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Assessing the Accuracy of Illinois RiverWatch Data: Study Results 1999

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Introduction
The RiverWatch Program (RW) is the volunteer stream-monitoring component of CTAP, which collects scientific information on Illinois streams. This data documents long-term trends in stream health based on biological monitoring of benthic macroinvertebrate organisms. In addition, a habitat survey is conducted to complement the biological survey. This program is designed for use in conjunction with data collected by professional biologists to better understand statewide trends in stream health.

This data is intended to support and complement professional data; therefore, comparability and replication studies are crucial to maintain the program’s credibility. A replication study was initiated in 1999 to determine how well trained citizen scientists follow Illinois RiverWatch (RW) field procedures. To examine this question, we compared data that were collected by certified EcoWatch trainers (control) with that of trained Citizen Scientists (volunteers). The assumption was that since EcoWatch trainers are responsible for instructing Citizen Scientists on RW procedures, the two groups should obtain similar results. If results vary, training efforts could be concentrated on parameters where discrepancies were seen and ultimately improve RW data quality.

Experimental Design
Trainers from each of the seven EcoWatch offices randomly selected five groups to shadow. Volunteers were asked to monitor their sites as usual following the procedures outlined in the RiverWatch Stream Monitoring Manual (IDNR 2000). Trainers were instructed to replicate the procedures within 48 hours of the volunteer monitoring period. However, trainers did not collect macroinvertebrate samples and this parameter was therefore, not analyzed. Sites were rejected if a major storm event occurred between the two surveys (this did occur). Originally, data were to be collected on 35 sites; trainers and volunteers managed to collect data on 29 targeted sites.

Results
Monitoring “Time”
Volunteers spent an average of 2.5 hours monitoring their sites with the shortest time recorded being 30 minutes and the longest being 7 hours. Trainers spent an average of 1 hour monitoring the same site with the longest time spent being 2.5 hours and the shortest time 30 minutes. Overall, trainers spent less time in the field than the volunteers. This, however, was expected since trainers have more experience and should use their time more efficiently. Volunteers also spent more time in the field since they collected macroinvertebrate samples and trainers were only required to identify the macroinvertebrate habitats and did not collect samples.

Trainers were to shadow volunteers within 48 hours when possible. The average difference in time between volunteer and trainer monitoring was three days. The two groups monitored 55% of the sites within 48 hours, 35% within 3 to 6 days, and 10% within 10 days of each other. Volunteers for the study had been participating in RiverWatch for an average of two years. Only 1 volunteer had been monitoring since 1995 and 10 volunteers were monitoring for the first time in 1999.

Substrate Parameters (%)
Volunteers determine the percentage of their stream reach covered by substrate types (e.g. gravel) that were defined by size and listed in the manual. The volunteers must then choose cover classes that match the percent cover for each substrate type (A = 0%, B = 1 to 5%, C = 6 to 25%, D = 26 to 50%, E = 51 to 75%, and F = 76 to 100%). The midpoints for each cover class were used in the analysis. Paired t-tests (P < 0.10) were performed on this data to determine if there were differences between the volunteer versus trainer results using the SAS procedure proc means (SAS Institute Inc. 1989). Appropriate
transformations were made when the data were not normally distributed and the variance was higher than the mean (Sokal and Rohlf 1981).

Results indicated that trainers and volunteers obtained the same results (P < 0.10) when measuring the following parameters: percent canopy cover, percent algae cover, percent bolder, percent cobble, and percent gravel. This indicated that trainers and volunteers were in agreement on these substrate types.

Volunteers and trainers did not agree in their measurements of bedrock, embeddedness, sand, and silt percent cover types (P > 0.10). Volunteers on average tended to estimate lower percentages of embeddedness (38%) than did the trainers (53%). The same trend was seen with percent sand with volunteers estimating a lower percentage than did the trainers (27% versus 34% for each, respectively). The opposite trend occurred when examining percent silt and percent bedrock. Volunteers were more likely to estimate a higher percentage of these substrate types. Overall, volunteers estimated percent silt at 22% versus 17% for trainers. This trend continued with percent bedrock with volunteers estimating a higher percentage (3%) when compared to trainers (1.3%).

Stream Measurements
Volunteers estimated average stream depth, stream discharge, average stream velocity, and stream width at their study sites. Paired t-tests were again performed to determine if there was a difference between volunteer and trainer measurements of these parameters using the SAS procedure proc means (P < 0.10) (SAS Institute Inc. 1989). Appropriate transformations were made when the data were not normally distributed and the variance was higher than the mean (Sokal and Rohlf 1981). Results indicated that there was no significant difference between any of these parameters when comparing volunteers to trainers.

Watershed Features
Volunteers indicated whether a landuse was dominant (d), present (x), or absent (left blank). The landuse must be within visual distance to be marked as present. Since these data were categorical, there was no statistical test performed. The data were turned into percentage values and graphed to examine how trainer versus volunteer data differed. There was no discrimination as to whether a watershed feature was just present (x) or dominant (d) but instead considered either selection as present (yes) or absent (no). Watershed features, which were rarely checked (less than 25% of the time), were not graphed.

Volunteers and trainers did agree most of the time when looking at watershed features. Typically, volunteers and trainers were within ±15% of one another. Some of this variability between volunteers and trainers may be due to interpretation in the field since most volunteers do not bring their manual to the site. The most common habitats present at the sites were forest, grassland, cropland, and scattered residential (Figure 1). Trainers and volunteers agreed within ± 5% when noting the presence of forests and scattered residential land uses. However, when looking at cropland and grassland there was more variability between volunteers and trainers (< ± 15%). Volunteers were more likely to indicate grassland (69%) was present at their stream sites compared to trainers (45%). The opposite was seen with cropland landuse with volunteers less likely to note its presence (42%) compared to trainers (59%). Volunteer and trainer responses noting the presence or absence of pipes, channel alterations, waste water treatment discharge plants, and sanitary landfills were identical.

Macroinvertebrate Habitat Selection
Volunteers were asked to indicate the two macroinvertebrate habitats present at their stream site, which were most likely to contain macroinvertebrates. For example, if a riffle, snag area, and undercut bank were all present at the site, the volunteer would select the riffle and the snag area because these
habitats tend to have the highest taxa richness and diversity. The volunteer would not select the undercut bank because the other two habitats are "better" and more likely to result in larger sample densities.

These habitats were rated on a numerical scale according to which were most likely to contain high taxa richness and diversity (Riffle = 1, most diverse versus bottom substrate = 5, least diverse). Since these data were categorical, there was no statistical test performed. The data were turned into percentage values and graphed to examine how trainer versus volunteer data differed.

Volunteers readily identified and selected riffles (most diverse habitat) to sample when present (Figure 2). Twenty percent of volunteers and trainers disagreed on the selection of snag areas versus undercut banks. Volunteers and trainers did not agree 12% of the time on the selection of leaf packs as the 2nd most diverse habitat.

Submerged Aquatic Plants

Some problems also were encountered in identifying submerged aquatic plants at stream sites. The RiverWatch Stream Monitoring Manual (2000) defines submerged aquatic plants (SAP) as those species that are rooted in the substrate and have their entire body underwater. A few volunteers were either not discriminating between emergent and submerged aquatic plants or were not adequately reviewing their manuals. For example, one volunteer identified duckweed as a submerged aquatic plant (SAP). Two volunteers put "unknown" for SAP indicating they did not know what this term meant.

Conclusions

Overall, volunteers and trainers agreed on most parameters indicating that volunteers were following and understanding the procedures. Disagreements between the two groups were especially prominent when examining the percent cover of some parameters (e.g. silt) and selecting secondary habitats for sampling macroinvertebrates.

The discrepancies revealed in this study indicate that RiverWatch trainers need to spend more time during training sessions explaining difficult concepts. For example, volunteers often confuse percent cover with depth of cover (personal observation) when deciding upon cover classes for embeddedness. Stream characteristics and habitats differ from site to site and may not fit the standard example provided in a training session. Challenging volunteers at training when difficult decisions are necessary would better equip them when they are out by themselves. Additionally, determining percent cover classes is subject to individual interpretation. Even highly trained professionals often disagree among themselves when measuring these types of parameters. Some of the variability seen here between trainer and volunteer results maybe due to the inherent subjectivity of these types of data. It should also be noted that some of the variability in embeddedness and silt estimates between volunteers and trainers might be due to storm events. Thirteen of the 29 sites monitored by volunteers reported showers/storms in the prior 48 hours while 11 of the sites experienced showers/storms 48 hours before the trainers monitored.

A small number of volunteers have problems identifying habitats for collecting their macroinvertebrate samples. Some of the discrepancies between volunteer and trainer results are due to differences between the groups in monitoring skill and experience. For example, leaf packs should be highly decayed in order to provide good habitat for macroinvertebrates and are frequently missed by volunteers (personal observation). This experience also explains volunteer problems with identifying submerged aquatic plants. SAP are quite rare at most sites and are typically not present during training sessions (personal observation). Therefore, volunteers may not recognize SAP when present at their own sites.

Emphasizing procedural reviews for participants appears to be an important yet overlooked policy. Volunteers collect data on an annual basis and may therefore forget important procedures over this time.
Trainers should also provide volunteers with theoretical problems and challenges that they may encounter when out monitoring their own sites.

Illinois RiverWatch has strict quality assurance/quality control procedures that were integrated into the program from its inception. Consistency when training volunteers to monitor sites is strongly emphasized to EcoWatch trainers when the program hires them. This study supports the assertion that trainers are generally instructing volunteers on proper monitoring techniques. However, training reviews and re-emphasis of key procedures will likely continue to improve the accuracy of volunteer data.

Volunteer data can provide valuable information, which can be utilized by professional scientists and policy decision-makers. Although volunteer data are less precise than professional data studies have indicated a high correlation between volunteer and professional data when looking at overall stream health (Ely 2000). Results here support the assertion that volunteers can follow monitoring procedures and lend credibility to the quality of volunteer data.

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References


Figure 1. Four most common watershed landuses noted by both volunteers and trainers; depicts average percentage across all sites.
Figure 2. Volunteer and trainer selection for most diverse habitat present to sample macroinvertebrates; depicts average across all sites.