Kentucky Index of Biotic Integrity (KIBI) User Overview

In the past three years, the Kentucky Division of Water has reevaluated the structure and application of the Index of Biotic Integrity (IBI) (KDOW 1997) based on additional data collection and analysis. The updated IBI, Kentucky Index of Biotic Integrity (KIBI), is comprised of six metrics for headwater streams and six metrics for wadeable streams. KDOW (2002) had classified streams into headwater streams (<8 mi^2) and wadeable streams (>12 mi^2). A "gray" area between 8-12 mi^2 existed and best professional judgment was used to classify streams into the respective class. Upon further analysis and observation, we now classify headwater streams as <6 mi^2, wadeable streams as >10 mi^2, and the gray area as 6-10 mi^2. The seven metrics retained for the Kentucky Index of Biotic Integrity (KIBI) were Native Richness (NAT), Darter, Madtom, and Sculpin Richness (DMS), Intolerant Richness (INT), Simple Lithophilic Spawners (SL), Relative Abundance of Insectivorous Individuals, excluding Tolerant Individuals (%INSCT), Relative Abundance of Tolerant Individuals (%TOL), and Relative Abundance of Facultative Headwater Individuals (%FHW). NAT is used only in wadeable streams and is replaced by %FHW in headwater streams. These metrics have undergone a screening process to test for score range, variability, repeatability, responsiveness to stressors, and discrimination between high quality and low quality stream reaches. The reference dataset (i.e. minimally impacted stream reaches) was used to calibrate each metric for drainage area influence using a combination of linear and binomial regression equations (after Urquhart 1982 and McCormick et al. 2001). The "Reference Criteria" were established from the 95th %ile of the reference dataset. For stream classification purposes, "ichthyoregions" were set up to provide for better interpretation of results. This classification scheme replaces the original framework that relied on Level III Ecoregions and accounts for the wide variability found in the Commonwealth's physiographic regions and river basins. Criteria with narrative classifications for each ichthyoregion have been established using the reference data set (see KIBI report for further details).

A template of the KIBI was created to simplify calculations and ensure precision among user analysis. The user will find multiple sheets in the KIBI template. The first sheet (KIBI calculation outline) documents the calculation process; scoring rules; and the 7 metrics with the respective equations, calibration constants, and 95th %iles. The Ichthyoregion Map sheet shows the 6 ichthyoregions for the state and was derived from the Level IV Ecoregion map (Woods et al. 2002), physiographic regions, and river basins. The third sheet is a map of the Level IV Ecoregions. The Criteria sheet provides criteria and narrative classifications (Good, Fair, etc…) for each Ichthyoregion. Sampling data entry and output is located on the KIBI sheet. The orange cells in the KIBI sheet represent site information and the user can modify the cells/columns to fit individual project objectives. The blue cells (10 fields) are required data entry cells (actual metric values) for the KIBI. Blue cells/columns are for data entry only, do not add or delete. The yellow cells will be the calculated KIBI output for each metric and the final KIBI score. The yellow cells/columns are not to be modified. The Calculation Step sheet is provided for the user to better understand the process of using the equations, which normalizes each metric to eliminate the drainage area effect, this sheet is not to be modified. The KIBI sheet and the Calculation Step sheet are currently set up for 200 sample events. To obtain more sample events, the user simply needs to drag columns S-AN and columns B-AP further down in their respective KIBI and Calculation Step sheets or make a new copy of the KIBI template.

To use the template, following these directions. First, enter data in the KIBI sheet. Orange cells can be deleted or expanded based on project objectives. The required raw data

(catchment area (mi.^{2}), total number of individuals (TNI), NAT, DMS, INT, SL, %INSCT, %TOL, %FHW) are entered under the blue cells. As data are entered, the yellow cells provide the output for the respective blue cells. Once all raw data are entered a final KIBI score is provided in the green cell. This value will range from 0-100. That value is then used to determine the narrative classification for the respective ichthyoregion found on the Criteria sheet. Determination of an ichthyoregion is provided using the Ichthyoregion Map and the Level IV Ecoregion Map. If the user wants to become more familiar with the calculation process, a KIBI outline and the actual calculation steps can be found on their respective sheets.

The KIBI is a model for evaluating stream health based on fish communities. Although 100% accuracy is not expected, the KIBI has been tested and an acceptable discrimination efficiency of roughly 80% has been obtained. To overcome the inherent flaws of a biological model and achieve an acceptable and reliable level of precision and accuracy, the user must follow the sampling protocol as outlined in KDOW (2002). Also, the user should be familiar with the numerous variables (e.g., stream flow, water clarity, time of day, season) in the project area, including knowledge of the watershed landuse (e.g., forest, residential, agricultural), and other practices upstream of and around the immediate area of the site. Perceived fish community expectations may not be met if simple natural and anthropogenic variables have been overlooked. On the other hand, expectations may be exceeded due to unknown causes; therefore, scrutiny of all possible variables will help in the explanation of a given KIBI score. In addition, when KIBI scores fall close (± 2 points) to the narrative classification thresholds it is recommended the classification contain both categories (e.g., Good/Fair). Occasionally, additional chemical or biological data (diatoms or macroinvertebrates), or an additional fish sample may be needed to help define the condition more clearly.

Certain outside influences limit the KIBI. The most prominent limitation is assessing sites that approach the extremes of the recommended drainage areas (2-300 mi^2), where the reliability and consistency of the KIBI becomes more uncertain. Therefore, the user needs to be aware of this factor, the result may be related to catchment area influence instead of an anthropogenic factor. In addition, streams with small drainage areas (<3 mi^2) tend to have fish communities dominated by tolerant species and have naturally low abundances and richness. Therefore, these communities may show little discrimination between high and low quality streams. Streams with very large drainage areas (250-300 mi^2) frequently have complex habitats, often with large deep sections (>2 m) of pool and run, thereby creating difficulties in sampling efficiency. Consequently, reliability and consistency is compromised. Overall, when the sampling protocol is followed, the KIBI is reliable within the recommended drainage areas, as long as the user is aware of all of the possible variables encountered in sampling. To obtain the sampling protocol, fish species classifications, KIBI scoring template, and other fish community information, refer to *Methods for Assessing Biological Integrity of Surface Waters in Kentucky*, (http://www.water.ky.gov/sw/swmonitor/sop/) (KDOW 2002) or contact KDOW for questions, concerns, and/or a copy of the manual on CD-ROM.

Literature Cited

Kentucky Division of Water (KDOW). 1997. Reference reach fish community report. Kentucky Department for Environmental Protection, Division of Water, Frankfort, Kentucky.

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