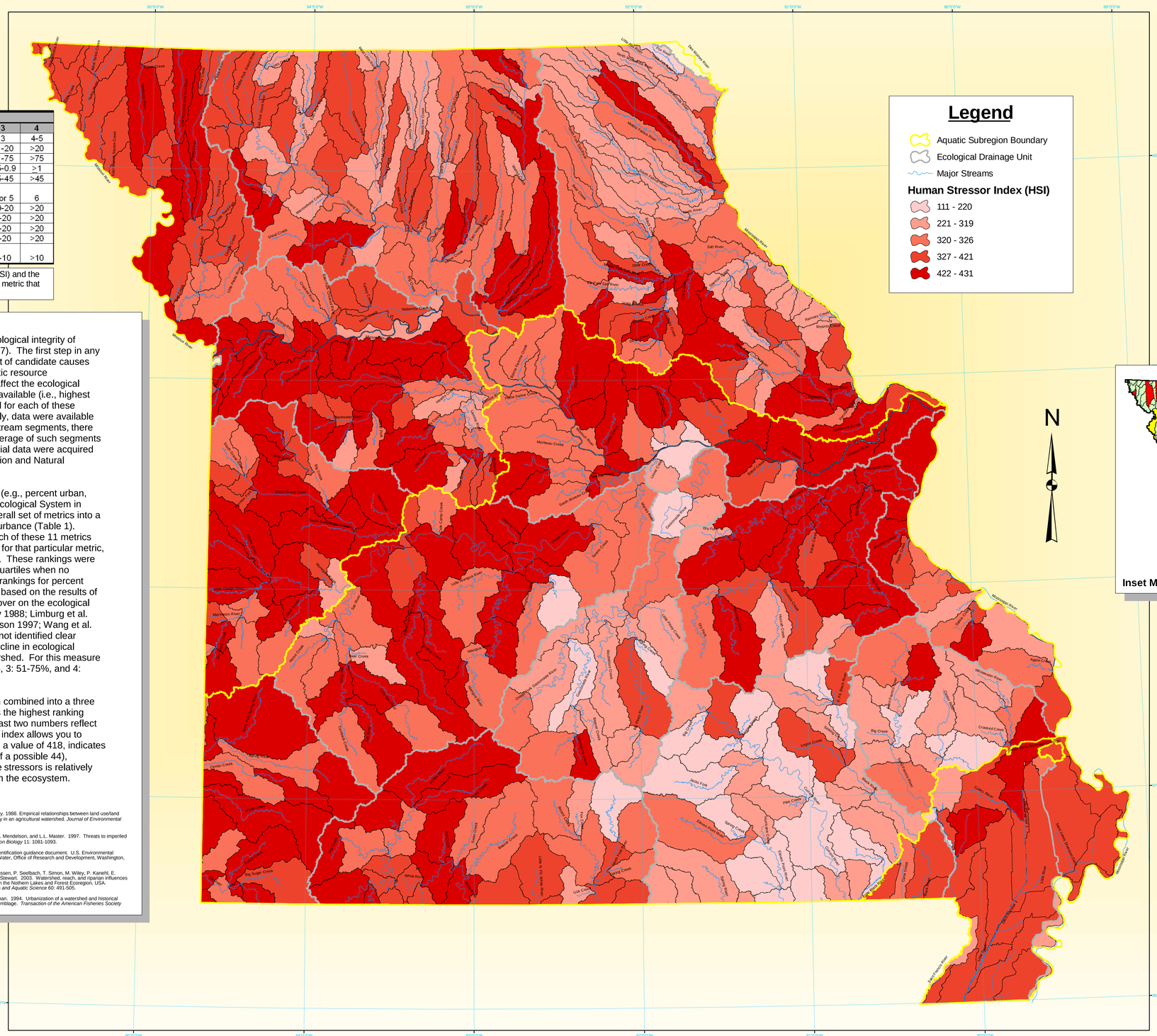
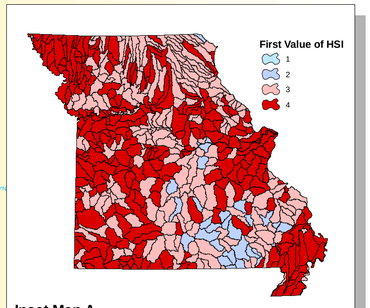
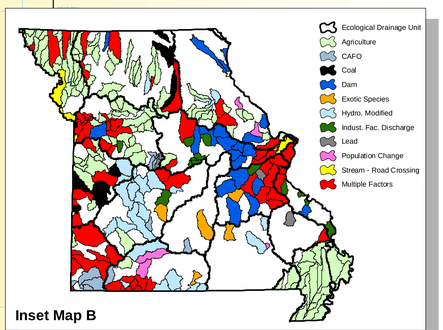




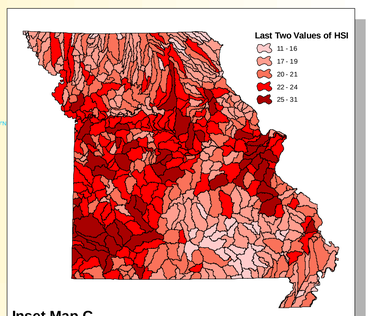
Inset Map A

Map showing the first value in the Human Stressor Index for each of the Aquatic Ecological Systems in Missouri. A value of 1 indicates a relatively low level of human disturbance, while a value of 4 indicates a relatively high level of disturbance. None of the AESs polygons received a value of 1.



Inset Map B

Map showing which Aquatic Ecological Systems received a value of 4 for the first value in the Human Stressor Index, further broken down according to which specific human stressor was responsible for this high value.



Inset Map C

Map showing the last two values in the Human Stressor Index for each of the Aquatic Ecological Systems in Missouri. A value of 11 indicates an extremely low level of cumulative impact. The highest possible value in theory is a 44, however, because some of the 11 metrics used in the index are mutually exclusive (e.g., % urban and %agriculture), the highest obtainable value is unknown. The highest value in Missouri was 31. Basically, the higher the value for these last two digits, the higher degree of cumulative disturbance.

Annis G. M., S. P. Sowa, M. E. Morey, and D. D. Diamond. 2005. Human Stressor Index Values for each Aquatic Ecological System in Missouri. MoRAP Map Series MS-2005-013.

Cartographer: Gust M. Annis

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