



CT DEEP'S 'TREASURE HUNT' FOR HEALTHY WATERS

Utilization of Macroinvertebrate-Based Volunteer Monitoring to Support Assessment of High Quality Streams in Connecticut



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ABSTRACT

The Connecticut Department of Environmental Protection established a volunteer stream monitoring program in 1999. The program trains volunteers to sample riffle stream habitat for macroinvertebrates. Detailed taxonomic identification is not emphasized; rather volunteers are trained to look for a particular subset of macroinvertebrates, each easily recognized by appearance and/or behavior. These target taxa are grouped into the categories 'least', 'moderately,' and 'most wanted' based on relative tolerance to pollution. Analysis of statewide macroinvertebrate records indicates the presence of four or more 'most wanted' taxa is consistent with a passing score for State stream health assessments for the Clean Water Act. Since the program's inception, volunteers have monitored more than 300 waterbodies, with approximately 25% of samples yielding a 'most wanted' taxa count of four or more. Recent incorporation of a GIS model that uses landscape characteristics to predict stream health has further improved program efficiency, with the continued goal of increasing miles of assessed healthy streams in Connecticut.

INTRODUCTION

The Riffle Bioassessment by Volunteers (RBV) protocol was developed by CT DEEP in 1999 to provide community groups with a relatively fast, low-technology water quality monitoring method. RBV has since grown into the most popular volunteer water quality monitoring program in the State. Several hundred RBV volunteers participate, providing DEEP with new water quality monitoring data for approximately 100 river and stream segments annually. (Fig 1)

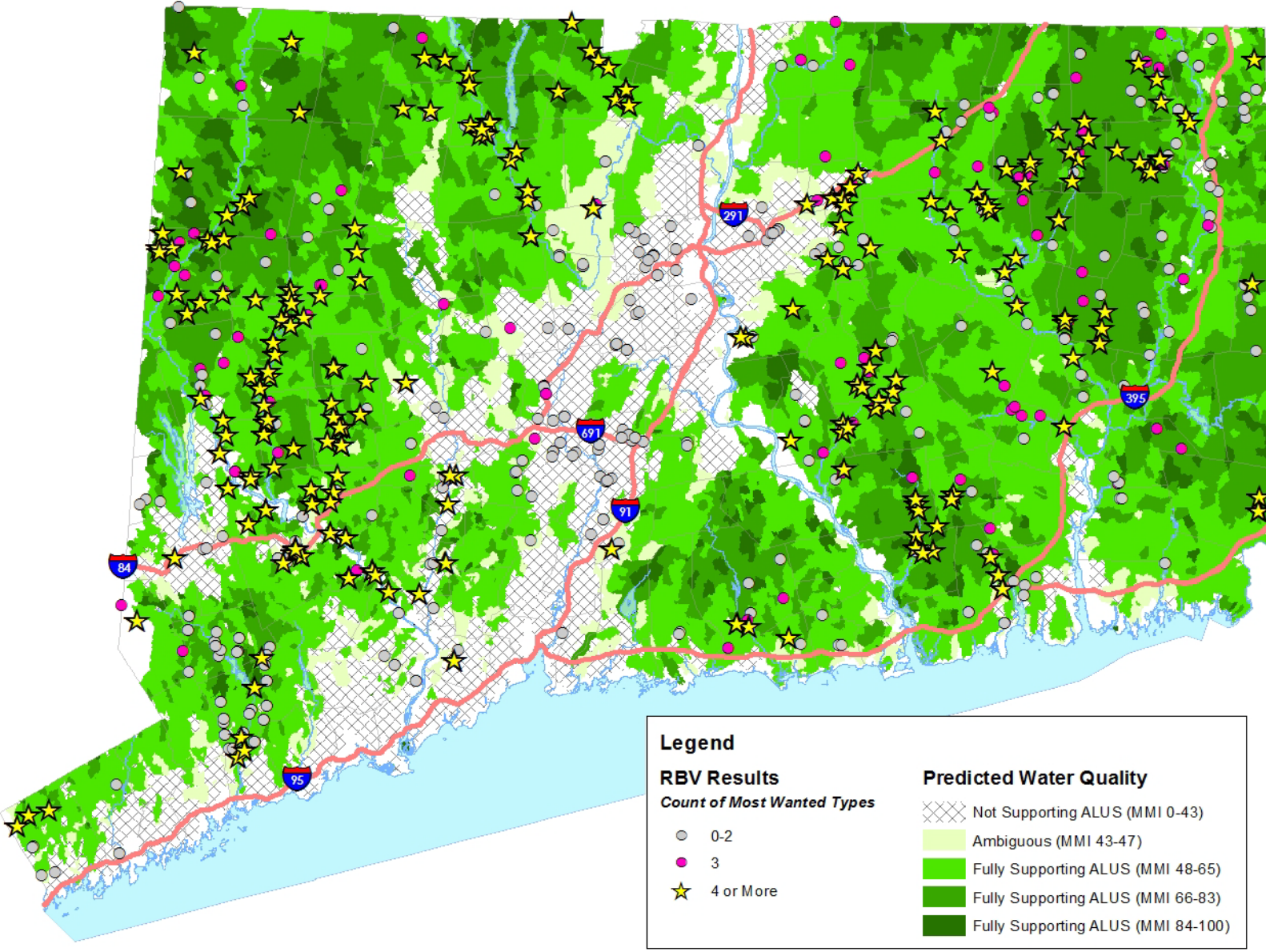


Fig 1. RBV Program monitoring locations 1999-2015. Yellow stars represent voucher submissions containing four or more Most Wanted types. Green shading indicates predicted water quality based upon the CT Macroinvertebrate Multimetric Index (CT MMI) model. CT MMI scores range from 0-100, with 48 indicative of full aquatic life use support.

The RBV program goal is to document streams with excellent water quality. The program is therefore particularly well suited to address gaps in water quality information for smaller Connecticut streams. Approximately 74% of all streams and rivers in Connecticut are small, headwater streams. A recently developed Connecticut water quality prediction model, the CT MMI model,¹ indicates that the highest water quality in the State is most likely located in these relatively undeveloped, and, to-date, relatively unmonitored small watersheds. Consequently, in 2012, the RBV program was 're-branded' as CTDEEP's 'Treasure Hunt' for the State's healthiest streams. Using the CT MMI model as a site selection tool, volunteers are now directed to focus efforts on previously unassessed, small watersheds, with predicted high water quality.

MATERIAL AND METHODS

The RBV program emphasizes a set of target macroinvertebrate taxa (Fig 2). These taxa are easily recognizable due to appearance or behavior and have a statewide distribution. The taxa are grouped into "Most Wanted," "Moderately Wanted," and "Least Wanted" categories based upon their relative sensitivity to pollution. Least Wanted taxa are pollution tolerant (i.e. least sensitive), while Most Wanted taxa are very pollution intolerant (i.e. most sensitive).

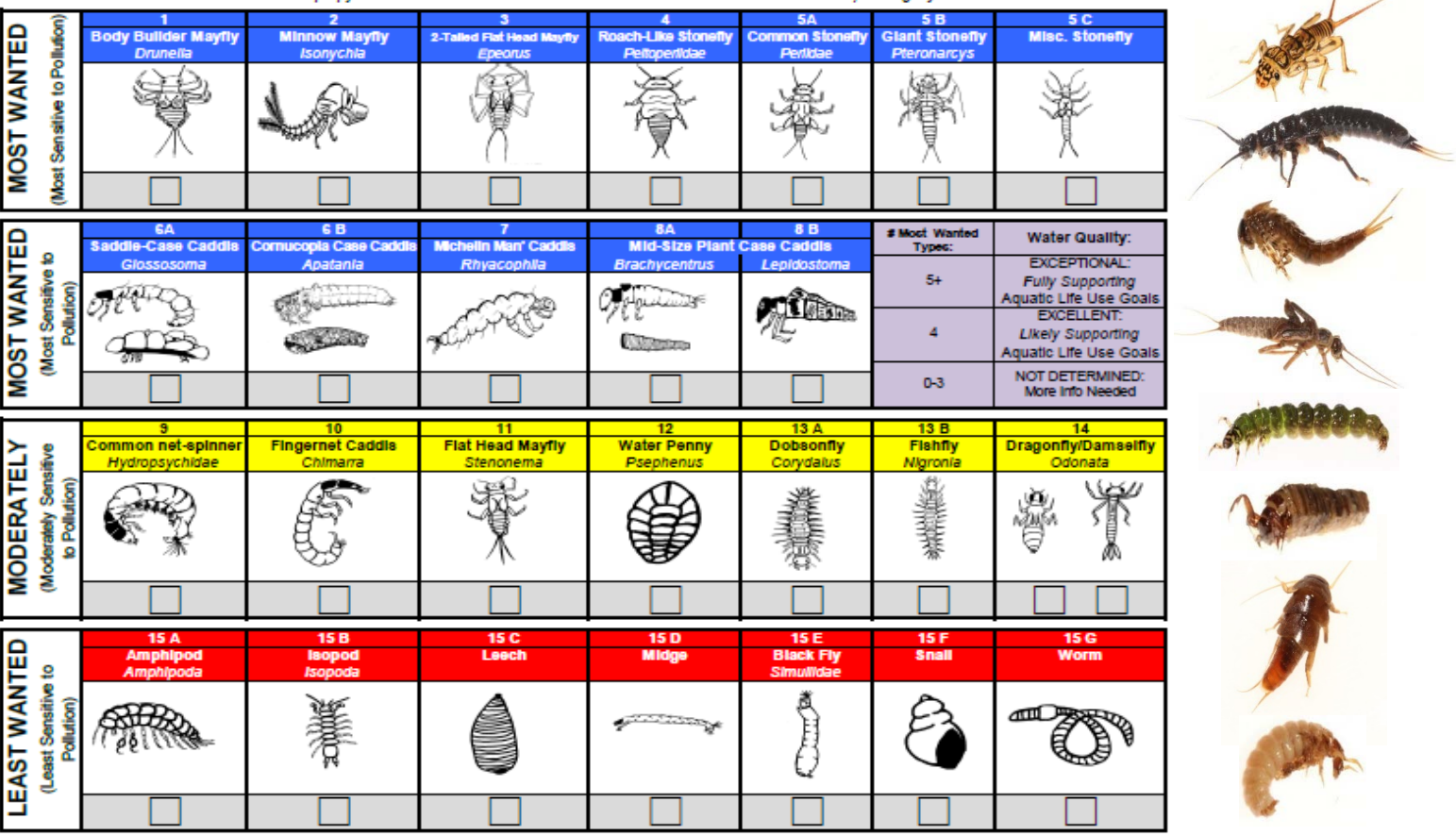


Fig 2. The RBV taxa. CT DEEP considers four or more "Most Wanted" taxa (blue panels, photographs at right) in a sample to be a reliable indicator of excellent water quality.

The RBV field protocol (Fig 3) is a modified version of the CT DEEP Ambient Monitoring Program's benthic macroinvertebrate collection protocol². During the fall, volunteers use a kicknet to collect a macroinvertebrate sample from 1m² of riffle habitat. The sample is then picked and 'sorted' in the field, with similar looking organisms grouped using ice cube trays. Preliminary taxa identifications are made, using RBV program identification materials, and recorded on the field data sheet. A voucher collection of organisms is then compiled by preserving several voucher specimens of each macroinvertebrate type marked present on the data sheet. At the conclusion of the event, preserved vouchers, datasheets, and site photographs are submitted to DEEP for review and taxa identification.



Fig 3. RBV field protocols include collection (top left), sorting (bottom left), field identification (center top and bottom), and voucher preservation (top right). Preserved voucher collections, field data sheets, and site photographs are submitted to CT DEEP for review (bottom right).

Beginning in 2013, volunteer training started placing greater emphasis on site selection. RBV sampling locations continue to be restricted to high gradient streams with riffle habitat. In addition, volunteers are now encouraged to target monitoring locations that also meet the following criteria:

- Upstream watershed area less than 15.0 mi²
- Predicted high water quality (e.g. CT MMI model score >48)
- Not currently impaired as "not supporting" aquatic life use

RESULTS

CT DEEP's Ambient Monitoring Program conducts benthic monitoring at 100-200 stations annually. Results are used to generate a composite Macroinvertebrate Multimetric Index (CT MMI) for each station. A CT MMI score of 48 or greater is considered sufficient evidence to list the corresponding stream segment as fully supporting aquatic life use (ALU). Retroactive analysis of ambient monitoring data between 1999-2011 (n=1,152) compared the CT MMI score to the number of most wanted RBV taxa present in the sample (Fig 4). 99.9% of all samples containing 4 most wanted RBV taxa were characterized by a CT MMI score of 48 or greater, demonstrating that the RBV method is a reliable screening method for identifying stations with excellent water quality.

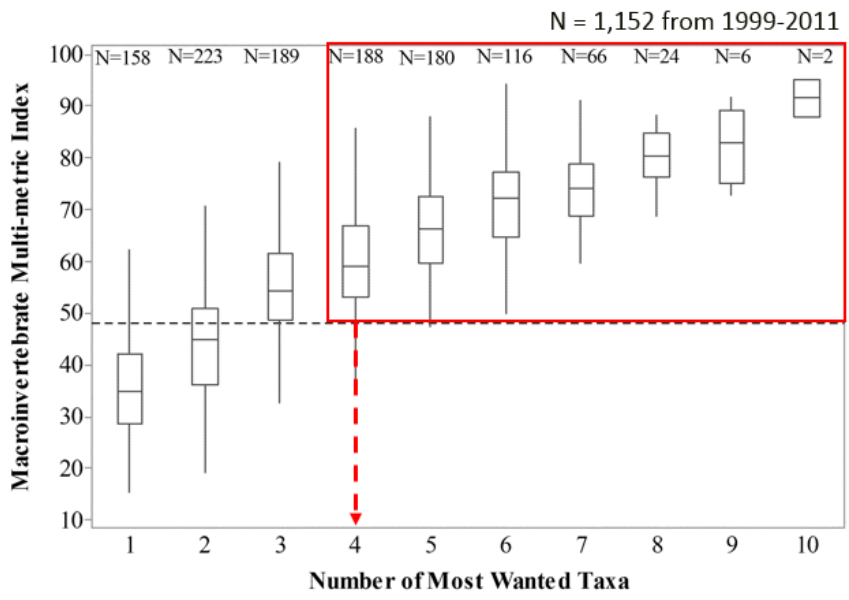


Fig 4 (left). CT MMI scores for 1999-2011 CT DEEP ambient monitoring data (n=1152). Boxplots indicate CT MMI scores grouped by the number of Most Wanted RBV types that were present in the sub-sample. A CT MMI score of 48 or greater is indicative of full aquatic life use support.

Table 1 (below). RBV data contribution to biennial water quality assessments published in the Connecticut Integrated Water Quality Report.

	IWQR Reporting Cycle							
Data Collection Period	2002	2004	2006	2008	2010	2012	2014	2016
1999-2000	1999-2000	2001-2002	2003-2004	2005-2006	2007-2008	2009-2010	2011-2012	2013-2014
# RBV Samples Submitted*	35	59	85	183	204	240	257	234
# Fall RBV Samples with 4+ 'Most Wanted' RBV Taxa	11	26	26	27	28	50	43	71
% Samples with 4+ 'Most Wanted' RBV Taxa	31.4%	44.1%	30.2%	14.8%	13.7%	20.8%	16.7%	30.3%

The RBV program has generated 1,297 vouchers from 536 stations on 289 waterbodies. Initial program ROI was high; 35% of 1999-2004 vouchers yielded a 'four or more' result (Table 1). As the program matured, ROI declined despite greatly increased voucher submissions; only 17% of 2005-2012 vouchers contributed to ALU support listings. To improve efficiently, in 2013, DEEP introduced more stringent monitoring site requirements and promoted the use of the CT MMI model as a site selection tool. The revision has resulted in measurable program improvements. Monitoring of new stations has increased and ROI has improved: 30% of 2013-2014 vouchers yielded a 'four or more' result. 2014 results were the best in the past 15 years of the RBV Program's history.

CONCLUSION

The protection of small, headwater streams is critical to maintaining clean water and healthy aquatic ecosystems. Combining the states' predictive modeling capabilities with its most popular volunteer water quality monitoring program has led to a demonstrable increase in the documentation and assessment of 'healthy' stream miles in Connecticut.

ACKNOWLEDGEMENTS

Macroinvertebrate photos courtesy of Jake Renkert/The Marvelwood School. The RBV Program would not be possible without the dedication of the Local RBV Program Coordinators, Certified RBV Trainers, and volunteers. Thank you!

REFERENCES

¹Bellucci, C.J., M.E. Becker, M. Beauchene, and L. Dunbar. 2013. Classifying the health of Connecticut streams using benthic macroinvertebrates with implications for water management. Environmental Management 51: 1274-1283.
²Connecticut Department of Energy and Environmental Protection. 2013. Ambient Biological Monitoring: Benthic Macroinvertebrate Samples – Field and Laboratory Procedures. Connecticut Department of Energy and Environmental Protection, Bureau of Water Protection and Land Reuse, Planning and Standards Division, Hartford, CT.