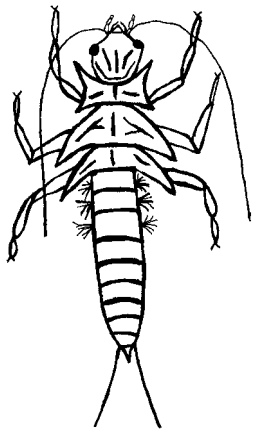
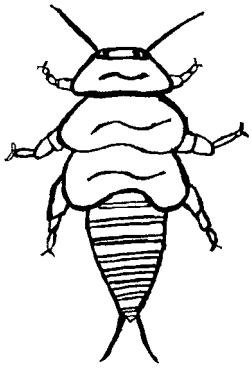
Rapid Bioassessment in Wadeable Streams and Rivers By Volunteer Monitors

Year 2003 Summary Report





State of Connecticut
Department of Environmental Protection
Bureau of Water Management
Planning and Standards Division
Ambient Monitoring Program
Arthur J. Rocque, Jr., Commissioner

Rapid Bioassessment in Wadeable Streams and Rivers By Volunteer Monitors

Year 2003 Summary Report
By Mike Beauchene
March 2004

Executive Summary: Rapid Bioassessment in Wadeable Streams and Rivers by Volunteer Monitors (**RBV**), http://www.dep.state.ct.us/wtr/volunmon/volopp.htm , (Appendix A), is a macroinvertebrate collection protocol developed by the Connecticut Department of Environmental Protection, Bureau of Water Management, Ambient Monitoring Program (herein referred to as DEP). The goal of RBV is to provide volunteer monitoring programs with a quick, efficient, and standardized methodology for the collection of macroinvertebrate community data from wadeable streams. This data can be used to screen for either very high or very low water quality and augment monitoring conducted by DEP. The DEP has 20 sets of equipment available for short-term loan to groups who have sponsored at least 1-RBV training session and intend to submit samples to the DEP.

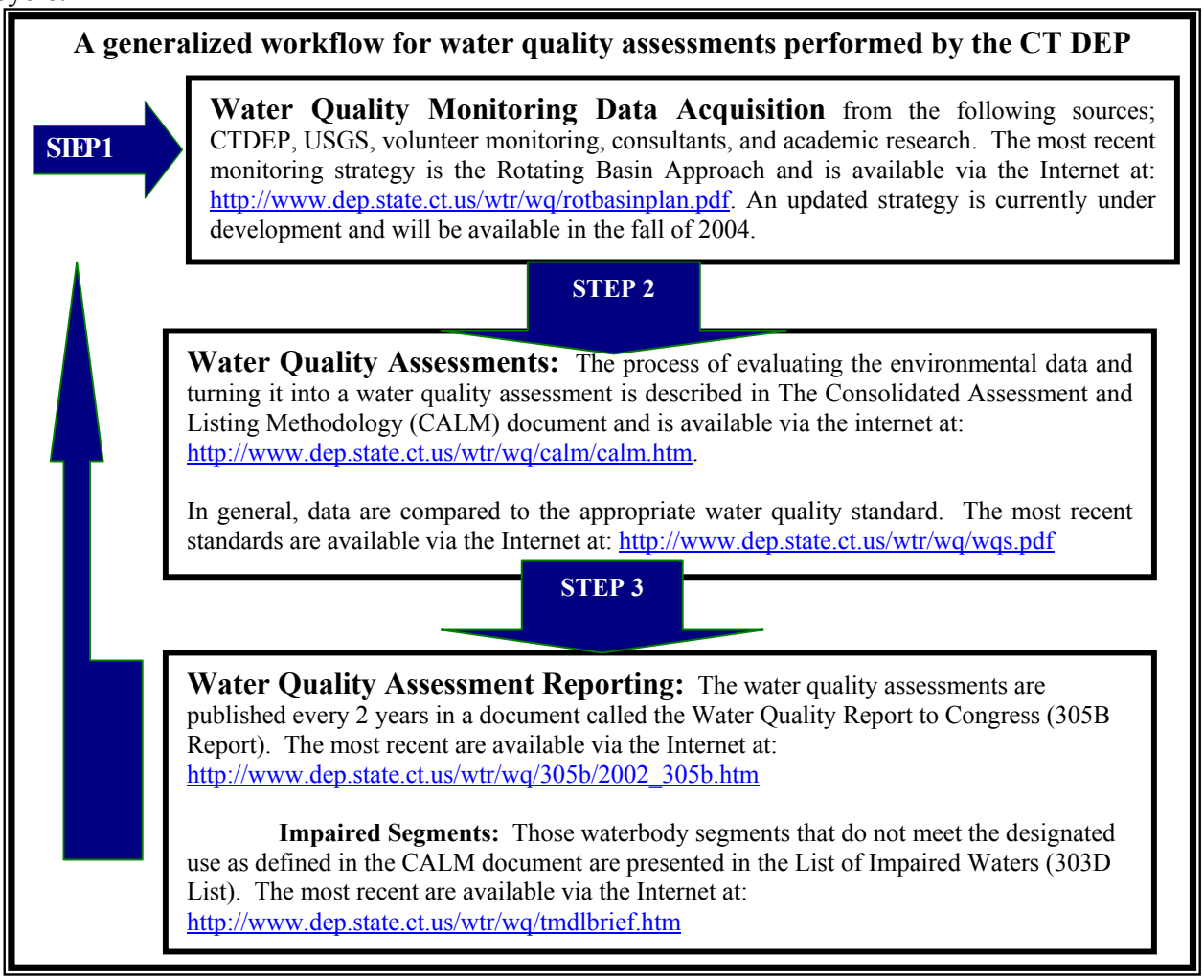
During the fourth official sampling season (fall 2003) 14 volunteer groups collected 31 macroinvertebrate samples on 26 different waterbodies across Connecticut. The number of "most wanted" types ranged from a high of 6 at Gages Brook, Tolland, to a low of 0 at Hemingway Creek, New Haven. In addition to Gages Brook, samples from 3 other river segments indicated full support of aquatic life use. Fourteen of 31 samples indicated excellent water quality, 10 very good water quality, and 6 fair/good water quality, and only 1 poor water quality. To obtain additional information about RBV or to become involved, please contact Mike Beauchene, volunteer monitoring coordinator, by phone (860) 424-4185 or email mike.beauchene@po.state.ct.us

Acknowledgements: This fall the weather was hit or mist, mostly mist, it seemed most people dealt with gray, gloomy, cool conditions and not the colorful, pleasant, warm, conditions typical of October. Without participation from the following this program would not be possible: **Chaplin Conservation Commission, Connecticut Audubon Center at Glastonbury, Connecticut River Watch (Bolton Conservation Commission, Eightmile River Watershed and Hockanum River Watershed Association), Enfield Conservation and Inland Wetlands Commissions, Farmington River Watershed Association, Manchester Community Technical College Science Club, Mansfield Conservation Commission, Naugatuck River Steward and Trout Unlimited, Naubesatuck Watershed Council, New Haven Land Trust via the Sound School, Salmon Brook Watershed Association, UCONN soil and water conservation society**, and Willimantic Water Works. Partial funding for this program was obtained from the USEPA through a CT DEP section 319 Non-Point Source Grant.

Introduction: Stream and River Water Quality Monitoring:

Staff assigned to the ambient water quality monitoring and assessment program are responsible for monitoring Connecticut's approximately 5,484 miles of perennial streams and rivers (CT DEP 1999). The monitoring program supports activities of the DEP by providing data (chemical, physical, and biological) and related expertise to assess surface water quality conditions and trends. Monitoring activities are prioritized and focus on the most significant resources, selected reference sites, and in response to nuisance complaints or concerns regarding pollution impacts. Approximately 20% of state rivers and streams are monitored (CT DEP 2004).

The ultimate use of water quality data is to provide an assessment of the level of support for each designated use for each river segment. This assessment process is documented and described in the CT-Consolidated Assessment and Listing Methodology (CT DEP 2004 CALM). A simple workflow diagram of the major steps in the CALM process is presented below. During step 1 data are collected and evaluated, in step 2 the data are compared to water quality standards and each river segment is assigned a level of support for each designated use, finally in step 3 the water quality assessments are reported to the public via the Report to Congress 305(b) [CT DEP 2004 305(b)] and the List of Connecticut Waterbodies not Meeting Water Quality Standards 303(d) [CT DEP 2004 303(d)]. The cycle is ongoing and repeats itself with the monitoring and assessment cycle.



WATER QUALITY MONITOIRING ASSESSMENTS:

A primary component of the Ambient Monitoring Program utilizes the riffle-dwelling benthic macroinvertebrate community as an indicator of biological integrity. Methods follow the USEPA Rapid Bioassessment Protocol III (RBPIII) for Streams and Rivers [http://www.epa.gov/owow/monitoring/rbp] (Plafkin et al 1989). The RBPIII involves collecting, sub-sampling, and identifying macroinvertebrates collected from riffle areas in wadeable streams. The variety and abundance of macroinvertebrates from each site are converted into a series of community structure metrics. The metrics from each site are then compared to metrics from a reference site. The final result is an assessment of the impairment level of the benthic community for each site.

The primary use of RBPIII assessments is to determine whether a section of stream supports or does not support goals for aquatic life use support (Figure 1) as described in the CT Water Quality Standards [http://www.dep.state.ct.us/wtr/wqs.pdf] (CT DEP 1997). These assessments are also used for priority setting, trend monitoring, establishing baseline conditions, and evaluating the effects of wastewater discharges and non-point source (NPS) pollution.

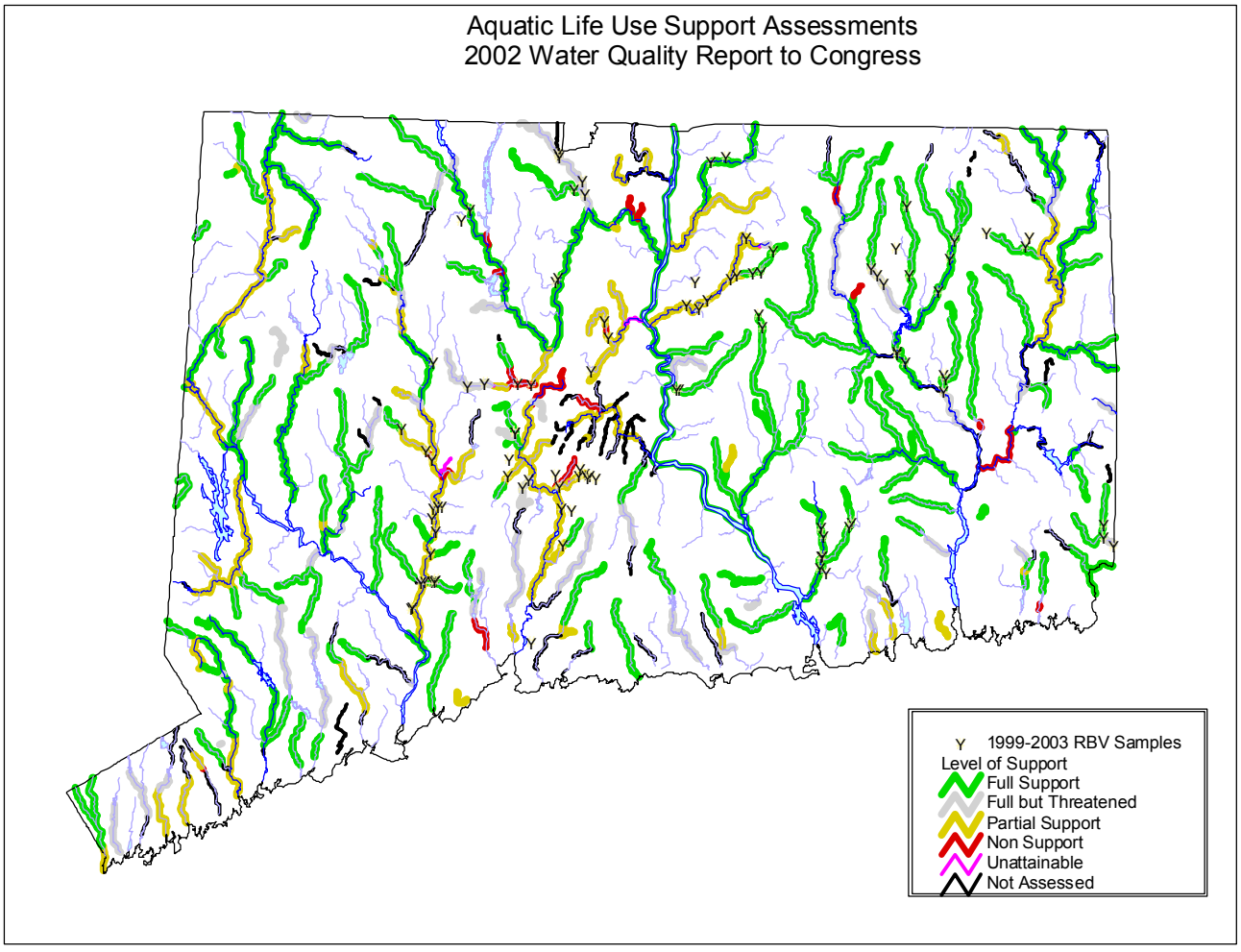


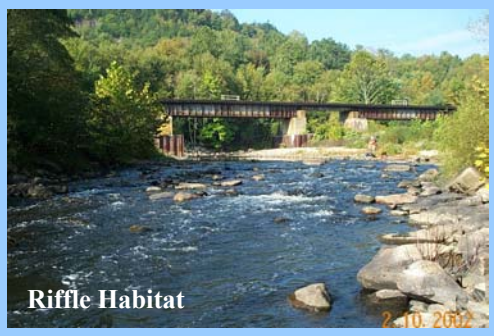
Figure 1. The aquatic life use support assessments for river and stream segments reported in the 2002 Water Quality Report to Congress 350(b).

Biological Indicators:

The presence, condition, and diversity of fish, insects, algae, and plants can provide accurate information about the health of a specific river, stream, lake, wetland, or estuary. These types of plants and animals are called biological indicators. Several different biological communities have been utilized to evaluate environmental condition. Other common communities used to assess aquatic systems are fish and periphyton (algae). Each community has advantages and disadvantage for use. Additional information regarding other bioindicators can be obtained via a website maintained by the US EPA. (http://www.epa.gov/bioindicators/html/about.html).

RIFFLE-DWELLING BENTHIC MACROINVERTEBRATES DEFINED: The terms used to characterize the organisms used in this water quality assessment tool are critical for understanding the type of organism and the habitat to be sampled. The RBV method will not provide accurate water quality assessment data if the definitions below are not met.

RIFFLE-DWELLING: A *riffle* is an erosional section of a stream or river characterized by rapid turbulent flow, a stable rocky substrate, and is wadeable most of the time. Other major stream habitats are pools and runs/glides. *Dwelling* means living at least part of the life cycle within the riffle habitat.



BENTHIC: Living in or on the substrate (bottom) of an aquatic environment.

MACRO: Large enough to be seen with the unaided eye. The US EPA further defines a macro-organism as one retained by a Standard Number 30-mesh sieve.

INVERTEBRATE: An animal without a backbone.

Other terms used to describe the RBP III method

SUB-SAMPLING: A process to generate a non-visually biased statistically representative sample of 100, 200 or 300 organisms collected in a sample.

COMMUNITY STRUCTURE METRICS: Are calculations based on the variety and abundance of Macroinvertebrates collected at a site. The values provide the mathematical basis for comparing biological communities from 2 distinct samples.

REFERENCE SITE: a specific locality on a waterbody, which is minimally impaired and is representative of the expected ecological integrity of other localities on the same waterbody or nearby waterbodies.

Why use RIFFLE-DWELLING BENTHIC MACROINVERTEBRATES?

Macroinvertebrates are good indicators of water quality because of the biology of the organisms. First, there are a large number of different types with various environmental requirements. This results in a wide spectrum of responses to environmental stress. Second, the organisms are small and have limited mobility during the aquatic life stage. This allows for efficient collection and the ability to assess water quality including the recent past. Third, established scientific methods for using macroinvertebrates to assess water quality are readily available.

The characteristics of the macroinvertebrate community serve as a useful tool for detecting environmental perturbation provided that the habitat and other environmental variables (including time of year) are controlled as much as possible. The composition of the macroinvertebrate community usually reflects water quality during the recent past, including any infrequently discharged pollutants and non-point sources of pollution that are difficult to detect by periodic chemical sampling.

Advantages for using macroinvertebrates: (http://www.epa.gov/bioindicators)

Macroinvertebrates are found in all ranges of water quality, even areas considered very poor.

Methods for sample collection, processing, and data analyses are widely accepted, established, and documented.

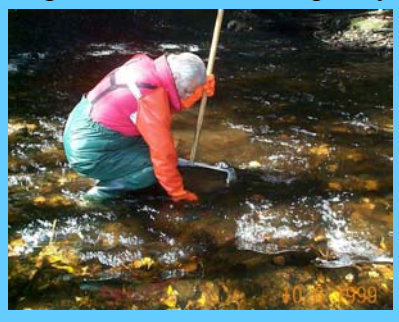
One or 2 people can capture a representative sample of the macroinvertebrate community with relative ease, in less than 1 hour, and with relatively inexpensive equipment.

Macroinvertebrate populations recover rapidly from repeated sampling.

Many macroinvertebrates are resident in a stream up to 2 years or more. This results in an integration of water quality conditions over time.

Macroinvertebrates have a wide range of environmental requirements.

Knowledge of changes in the community structure and function of benthic macroinvertebrates helps to indicate water quality status and trends in the aquatic environment.



Volunteer Monitoring and Macroinvertebrates:

Due to the utility of macroinvertebrate data, some volunteer monitoring groups have implemented programs similar to RBPIII used by the DEP. However, many monitors will agree that this process is anything but rapid. Even the most dedicated volunteers can struggle with the tedium of sub-sampling and family level identification. RBV capitalizes on the utility of macroinvertebrate data while keeping the methods and equipment straightforward, standardized, inexpensive, and most importantly "rapid".

The RBV method may be less sensitive in terms of its ability to detect subtle differences in the community structure because of reduced taxonomic rigor. However, the ability to characterize a broad range of water quality conditions is good. We believe the benefits of RBV in terms of the utility it provides to volunteer monitoring groups and consequently the additional data they provide to DEP far offset any loss of sensitivity.

The RBV protocol includes 26 macroinvertebrates, each with distinct shape, structure, color, or behavior. Detailed information about each organism can be found on the field identification cards/panels (http://dep.state.ct.us/wtr/volunmon/rbvcards.pdf). Each of these organisms has been placed into 1 of 3 categories ***most wanted*** (card/panels 1-8), ***moderately wanted*** (card/panels 9-14), and ***least wanted*** (card/panel 15). The most wanted category consists of macroinvertebrates typically found in streams characterized by high water quality. The moderately wanted category consists of those found in both unimpaired and slightly impaired water quality. The least wanted category consists of those found in all types of water from unimpaired to severely impaired. These 3 qualitative categories are intended to characterize water quality and are not intended to imply that a specific group is harmful or result in nuisance conditions. No organism included on the RBV list has higher or lower ecological value than any other.

THE RBV ORGANISMS

Additional information including Field Identification Cards can be found on the web at:
(http://dep.state.ct.us/wtr/volunmon/volopp.htm)

Each RBV organism has distinct shape, structure, color, or behavior and provides key ecological information about the stream environment. Each of the organisms are grouped into one of three "wanted" categories; Most, Moderate, or Least.

Most Wanted: In general these organisms require a narrow range of high quality environmental conditions. When found in abundance very good water quality can be inferred.

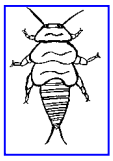
Moderately Wanted: These organisms can be found in a variety of environmental conditions from high to medium quality. When found in abundance and in the absence of most wanted types, water quality may be less than optimal.

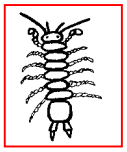
Least Wanted: These organisms tend to be tolerant of a wide range of environmental conditions including poor water quality. When found in abundance and in the absence of either most or moderate representatives, some level of water quality impairment can be inferred.

It is important to note that the "least wanted" are able to thrive in many environmental conditions while the "most wanted" thrive only under non-impacted high quality conditions. Therefore the most definitive RBV data are the collections with good representation of organisms in the "most wanted" category.

RBV Program Implementation:

Fourteen volunteer monitoring programs participated during the 2003 sampling season (September-December). Prior to collecting the macroinvertebrates most groups sponsored a 3-hour training session in which the DEP Volunteer Monitoring Coordinator described the program and introduced the participants to the RBV methodology. Approximately 110 people attended at least one of these training sessions. In most cases, the organization implemented RBV either immediately following the training session or within a week. A quality assurance project plan (QAPP) was written by DEP and approved by EPA in January of 2003. This document describes all aspects of the RBV program and how controls are in place to insure the data collected meets data quality standards. Any group participating in the program will be covered under the QAPP until 2007.





Groups who participated in RBV were loaned all the equipment necessary to complete the protocol; including, kick-net, sorting trays, forceps, hand-lenses, vial and alcohol, and the list of macroinvertebrates (Appendix C). Each organism on the list has distinct shape, structure, color, or behavior and provides key ecological information about the stream environment. Following the standard procedures, volunteers collected benthic macroinvertebrates in the fall and determined the relative abundance (none, few, some or many) of each macroinvertebrate on the list. At least one specimen of each type was preserved in a labeled vial containing rubbing alcohol (voucher collection). The final products from the RBV protocol were a completed data sheet and a voucher collection. The datasheet was submitted to DEP via phone, fax, or email. The voucher collection was delivered to DEP soon after the protocol was completed. In general the entire process occurred at the stream site and was completed by most monitors within a few hours. The most useful information for the DEP came from those groups who completed the RBV process at multiple sites along a reach of river not routinely monitored by DEP. Samples collected at 15 of the 31 sites were at locations that were not prioritized for ambient monitoring by DEP personnel (Figure 2).

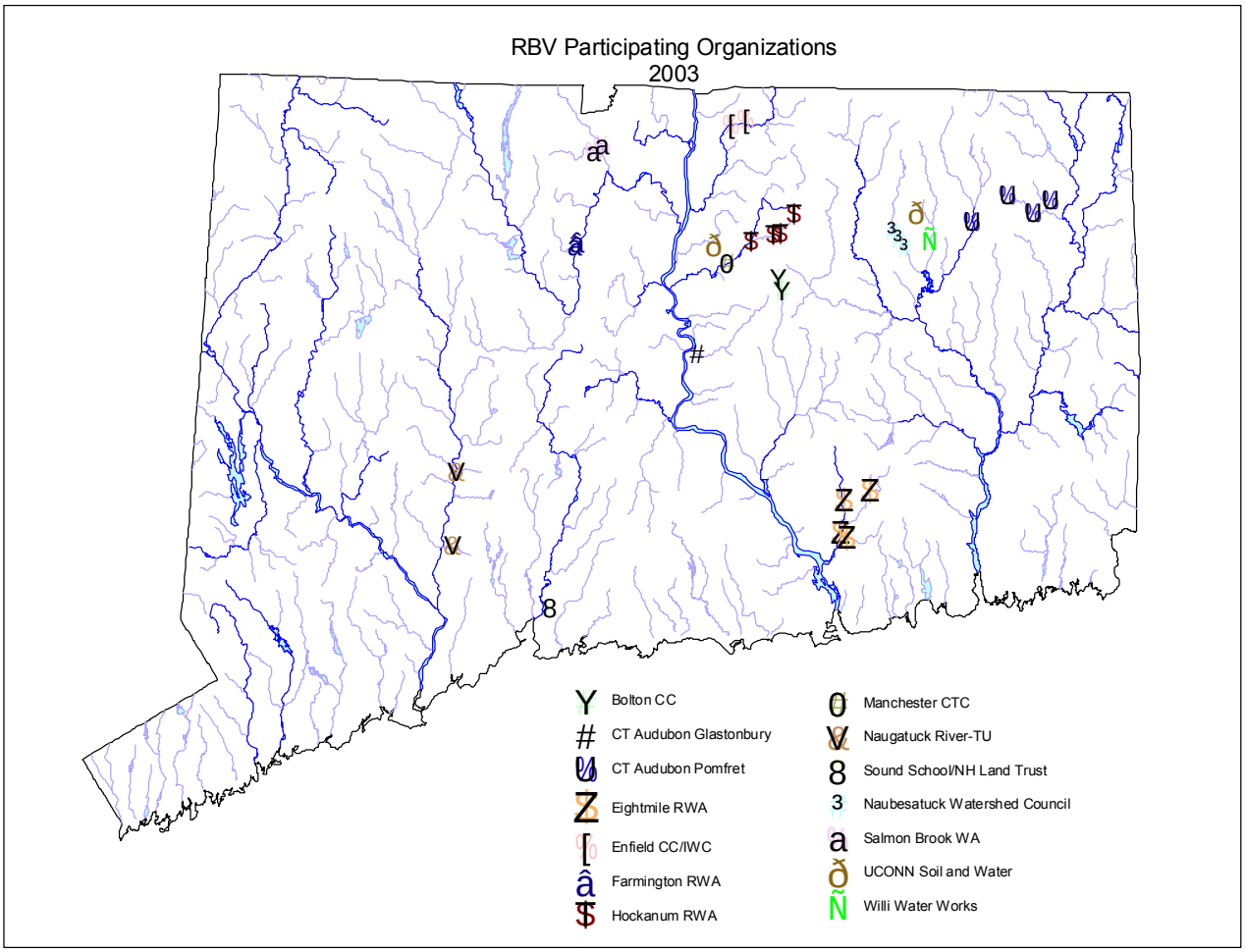


Figure 2. Location of the 31 RBV sampling sites and watersheds with samples collected by 14 organizations during fall 2003. Specific location information for each site is listed in Appendix B.

Results:

As part of the EPA RBP III protocol, the DEP routinely samples a network of 10 reference sites. A reference site is a specific locality on a waterbody, which is minimally impaired and is representative of the expected ecological integrity of other localities on the same waterbody or nearby waterbodies. To provide some numbers for comparing the RBV to reference condition, samples collected from 1995-2000 were applied to the RBV "wanted categories". The summary statistics for the reference site community data are presented in Table 1. The minimum number of most wanted for reference condition is 4; the average is 7 and the maximum 9. For DEP aquatic life use assessment purposes any site with 5 or more most wanted organisms was considered to be fully supporting the use. This is a conservative criteria but one that combined with the method provides the most conclusive conclusions for the RBV dataset.

Table 1. Summary statistics for the 10 reference station community data collected from 1995-2000.

Statistic	Most Wanted	Moderately Wanted	Least Wanted
Maximum	9	7	4
75th percentile	8	6	3
Median	7	6	2
Average	7	6	2
25th percentile	5	5	1
Minimum	4	3	1

A list of the RBV organism categories collected at each site during fall 2003 is presented in Table 2. The variety of RBV organisms collected ranged from a high of 13 total types to a low of 6 total types. At least one representative from the "most wanted" category was collected every site except for the Hemingway Creek site.

Four sites, (Gages Brook 32-006, Nod Brook 07-001, Knowlton Brook 38-001, and the Tankerhoosen River 32-002) had >4 most wanted and are fully supporting the aquatic life standard. Sites with 3 or 4 most wanted types are probably fully supporting but lack the few extra taxa that make the four sites above exceptional.

The 3 most commonly collected organisms were *Chimarra* (97% of sites), Hydropsychidae (94% of sites), and Perlidae (81% of sites). The 3 least commonly collected were *Drunella and Epeorus* (0% of sites) and *Corydalus* (3% of sites). As expected, moderately wanted organisms (panels 9-14) were the most commonly collected category (Figure 3).

Table 2. Occurrence of each type of RBV organism category by sample. Samples are sorted in decreasing order of total number of "Most Wanted". Water quality at the sites with 4 or more types in the most wanted category is considered very good. Sites with 5 or more total most wanted types approximate reference condition and are considered to be fully supporting the aquatic life standard. Sites with multiple sites along the waterbody have the label -UP for uppermost location, -MID for middle location, and -LWR for lower most location.

											Total most							Total moderate		Total Least	Total Types
				Number of representatives within each panel																	
Waterbody	Basin	Site #	Date	1	2	3	4	5	6	7	8		9	10	11	12	13	14		15		
Gages Brook	4503	32-006	11/1/03				1	1	2	1	1	6	1	1				1	3	3	3	12
Nod Brook	4317	7-001	11/4/03		1			1	2	1		5	1	1	1		1	1	5	1	1	11
Knowlton Brook	4004	38-001	12/5/03		1			2	1	1		5	1	1	1	1	1		5	1	1	11
Tankerhoosen River -MID	4503	32-002	11/1/03					2	2	1		5	1	1		1	1	1	5	2	2	12
Bladdens River	6919	5-017	11/15/03					2	1	1		4	1	1	1		1	1	5	4	4	13
Cemetery Brook	3710	21-003	10/31/03				1	1	1		1	4	1	1	1		1		4	1	1	9
Fenton River-MID	3207	11-002	9/27/03		1			1	1	1		4	1	1		1	1	1	5			9
Fulling Mill Brook	6915	5-016	11/15/03					2	1	1		4	1	1			1	1	4	2	2	10
Mashamoquet Brook	3710	21-005	10/17/03		1			1	2			4	1	1	1	1	1	1	6			10
Roaring Brook	4009	28-002	9/27/03					1	1	1	1	4	1	1	1		1		4	5	5	13
Tankerhoosen River-UP	4503	32-001	11/1/03				1	2		1		4	1	1	1		1	1	5	1	1	10
Tankerhoosen River-LWR	4503	32-004	11/1/03					2	1		1	4	1	1	1		1		4	5	5	13
Tributary to Eight Mile River	4800	26-007	9/27/03				1	2	1			4	1	1	1		1	1	5	3	3	12
West Branch Salmon Brook	4319	24-001	11/1/03		1			2	1			4	1	1	1	1	1	1	6	2	2	12
Beaver Brook	4803	26-005	9/27/03					1	1		1	3	1	1	1	1	1	1	6	2	2	11
Burhams Brook	4800	26-008	9/27/03				1	1			1	3	1	1	1		1	1	5	1	1	9
East Branch Salmon Brook	4320	24-002	11/1/03					1	1	1		3	1	1		1	1	1	5	2	2	10
Fenton River-UP	3207	11-003	9/27/03		1			1	1			3		1	1	1	1	1	5			8
Fenton River-LWR	3207	11-004	9/27/03		1			1	1			3	1	1	1	1	1	1	6	2	2	11
Mount Hope River	3206	11-005	9/27/03		1			1	1			3	1			1	2	1	5			8
Nod Brook	4317	7-002	11/4/03		1				2			3	1	1	1	1		1	5	4	4	12
Scantic River	4200	36-001	10/17/03		1			1			1	3	1	1	1	1			4	3	3	10
Blackledge River-UP	4707	35-001	10/19/03					1	1			2	1	1	1			1	4	4	4	10
Harris Brook	4801	26-006	9/27/03					1			1	2	1	1			1	1	4			6
Blackledge River-LWR	4707	35-002	9/27/03					1				1	1	1	1	1	1		5	1	1	7
Day Brook	3709	21-002	11/14/03					1				1	1	1	1	1			4	2	2	7
Hockanum River	4500	20-002	11/15/03						1			1	1	1	1				3	3	3	7
Plum Gully Brook	3205	38-002	12/13/03					1				1	1	1	1		1	1	5	3	3	9
Natchaug River	3200	21-004	10/25/03					1				1	1	1	1	1	1	1	6			7
Terry Brook	4200	36-002	10/17/03						1			1	1	1	1			1	4	5	5	10
Hemingway Creek	5200	34-001	10/23/03									0		1					1	5	5	6

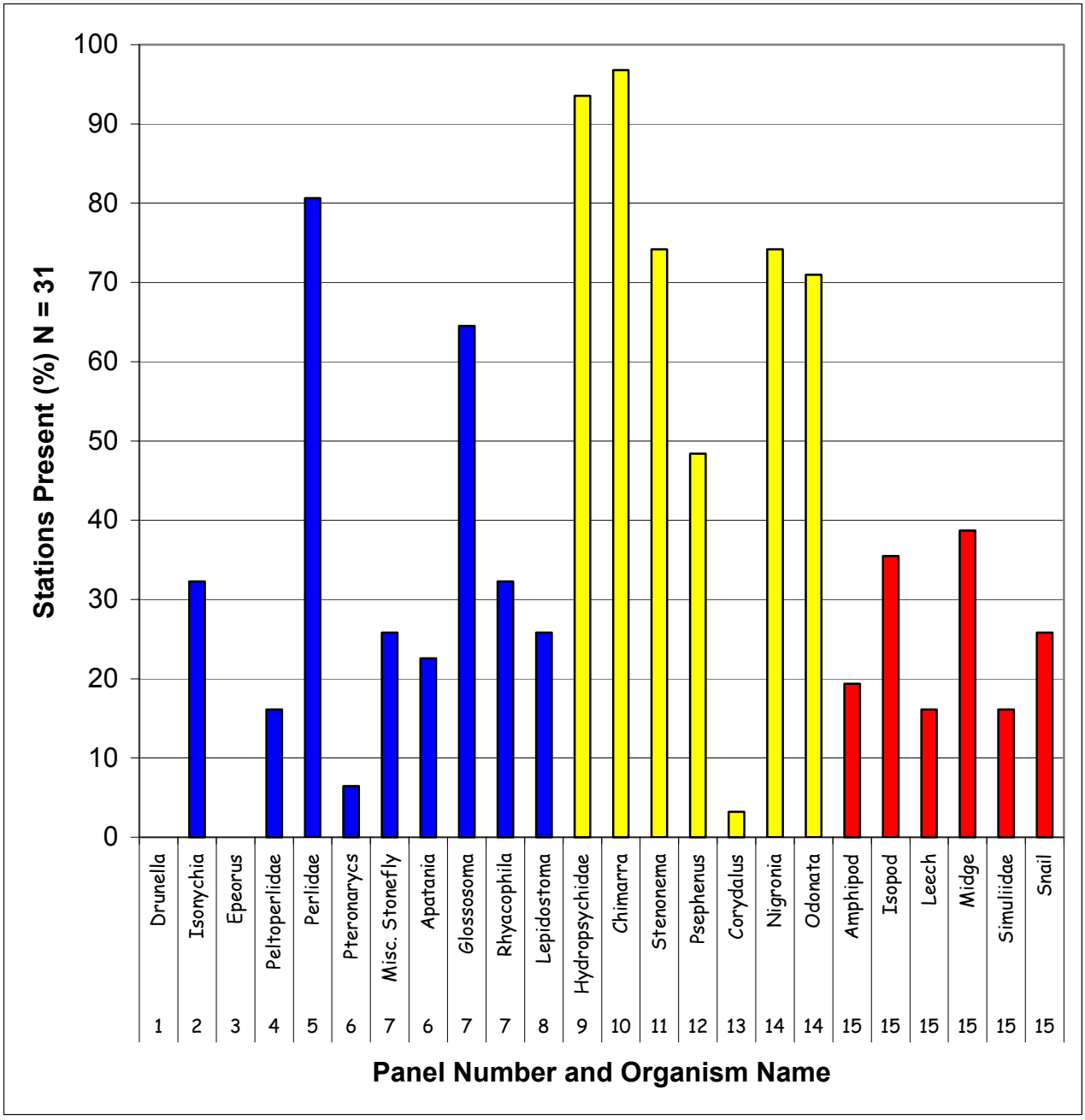


Figure 3. Percent occurrence of each type of organism included in the RBV protocol. Samples were collected from 31 sites during the fall of 2003**.** "Most Wanted" organisms are blue (panel numbers 1-8), "Moderately Wanted" are organisms are yellow (panel numbers 9-14), and "Least Wanted" organisms are red (panel 15). *The panel number is an identification aid. The panel number refers to the category order on both the identification card and the datasheet.

Most sites had good representation in the most wanted category. Nine sites had >40% most wanted types with Gages Brook having the highest percent (50%). Sites sampled in 2003 tended to be high quality small to medium size streams. Only 4 sites had >40% least wanted with Hemingway Creek having the highest (83%). Additionally, Hemingway Creek was the only stream not to have at least 1 representative from the most wanted category. The sites at the low end of the scale were for the most part in high-density residential areas with a large percentage of impervious surface land use (Figure 4 and Figure 5).

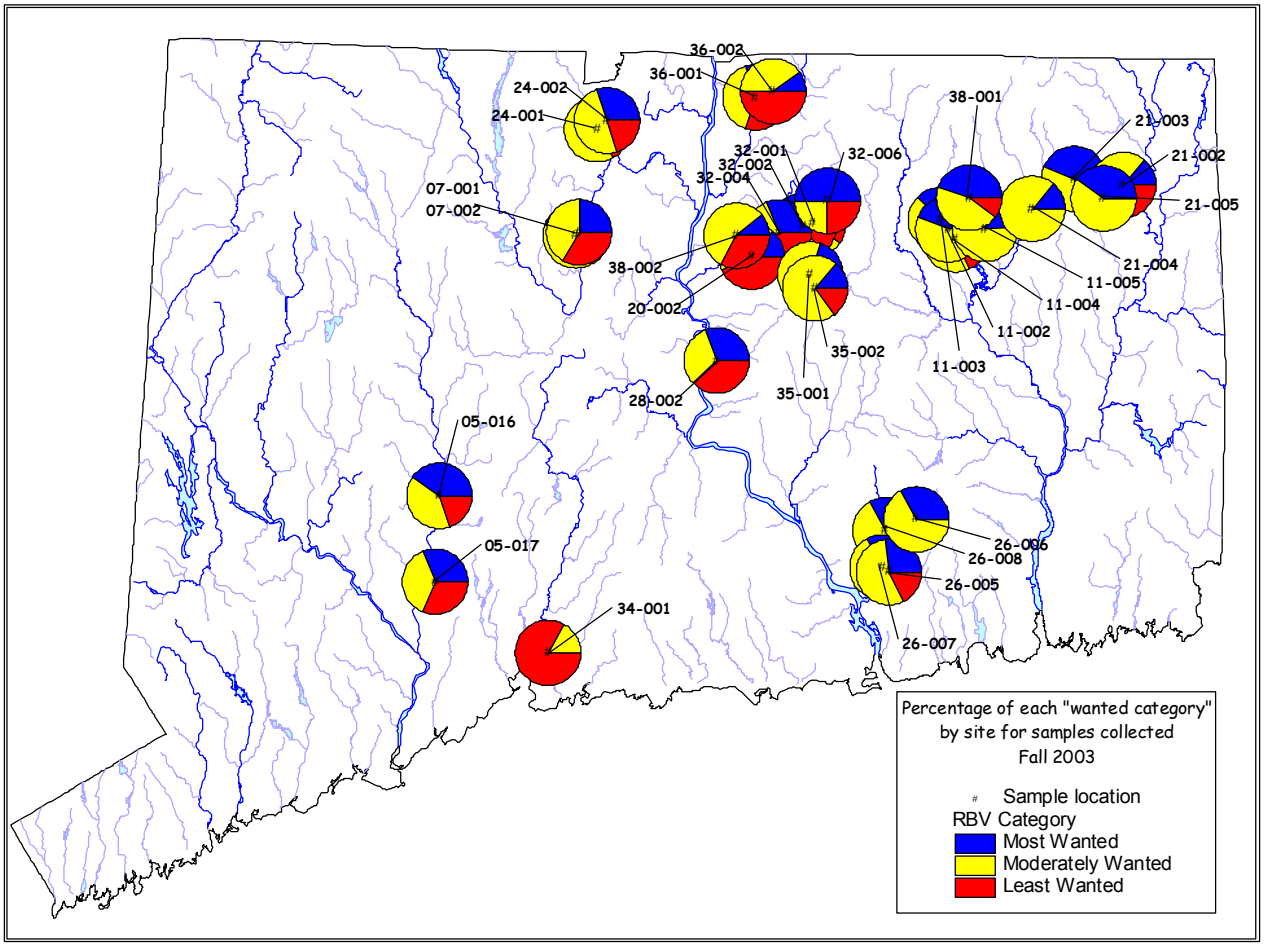


Figure 4. Distribution of each RBV category for samples collected during fall 2003**.** A blue wedge indicates the proportion of the "most wanted" types of macroinvertebrates, yellow "moderately wanted" and red "least wanted". Each site is assigned a number for use within DEP. The number is based on the following XX-YYY, where XX=an id assigned to the volunteer monitoring group and the YYY is the site number assigned chronologically. For example, 24-001 is the first site monitored by the Salmon Brook Watershed Association. A complete description of each site location by site number is presented in Appendix B.

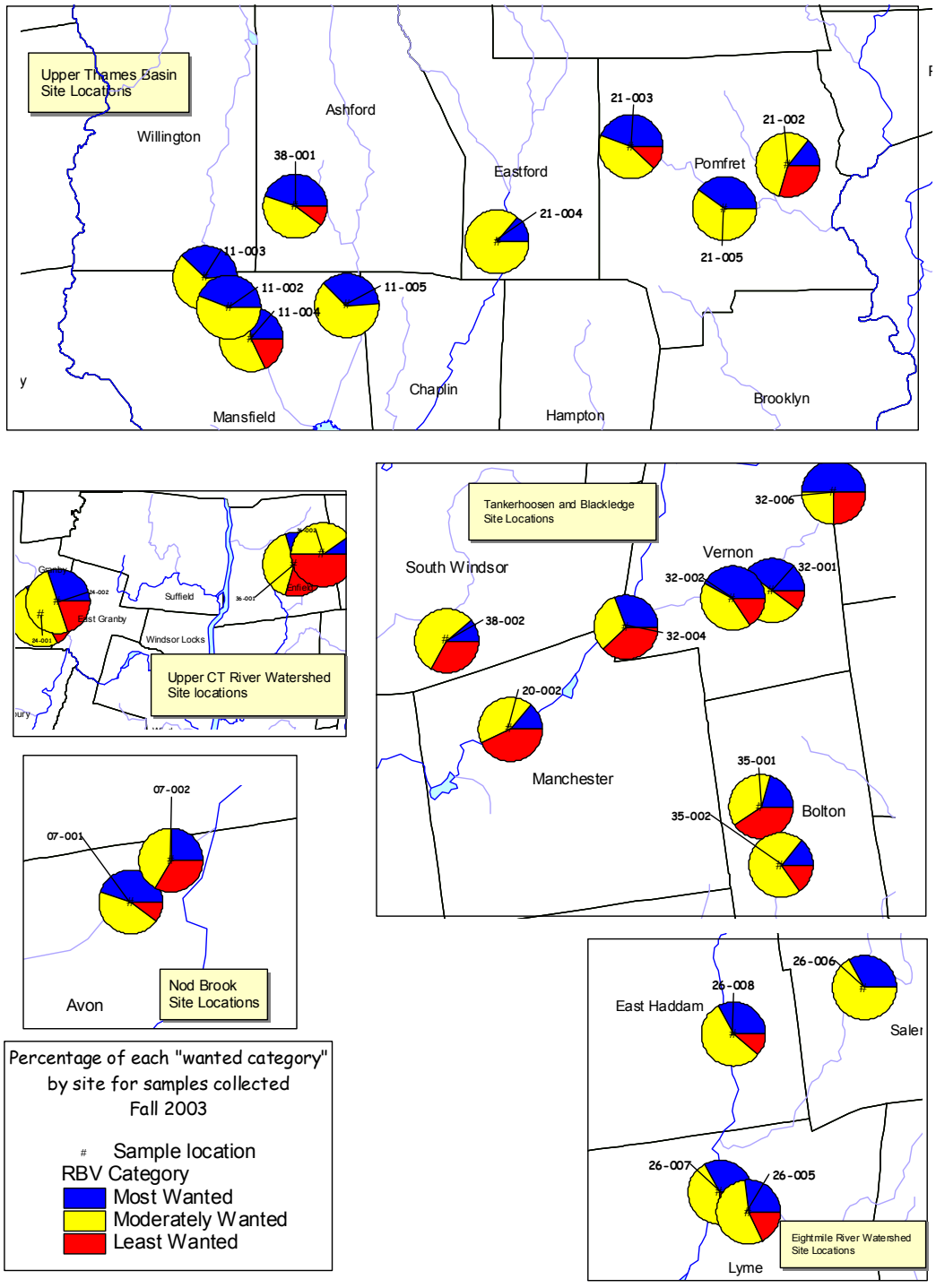


Figure 5. Distribution of each RBV category for selected samples collected during fall 2003**.** A blue wedge indicates the proportion of the "most wanted" types of macroinvertebrates, yellow "moderately wanted" and red "least wanted". These close-up maps were made because at a smaller map scale the pies overlap. A complete description of each site location by site number is presented in Appendix B.

Sites monitored consecutive years:

Eight of the 31 sites were monitored during consecutive years (Table 3). The community structure remained stable or changed only slightly at all of these 8 sites. The stream flows this fall were well above median values throughout the entire fall sampling season. Sampling during high flows can and usually does reduce the sampling efficiency. The Salmon Brook Watershed association noted very high flows with difficult sampling conditions on their sample date. The Chaplin Conservation commission (3 year participant) was unable to sample at all due to the continuous elevated flows on the Natchaug River.

Macroinvertebrate community sampling is inherently variable. The data presented below may be a reflection of this variability and not a reflection of subtle changes in water quality. Additional sampling events at these locations are necessary to determine long-term trends.

Table 3. A comparison of the 8 sites that have been monitored during consecutive years. The total numbers of each RBV category are listed. The change in the community structure is noted. *(Macroinvertebrate community sampling is inherently variable. The data presented below may be a reflection of this variability and not a reflection of subtle changes in water quality. Additional sampling events at these locations are necessary to determine long-term trends).*

Stream name	Drainage code	Site number	Fall of Year	Most	Moderate	Least	Community Structure
Tankerhoosen River	4503	32-001	2003	4	5	1	Slight Decrease
			2002	6	5	0	
Tankerhoosen River	4503	32-002	2003	5	5	2	Stable
			2002	5	4	4	
Tankerhoosen River	4503	32-004	2003	4	4	5	Slight Increase
			2002	2	5	4	
Fenton River	3207	11-002	2003	4	5	0	Stable
			2002	4	5	0	
Fenton River	3207	11-003	2003	3	5	0	Stable
			2002	4	5	2	
			2000	4	4	1	
Fenton River	3207	11-004	2003	3	6	2	
			2002	6	6	1	Slight Decrease
			2000	6	7	2	
Salmon Brook	4320	24-002	2003*	3	5	2	Slight Decrease*
			2002	5	6	1	
			2001	6	5	1	
West Branch Salmon Brook	4319	24-001	2003	4	6	2	Stable
			2002	4	4	2	

*Difficult sampling condition noted due to high flow

Discussion

The major success of the RBV program during the fourth sampling season was the level of participation by volunteer monitoring programs. During the early to mid 1990's volunteer monitoring using macroinvertebrates was very popular. Most groups implemented the family-level bioassessment method. Unfortunately the extensive time commitment required to complete the process at a single site caused many groups to abandon or reduce their monitoring activity. During the RBV field trial year (1999), the DEP encouraged these programs to "try" the new RBV protocol. Following the first field season (fall 2000), most groups were very successful and intended to participate in fall 2001. Only 3 of the 7 groups originally trained in either 1999 or 2000 participated in the program during 2003. Of the 9 groups who participated in 2002, five returned to repeat the sampling during 2003.

In 2003, 5 monitoring groups participated in the RBV program for the first time (Figure 6). All 5 groups agreed the new method would enable their monitoring to start and/or expand. All of the groups were able to take advantage of the equipment kits loaned by the DEP in order to complete the protocol. For the third year the number of groups returning for a consecutive sampling season increased. The number of stations and waterbodies monitored remains fairly consistent.

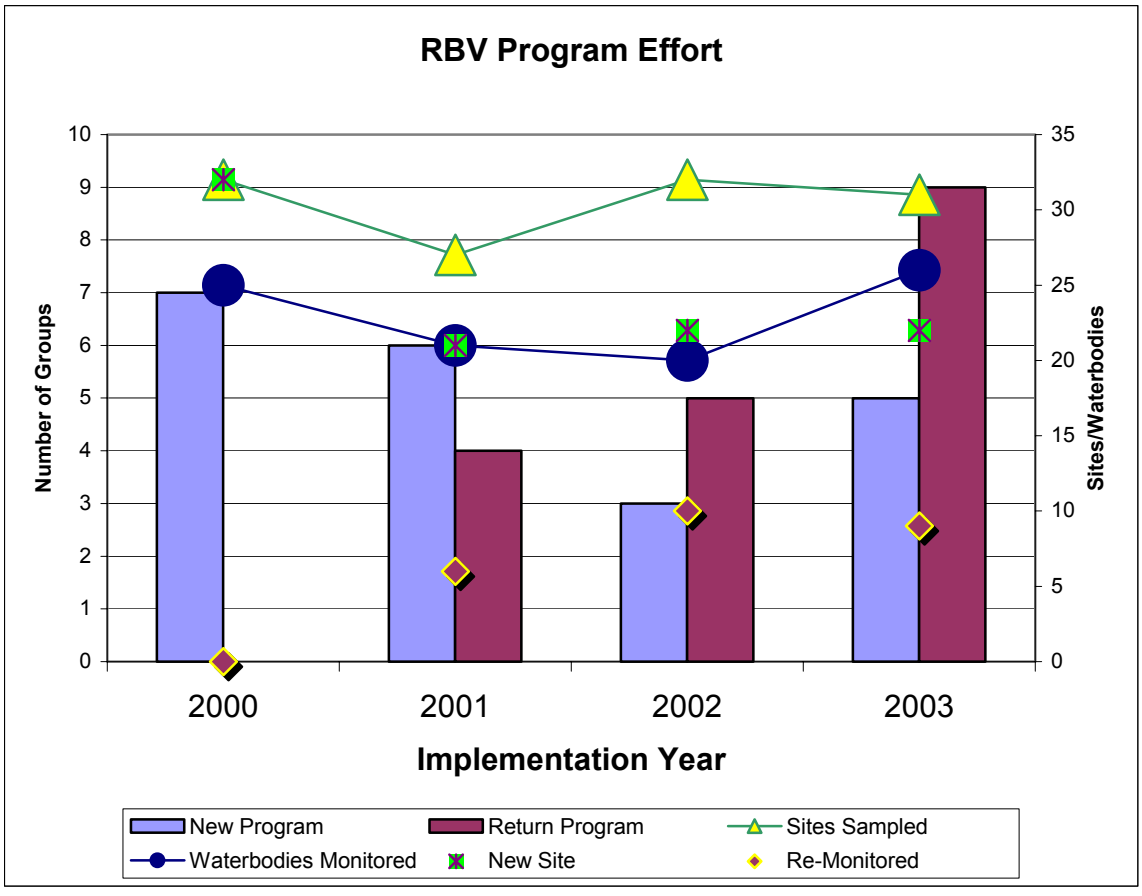


Figure 6. Level of effort for RBV program. The program started in the fall of 2000, thus there are no returning programs.

Of equal if not greater importance, was the sense of accomplishment by the volunteers. After completing the protocol many volunteers were satisfied that they had (1) helped their program meet it's goals, (2) provided some useful information to the DEP, and (3) successfully used a tool to obtain additional knowledge about a stream based upon the resident aquatic life. Compared to traditional family-level bioassessment, most participants agree the RBV program is better for their needs.

The most efficient implementation of RBV was through an "RBV day". An "RBV day" is a daylong event sponsored by a volunteer group. All participants meet at a central location where the morning is dedicated to training and the afternoon to collection and data analysis. Each team of monitors are assigned a sampling site(s) and provided with an equipment kit borrowed from the DEP. The participants then travel to their site, collect, identify, and preserve their voucher collection. The samples and equipment are then returned to the DEP. The entire "RBV day" lasts 6-7 hours. Additionally, on such days, Mike Beauchene (DEP volunteer monitoring coordinator) was able to attend to provide both technical assistance and quality assurance/quality control (QA/QC).

The DEP encourages implementation of the RBV protocol through "RBV-days". By having the day split between training (or refresher training) and actual sample collection, DEP resources (loaner equipment and QA/QC support) are maximized while reducing the time commitment for each volunteer. As the program organizers gain confidence in the sampling methodology, the DEP encourages the veteran groups to "strike out on their own". This enables DEP staff to focus on training new programs or refreshing year 2 programs.

DEP Concerns and Potential Solution from year 4 and progress:

While some minor issues were discovered during these first 4 sampling seasons the RBV method seems to be a useful tool. It has been observed that as each group gains experience and confidence their effort becomes more efficient. They are successful at implementing the program independently while borrowing the equipment from DEP.

Concern: "Too rapid": The major concern regarding the RBV protocol is the volunteer's perception of "ease". One major advantage of RBV is the reduced total time commitment for volunteers. The reduced time is a result of the elimination of post collection processing (sub-sampling), family level identification, metric calculations, and metric comparison. However, the field component of the RBV protocol (collection and observation of the organisms) is not any less time consuming than more intensive methods like family-level bioassessment. In fact, to collect high quality data, the collection and observation of the organisms must involve **more time** than traditional methods. Participants must take significant time and care to (1) select an appropriate riffle sampling location (2) perform an adequate kick sample, and (3) **observe and sort the organisms carefully to insure representation of all types of macroinvertebrates present.**

Solution: *Additional support materials were developed to emphasize "Good Technique". A Microsoft Power-point presentation was implemented during the training*

sessions, which served to compare and contrast good vs. poor techniques. Several "*Good techniques" for the RBV protocol include; look for loosely embedded cobbles in moderate to swift moving sections of a riffle, carefully rub each rock in order to remove all organisms, and spread the collected debris thin enough with limited water in each tray to optimize organism visibility. The integrity of the protocol is greatly reduced by poorly selected riffles, limited kick effort, and/or hasty organism sorting.*

Concern: "Other organism(s)": The potential for collection of organisms not included in the RBV protocol is very high because RBV focuses on relatively few stream macroinvertebrates. While all participants understood the issue when discussed, the what to do with the "other organism(s)" created some minor confusion during identification and enumeration.

Potential Solution: *Add a box for "Other Organisms" on the datasheet. Encourage use of support materials like the laminated cards. The cards have information that may help the participant refine the identification. Emphasize placing one of each into the voucher sample. This enables DEP to gain additional information about the community and helps to correct mis-identifications.*

References:

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CT DEP 2004 CALM. *Consolidated Assessment and Listing Methodology for 305(b) and 303(d) Reporting*. Bureau of Water Management, Planning and Standards Division, Hartford, CT. http://www.dep.state.ct.us/wtr/wq/calm/calm.htm

CT DEP 2004 303(d). *2004 List of Connecticut Water Bodies not meeting Water Quality Standards*. Bureau of Water Management, Planning and Standards Division, Hartford, CT. http://www.dep.state.ct.us/wtr/wq/tmdlbrief.htm

CT DEP 1999. *Ambient Monitoring Strategy for Rivers and Streams, Rotating Basin Approach*. Bureau of Water Management, Planning and Standards Division, Hartford, CT. http://www.dep.state.ct.us/wtr/wq/rotbasinplan.pdf

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Plafkin, J.L., M.T. Barbour, K.D. Porter, S.K. Gross, and R.M. Hughes. 1989. *Rapid Bioassessment Protocols for use in Streams and Rivers: Benthic Macroinvertebrates and Fish*. EPA/444/4-89-00.

Additional Sources of Related Information

Connecticut Department of Environmental Protection

DEP Web site: http://dep.state.ct.us/
DEP Bureau of water management: http://dep.state.ct.us/wtr/index.htm
RBV web page: http://dep.state.ct.us/wtr/volunmon/volopp.htm

United States Environmental Protection Agency:

Volunteer monitoring: http://www.epa.gov/OWOW/monitoring/vol.html
Rapid Bioassessment Protocols: http://www.epa.gov/owow/monitoring/rbp/
Biological Monitoring: http://www.epa.gov/bioindicators

Regional Web Sites:

New England Regional Monitoring Collaborative:
http://www.umass.edu/tei/mwwp/nermc.html

RBV Participant Program web sites:

Naugatuck Trout Unlimited: http://murp.home.att.net/trout.html
Connecticut Audubon
Pomfret, Contact: Paula Coughlin (860) 928-4948
http://www.ctaudubon.org/centers/pomfret/pomfret.htm
Glastonbury, Contact: Judy Harper (860) 633-8402
http://www.ctaudubon.org/centers/glastonbury/glastonbury.htm

Other Volunteer Monitoring Organizations In Connecticut Who Have Submitted Wadeable Stream Data to DEP:

A national directory of volunteer monitoring organization can be found at:
http://www.epa.gov/OWOW/monitoring/vol.html

Connecticut River Watch Program
Middletown, Contact Jane Brawerman (860) 346-3282.

Housatonic Valley Association
Cornwall, Contact: Ruth Malins (860) 672-6678.

Windham County Soil and Water Conservation District
Brooklyn, Contact: Scott Gravatt (860) 774-8397.

Nature Center for Environmental Activities
Westport, Contact: Richard Harris (203) 227-7253.

Project SEARCH
Derby, Contact: Chris Sullivan (203) 734-2513.

Quinnipiac River Watershed Association: http://www.qrwa.org/

APPENDIX A: RBV resources available on the Internet:

All of the materials for the RBV program are available on the DEP web page at these addresses. HOME PAGE: http://dep.state.ct.us/wtr/volunmon/volopp.htm

2002 Summary of Volunteer Monitoring Program (PDF, 1230K)
2001 Summary of Volunteer Monitoring Program (PDF, 869K)
2000 Summary of Volunteer Monitoring Program (PDF, 433K)

Part 1: Program Description (PDF, 750 K) - This document describes the Rapid Bioassessment in Wadeable Streams and Rivers by Volunteer Monitors (RBV) program.

Part 2: Instructions (PDF, 1415 K) - This document provides step by step instructions for the RBV protocol and provides a consistent method for volunteer groups to use when submitting surface water quality information to DEP.

Macroinvertebrate Field Identification Cards (PDF, 676 K) - At the core of the RBV program are the macroinvertebrates represented on these cards. Each organism has distinct shape, structure, color, or behavior and provides key ecological information about the stream environment. Each card lists the common name across the top and the category at the bottom. These bands are color-coded based on the ecology of each organism.

- Blue = **Most Wanted**. In general these organisms require a narrow range of environmental conditions. When found in abundance one can infer non-impaired stream condition.
- Yellow = **Moderately Wanted**. These organisms can be found in a variety of water quality conditions. When found in abundance further information about the upstream watershed may be necessary to infer water quality.
- Red = **Least Wanted**. These organisms tend to be very tolerant of a wide range of environmental conditions. As a result when these organisms comprise the majority of a sample, one can infer some level of water quality impairment.

Data sheet (PDF, 133 K) - This is the official data sheet for the RBV protocol. It should be submitted along with the collection of macroinvertebrate vouchers to Mike Beauchene, Volunteer Monitoring Coordinator, at phone (860) 424-4185, fax (860) 424-4055, or mike.beauchene@po.state.ct.us

Macroinvertebrate Sorting Guide (PDF, 211 K) - This 1 page flow chart will assist volunteer monitors in narrowing their macroinvertebrate identification choice. The flow chart is not designed to be a comprehensive key for macroinvertebrates. The chart should be used for preliminary sorting and grouping when implementing the RBV protocol.

Quality Assurance Project Plan (PDF, 163 K) - A Quality Assurance Project Plan is a document that provides a plan to insure data collected for a specific project will meet a particular standard. A QAPP is required for any water quality monitoring program that receives funding through EPA. This document is a template that can be used by any volunteer monitoring program intending collect macroinvertebrate community data using the RBV method. Standardized guidance for QAPP can be found on the EPA volunteer monitoring web page: http://www.epa.gov/OWOW/monitoring/vol.html

Appendix B Table of locations sorted by Volunteer Group name and site number.

Volunteer Group	Site number	Stream Name	Basin	Proximity	Landmark	Municipality
Bolton Conservation Commission	35-001	Blackledge River	4707	Downstream	Converse Road	Bolton
Bolton Conservation Commission	35-002	Blackledge River	4707	500 meters Downstream	Deming Road	Bolton
CT Audubon-Glastonbury	28-002	Roaring Brook	4009	Upstream	Route 17	Glastonbury
CT Audubon-Pomfret	21-002	Day Brook	3709	At	Day Road and Needles eye road intersection	Pomfret
CT Audubon-Pomfret	21-003	Cemetery Brook	3710	Downstream	Taft Pond Road at 4-H Horse camp entrance	Pomfret
CT Audubon-Pomfret	21-004	Natchaug River	3200	At	Route 198 entrance to Natchaug SF	Eastford
CT Audubon-Pomfret	21-005	Mashamoquet Brook	3710	500 meters Downstream	Route 44 in State Park	Pomfret
Eightmile River Association	26-005	Beaver Brook	4803	Downstream	Bridge at 55-1 Beaver Brook Road	Lyme
Eightmile River Association	26-006	Harris Brook	4801	At	Mouth	Salem
Eightmile River Association	26-007	Tributary to Eight Mile River (PV brook)	4800	At	Macintosh Road Crossing	Lyme
Eightmile River Association	26-008	Burhams Brook	4800	At	Mouth	East Haddam
Enfield Conservation Commission	36-001	Scantic River	4200	100 meters Downstream	South Maple St.	Enfield
Enfield Conservation Commission	36-002	Terry Brook	4200	Downstream footbridge	Green manor Park	Enfield
Farmington River Watershed Association	7-001	Nod Brook	4317	Downstream	Route 10	Avon
Farmington River Watershed Association	7-002	Nod Brook	4317	Upstream	Footbridge and Pond in Nod Brook FCA	Avon
Hockanum River Watershed Association	32-001	Tankerhoosen River	4503	Downstream	Bolton Road	Vernon
Hockanum River Watershed Association	32-002	Tankerhoosen River	4503	Upstream	Tunnel Road	Vernon
Hockanum River Watershed Association	32-004	Tankerhoosen River	4503	100 meters upstream	Mouth at golf land	Vernon
Hockanum River Watershed Association	32-006	Gages Brook	4503	At	Footbridge on Tolland Agricultural Center Property	Tolland

Volunteer Group	Site number	Stream Name	Basin	Proximity	Landmark	Municipality
MCTC Science and Technology Club	20-002	Hockanum River	4500	Behind	Adams Mill Restaurant	Manchester
Naubesatuck Watershed Council	11-002	Fenton River	3207	Behind	Uconn Well Field building A	Mansfield
Naubesatuck Watershed Council	11-003	Fenton River	3207	100 meters downstream	Old Turnpike Road	Willington
Naubesatuck Watershed Council	11-004	Fenton River	3207	10 meters downstream	Stone Mill Road	Mansfield
Naubesatuck Watershed Council	11-005	Mount Hope River	3206	At first pull off downstream	Tower Road/Mount Hope Road	Mansfield
New Haven Land Trust & Sound School	34-001	Hemingway Creek	5200	Upstream 50 meters	Eastern Street In Housing Project	New Haven
Salmon Brook Watershed Association	24-001	West Branch Salmon Brook	4319	Adjacent	Salmon Brook Park	Granby
Salmon Brook Watershed Association	24-002	East Branch Salmon Brook	4320	Downstream	Route 20	Granby
Trout Unlimited-Naugatuck Valley Chapter	5-016	Fulling Mill Brook	6915	At	Pool just prior to entering Naugatuck River	Naugatuck
Trout Unlimited-Naugatuck Valley Chapter	5-017	Bladdens River	6919	100 meters downstream	Legion Pool dam	Seymour
UCONN Soil and Water Conservation Club	38-001	Plum Gully Brook	4004	Between	Clark Street and Pumping Station	South Windsor
UCONN Soil and Water Conservation Club	38-002	Knowlton Brook	3205	Downstream	Upton Road	Ashford

Appendix C: Ecological information for RBV organisms.

The RBV protocol has 26 types of macroinvertebrates, each with distinct shape, structure, color, or behavior. Detailed information about each organism can be found on the field identification cards/panels (http://dep.state.ct.us/wtr/volunmon/rbvcards.pdf). Each of these organisms has been placed into 1 of 3 categories most wanted (card/panels 1-8), moderately wanted (card/panels 9-14), and least wanted (card/panel 15). The "most wanted" category contains the macroinvertebrates typically found in streams characterized by high water quality. The "moderately wanted" category contains those typically found in both high and slightly impaired water quality. The "least wanted" category contains those typically found in all types of water quality from high to severely impaired.

RBV Panel Number	Taxa Name	Common Name	Tolerance Value*	Feeding Group**	RBV wanted Category	Order
1	*Drunella*	Body Builder Mayfly	0	Scraper	Most	Ephemeroptera
2	*Isonychia*	Minnow Mayfly	2	collector filterer	Most	Ephemeroptera
3	*Epeorus*	2-tailed Flat Head Mayfly	0	scraper	Most	Ephemeroptera
4	Peltoperlidae	Roach-like Stonefly	0	shredder	Most	Plecoptera
5	Perlidae	Common Stonefly	1	predator	Most	Plecoptera
5	*Pteronarcys*	Giant Stonefly	0	shredder	Most	Plecoptera
5	Misc. Stoneflies	Stonefly	1	shredder	Most	Plecoptera
6	*Apatania*	Cornucopia Case Maker	0	scraper	Most	Trichoptera
6	*Glossosoma*	Saddle Case Maker	0	scraper	Most	Trichoptera
7	*Rhyacophila*	Michelin-man Caddisfly	0	predator	Most	Trichoptera
8	*Brachycentrus*	Mid-size Plant Case Builder	1	shredder	Most	Trichoptera
8	*Lepidostoma*	Mid-size Plant Case Builder	1	shredder	Most	Trichoptera
9	Hydropsychidae	Common Net Spinner	4	collector filterer	Moderately	Trichoptera
10	*Chimarra*	Orange Head Caddisfly	3	collector filterer	Moderately	Trichoptera
11	*Stenonema*	Flat Headed Mayfly	4	scraper	Moderately	Ephemeroptera
12	*Psephenus*	Water Penny Beetle Larva	4	scraper	Moderately	Coleoptera
13	*Corydalus*	Dobsonfly larva	6	predator	Moderately	Megaloptera
13	*Nigronia*	Fishfly larva	4	predator	Moderately	Megaloptera
14	Odonata	Dragonfly and Damselfly Nymphs	5	predator	Moderately	Odonata
15	Amphipod	Amphipod, Scud	8	collector gatherer	Least	Amphipoda
15	Worm	Aquatic Earthworm	9	collector gatherer	Least	Oligochaeta
15	Isopod	Aquatic Sowbug	8	collector gatherer	Least	Isopoda
15	Simuliidae	Black Fly	6	collector filterer	Least	Diptera
15	Leech	Leech	8	predator	Least	Hirudinea
15	Midge	Midge	7	collector gatherer	Least	Diptera
15	Snail	Snail	7	scraper	Least	Gastropoda

***Tolerance values** are a relative scale from 0 (least tolerant) to 10 (most tolerant) these values were developed to summarize overall pollution tolerance of the benthic arthropod community with a single value. The values are used in the Hilsenhoff Biotic Index (HBI) developed as a means of detecting organic pollution in communities inhabiting rock or gravel riffles. Although it may be applicable for other types of pollutants, use of the HBI in detecting non-organic pollution effects has not been thoroughly evaluated. This scale forms the base for the RBV protocol. A stream segment supporting a diverse community of organisms with low tolerance values indicates little organic enrichment and high water quality (EPA-600-4-90-030 Marcroinvertebrate Field and Laboratory Techniques).

****Feeding Group:** Most aquatic insects are grouped into 1 of 5 general categories based on the type of food utilized and the feeding mechanism. Predators are secondary consumers generally feeding on other aquatic macroinvertebrates. Shredders use cutting mouthparts to feed on coarse organic matter like leaves.

Scrapers use file-like mouthparts to feed primarily on microscopic algae. Collector-filterers and collector-gatherers both utilize fine organic material as the primary food but differ in feeding mechanism. Filterers allow the stream flow to carry the food to them while the gatherers actively search. Feeding groups can reflect the food base of the riffle and provide insight into the nature of potential disturbance factors. Proportion of feeding groups is important because predominance of a particular type may indicate an unbalanced community responding to an overabundance of a particular food type. The predominant feeding strategy reflects the type of impact detected. In general shredders and scrapers are dominant in high quality stream while collector-filterers and gatherers dominate in disturbed systems.