When developing the IBI, steps included compiling and preparing data, defining site disturbance categories and criteria, performing classification analyses, scoring and selecting metrics, compiling index alternatives, evaluating performance, and selecting and validating the final IBI. The top candidate IBIs had high discrimination efficiency (minimal error when discriminating between reference and stressed sites) and metrics that were familiar to the workgroup members, ecologically meaningful, and diverse in response mechanisms. The workgroup also wanted an IBI that performed well with different subsample sizes (300-, 200-, and 100-organism samples) to simplify application across the region.

The input metrics for the final IBI are listed in Table ES-1. The IBI had low error in the separation of index values in least-disturbed reference and most disturbed stressed sites (Index DE: 97.6%; higher discrimination efficiency indicates that a greater percentage of stressed index values are outside of the reference inter-quartile range) (Figure ES-1). As an alternate measure of performance, the relationship between IBI scores and four measures of disturbance (overall watershed condition at local and total watershed-scales, percent urban, and percent agriculture) were also evaluated. Associations with all but the percent agriculture metric were fairly strong (Spearman correlation coefficients ≥ |0.53|) and in keeping with the expected direction of response. Most sites had low percent agriculture, which likely accounts for the weak correlation between the IBI and percent agriculture.

To validate the IBI, relationships between IBI scores and stressor indicators that were not used in defining the IBI calibration stressor gradient were evaluated. The independent stressor variables included habitat scores, dissolved oxygen (DO), conductivity, and percent forest cover in the watershed. Some natural (non-stressor) variables were also compared, including acidity (pH), substrate, and temperature. Results confirmed that the IBI was indeed responsive along the stressor gradient.

As a final step, exploratory analyses were performed to inform potential numeric thresholds for four biological condition categories (Exceptional Condition, Satisfactory Condition, Moderately Degraded, and Severely Degraded). The thresholds proposed in this report are preliminary and subject to further review, refinement, and approval by MassDEP and RI DEM before they are applicable in biological assessment programs. The new low gradient IBI and preliminary thresholds improve the ability of MassDEP and RI DEM to identify degradation in biological integrity and water quality and will be re-evaluated in coming years as they obtain and analyze more low gradient samples.

Table ES-1. Metrics included in the low gradient IBI.

Metric (abbrev)	Response to increasing stress	Scoring formula
% Plecoptera, Odonata, Ephemeroptera, and Trichoptera (POET) taxa (pt_POET)	Decrease	100*(metric)/40
% Predator taxa (pt_ffg_pred)	Decrease	100*(metric)/32
% Non-insect taxa (pt_NonIns)	Increase	100*(46-metric)/42
% Odonata, Ephemeroptera, and Trichoptera (OET) individuals (pi_OET)	Decrease	100*(metric)/49
% Tolerant taxa (pt_tv_toler)	Increase	100*(36-metric)/33
% Semivoltine taxa (pt_volt_semi)	Decrease	100*(metric)/12

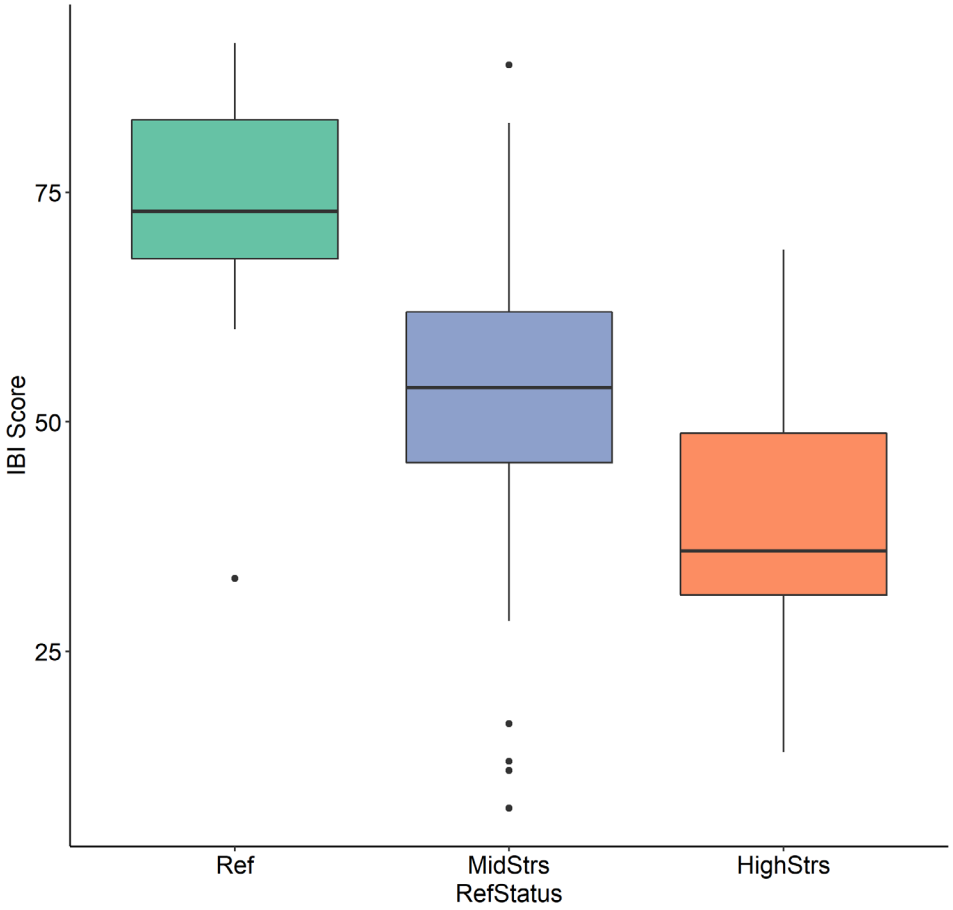

Figure ES-1. Distributions of low gradient IBI values in reference (Ref), intermediate (MidStrs), and stressed (HighStrs) sites.