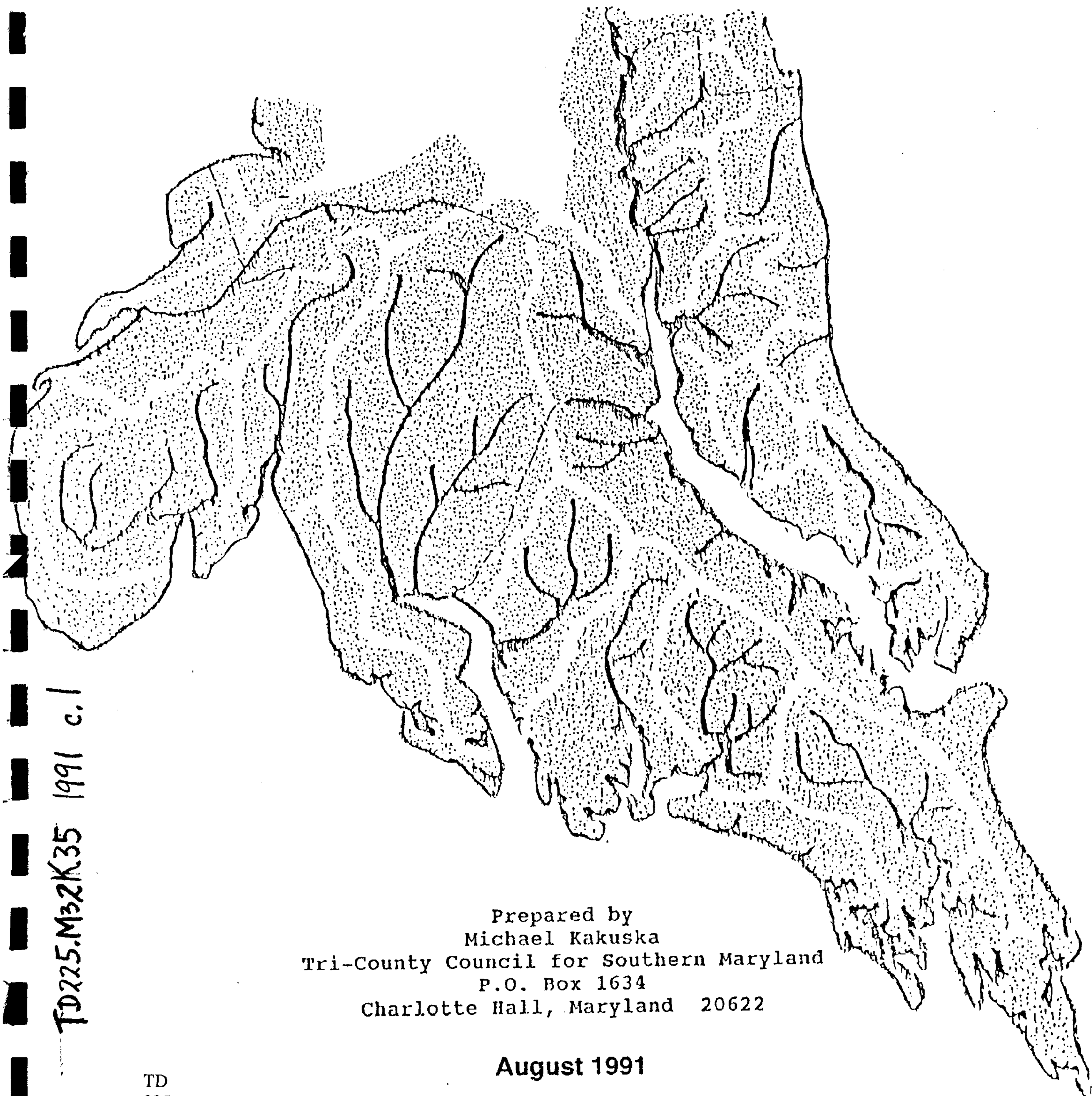
COMMUNITY STREAM SURVEYING NETWORK

Results and Recommendations



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The Tri-County Council's Environmental Specialist organized with local environmental coordinators, Maryland Save Our Streams (SOS), teachers and others to incorporate stream surveying and aquatic resources education into each county's public school curriculum. Although each county pursued the effort in their own slightly different manner, many components were similar and some very useful insights were able to be drawn.

The objectives of this surveying effort have been to:

- draw volunteer citizen support to assess water quality in the three Southern Maryland counties,
- train team leaders,
- survey streams and identify and document environmental parameters,
- assess the overall health of the surveyed stream segments, discuss the results, answer questions and suggest what can be done to improve stream quality, and finally,
- make recommendations to improve and perpetuate the program based on these trial experiences.

At the very outset, organizational meetings were held with teachers, hopefully willing to volunteer their students' efforts and serve principally as team leaders - thereby laying the foundation for the stream surveying network. Maryland SOS was very helpful and volunteered their support to describe stream surveying and promote support for each of the counties' individual programs. Nearly 30 different people became involved as active leaders throughout the region. Many others showed interest but, for one reason or another, were unable to participate. The participants reacted very enthusiastically at first and in some instances steering committees were organized to develop more specific logistical details.

Later, the local team leaders from each of the three southern counties were brought together to be trained in the field procedures, discuss questions, understand how the surveys would be conducted, and basically allow them to become more familiar and confident with the exercises. Each county's program actually became a unique synthesis of the individuals involved, specifically tailored to their own particular purposes: Calvert County's program was aimed at high school students, St. Mary's program targeted elementary and middle school students, and Charles County pursued dual programs - the first, composed of high school teachers and emphasizing biological diversity and appreciation for human impacts on water quality; and the second program being a "core" of dedicated volunteers to systematically sample the Mattawoman Creek for various chemical constituents.

In addition, teachers indicated that pre- and post-activities conducted in the classroom would be useful for focusing students' attention on the task at hand and also expand on what they learned in the field. Many of these can also be easily performed at home. Hopefully their experiences will carry them into their adult lives where they may develop additional and more significant opportunities for community involvement. We found that many students were already involved in recycling and other environmental protection activities and simply needed a previously developed framework, like the stream surveys, in which to channel their interests. The fact that these activities can be conducted in lieu of typical classroom studies also makes them even more attractive.

RESULTS

Calvert County

Encouragingly, the stream surveys coordinated in Calvert county went exceptionally well. In all, over 40 sites were surveyed utilizing the efforts of nearly 100 students, teachers and outdoor education specialists. After an initial promotional/introductory meeting, four high school teachers volunteered their classes to participate in the field surveys. From that point on, three distinct components were orchestrated to develop the necessary background materials and coordinate the operational details. These components included:

- Local coordination,
- Student preparation,
- Technical assistance.

Local Coordination

Local coordination was provided by Joann Roberts, director of environmental education at CHESPAX, a county/State outdoor education program. She was principally responsible for developing the pre-activities, described below. In addition, she arranged bus transportation, survey dates, organized equipment and served as the local contact for problems and other details, working closely with the teachers and with whom they trusted.

Student Preparation

Teachers were responsible for setting survey dates for their classes, arranging permission with parents and other teachers. They conducted the pre-activities, made sure the students would be available for the field exercises and remained on hand to maintain the general conduct of the students.

Technical Assistance

Technical assistance was provided by the Tri-County Council's environmental scientist who, working through the guidance of Maryland SOS, determined proper sampling sites, checked each sampling station for safety and accessibility (Appendix A), and also educational content; he planned the days activities and basically ensured the program would be conducted in a smooth, orderly and safe manner and also have the students back at a pre-determined time to make their connecting rides home. Most importantly, however, property owners were contacted to obtain their pemission - and in all but one instance, they were warmly receptive to the students surveying their streams.

Venturing onto private property without permission is trespassing; the owner of a given property may easily be determined by:

- Talking to folks who live nearby.

- Consulting property ownership maps prepared by the Maryland Department of Assessments and Taxation, that may be viewed either at the local Tax Assessor's office or County Planning and Zoning.

Also, in our experiences, children and teachers were covered under personal liability through their school's insurance policy, as it related to student field trips and teacher inservice. Stream surveyors not similarily covered should proceed with extreme caution because they will be responsible for their own health, safety and well-being.

Program Execution

Prior to each of the field surveys, teachers conducted various pre-activities with their students and also obtained permission from parents and other teachers having conflicting classes. The pre-activities included a video describing the biological survey, (supplied by Maryland SOS) and a mapping exercise (Appendix B) conducted the week prior to the field surveys. In addition, the day before each field exercise, the teacher walked the students through the assessment procedures (Appendix I) and helped them identify sample insects.

This last activity was particularly valuable and quite interesting. Prior to the field surveys, samples of the various aquatic insects were collected in separate vials and numbered. Unknown to the students, the insect samples were separated into three groups representing excellent, good and poor water quality streams (as described in Appendix E). Students were directed to go to each of the three stations, identify the insects and, based on what they found, assess the water quality of that sample and state their reasons. Previously, the numbered vials had been arranged in a master list held by the teacher indicating the types of insects within each vial. In this manner, the students could check to see how well they identified the insects.

In most cases, the children were fascinated by the different kinds of strange creatures found in their own backyards. Previously, they did not appreciate the diversity of life living in these streams and the fact that these "bugs" can actually reflect the quality of the water in which they are found. Overall, this activity seemed like a welcomed departure from their routine classroom activities, and generated both added interest and inquiry.

The day of each field exercise, the students boarded a school bus, taking them to a central outdoor location near an introductory stream. There, the local outdoor education specialist described the relationship between land use, water quality and diversity of these so-called "index" insects. After the presentation, the students were divided into groups of between 2 and 5 (depending on the ratio of adult team leaders to students) and issued a box of equipment (hoop and bucket, sample vials, tweezers, assessment forms, clip-board, etc...) and then boarded the bus. The bus traveled along a pre-determined route, dropping off student teams at prescribed locations. By the time the bus had released all the students (approximately 45 minutes) the driver was instructed to go back to the beginning and pick them back up again - in the same order. After this had been accomplished, the entire group broke for lunch and the different insects they collected were passed around for the others to see. After lunch, the entire drop-off and sampling procedure continued once again, on different stream segments identical to the circuit planned earlier that morning.

At the sampling stations, each team would familiarize itself with its surroundings, find an adequate riffle to test for aquatic insects and then begin the habitat assessment. After the habitat assessment was completed, the students began the biological survey, using the "hoop and bucket" method (see Discussion, page 20) - tallying and identifying the numbers and kinds of insects they found in the stream. These two tasks can be done either simultaneously or sequentially, depending on the students' preferences. Forty-Five minutes seemed sufficient to perform both tasks successively, but then there was little time left to relax. At the completion of the exercise they went back to the nearby drop-off point and waited for the bus to come around, pick them up and return them to school.

It became evident during the habitat assessment that the students often had difficulty interpreting the questions based on their limited experiences. For example, it was difficult for students to determine, for instance, "moderate" versus "considerable" erosion potential; or "minor," "common" and "frequent" bank failure. The students were able to progress through the assessment, but with some difficulty. It would therefore be extremely helpful someday to have picture presentations provided, showing students examples of the various streamside conditions they are likely to encounter. Thus, "minor cut banks" or "common bank failures," will no longer be so foreign to them.

Also helpful would be a simple dichotomous key, once again with pictures, students could use to help them identify the insects. At first glance and especially to the uninitiated, most insects look much the same. A dichotomous key, featuring yes/no questions will help focus students' attention on key anatomical characteristics and guide them through the insect I.D. If the students have time, they could also take them back to school and identify the insects in the lab.

At the completion of the habitat assessment and insect surveys, scores were tallied and the stream's habitat and water quality rated based on the students' findings. In addition, existing problems were discussed and corrective measures were suggested.

Adult team leaders were asked not to coach the students but offer assistance as needed. Students were told they were responsible for their own analyses, and it was quite surprising to see the almost exaggerated activity the students took to task. This seemed very much related to the excitement of school being held outdoors, the novelty of the activity and, to be quite honest, the overall general feeling that their participation was being secretly graded and recorded. Students, who otherwise probably refuse to perform routine chores at home, actually jumped at the opportunity to participate, and everyone performed well as team members. It was also interesting to see how adept they were at coaxing free information from their adult supervisors.

At one point, a newspaper reporter followed the students to get their perceptions (Appendix C). Most of the students were surprised, and commented with more than a little indignation on the poor water quality they found in some areas. The survey was set up so that, where possible, student teams were able to survey both a good and also degraded stream in order to contrast their mental impressions as well as their survey results.

We found the "Hoop and Bucket" method worked very well. It was better suited and easier to use in the often shallow streams we experienced: the results were less time consuming to prepare, the procedure less vigorous and therefore more interesting for the students and finally, the results seemed comparable to the seining technique - especially for our purposes. Seining would have been better suited for deeper streams where a more disciplined, and statistically valid invertebrate assessment is required. In fact, we found seining would have been cumbersome and would have probably distracted from what we wanted to accomplish here.

Charles County

Each of the three counties was a unique experience, attempting to satisfy their own particular needs. In Charles county, two approaches were taken: the first was to promote stream surveying in the public school system. Meetings were held with teachers from four high schools, Maryland SOS and county employees. Once again, a training session was held with the teachers at the Nanjemoy Creek Environmental Center, where they surveyed the streams for insects and become more familiar with the procedures.

In the second approach, seven other team leaders were trained to become familiar with various additional chemical procedures. These included tests for temperature, dissolved oxygen, phosphorous, nitrogen, biological oxygen demand, turbidity, pH, and alkilinity - using portable chemical kits. One complete set of kits cost approximately $200 and would probably allow 50 routine sample observations. The leaders would assist citizen volunteers in the chamical analyses and essentially comprise the "core" element of this second approach.

Initially, both the teachers and other team leaders showed strong interest but, as summer arrived we seemed unable to sustain the necessary support. In the first instance, the teachers went on vacation and unusually hot temperatures made stream surveying a not all too attractive outdoor activity. We anticipate pursuing this again this fall once school resumes and summer temperatures drop.

In the second instance, an ad placed in the local newspaper did not draw adequate citizen response, and the effort was temporarily set aside. Instead, a high school student volunteered his free time to perform the chemical analyses. The student was taken through the chemical procedures and later left to accomplish the surveys on his own.

He was later interviewed and stated the surveys went well, and that he thoroughly enjoyed doing them. He was able to fulfill half of his parochial community service requirements and surveyed nearly a dozen stream sites throughout the Mattawoman Creek watershed. Concerns he had included: low stream flows, safety considerations, and particularly - meaningless data.

Low stream flows often created stagnant stream conditions, and the student questioned the validity of his data. Considering this, it might be best to conduct the surveys in the future under more "representative" flow conditions in the spring and/or fall.

Another concern his mother had was for the student's safety. Some of the sample sites were located some distance beyond his parked vehicle; often he fell in, and there are ample opportunities in which to break one's leg. It would be prudent, therefore to conduct the surveys with a companion.

Lastly, the student had no idea what his results meant - is pH 7.3 good or bad? Water quality data is often extremely difficult to interpret and surprisingly, college courses on the subject really makes things no easier. One needs to take the entire picture into consideration and this can usually only be accomplished through years of practical experience and sometimes statistical analysis. Nevertheless, the student may be able to satisfy his curiosity by contrasting his chemical results with those described in appendix D. With some persistance, useful insights can nonetheless be drawn.

St. Mary's County

St. Mary's county took a somewhat different coarse of action. In the beginning, eight teachers belonging to the PACE[1] gifted and talented program attended a promotional meeting to discuss stream surveying for their teachers and students. The PACE teachers showed much interest and later participated in a training session held on both Moll Dyer's Run and also Town Run located just south of Leonardtown, Maryland. Moll Dyer's Run exhibits excellent water quality and was chosen especially for this reason. Teams of between two and three teachers went out separately and performed the habitat assessment and also the biological survey. They were pleased with the outdoor educational opportunities these activities offered their middle and elementary students.

The group then moved on to Town Run which also exhibits excellent water quality - up to a certain point. This is where a small feeder tributary enters the stream. The feeder creek drains a steeply sloped, intensively developing area and there was much associated sediment transport. Simple hand samples of rocks, twigs and leaf packs showed that the stoneflies and other insects present upstream from the tributary were missing below. There were also sediment bars, clearly the result of the ground disturbances located nearly half a mile away. The teachers enjoyed the presentation and thought it illustrated human impacts on stream quality in a manner children could appreciate. They suggested we arrange another workshop with more teachers

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[1]Program for Advance Challenge and Enrichment.

early in the Fall. This would give them time to plan and get their students involved. They particularly liked the mapping exercise, the video and actually getting out and doing the field exercises. They also pointed out that fellow teachers and students would not want to be lectured, and like that day, would prefer similar "hands-on" experiences.

Also, downstream of this site there exists a wastewater treatment effluent point, below which were found coatings of green algae resulting from effluent loadings of phosphorous and nitrogen. However, this had to be described to the teachers because we were unable to reach the site due to private property restrictions, briars and lack of available time. Nonetheless, relationships were able to be drawn between growth, urban sprawl, failing septic systems, eutrophication and the fate of the Chesapeake Bay.

Although it was too late to incorporate stream surveying into last year's curriculum, this year they said they would be better prepared; and despite the short time frame, three of the participants were still able to get some of their students out to survey streams and were anxious to start up again in the Fall. In all, 38 elementary and middle school students became involved.

The teachers had mixed success. The first teacher took three separate classes of 12 students each out to survey the stream behind their own school. Two of the three occasions they did not find a lot of insects. She attributed this to high water following recent storms, thinking it washed them away. It is possible the insects burrowed into the mud to escape the current, or the high water did not allow students to properly sample the stream. Less likely, they were killed by something toxic washed into the water - although possible.

Nevertheless, the teacher suggested that sampling take place during low flow conditions, when she seemed to have the most luck. Also,it seems that there are far fewer insects in the stream during the summer months after most of the aquatic larvae have hatched into winged adults.

As an aside and ideally, the Environmental Protection Agency suggests that insects be surveyed while they are really stressed, and summertime is the best time to take account of what will survive the dry season. On the otherhand, we found it really doesn't make for a very interesting field trip.

Sampling is probably best during fall, winter or spring, although in the winter the water is really cold. There were also other difficulties: the second teacher somehow lost track of her two student's progress and another teacher took a group of her students down to a local stream, but decided not to let them survey because of unexplained substances in the water she thought looked unsafe.

These difficulties will remain common, considering the limited background those teachers have to explain or incorporate these unfamiliar circumstances. This has not discouraged them, however. It is important to note that during each field surveying exercise all kinds of questions and observations came up; brought about by all kinds of strange kinds of insects, unusual circumstances and other interesting events unique to each event: we found nests of spawning brook lampreys, watched water striders, stumbled upon an occasional deer skeleton or turtle shell; we walked through unusually large stormwater culverts that had only a trickle of water flowing through them (anticipating large storm events from developed property), we made wishes on whirling water beetles that write your wishes in the water, we kicked-up an occasional racoon or whitetail deer, we witnesed destructive land uses, we talked about employment opportunities outdoors, and occasionally someone fell in - all in all it was great fun.

Overall, the teachers were pleased with all the activities and have volunteered their continued support. They are also talking with other teachers who may also be interested in attending another training in-service workshop this coming year. As the teachers gain more experience, hopefully they will become more confident and stream surveying may become a more routine class activity.

DISCUSSION

Lately there has been growing interest and activity concerning the development of a community-based stream surveying network, being spread throughout Calvert, Charles and St. Mary's counties. Clearly there is public need. At this time little, if any water quality data has been, or is being collected from the many stream systems draining the land and emptying into the Chesapeake Bay.

The method outlined below is probably the most cost effective means of obtaining large amounts of valuable water quality data, throughout the region, while simultaneously heightening people's appreciation for the relationships between their actions and surrounding environmental quality. The effort here reflects other successful experiences in Anne Arundel and Baltimore counties and other areas that have benefited from citizen involvement and especially the experience and guidance supplied by Maryland Save Our Streams (SOS).

The methodology presented below is based on the principle assumption that water quality is reflected in the numbers and types of insects living within a particular stream segment. For example, pollution-tolerant insects thrive in degraded waters and will usually exhibit misleading large numbers of individuals, but low species diversity. Pollution-intolerant insects, on the other hand, survive only in clean water, and upon closer inspection one will find a more diverse array of these so-called "index species".

Biological monitoring, unlike chemical and physical analysis, is a simple and inexpensive way to record a "snapshot" of a stream's health. Expensive equipment and highly skilled people are not required and unlike most chemical examinations, this method allows detection of impacts from substances that have quietly long since washed away. Examples of the stream insects and crustaceans that can be used to assess stream quality and also their sensitivity to pollution are included in Appendix E. As described earlier, pollution-sensitive index organisms can only live in excellent or good quality streams; somewhat tolerant index organisms will be found in fair quality streams and finally, an abundance of pollution-tolerant orgamisms will reflect poor water conditions.

According to another, simpler methodology developed by the Maryland Save Our Streams program (Appendix F), stream quality is rated **excellent** when stoneflies, mayflies and caddisflies are present. An excellent quality stream is suited for all human uses. If both mayflies and caddisflies are present, but stoneflies are missing, the stream is in **good** condition. Such a waterway is suited for most human uses - except drinking. If only caddisflies are present, stream quality is rated only **fair**. A fair quality stream is unfit for swimming, but may be okay for wading; it probably supports few game fish and would be a poor water supply source. If none of the insect groups are present, the stream is rated **poor**. A poor quality stream is unfit for most human uses. It is probably devoid of fish life. This method is not "scientific," nor is it as detailed as the preceding technique; but it is easy to perform and can provide useful information to help identify and target pollution problems and corrective strategies.

Either of these two methods will yield similar results however, the former accounts for a more diverse array of species that may be of interest, while the latter may be employed in sake of time or participants less experienced identifying insects. We chose the former, largely because it was more challenging to the participants and also because it more clearly illustrates the important relationship between insect diversity and environmental quality.

There are three methods, described below, that can be employed to collect the insects - based almost entirely on one's ambitions. The first is the most accurate, but is also more laborous and time consuming. This insect assessment utilizes a "kick seine" that has small 3 in. x 3 in. squares marked on it.

As indicated in the sampling procedure (Appendix G), the participants place the seine in the water immediately downstream of a gravel riffle and then a 3 ft. by 3 ft. section of substrate is agitated: cleaning rocks, sticks, sediment and other debris. Then, successive individual 3 in. x 3 in. squares printed on the screen mesh are picked clean of insects, which are placed in marked vials for later identification. Each individual square must be picked entirely clean of insects before proceeding to the next one. This activity continues until a minimum of 100 individuals have been collected. If 100 individuals cannot be found, the entire net should be examined, and duly noted on the survey sheet. The sample vials are then marked and returned to the laboratory where the insects are carefully identified and counted. Insects can be tallied in the field however, moderate experience is required to quickly and correctly identify them. Appendix H describes the Species Diversity Index (d) as it relates to water quality, or another similar approach that simply examines the number of taxanomic species. In effect, the 3 in. x 3 in. sections force the investigator to sample the stream in a strict, statistically uniform manner, eliminating the natural tendency to bias the sample by picking larger, and often more active insects.

This method offers valid "scientific" biological information and requires significantly more time, experience and patience then the "Hoop and Bucket" method we employed, described below. From our experiences, kick seining would have been better suited for larger, deeper streams than we found, where a more statistically valid assessment is required. Many of the streams we surveyed were too shallow to allow kick seining and, for our principally educational purposes, the "Hoop and Bucket" method was sufficient to meet our objectives.

As the name implies, the "Hoop and Bucket" method for invertebrate assessment utilizes exactly that: a 9 in. embroidery hoop fitted with fine mesh screening available at no charge through Maryland Save Our Streams, and of course, a bucket. The bucket is filled with water and then sand, leaf-packs, stones and twigs are vigorously agitated in the water and subsequently removed. The water sample is then poured through the hoop mesh where the insects can be identified, counted and collected in small sample vials and then recorded on a summary sheet.

This was the assessment technique that worked best for us.

A final and even simpler method is to simply grab handfuls of stones, clumps of leaves or sticks, turn them and see what is living underneath: in general, stone flies indicate excellent water quality, mayflies indicate good, caddisflies can live in fair conditions and absence of all three insects indicate poor water quality.

In order to make any meaningful sense of the biological survey, a Habitat Assessment is also performed (Appendix I) and all this information included on the final summary sheet that facilitates the data being fed into Maryland Save Our Stream's central computer system.

The Habitat Assessment rates streamside characteristics like runoff potential, streambank buffers and stability, channel capacity and sedimentation, substrate and habitat diversity, etc. ...; on a principally objective basis to arrive at an overall index score, or habitat rating. By comparing the habitat rating with the biological survey, one can usually determine the relative amount of impact to a particular stream segment.

For example, a stream showing either good or excellent habitat but having only fair or poor water quality tolerant insects, indicates a stream that is being impacted. Very often it is possible to look at the mix of surrounding land uses to determine the cause of impact. In other cases, more vigorous chemical or biological scientific analysis may be necessary. Sometimes poor insect diversity is the result of poor habitat, that can either be natural, or created by negligent human actions. Nonetheless, these impacted areas need to be identified and documented. In this manner, often limited water quality restoration efforts can be directed where they are needed most; through measures such as stormwater and sediment control devices, buffers or streambank stabilization.

Although our data is well suited as a rough estimate of stream quality, this activity was principally designed to increase students' environmental awareness. Nevertheless, our experiences show the students' data was very often consistent with surrounding environmental parameters; but realistically, quality assurance cannot be guaranteed working with inexperienced school-children, often doing this for the first time. Also, it was a tremendous amount of work finding acceptable sampling sites, obtaining permission, etc...; and the sheer logistics of the exercise really does not allow for many new sites to be sampled by more large groups of students. Instead, those resources might best be used to employ a single trained technician in the natural sciences, to compile the data in a disciplined and more meaningful fashion (discussed later) - as a matter of fact, our purposes were to inspire these students in exactly this, and also related type professions.

As one would expect, the field work described above can be time consuming and there are hundreds of miles of streams in each of the three Southern Maryland counties. The question then becomes: how can this be accomplished given the very limited staff resources and funding available for this far-reaching task?

One suggestion was to incorporate stream surveying into the public school curriculum. The benefits are clearly evident:

- employs an otherwise "captive" audience,
- utilizes a formal organizational structure - the public school system,
- adult teachers are available to lead student teams, and conduct field surveys,
- opportunities exist for related post-activities like storm drain painting, tree planting, etc.,
- young adults offer a unique constituency for environmental protection - now and in the future,
- quality of the data is usually good since the students believe they are being graded on their efforts,
- manpower is freely available,
- students employ practical applications to what they have learned in school and finally,
- it beats sitting in class.

One possible niche for stream surveying in Southern Maryland is in April, 1989 the Maryland State Board of Education enacted an environmental education bylaw (Appendix J). The bylaw specifies the purpose of environmental education and establishes the minimum program that local school systems must include within existing curricular offerings. The bylaw places particular emphasis on assisting students in applying knowledge learned in different subject areas, at both a personal, home-based decision making level and at the community level. Outdoor education and science are particular areas in which the bylaw is being implemented.

FY 92 will be the eighth year that the Department of Education has provided funds for environmental education to the 24 school systems in Maryland. Funds are used by school systems for program and curriculum development, teacher training, and the purchase of instructional materials. Funding is coordinated through the Department of Education specialist in environmental education and is currently targeted at implementation of the environmental education bylaw. In addition, teachers are always looking for interesting instructional projects for their children that they do not otherwise themselves have time to develop.

Another incentive can be found in a new package of graduation requirements proposed by the Maryland State Board of Education last March. One component would make high school students perform 75 hours of community service as a requirement for graduation. However, a decision on the proposed requirements is not set until November 1991.

By proposing the community service and other increased course requirements, the State Board of Education hopes to meet the goals of Maryland's education reform program called "Schools for Success." The graduation requirements were revised to prepare high school students for further education and employment.

Should the measure pass, Maryland will be the first state to have a public service requirement. The first wave of students affected would be those starting ninth grade in September 1993.

Opponents of the proposal say that, although they certainly appreciate the spirit of doing something worthwhile in the community, students may face trouble with transportation, especially in rural areas. They feel kids living in rural areas do not have the same opportunities to do community service as in urban areas.

But consider, Maryland is blessed with 17,000 miles of streams and rivers. These waterways are so pervasive that anyone will find a stream within a fifteen minute walk of every home in the State. Five thousand miles of Maryland's streams have already been degraded, and we are losing more each year. These streams are the source of a great economic and environmental resource; serving actually as the circulatory system for the Chesapeake Bay. Nonpoint pollution sources abound - many of which go completely unnoticed. Students can therefore help monitor the pulse of the Chesapeake Bay and even prescribe corrective measures. They can work individually, in teams or as part of classroom field visits.

Historically, teachers simply informed students. But, the emphasis now is for kids to apply what they have been taught; taking established principles, making decisions and acting upon them. Simple awareness and information is no longer enough. Rather, students need to be walked through the "doing" part. The Department of Education is currently developing a statewide criteria-referenced testing program for grades 3, 5, 8 and 11. Environmental education will be integrated into the science and social studies component of this program that will begin in May 1992. This is the beginning of a different education process that emphasizes more active involvement. Tests will require students to apply what they have learned; and kids learn and profit most when they are actively "doing" things. Hopefully, this system will produce more active citizens - and besides all that, it's fun.

Conclusions

Even though Maryland Save Our Streams takes three months to organize their 100 points monitoring effort (which has taken years and much commitment to develop), their experiences and those outlined previously indicates that there is another, possibly easier way - depending on one's objectives and especially on the incentives that one makes available to the participants.

For instance, given the amount of time, money and effort to coordinate something similar to a single 100 points stream surveying effort, it may be much easier to fund a single position in each, or all three Southern Maryland counties. That employee would be responsible for sampling select sites throughout each county for the typical chemical, physical and biological parameters, and move around between watersheds. Given the relatively short amount of time required to sample each site, the stream surveyor could probably sample as many as ten sites per day. Over a year's time, that is a lot of valuable water quality and land use data. In addition, Maryland SOS will incorporate this data into their central computer system. This information would clearly be useful, by establishing baseline conditions and also "red-flagging" those areas where corrective strategies will have the most benefit.

Assuming that stream quality data is a local priority, there are many positive aspects associated with this type of approach:

- it's simple,
- it generates large amounts of reliable information,
- and it is cost effective.

Walking entire stream segments, on the otherhand, to gather the data and identify nonpoint source pollution sources, we found, is cost prohibitive and therefore not recommended. Time would be much better spent sampling strategic points throughout the watershed, like at the mouths of tributaries and subwatersheds. In this manner, more ground can be covered and less effort will be wasted on sections that may not otherwise be impacted. Most stream segments are adequately buffered, and one quickly begins to realize this after they have spent time trying to fight their way through the thick undergrowth. In addition, most disturbances originate beyond the 100 year floodplain. Instead, sampling points at strategic locations will help identify human impacts upstream and allows problem areas to first be identified, and then targetted for more thorough investigation or corrective action, as necessary.

The single largest obstacle, of course, is lack of available funding. Charles county attempted to avoid this difficulty by employing the volunteer services of a parochial high school student seeking community service credits. The Tri-County Council is also right now attempting to attract undergraduate student interns from St. Mary's College. Regardless, lack of adequate funding incentives does not allow any routine or continuous sampling program and so far, hamstrings most efforts for meaningful data collection.

On the other hand, another possibility, as indicated in this report, is to incorporate stream surveying into the public school curriculum, to develop a more impressionable educational slant, and also attack the problem at the source. This was accomplished very successfully in Calvert County and large strides gained in St. Mary's and Charles counties. This success seemed particularly dependent on the strong commitment and planning efforts coordinated among the local participants.

However, there are still many difficulties to be overcome; the largest of which centers around competing classes. It was difficult for teachers to schedule an entire day for their students to go out and sample streams. Other classes had tests and important lessons that were missed and had to be made up; and there were also music and sporting events, each with their own conflicting interests. Nevertheless, if Calvert County can maintain the same strong commitment it has received from its outdoor education director and local teachers, it will have clearly established itself a successful model for a self-sustaining stream surveying network. Also, the environmental bylaws and the prospects for community service requirements can only enhance participation, since stream surveying is easy, it's fun and not surprisingly, many students are genuinely concerned for the condition the Chesapeake Bay will be left for them.

Ideally, stream surveying to satisfy community service requirements needs to be expanded and promoted throughout the three southern Maryland counties. First of all and most importantly, there is strong incentive: it would be required for students to graduate, it helps save the Chesapeake Bay and besides all that, it's fun. Community service would allow students to survey streams on their own time and possibly team up with their friends. This would allow much greater flexibility, reduce conflicts and open up more strategic sampling sites that are otherwise not available to the typically large groups of students on field trips, limited by the relatively few stream crossings accessible to school buses. Community service would encourage stream surveying on students' own time, after school and on Saturdays - thereby avoiding conflict with other classes. The activity would be less costly, requiring far less adult supervision and organization and finally, stream surveying has many educational and professional spin-offs. If nothing else, students may receive a certificate recognizing their efforts (Appendix K).

Community service requirements need to incorporate and take advantage of these many fine environmental and educational activities to monitor the pulse of the Chesapeake Bay - at the same time harness the excitement and challenge of once again being young, but otherwise confined to a desk sitting in school.

RECOMMENDATIONS

Given the limited funding for the project, it seemed tremendously successful: an activity framework was developed and tested, valuable insights were gained, and over 50 sites were sampled throughout the southern region in this very first year. But most importantly, we gained a toe-hold for stream surveying in the southern region by organizing a core of team leaders in each of the three southern counties. As the word spreads, we hope that people will become more curious about the stream quality flowing through their own backyards, and go out and investigate their streams using the methodology described here that their children may bring home.

But to begin with, we found initiating a successful surveying effort very much centers around providing adequate incentives: it is very difficult to ask someone else to work free of charge that you, yourself would be reluctant to perform. Yes, people care for their environment and yes, there are those select individuals that will without hesitation volunteer their Saturdays to survey streams on a hot summer afternoon; but finding these individuals and organizing single events takes considerable time and effort - witness the Maryland Save Our Streams' 100 points monitoring program in Baltimore county, which takes three months to organize and another two months to identify the insects (Appendix L) - and they possess the funding, staff experience and standing reputation for environmental activism, as well as a pre-existing, centralized network for successfully drawing citizen support.

This became particularly evident last season. Local stream surveying events advertised in Calvert and Charles counties drew not a single participant. Team leaders, composed primarily of government employees were present, but no private citizens showed up. This must in no way reflect the fine efforts of the organizers but rather, human nature - after a hard weeks work, people probably find better activities to occupy their precious free time. Many of the teachers involved were also reluctant to commit to any formal or routine sampling program and preferred instead to remain very flexible and do much at their own leisure.

Nonetheless, a few final simple guidelines will help get the most out of local surveying programs:

- Provide adequate incentives.
  - Hire a single, full-time intern stream surveyor.
  - Take advantage of environmental bylaws and community service requirements to enlist interested students.
  - Incorporate stream surveying as a classroom activity.
- Identify and enlist the support of key community organizers: scout leaders, science teachers, environmental coordinators, etc. - and do not forget media exposure.

- Ensure that momentum does not expire, through close coordination and follow-up.

- Sample at strategic locations: near road crossings and at tributaries, and look back up at the surrounding watershed.

- Most importantly, have fun. Stream surveying is an excellent excuse to get outdoors - you will find every event results in a tremendously unique and satisfying experience.

Appendix A

SAMPLING STATION INVENTORY FORM

STATION NO:________________DATE:____________________TIME: AM PM_______

STREAM:__________________________LOCATION:____________________________

INVENTORIED BY:____

YES NO Is there safe, convenient parking for at least one car? A car should be able to pull fully off the road. The parking location should be located within a convenient walking distance from the stream. Please describe any other parking factors:_______________

____

YES NO Are "No Trespassing" signs ABSENT on at least one side of the stream crossing? If both sides of the crossing are posted then we will either drop the sampling station or attempt to secure the property owner's permission. Please describe where, if any, signs are posted:____

____

YES NO Is there a safe, easy way to get down to the stream? We want to avoid sending people to stations where they have to climb steep, dangerous, banks; crawl through dense patches of thorns; or come in contact with vicious dogs. Please describe any accessibility factors:____

____

YES NO Can you see at least one riffle from the crossing? A riffle is a place where the stream flows shallow and swift over stones or boulders. Since the sampling can only be performed in riffles, these channel forms must be present. If no riffle is visible from the crossing, please give general location of first visible riffle:

____

____

Please note any other factors which may affect the suitability or safety of the station:____

____

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Appendix B

MAPPING THE WATERSHED

What is a Watershed?

Not everyone lives by a stream, but we all live in a watershed - the ultimate source of every stream.

A watershed, or stream basin, includes the entire area - visible and invisible - drained by a particular creek or river. The visible area is the landscape on which rain and snow fall. Surface water then runs off into streams and rivers or collects in lakes or in shallow depressions, which are collectively called wetlands.

The larger, invisible portion of the watershed lies beneath the surface, within the permeable soils and rock which act like a giant sponge. There, rainwater that has infiltrated the surface collects as groundwater above deep impermeable layers or rock or clay.

This underground water flows in tiny pores between the soil particles, through rock caviites and fractures, and along underground channels, following the slope of the underlying solid rock until it drains into a stream channel. If the water table (top of the groundwater) is above the level of the stream bed, water flows from springs, seeps from the stream banks, or bubbles up through the streambed into the stream channel to run out as stream flow.

The quality of a stream or a river is a product of what happens along the stream bank and in the watershed. In a watershed which has been transformed into housing developments, parking lots, farms, businesses, and highways, many potential water pollution sources exist. Eventually, pollution from these sources will effect stream's ability to support fish or other living things.

1. List some sources of point source pollution found in a watershed that may effect the environmental "health" of a stream. ____________________________________

____

____

2. List some sources of non-point source pollution found in a watershed that may effect the environmental "health" of a stream. ____________________________________

____

____

Purpose of activity:

* To map the watershed of the stream that you will survey
* To identify the land use of the watershed
* To predict any potential sources of pollution which may effect the environmental quality of the stream that you will survey

Materials:

Topographic maps	fine line magic markers or
Land Use maps	colored pencils
Highway maps	acetate sheet

Procedure:

1. Locate the stream that you will survey on the topographic map. Find where the stream starts and where it empties into the next largest stream or river.

2. Mark the stream and its tributaries with a fine line blue magic marker so that it can be readily distinguished from the surrounding detail.
3. Using contour lines as your guide, trace the perimeters of the watershed with your pencil.
a. each of the contour lines around the stream represents a 20 ft. rise in elevation. Approximately every fifth line is slightly darker than the rest. If you follow this line yo will find a number printed on it. This is the elevation of that point above sea level.
b. Place your pencil on the stram at any point along its course. Move it uphill perpendicular to the stream, as if you were walking uphill away from the stream. When you get to the ridge or the highest point, put a mark there. Do this first on one side of the stream and then the other.0
c. Repeat step 4 at the other intervals all along the stream from its mouth to the headwaters. You will now have an irregular semicircle of dots froming a halo around the stream.
d. Connect the dots. All the land area within the halo drains into the stream that you are studying. Any sources of pollution that you observe in the stream that you will survey may come from anywhere within the area upstream from your survey location, but generally from nowhere else.
e. When you are sure the watershed boundary is accurately marked, go over the pencil marks with a red magic marker. You should have a picture looking something like this:

4. Place an acetate sheet on top of the watershed map and secure it with tape. Trace the stream in blue and the watershed in red onto the acetate sheet.
5. Using Land Use maps and highway maps, add prominent land marks (highways, towns, housing developments, sewage treatment plants, parking lots, shopping centers, etc.). You may want to find out more about this area on your own to determine if there has been any changes in land use in the last several years.
6. Using the map that you have constructed, list any potential sources of pollution which may effect the environmental quality of the stream that you will study.

____
____
____
____
____

7. How could you possibly test the stream to see if these kinds of pollution where actually present?

____
____
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8. List any county, state, and federal agency that you would contact if you discovered a serious pollution problem in a stream. (You may want to use the blue pages of the phone book to give you some ideas.)

County ______________________________
State ______________________________
Federal ______________________________

David Ropiski

Brandi Marstaller, a 16-year-old Calvert High School student, checks for signs of life in a stream off German Chapel Road in Prince Frederick. Marstaller was with a group of Calvert High Schools students who spent part of their morning on Wednesday surveying local streams for their environmental science class.

Raising their consciousness

Environmentally speaking

David Ropiski
Staff Reporter

On Wednesday a group of Calvert High School students were sent out on a mission to survey four different streams in Calvert County and record their health.

This was one of many groups from both Calvert and Northern high schools who are currently enrolled in environmental science classes. The stream surveys are a way that students see first hand the effects of pollution that will ultimately affect the Bay or the Patuxent River.

"Too often we teach out of books," said Jo Ann Roberts, coordinator of the CHESPAX. Roberts said the stream surveys give a chance for the students to gain hands-on experience dealing with environmental problems on a local level.

The CHESPAX program, started two years ago, is designed to help students in Calvert County public schools have a better understanding of the environment. The program, which uses Kings Landing Park as its operating base, also uses other local parks such as Jefferson Patterson Park, Flag Ponds, Battle Creek Cypress Swamp and the Calvert Marine Museum to help educate the students about the environment.

The students were divided into four different groups. Each group went to various streams that surround the Battle Creek watershed. Armed with strainers, rubber boots, and a clipboard with a survey sheet, the students went to work.

To determine the health of the streams, the students would grab a handful of leaves and twigs in the stream bed. They put the leaves in a strainer to see what kind of organisms live in the stream. They also calculated the water flow in the stream by placing a small twig in the water and timing it for a set distance. Other general observations about the stream and the surrounding area were also used for analysis.

Many of the students who surveyed the streams were surprised at their condition. "It was pretty bad," said 15-year-old Ron Jetmore of Solomons. Jetmore said the stream he surveyed had very little life in it.

Craig Johnson, 17, of St. Leonard said he wasn't surprised at the condition of the

See SURVEY, Page A-8

Students study streams in Calvert

SURVEY, From Page A-1

streams. "I was expecting it to be pretty bad," he said.

When asked why he took environmental science, 17-year-old Chris Perrygo replied, "To become more environmentally aware of the area around us."

Paul Weil, 17, of Lusby said he enjoyed doing the stream survey. "These field trips make it fun and you learn something at the same time."

Shawn Peters, 18, of Chesapeake Beach said the environmental science class has given him a better understanding of the environment and the ecologymovement. "I kind of looked at environmentalists and thought they were a bunch of radicals," said Peters.

Michele Fuson of Lusby said she was interested in environmental issues before she took the class. "I knew there were environmental problems but I have become more aware of them now. There were some problems that I didn't even know about."

David Kistler, their teacher at Calvert High, said that doing the field research is good way to help the students learn more outside of the classroom. "I think it's great for the kids," he said. "They learn a lot more then they would in the classroom."

Michael Kakuska, environmental scientist for the Tri-County Council for Southern Maryland, is helping with the stream surveys.

According to Kakuska the council is trying to get community stream surveys in all three counties so the health of local streams can be recorded and studied. "There is no data on any of these streams in the three counties," said Kakuska.

Kakuska said that preliminary results are not good. "Many of the streams are being affected by development." Sediment run of from construction sites seem to b one of the major factors in th health of the streams, he said.

After the surveys are complete the finding will be shared with the Save Our Streams organization, which will add the information to a data base on the streams and provide baseline data for monitoring the health of the streams.

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DESCRIPTION OF CHEMICAL PARAMETERS

Water Temperature was measured with a YSI (Yellow Springs Instrument Corporation) Tele-thermometer. The temperature of a stream is controlled by shading vegetation, groundwater inflow (which in this area averages 55°F year-round), air temperature, wind and the volume of the stream. WRA regulations state that the temperature of natural trout waters (Class III) may not exceed 68° F. Recreational trout waters (Class IV) cannot exceed 75°F and all other waters cannot exceed 90°F. The Big Gunpowder Falls below Loch Raven and its tributaries are classified as Class I, waters. Additionally, Save Our Streams recommends that factors, which would change' natural stream temperature by more than 2°C, not be allowed to occur. Such factors may include heated discharges (cooling and process water), removal of bank vegetation, storm water runoff from paved areas, and so forth.

Dissolved Oxygen was measured with a YSI Model 57 Dissolved Oxygen meter. The meter was calibrated, before and after the survey, with the air saturation method. The amount of oxygen dissolved in a stream is primarily affected by temperature, algae and organic substances. For any given temperature there is a limit to the amount of oxygen water can hold in solution. This limit is known as the saturation value. For the temperatures occurring during this study the saturation value averaged 10.0 mg/l. Normally, an unpolluted stream will exhibit dissolved oxygen values within 80% to 120% of the saturation point. Values lower than these, during the day, may indicate the presence of an excessive amount of organic wastes. Dissolved oxygen levels in excess of 120% of saturation may indicate an excessive amount of algae growth.

Specific Conductance (conductivity) was measured with a YSI S-C-T Meter. This parameter expresses the rate at which water will conduct an electrical current. The conductivity of a solution is determined by the amount of ions present. The greater the ionic content the greater conductivity will be. In limestone areas conductivity will range between 100 to 400 micro mhos per centimeter (umhos/cm). In other areas conductivity should be between 50 to 150 umhos/cm. Values higher than these usually indicates a pollution situation.

pH was measured both in the field, with an Orion Specific Ion Meter and by the WRA labratory. WRA regulations require that pH be between 6.0 and 8.5 in all water classes. Limestone streams normally exhibit pH values between 7.5 and 9.0, while other streams will usually range from 6.0 to 7.5. pH values below 6.0 indicate the presence of acidic conditions which may be due to industrial discharges, acid rain (possibly), mine drainage, and so forth. Alkaline readings, above 9.0, may result from the presence of a caustic pollutant such as concrete washings, industrial sodas, and others.

Suspended Solids was measured in the WRA labratory. Solid particles, suspended in the stream, include any matter that is not dissolved and, therefore, will not pass through a filter with 0.45 micron (0.0000176 inches) openings. These solids usually include algae cells, soil particles, particles of leaves and other organic matter, and a variety of similar items. While the U.S.EPA recommends that suspended solids be less than 25 mg/l, unpolluted streams normally have less than 10 mg/l of suspended solids.

Courtesy: "Charles County Stream Quality Study," June, 1980; Richard Klein, Maryland Save Our Streams

Dissolved Solids was measured in the WRA labratory. Being somewhat the opposite of suspended solids this parameter includes all matter that will pass through a filter having 0.45 micron openings. It may include small molecules or ions. Usually, dissolved solids will be less than 200 mg/l. Although limestone waters may exhibit concentrations greater than this under natural conditions. When the level of dissolved solids exceeds 200 mg/l a pollution source may be suspected.

Turbidity was measured in the WRA labratory. Turbidity is a measure of the amount of light water will transmit. It is affected by any matter present in a suspended or colloidial state. As such, turbidity does not measure a precise substance but a general characteristic. Substances such as algae cells, suspended soil particles, and colloids such as milk, will affect turbidity values. Normally, turbidity will be less than 10 FTU's.

Organic Nitrogen was measured in the WRA labratory. Generally, this parameter reflects the quantity of nitrogen present in organic compounds such as proteins and amino acids. But it does not include all nitrogeneous organic material. Organic nitrogen serves as a source of nourishment for stream dwelling micro-organisms and may account for the bulk of oxygen depleting materials in polluted streams. Normally, an unpolluted stream will have less than 0.40 mg/l of organic nitrogen as N.

Ammonia was measured in the WRA labratory. Ammonia is a decomposition product of organic nitrogen. It may serve as a nutrient source for algae and other aquatic plants. At high concentrations it can be toxic to aquatic life. Usually, ammonia levels are below 0.05 mg/l as N. Levels higher than these like high organic nitrogen levels, usually indicate a source of organic waste.

Nitrite was measured in the WRA labratory. Nitrite is an oxidation product of ammonia. It is quite unstable in the stream environment and is quickly converted to nitrate. It may serve as a plant nutrient and can be toxic in high concentrations. Normally, values in unpolluted streams are less than 0.010 mg/l as N. Sources of high nitrite values may include organic waste particularly when oxygen levels are depleted.

Nitrate was measured in the WRA labratory. Nitrate is the most readily utilized nitrogen source for plant growth. It is converted from nitrite and can be toxic in high concentrations. At levels above 10 mg/l as N, nitrate can be toxic to human infants. Sources of high nitrate values includes excessive fertilizer use and organic wastes. Normal levels of nitrate are usually less than 3.00 mg/l as N, in freshwater streams.

Total Phosphate was measured in the WRA labratory. Phosphorus is a nutrient essential to plant growth. And phosphate (PO4) is the most readily usable form of phosphorus. Total phosphate includes all forms of phosphate occurring in a stream sample. Values are usually less than 0.10 mg/l as P. Levels higher than this may indicate a source of organic waste or excessive fertilizer use.

Ortho Phosphate was measured in the WRA labratory. Of the various forms of phosphate the ortho is the most readily utilized. Values in unpolluted streams are normally less than 0.10 mg/l as P.

Total Organic Carbon was measured in the WRA labratory. This parameter measures all organically bound forms of carbon. It can be used as a measure of the amount of food material available to micro-organisms. Sources of high TOC readings include any input of organic wastes. Sufficient data does not exist to give maximum values in unpolluted waters.

Total Acidity was measured in the WRA labratory. Normally, total acidity will be less than 4.0 mg/l as CaCO3. Sources of levels higher than this include industrial waste, mine drainage, acid precipitation, swamp drainage, and so forth. An acidic input to a "free-stone" stream can exert considerably more damage than an equal amount of acid released to a limestone water. The high carbonate content of the limestone stream will buffer and neutralize the acid. Free-stone streams lack this carbonate buffer. Additionally, most headwater streams, except those draining limestone, have an appreciably lower buffering capacity than larger creeks.

Sulfate was measured in the WRA labratory. Sulfate may stem from precipitation, geologic weathering or normal biological activity. Levels are normally less than 50 mg/l as S. Higher values may be due to organic waste or mine drainage.

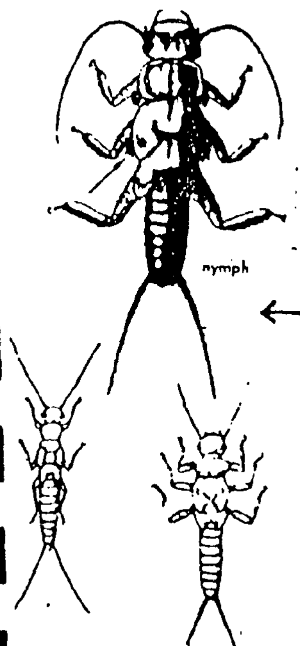
Total Alkalinity was measured in the WRA labratory. Being the opposite of acidity, alkalinity is defined as the ability of water to neutralize an acid. In limestone streams alkalinity may range from 50 to 200 mg/l as CaCO3. Freestone waters normally exhibit alkalinities of less than 50 mg/l as CaCO3.

Total Hardness was measured in the WRA labratory. Hardness reflects the quantity of calcium and magnesium present in a stream sample. Like alkalinity, hardness is greater in limestone streams than freestone. It is uncertain as to what "normal" levels should be. When hardness is high, yet alkalinity is low, a stream quality problem may be present.

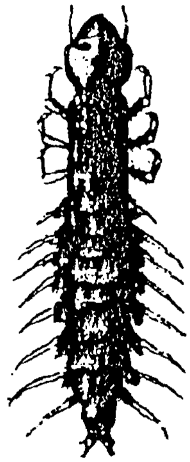
Chlorides was measured in the WRA labratory. Chloride is an ion of the element Chlorine. Under natural conditions it stems from the movement of water through soil and rainfall. Usually, chloride levels will be between 8 to 12 mg/l as Cl^-, in an unpolluted stream. Higher values may result from sewage entry into a stream or road salt applications upon the watershed. In heavily developed watersheds it is not uncommon to find high chloride values in mid-summer when sewage is not present in the stream. Salt spread upon winter streets can soak into adjacent soils and continually leach into nearby streams throughout spring, summer and into fall. Chlorides may become toxic to aquatic life at levels as low as 400 mg/l as Cl^-.

Stream Insects & Crustaceans

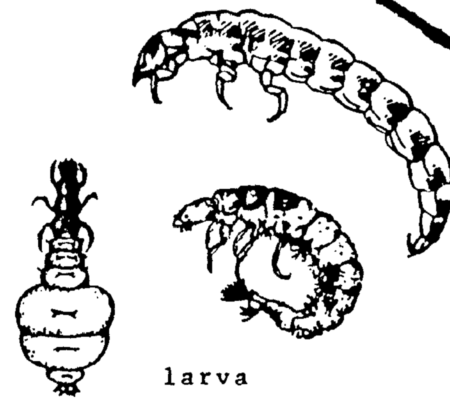
GROUP 1 TAXA – GOOD WATER QUALITY



STONEFLY:
ORDER PLECOPTERA
1/2 - 1 1/2", 6 legs with hooked tips, long antennae, 2 hair-like tails.

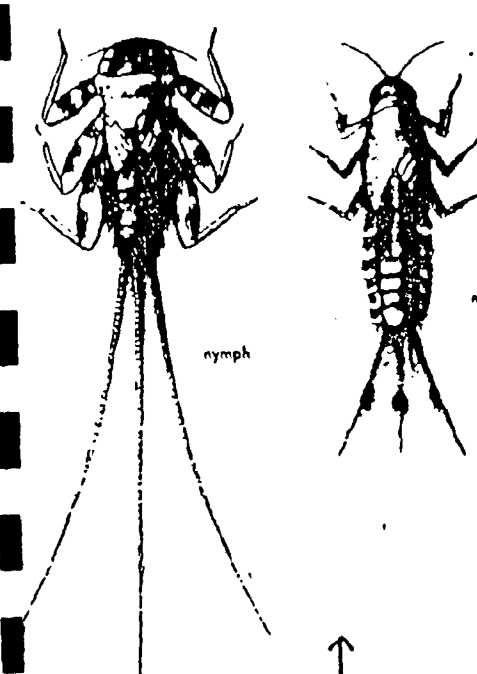


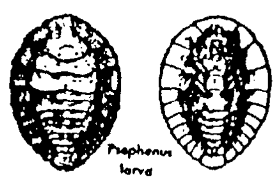
DOBSONFLY (HELLGRAMMITE):
SUBORDER MEGALOPTERA
3/4 - 4", dark-colored, 6 legs, many long feelers on lower half of body, short antennae, 4 hooks at back end.



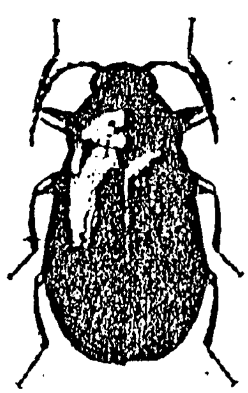
larva

CADDISFLY:
ORDER TRICHOPTERA
Up to 1/2", 6 hooked legs on upper third of body, 2 hooks at back end. May be in a case, with its head sticking out.



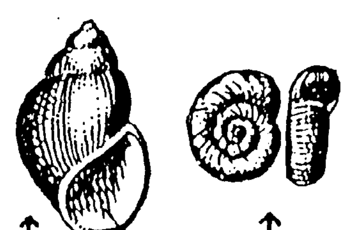


WATER PENNY: ORDER COLEOPTERA
1/4", saucer-shaped body with a raised bump on one side and 6 tiny legs on the other side. Immature riffle beetle.



RIFFLE BEETLE: ORDER COLEOPTERA
1/4", oval body covered with tiny hairs, 6 legs, antennae.

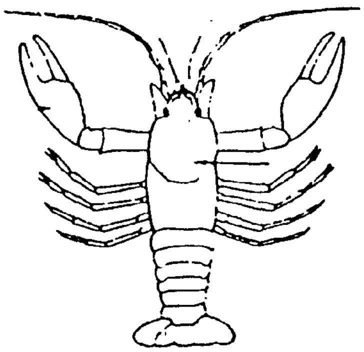
MAYFLY: ORDER EPHEMEROPTERA
1/4 - 1", brown, plate-like gills on sides of body, 6 large hooked legs, many long feelers on lower half of body, antennae, 2 or 3 long hair-like tails.



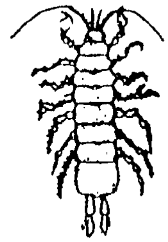
OTHER SNAILS:
PHYLUM MOLLUSCA
Shell opens on right or in center.

Courtesy: Maryland Save Our Streams

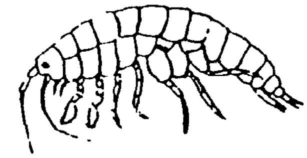
GROUP 2 TAXA — FAIR WATER QUALITY



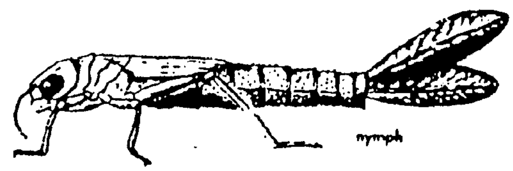
CRAYFISH:
ORDER CRUSTACEA
1/2 - 6", 2 large claws, 8 legs, resembles small lobster.



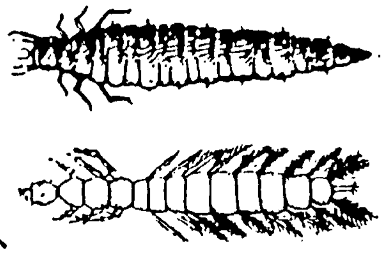
SOWBUG: ORDER CRUSTACEA
1/4 - 3/4", gray oblong body wider than it is high, more than 6 legs, antennae.



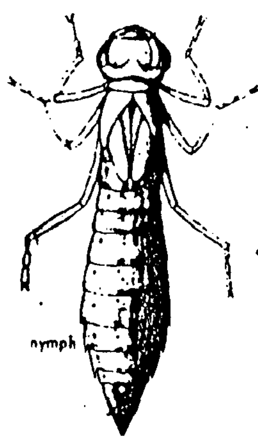
SCUD: ORDER CRUSTACEA
1/4", fat body higher than it is wide, swims sideways, more than 6 legs, resembles small shrimp.



DAMSELFLY: ORDER ODONATA
1/2 - 1", large eyes, 6 hooked legs, 3 broad oar-like tails.



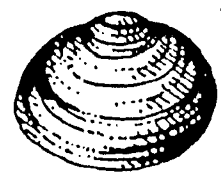
BEETLE LARVA:
ORDER COLEOPTERA
1/4 - 1", light-colored, 6 legs on upper half of body, feelers, antennae.



DRAGONFLY:
ORDER ODONATA
1/2 - 2", large eyes, 6 hooked legs.

CLAM:

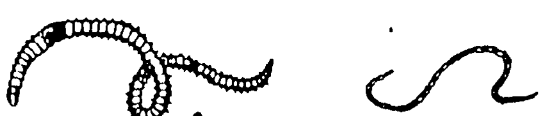
PHYLUM MOLLUC



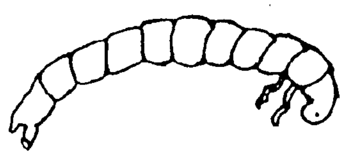
WATERSNIPE FLY LARVA:
ORDER DIPTERA (ATHERIX)
1/4 - 3/4", green, many caterpillar-like legs, conical head, feathery "horn" at back end.

CRANE FLY: ORDER ODONATA
1/3 - 2", green or brown, plump caterpillar-like segmented body, finger-like lobes at back end.

GROUP 3 TAXA — POOR WATER QUALITY

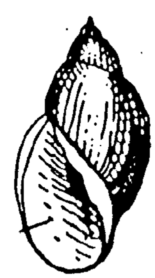


AQUATIC WORM: ORDER OLIGOCHAETA
1/4 - 1", can be very tiny, thin worm-like body.



MIDGE FLY LARVA: ORDER DIPTERA
Up to 1/4", worm-like segmented body, 2 legs on each side.

POUCH SNAIL:
PHYLUM MOLLUSCA
Shell opens on left.

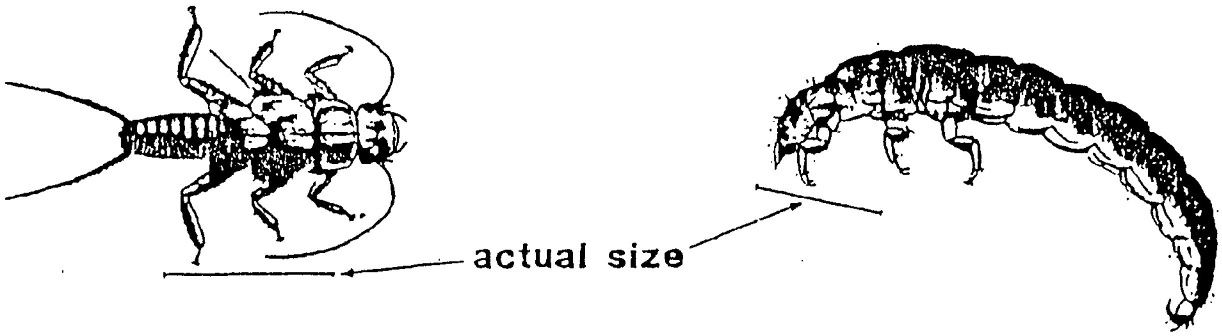


LEECH:
ORDER HIRUDINEA
1/4 - 2", brown, slimy body, ends with suction pads.

BLACKFLY LARVA:
ORDER DIPTERA
Up to 1/4", one end of body wider, suction pad.

Stoneflies
(Order: Plecoptera)

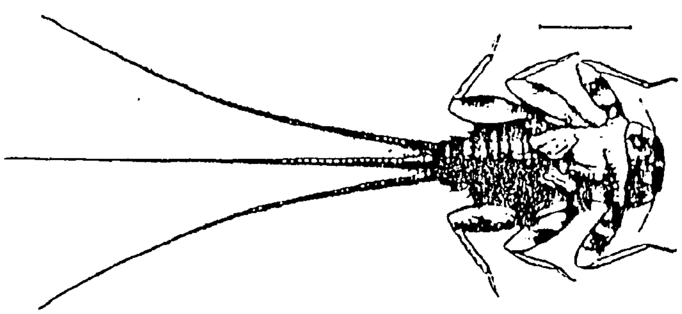
Caddisflies
(Order: Trichoptera)

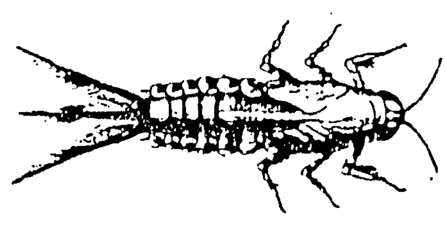


Roachlike body, 2 tails, and each leg tipped with 2 claws.

Maggotlike body and 6 distinct leg:

Mayflies
(Order: Ephemeroptera)





Roachlike body, 2 - 3 tails, and each leg ends in a fine point.

Appendix G

KICK SEINE SAMPLING PROCEDURES

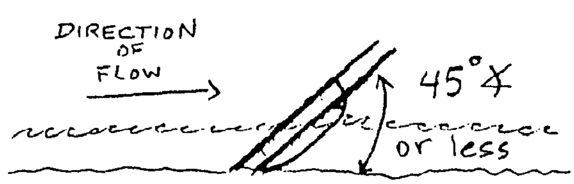
1. Walk a 100-foot section of the stream. The section should begin at least 100-feet from any human-made modification of the channel, such as a bridge, dam, or pipeline crossing. **Avoid walking in the stream, since this may dislodge insects and alter the sample results.** Compare all of the riffles within the 100-yard section in terms of speed of water flow and the size of stones lying upon the bed. The kick-seine sample will be collected in the riffle with the greatest speed of flow and largest stones.

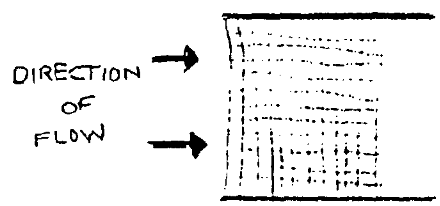
2. Select a 3-foot by 3-foot sampling area within the riffle where the speed of flow and stone size is greatest.

3. Complete the "Habitat Assessment" form in the packet.

4. Wash the net off and check it to make certain no insects remain from the last time the kick-seine was used.

5. Place the net along the downstream edge of the sampling area. The seine should be perpendicular to the water flow. Hold the seine handles so they create at most a 45 degree angle with the water surface. Make certain that the bottom of the net lies against the stream bed, otherwise insects may wash beneath the seine.





6. While one person holds the seine the second person should pick up any stone within the sampling area which has a diameter greater than 3-inches. Each stone should be held submerged against the upstream surface of the net, while the entire surface is vigorously brushed with the hands to dislodge any attached insects. Try to stay out of the sampling area to avoid biasing the sample. The thumbs should be used to break off any bumps that may house insects on the surface of each stone. When you think you've dislodged all the attached insects carefully examine the surface of the stone for any remaining organisms. If you're satisfied that it's clean, then carefully place the stone back where you found it and go on to the next.

7. When you've brushed all of the stones, then step into the sampling area at the upstream edge. Note the time on the second hand of a watch and begin vigorously disturbing the bed with your feet. Try to dig down at least 2-inches into the stream bed. Stir the bed sediments all around within the sampling area. Continue working the bed for at least 60 seconds. At the end of the 60 second period you should have disturbed the entirety of the 3-foot by 3-foot sampling area. If at that time, the bed is not entirely disturbed, continue working the bed for another 30 seconds.

8. Now remove the seine from the stream without allowing any of the insects to wash off the netting. While one person holds the seine handles, a second person should grab each handle close to the stream bed. Now, remove the seine from the stream with a forward scooping action. In this way you can use the force of flowing water to hold the insects on the net.

9. After removing the seine from the stream, carry it to a flat, sunlit spot on the stream bank.

10. Now, you're going to transfer insects from the net into one of the alcohol-filled vials you were provided. Be certain to place the vial on a stable spot where it will not spill. The kick-seine is marked off in 3-inch by 3-inch squares. Note which square has the AVERAGE amount of debris. Remove all of the insects from this square. As you transfer each insect to the alcohol-filled vial, call out the type to a second person. This second person should record each insect type on the Aquatic Insect Tally portion of the Sampling Station Data form. Use pencil to record this information and all other information. When you think you've gotten all of the insects out of this first square, then bring your eyes within a couple of inches of the net. Stare at the net for 15 seconds. If nothing moves, then you're finished with that square. If you have less than 100 insects, go on to the next AVERAGE debris-covered square. Repeat the process described above. If you still have fewer than 100 insects after picking this second square clean, then go on to a third square, and so on. You may need to pick insects off the entire net. Record which squares you picked clean on the "Insect Tally Form".

11. There are only four types of indicator insects we'd like you to note: stoneflies, mayflies, caddisflies, and midges.

STONEFLIES have roach-like bodies, long tails, and scurry about the net when prodded with the tweezers.

MAYFLIES also have roach-like bodies and long tails, but they tend to sit still when poked with the tweezers while raising their tails in the air.

CADDISFLIES have maggot-like bodies (or worm-like/caterpillar-like), six distinct legs, and they curl up when poked with the tweezers.

MIDGES also have maggot-like bodies, but appear to lack legs or have two stubby looking projections which might be legs. Midges also tend to be small; some look like a piece of hair wiggling on the net.

All other insects should simply be recorded as "OTHER".

12. When you have removed the insects from the net, complete the "Sampling Station Data Form" and fill out the small paper tag. BE CERTAIN TO USE A PENCIL, NOT A PEN BECAUSE THE INK WILL RUN IN THE ALCOHOL! Insert the paper tag inside the vial so that the writing can be seen clearly.

13. Wash the net out in the stream and check it to make certain that no insects remain attached.

14. Before leaving the site, make certain that you have the forceps, magnifying lenses, pencils, and the rest of your sampling equipment.

AQUATIC INSECT TALLY

Please use hatch marks to record each insect type.
For example: = 7

STONEFLIES:

(armor-like, 6 distinct legs, toes end in 2 claws, 2 tails, scramble about when prodded)

______________________________ TOTAL_______

MAYFLIES:

(roach-like, 6 distinct legs, toes end in 1 claw, 2-3 tails, raise tails when prodded)

______________________________ TOTAL_______

CADDISFLIES:

(caterpillar-like, 6 distinct legs, no tail, curl-up when prodded)

______________________________ TOTAL_______

MIDGES:

(tiny, hair-like, no distinct legs or with stubby projections)

______________________________ TOTAL_______

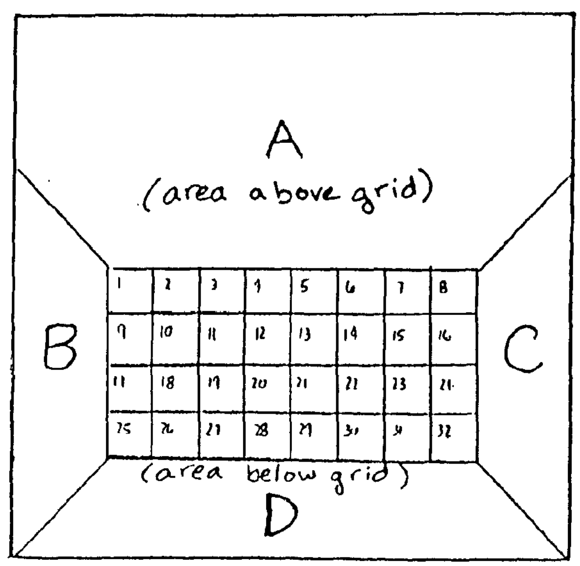
OTHER ORGANISMS:

(any other organism not belonging to above insect types)

______________________________ TOTAL_______

TOTAL NUMBER OF INSECTS COLLECTED:_________

Please mark (x) on this representation of the kick-seine the corresponding number and/or letter section(s) of the seine used to collect the aquatic organisms.



Initial Stream Quality Rating: (Please Circle One)

a. EXCELLENT: stoneflies, mayflies, caddisflies, midges present
b. GOOD: stoneflies absent; mayflies, caddisflies, midges present
c. FAIR: stoneflies, mayflies absent; caddisflies, midges present
d. POOR: stoneflies, mayflies, caddisflies absent; midges present

If you rated the stream FAIR or POOR, do you have any ideas what the reason for the degradation might be?

Appendix H

DESCRIPTION OF BIOLOGICAL PARAMETERS EXAMINED

In any healthy environment one normally finds many different kinds of life with each kind or taxa, represented by relatively few individuals. As environmental quality declines the most sensitive organisms are eliminated. This leaves a greater quantity of food and cover available for the more pollution tolerant organisms. Additionally, the disappearance of other organisms reduces predation and competition for the remaining creatures. As a result, a decline in environmental quality normally produces fewer taxa but a greater number of individuals per taxa - where before 12 taxa may have been represented by 10 individuals each, following degradation only 6 taxa may have remained but with 20-40 individuals per taxa.

The relationship described above can be examined through an equation known as the Species Diversity Index ($\overline{d}$). This equation yields a number between 0.00 to 4.00. The lower the index value the more stressed the environment. The diversity index can be translated into a verbal rating according to the following table.

SPECIES DIVERSITY INDEX	RATING
4.00 - 3.00	EXCELLENT
2.00 - 2.99	GOOD
1.00 - 1.99	FAIR
0.00 - 0.99	POOR

Another approach is to simply examine the number of taxa. Through this approach a quality rating can be determined as follows.

NUMBER OF TAXA	RATING
11 or more	EXCELLENT
7 - 10	GOOD
4 - 6	FAIR
0 - 3	POOR

Additionally, one should take a look at the number of organisms per square foot of stream bed sampled. Normally, an "unpolluted" stream will support 15 to 30 organisms, per square foot of bed when all taxa are combined. A lesser number of organisms, per square foot, may indicate stream quality degradation due to a toxic substance or a physical impact. Greater number of organisms usually indicate an enriched stream condition such as that resulting from the entry of livestock or human body wastes. High nutrient levels may also produce an abundance of organisms per square foot. But, like all the approachs given, the use of these general "rules of thumb" should be done carefully. A recent flood could greatly reduce the number of organisms per square foot. And limestone streams tend to naturally support a greater number of individuals.

Finally, one should examine the relative percent of sample population accounted for by each taxa. When one kind of creature greatly outnumbers all others a problem is usually indicated. Also each taxa has its own stream quality preferences. An abundance of clean water organisms would obviously indicate a healthy stream system.

Courtesy: "Charles County Stream Quality Study" June, 1980; Richard Klein, Maryland Save Our Streams

Throughout Maryland some 230 genera of insects are known to inhabit streams and rivers. These genera are contained within 10 orders, seven of which can be considered as common. When a stream sample is dominated by any one order it is possible to make gross statements of overall quality. For instance;

Diptera (True Flies) - generally prefer water of poor to fair quality. When Chironomids (Midge Flies) or Simulium (Black Flies) dominate the sample the stream is probably degraded.

Trichoptera (Caddisflies) - generally, when these insect larvae dominate the sample the stream is probably in fair condition particularly when one genera greatly overshadows all others. When two or more genera are present, in roughly equal numbers, the stream is probably in fair to good condition.

Ephemeroptera (Mayflies) - generally, these nymphs prefer good quality streams. Although one mayfly seems particularly adapted to severely degraded urban streams. This nymph may be present when all other life has been exterpated. Generally when two or more mayflies dominate the sample the stream is probably in good condition.

Plecoptera (Stoneflies) - the stoneflies appear to only occur in good to excellent quality streams.

Generalizations concerning the remaining orders are rather difficult to make. The statements given above may be used when any one order accounts for 50% to 70% of the sample population.

Appendix I

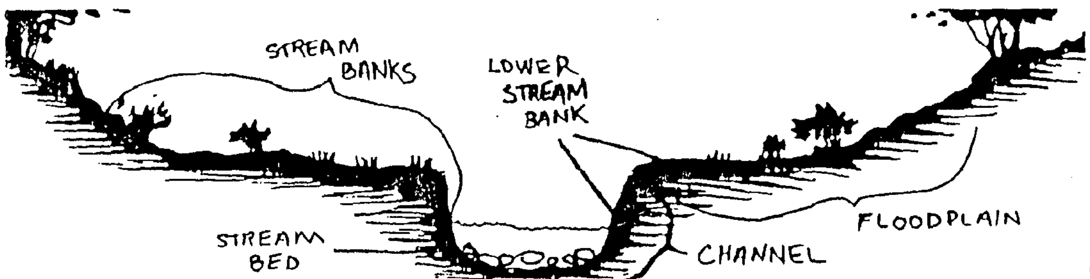
PHYSICAL HABITAT ASSESSMENT PROCEDURES
100 POINTS OF STREAM MONITORING
PIEDMONT REGIONS

STATION NO:__________DATE:___________TIME: AM PM________________________

STREAM:________________LOCATION:_______________________________________

HABITAT ASSESSORS:____

PLEASE RECORD THE MOST APPROPRIATE RESPONSE FOR EACH CATEGORY.
YOU MAY FIND THAT THE BEST RESPONSE IS IN-BETWEEN THE GIVEN SCORES
THEREFORE, CHOOSE THE BEST NUMBER BETWEEN THE SCORES
AND RECORD IT IN THE SPACE MARKED "YOUR SCORE".
REMEMBER TO RECORD OVERALL SCORE AND RATING AT END OF THIS FORM.
USE THE BACK OF THIS FORM FOR ANY ADDITIONAL COMMENTS.



LOCAL WATERSHED NONPOINT POLLUTION SOURCES: High quality waterways occur when the watershed is blanketed with forest. Nonpoint potential pollution increases as watershed land use shifts from forest, to pasture, to cropland, to developed (homes, buildings, streets,...). Based on what you can see from the stream rate this habitat factor by estimating the percentages of the following land use:

EXCELLENT: No evidence of source. Stable woodland with vegetated drainage ditch. Little potential. SCORE: 16

GOOD: Minor potential. Piped stormwater, minor residential, pasture, fallow ground (plowed land that is left planted or unplanted). SCORE: 14

FAIR: Moderate potential. Piped stormwater drainage. Parking lots, or up to 25% bare ground. SCORE: 10

POOR: Large Potential. Urban industrial paving, feed lots or greater than 25% bare ground. SCORE: 8

YOUR SCORE:

LOCAL WATERSHED EROSION: Mud pollution occurs when rainwater transports large quantities of eroded soil into a waterway. Rate this habitat factor by estimating the amount of land visible from the stream which consists of bare, exposed soil.

EXCELLENT: Stable woodland with minor grassland/pasture. Minor erosion potential. SCORE: 16

GOOD: Moderate erosion potential. Minor bare areas visible away from stream. SCORE: 14

FAIR: Considerable erosion potential. Moderate bare areas. Storm event erosion. SCORE: 10

POOR: Almost continual heavy erosion. Substantial bare areas. SCORE: 8

YOUR SCORE:

Courtesy: Maryland Save Our Streams

STREAMSIDE BUFFER: One of the most effective ways of protecting a stream is to maintain a buffer of trees and shrubs along both banks. Note the average and types of vegetation extending out from both banks within 50 feet of the stream.

EXCELLENT: Dominant vegetation trees, with thick shrub/grass. SCORE: 16

GOOD: Dominant vegetation trees, with sparse grass/plant. SCORE: 14

FAIR: Dominant vegetation woody shrubs and plants. SCORE: 6

POOR: Majority of plants present bloom and grow once a year. SCORE: 2

YOUR SCORE:

STREAMBANK VEGETATION STABILITY: Trees and shrubs are better at protecting streambanks than grasses. Estimate the percentage of the streambanks within 50 feet of the stream that are vegetated with woody plants.

EXCELLENT: Majority of plants are trees/shrubs or grasses. Less than 10% of bank exposed erodible soil. SCORE: 20

GOOD: Plants at 50% / grass at 50%. Up to 30% of bank is exposed sand, clay, or mud. SCORE: 14

FAIR: Plants (not grasses) in the majority. Up to 75% of bank is exposed soil. Minor human alteration through channelization. SCORE: 8

POOR: No grass present, only plants. Greater than 75% of bank erodible. Major concrete/stone channelization. SCORE: 2

YOUR SCORE:

STREAMBANK STABILITY: Based on the results above, estimate the erosion potential of stream banks depending upon the the amount of the bank that consists of exposed (erosion susceptible) soil:

EXCELLENT: Little/no failure. Lower banks covered with root mat, grasses and shrubs. Little potential. SCORE: 20

GOOD: Minor cut banks and bank failure. Erosion potential during flood. SCORE: 14

FAIR: Bank failure common. Up to 50% cut banks. Considerable erosion during high water. SCORE: 8

POOR: Bank failure frequent. Greater than 50% cut banks with almost continual erosion. Channelized with > 50% concrete/stone. SCORE: 2

YOUR SCORE:

CHANNEL CHARACTERISTICS/DEPOSITION: As more mud pollution enters a stream, sediments (gravel, sand,...) will accumulate within the channel. These accumulations will take the form of soft, "quicksand-like" deposits and unvegetated sand or gravel bars. Note the abundance of these formations as you walk the channel.

EXCELLENT: Little/no point bar enlargement. Stable bottom, < 5% affected by large storms. SCORE: 20

GOOD: Minor movement of gravel and channel during flood. Some scour and deposition. 5-30% of bottom affected. SCORE: 14

FAIR: Considerable movement of gravel, sand and channel during high water. 30-50% of bottom affected by flooding. SCORE: 8

POOR: Almost continual channel sand movement. Greater than 50% of bottom affected. Severe channelization. SCORE: 4

YOUR SCORE:

CHANNEL CAPACITY: Transforming a forest to homes can increase flooding by 100-fold and cause a stream channel to widen through erosion. As enlargement grows worse the water will wet smaller portions of the stream bed. The water in a natural stream will fill the bottom of the channel from the base of one bank to the base of the other bank. The amount of flooding can be estimated by using both visual clues along the banks, such as erosion, as well as calculating how much water fills the stream channel during dryer periods. Estimate the average percent of the stream bed which is covered with water, and determine if overflows occur using vegetative clues on the banks.

EXCELLENT: Water reaches both banks, no vegetative loss, overflows rare.	SCORE: 16
GOOD: Water almost reaches, or does reach both banks. Little or no vegetative loss, overflows occasional.	SCORE: 14
FAIR: Water fills the channel 20-80%. Substantial vegetative loss. Overflows common.	SCORE: 10
POOR: Very little water in channel. Channelized, or little vegetation. Peak flows contained or overflow every rain event.	SCORE: 8
	YOUR SCORE:

STREAMBED SUBSTRATE: The composition of the streambed at the riffle can tell us what types of landforms or how local watershed erosion is impacting the stream. Estimate how much of the following is present in the stream bed within the sampling area:

EXCELLENT: Stable rubble, rocks with about a 4" diameter (cobble or gravel) on bottom. Little or no sand, algae, or moss.	SCORE: 22
GOOD: Boulder/Bedrock with less rubble and gravel. Minor sand, gravel and algae.	SCORE: 16
FAIR: Mostly smaller gravel (.5 - 4"diameter) and course sand. Major amounts of sand, algae and moss.	SCORE: 10
POOR: Completely imbedded rubble and smaller gravel, Concrete channel, or streambed covered with algae.	SCORE: 2
	YOUR SCORE:

WATER VELOCITY/HABITAT VARIETY: Generalize the composition of the streambed and estimate the length and width of the riffle sampled. Next measure the speed of water flowing through the 3' x 3' sampling area. To do this, drop a small stick in the stream and measure the number of seconds it takes for the stick to travel 10 feet. The 10-foot section should overlap the kick-seine sampling site. Divide 10 by the number of seconds to determine water velocity in "feet per second" (fps).

EXCELLENT: Variety of particle size. Riffle longer than wide. Velocity (fps) > 3.	SCORE: 20
GOOD: Streambed with some limitations in rock size variety. Riffle no longer than wide. Velocity (fps) 2 - 3.	SCORE: 14
FAIR: Major substrate limitation. Velocity (fps) 1 - 2.	SCORE: 8
POOR: Little or no riffle. Little wave movement. No variety in rocks, channelized. Velocity (fps) 0 - 1.	SCORE: 4
	YOUR SCORE:

TOTAL SCORE:______ TOTAL RATING:______________

EXCELLENT: 156 or More	GOOD/EXCELLENT: 133 - 155
GOOD: 112 - 132	FAIR/GOOD: 89 - 111
FAIR: 68 - 88	POOR/FAIR: 52 - 67
POOR: less than 52	

100 POINTS OF STREAM MONITORING
SAMPLING STATION DATA FORM

STATION #____________ DATE_______________ TIME_________ AM PM
STREAM______________________________ LOCATION__________________________
SAMPLERS____

1. Please describe the specific location where the sample was collected. For example: *"300 ft upstream of Rt. 1, next to a large sycamore, and in the center of the stream."*

2. Dimensions of area sampled: _____ ft. by _____ = _____ square ft.

3. Approximate number of seconds used to disturb stream bed: ___________

4. Water Color: (Please Circle One)
   a. medium brown b. dark brown c. reddish brown d. green brown
   e. yellow brown f. green g. other (describe)____________________
   h. clear and colorless

5. Water Odor: (Please Circle One)
   a. sewage b. oily c. musky d. fishy e. rotten eggs f. none
   g. chlorine h. other (describe)____________________________________

6. Is there black color on deeply imbedded stones? YES NO

7. Is there any scum, foam, or other substance on the surface of the water? YES NO
   If yes, please describe the color, abundance, any any other characteristics of the substances:____

8. Are there any growths or coatings on the streambed? YES NO
   If yes, please describe the appearance:_____________________________________

MACROINVERTEBRATE COUNT

Use letter codes (A = 1 - 9, B = 10 - 99, C = 100 or more) to record the numbers of organisms found in a 3 foot by 3 foot area. Then add up the number of letters in each column and multiply by the indicated index value.

GOOD	FAIR	POOR
☐ caddisfly larvae	☐ beetle larvae	☐ aquatic worms
☐ dobsonfly larvae	☐ clams	☐ blackfly larvae
☐ mayfly nymphs	☐ crane fly larvae	☐ leeches
☐ other snails	☐ crayfish	☐ midge larvae
☐ riffle beetle adult	☐ damselfly nymphs	☐ pouch snails
☐ stonefly nymphs	☐ dragonfly nymphs	
☐ water penny larvae	☐ scuds	
	☐ sowbugs	
	☐ atherix	
_____ # of letters	_____ # of letters	_____ # of letters
times 3 =	times 2 =	times 1 =
☐ index value +	☐ index value +	☐ index value

Now add together the three index values = _____ total index value.

Compare this total index value to the following numbers to determine the water quality of your stream. Good water quality is indicated by a variety of different kinds of organisms, with no one kind making up the majority of the sample.

☐ *Excellent (> 22)* ☐ *Good (17 - 22)*

☐ *Fair (11 - 16)* ☐ *Poor (< 11)*

Note: You should test at least 3 different riffles within a 24-foot area to ensure that you have a truly representative sample which includes all key organisms. You may also want to sample some of the rocks in slower-moving water, nearer the banks, because mayflies and stoneflies are sometimes found there instead.

Fish water quality indicators:

_____ scattered individuals
_____ scattered schools
_____ trout (good)
_____ bass (good)
_____ catfish (poor to fair)
_____ carp (poor)

Barriers to fish movement:

_____ beaver dams
_____ dams
_____ waterfalls
_____ other
_____ none

Land uses in watershed:

_____ factories _____ farming _____ fields _____ homes _____ stores _____ woods

Are there any discharging pipes? _____ no _____ yes If so, how many? _____

Did you test above and below the pipes to determine any change in water quality and were changes noticed?

____

Describe % and type of litter in and around the stream: _______________________

____

____

100 POINTS OF STREAM MONITORING
SUMMARY SHEET

STATION #____________ DATE____________________ TIME________ AM PM
STREAM__________________________ LOCATION____________________________
MONITORS____

Please summarize your findings from the Habitat Assessment, Sampling Station Data Form, and the Aquatic Insect Tally on this chart.

ITEMS ASSESSED	SUMMARY
Habitat Assessment Score	
Habitat Assessment Rating	
Water Color (list letter choice)	
Water Odor (list letter choice)	
Black Color on Rocks (Y or N)	
Surface Substance (Y or N)	
Streambed Coatings (Y or N)	
# Stoneflies	
# Mayflies	
# Caddisflies	
# Other Organisms	
Total # all Organisms	
Initial Stream Quality Rating	
Sections of Kick-Seine Used (list letters, numbers)	

FOR OFFICE USE ONLY

File Number__________ MDE Stream Code__________ Watershed Level________

Appendix J

MARYLAND STATE DEPARTMENT OF EDUCATION
ENVIRONMENTAL EDUCATION BYLAW

.01 Program.

Each local school system shall provide a comprehensive, multi-disciplinary program of environmental education within current curricular offerings to be taught at least once in the early, middle, and high school learning years.

.02 Purpose.

The purpose of this environmental education program is to enable students to make decisions and take actions that create and maintain optimal relationship between themselves and the envirohment, and to preserve and protect the unique natural resources of Maryland, particularly those of the Chesapeake Bay and its watershed.

.03 Goals.

The following environmental education goals and subgoals should be incorporated in local school system curricular offerings:

A. **Understand and value the diversity and interdependence of the biological and physical environment, which includes to:**
   (1) Observe and investigate the biological and physical environment,
   (2) Understand that plants and animals that use the environment to satisfy their needs are linked with biological and physical components of their environment,
   (3) Understand that people have a powerful impact on and responsibility for environmental conditions,
   (4) Recognize that as human population increase, its impact on the environment becomes more pronounced;

B. **Understand and value the interdependence between the environment and our health, economy, and culture, which includes to:**
   (1) Participate in activities that demonstrate the relationship between personal health and the quality of the environment,
   (2) Recognize that a viable economy is dependent on responsible use of natural resources,
   (3) Understand that impact of interaction of culture and technology on the use and alteration of the environment,

C. **Understand and value how aesthetic experiences provide insight and enrich interactions with the environment, which includes to:**
   (1) Develop an understanding of the aesthetic qualities that exist in the environment,
   (2) Develop the skills and sensitivities to apply aesthetic criteria to environmental concerns,
   (3) Develop the ability to formulate , apply, and communicate personal aesthetic criteria for assessing environmental issues.

D. **Develop and apply their knowledge and skills to protect and sustain environmental quality, which includes to:**
   (1) Understand how individual decisions and actions impact the environment,
   (2) Apply knowledge of environmental concepts to patterns of personal behavior and choice,
   (3) Apply responsible decision-making to home-related activities impacting the environment,
   (4) Explore and evaluate careers in the environmental field;

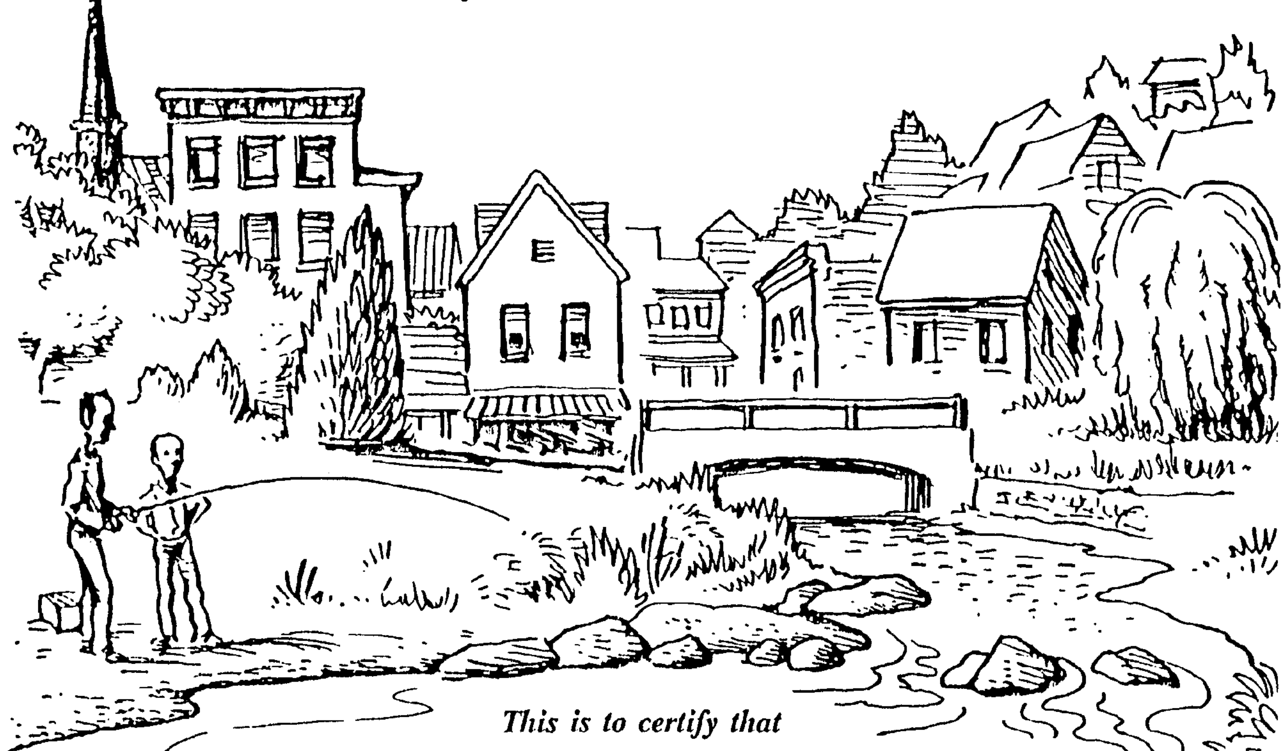
E. **Develop and apply knowledge and skills at the community level for cooperative action to protect and sustain the environment, which includes to:**
   (1) Understand how cooperation among communities (including citizens, businesses, interest group, governmental agencies, and others) is essential to maintain and improve the environment,
   (2) Work with others in groups and organizations to maintain and improve the environment.

04. Certification Procedures.

By September 1, 1990, and each 5 years after, each local superintendent of schools shall certify to the State Superintendent of Schools that the comprehensive programs of environmental education meets, at a minimum, the requirements set forth in Regulations .01 and .03. This certification shall describe how the regulations are being met at each learning level in accordance with reporting standards developed by the Department of Education.

Appendix K

Certificate of Adoption



This is to certify that

John Doe

in accordance with the Adopt-A-Stream Program sponsored by the Maryland Department of Natural Resources, Tidewater Administration and by Maryland Save Our Streams, in conjunction with One Million Marylanders for the Bay, has adopted

Moll Dyer's Run

and has taken active responsibility for the improvement of this waterway by conducting a

Water Quality Assessment, October 27, 1991

Barbara Taylor
Executive Director, Maryland Save Our Streams

Dr. Torrey Brown
Secretary, MD Department of Natural Resources

Save Our Streams

ADOPT-A-STREAM

printed on recycled paper

TIMELINE FOR 100 POINTS OF STREAM MONITORING
BALTIMORE COUNTY - YEAR 1

<u>13 Weeks Before Workshop</u>
Define goals event
Set date for event

<u>12 Weeks Before Workshop</u>
Write budget and submit for approval
Write grant proposal and submit for approval
Recruit planning committee members

<u>11 Weeks Before Workshop</u>
Select points
Make up tentative day-of-event schedule

<u>10 Weeks Before Workshop</u>
Secure event locations
Make initial invitations
Hold first planning committee meeting
- Discuss agenda for workshop
- Plan recruitment strategies and assign tasks
- Have volunteers check sites for accessibility
- Send out initial invitation to workshop participants and members
- Take minutes of meeting

<u>9 Weeks Before Workshop</u>
Mail minutes from meeting to those who did/did not attend
Send letters and invites to Baltimore County school teachers
Place orders for field supplies
Set date and recruit volunteers for kick-seining

<u>8 Weeks Before Workshop</u>
Send sites for approval

<u>7 Weeks Before Workshop</u>

<u>6 Weeks Before Workshop</u>
Check alternative/backup sites for accessibility to complete the list

<u>5 Weeks Before the Workshop</u>
Hold kick-seine assembly
Check out workshop locations
Make flyers

<u>4 Weeks Before the Workshop</u>
Distribute flyers to planning committee members for disbursement in communities

<u>3 Weeks Before the Workshop</u>
Finalize the day-of-event schedule
Prepare and send out press releases
Publicize to newspapers and community newsletters
Complete all visual aids to be used during the training session
Prepare literature for inside packets

Courtesy: Maryland Save Our Streams

2 Weeks Before the Workshop
Copy maps for site locations
Get list of all who received invitations
Copy literature for inside the packets
Hold second planning committee meeting
- Finalize logistics for workshop
- Place follow up phone calls for those who received invitations
- Highlight maps of approved sites
- Collate packets
- Assign volunteers day-of-event tasks
- Take minutes

1 Week Before the Workshop
Mail minutes to those who did/did not attend
Recontact VIPs and volunteers who will be included in the agenda
Prepare literature and materials to be distributed at event
Courtesy confirmation call to workshop locations
Write day-of-event press release

1 Day Before Workshop
Call press to encourage day-of-event coverage

1-2 Weeks After Workshop
Send out follow up evaluations to workshop participants
Organize field materials, packets and collected specimens
Go through packets and determine if all site assessments were completed and summarize the ratings (insect and habitat)

4-5 Weeks After Workhop
Set up and recruit interested volunteers for the insect I.D. class
Assess evaluations as they are returned stressing strengths, weaknesses, and recommendations
Assess field materials stressing strengths, weaknesses, and recommendations
Assess training materials stressing strengths, weaknesses, and recommendations
Assess actual budget as compared to the projected budget

6-7 Weeks After Workshop
Arrange to have incomplete sites completed
Hold insect I.D. classes
Summarize results of data
Devise a timeline and workplan for site selection and assessment of accessibiity
Revise the timeline and workplan for the initial 100 points
Devise a timeline and workplan for next phase
Begin to finalize overall report