ANNUAL PROGRESS REPORT

Organization: Dr. Nels H. Troelstrup, Jr.
Biology & Microbiology
South Dakota State University
Brookings, SD 57007

Gene Stueven
Department of Environment and Natural Resources
Pierre, SD 57501

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ANNUAL PROGRESS REPORT - 2008

Reference Site Selection for Monitoring and Assessment of Intermittent Streams in South Dakota

Project Description

Intermittent streams are defined as those stream channels which flow for only a portion of the year. These streams have well defined bed and bank features and typically display seasonal flow during spring and early summer before drying toward the middle and end of the growing season. Recent emphasis has been placed on monitoring and assessment of intermittent streams. Ephemeral and intermittent channels contribute the bulk of the nation's stream network and contribute greatly to downstream water quality, habitat conditions and biotic integrity. Clearer understanding of the importance of these small catchments to downstream water quality, habitat and biotic integrity has fueled demands to expand protection and monitoring up into these headwater catchments.

This project will define intermittent, headwater stream reference sites and provide supporting field data for the Northern Glaciated Plains (NGP) ecoregion (LIII Ecoregion 46) of South Dakota (Figure 1). The objectives of this proposed effort are to (1) define candidate intermittent stream reference sites within the NGP, (2) conduct field sampling to characterize natural, intermittent reference stream water quality, physical habitat and biological conditions, (3) define optimal macroinvertebrate metrics for monitoring headwater intermittent prairie streams, (4) define the appropriate index period for macroinvertebrate sampling within headwater intermittent prairie streams and (5) validate selection of intermittent stream reference sites against random and targeted intermittent drainages within the NGP.

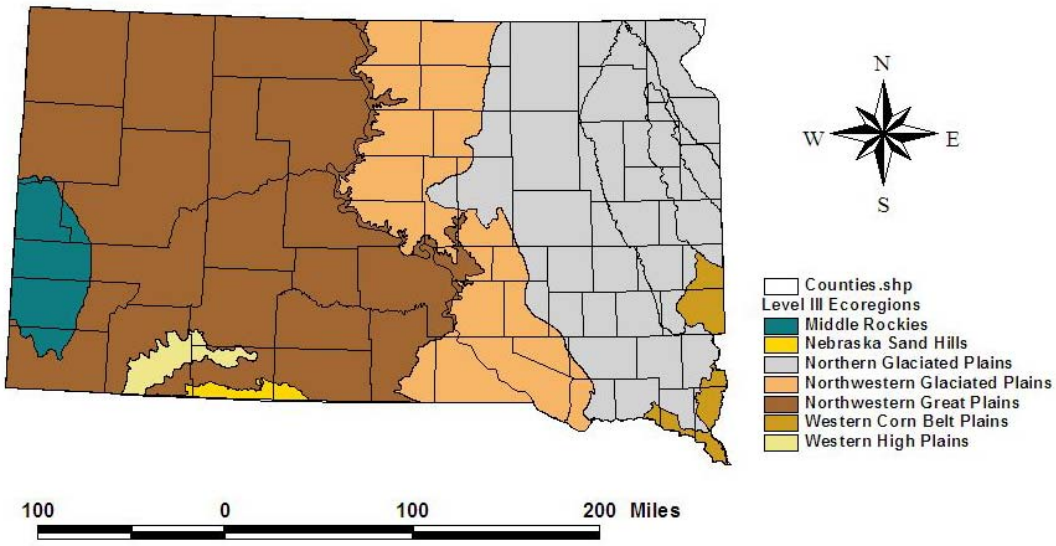

Figure 1. The Northern Glaciated Plains (gray) target area for selection of intermittent stream reference sites in eastern South Dakota.

Year II Accomplishments

Major accomplishments in 2008 by South Dakota State University and the South Dakota Department of Environment and Natural Resources included: (1) communication with private landowners within the study area and solicitation of permission to access sites for summer sampling; (2) preparation for summer sampling, (3) monthly visitation and sampling of study sites through the period April – August, 2008; (4) management of analytical water quality data received from the South Dakota DOH; (5) management of habitat data collected from field sampling; (6) initiation of invertebrate sample processing; (7) presentation and publication of results generated from 2007 and 2008 field seasons.

1. Communications with Private Landowners

Letters were sent to all cooperating landowners toward the end of January 2008 outlining progress on the project and our intention to sample through the April-August period. Verbal communication was made with each landowner again in March 2008, outlining our tentative sampling schedule. In some cases, additional verbal communication was necessary through the sampling season to gain access on the day of sampling. We had no issues gaining access to our sampling sites.

2. Preparation for Sample Collection

Much of our time through the period January – March was spent planning and organizing for field sampling. Two field teams were defined (North Team, South Team), each comprised of two people. Sampling sites were divided into northern and southern sets (n=30 each) and each team was responsible for data collection on its set each month. Each team was comprised of one graduate student and one undergraduate technician.

Water chemistry collection, preservation and shipping procedures were standardized against South Dakota Department of Health protocols. Water chemistry and benthic invertebrate sample containers were prepped and labeled in the laboratory in advance. Each container set was placed into a labeled bag for easy transport to the field site. Sites selected at random for QA/QC received extra sets of bottles for that month.

Field data sheets (Peck et al. 2006) were reconstructed in EXCEL on Panasonic Toughbook computers. These sheets included cross-links and formulas to facilitate efficient data entry and calculation of stream discharge as data were collected.

Field crews were trained on field protocols during the month of March. This training was done together to assure that data collection would be consistent among the two field crews. South Dakota DENR also conducted QA visits during June.

3. Collection of Field Data

Sampling was initiated on April 1, 2008 and terminated on August 21, 2008. All 60 sites were visited monthly and each site was revisited in early September to recover and download Hobo data loggers. Water chemistries were collected from all sites with at least pooled water >10cm in depth. Invertebrates were collected if water was present within the channel reach. Stream drying prevented collection of several samples through the sampling period (Table 1, Table 2).

Table 1. Stream flowing conditions through the period April – August, 2008.

Stream Condition	**#(%) Sites**
Dry channel early and never flowed	2(3.3)
Flowing early and transitioned to dry condition	31(51.7)
Flowing early and transitioned to pooled state but never completely dried	5(8.3)
Continuously flowing throughout the sampling period	22(36.7)

*Note! These tallies are based upon stream conditions at the time of sampling each month. More detailed hydrologic conditions will be presented following analysis of Hobo stream temperature data.

Table 2. Number of water quality samples projected and collected from headwater stream sites in eastern South Dakota, 2008.

Sample Type	**Samples Projected**	**Samples Collected**
Water Chemistries	300	221
Invertebrates	300	233

*Projected numbers would have been achieved if all streams (n=60) could be sampled each month (m=5). Some streams could not be sampled due to dry channel conditions.

4. Management of Water Quality Data

Analytical chemistries were shipped to the South Dakota Department of Health laboratory for analysis. Data retrieved from DOH were entered onto EXCEL data sheets throughout the summer. Calibration, duplicate and blank data were entered onto separate sheets and monitored throughout the sampling season. Back-up files were generated weekly as new data were entered.

5. Management of Habitat Data

Completed data sheets from each sampling site were saved alongside digital pictures and hobo download files in a folder named with the ComID (site code) and date of sampling. All files/folders for a particular month were saved in separate folders and all data were backed-up weekly through the sampling season. Digital data were extracted from field files and reformatted for analysis into EXCEL data files.

6. Initiating Invertebrate Sample Processing

Invertebrate sample processing was initiated in September following completion of field work. We have three people presently working on invertebrate samples at least part-time. All three have successfully achieved sorting QA criteria. About 25% of our samples have been sorted and identifications of these sorted samples have just started. We anticipate completion of invertebrate sorting and identification by August 2009.

7. Presented and Published Results

Several oral and poster presentations of preliminary project results were delivered at professional conferences. Two manuscripts have been accepted for publication (in press) and another will be submitted before the end of the year.

Rasmussen, E.J., R.W. Vander Vorste, N.H. Troelstrup, Jr. In Press. Habitat characteristics of intermittent streams within South Dakota's Northern Glaciated Plains ecoregion. Proceedings of the South Dakota Academy of Science.

Rasmussen, E.J., R.W. Vander Vorste, and N.H. Troelstrup, Jr. 2008. Problems associated with stream monitoring protocols for intermittent, headwater streams. Presented at the East Dakota Water Conference, Brookings, SD.

Troelstrup, N.H., Jr., E.J. Rasmussen, R.W. Vander Vorste. In Prep. Use of ATtILA for the evaluation of headwater watersheds in the Northern Glaciated Plains ecoregion. Environmental Management manuscript in preparation.

Troelstrup, N.H., Jr., E.J. Rasmussen, R.W. Vander Vorste, S. Brich. 2008. Using ATtILA to assess headwater catchments within the northern glaciated plains ecoregion of eastern South Dakota. Bulletin of the North American Benthological Society 25(1): 187 (abstr, poster).

Troelstrup, N.H., Jr., E.J. Rasmussen, R.W. Vander Vorste, S. Brich. 2008. Selection and validation of intermittent stream reference sites for eastern South Dakota: Evaluation of GIS-generated watershed condition scores against field validation data. U.S. EPA Region 8 Western Wetland Monitoring and Assessment Training Workshop, Rapid City, SD.

Vander Vorste, R.W., E.J. Rasmussen, N.H. Troelstrup, Jr. In Press. Family-level community structure of insects inhabiting intermittent streams within the Northern Glaciated Plains. Proceedings of the South Dakota Academy of Science.

Vander Vorste, R.W., E.J. Rasmussen, N.H. Troelstrup, Jr. 2008. Hydrologic connectivity of intermittent headwaters with downstream reaches. Presented at the East Dakota Water Conference, Brookings, SD.

Preliminary Observations

Wadable Stream Protocols

Several wadeable stream protocols presented problems during assessment efforts. High variability in mean wetted width was observed from one sampling date to the next at all sites. Sampled reach lengths based upon mean wetted width were thus found to vary significantly depending on the hydrologic status of the stream. We would suggest modification of the protocol to use bankfull width for delineation of reach length as this parameter is less likely to vary from visit to visit.

According to protocol, eleven, equally spaced transects divide the reach with habitat observations collected at these 11 plus 10-15 sub-transects between the main transects. Woody debris, thalweg depth, soft/small sediment and habitat classes were observed at these subtransects. However, these subtransects are so close together in these small headwater streams that observation areas often overlap. Thus we suggest reduction in the number of subtransect observations to one to avoid overlap.

Under established stream protocol, bank, riparian and human influence assessments are made from 10m x 10m areas centered around the 11 main transect points. Riparian vegetation, human influence, in-stream biota cover, bank measurements, canopy cover, legacy trees and alien plant observations all occur from these observation areas. These 10m x 10m areas overlap when assessing shorter stream reaches, resulting in data redundancy along the sampled reach. Thus, we suggest retaining the size of the bank/riparian observation areas (10m x 10m) but reducing the number of areas to three on each bank (upstream, middle and downstream transects) to eliminate overlap and still cover the entire reach.

Under established protocol, channel slope and bearing measurements are made from backsighting at main transect points along the reach. However, slopes could not be detected between adjacent transects of our short headwater streams. This was due to short distances between adjacent transects and also the flat topography of our study area. Thus, we propose taking slopes by backsighting from the downstream (A) to the middle (x-point) transect, from the middle to the upstream transect and from the downstream to the upstream (K) transect.

Observations of Intermittency

Stream hydrologic condition (flowing, pooled, dry) was determined from visual observations during sampling visits, measurement of channel flow on those visits and measurement of temperature amplitude using Hobo temperature loggers between visits. Temperature amplitude data are currently under analysis. However, visual observations and measured flows suggest that approximately 35% of sample sites flowed continuously during the sampling season. Analysis of Hobo temperature data will allow us to examine shorter drying periods and the occurrence of channel rewetting through the sample season (April – September).

Water Quality vs Watershed Condition

Preliminary analyses of water chemistry data suggest reasonably good correspondence between water quality and ATtILA generated watershed condition scores. Specific conductance, chloride

and total phosphorus concentrations (in particular) demonstrated significant relationships with watershed condition. Those watersheds with poor ATtILA scores also generally displayed poorer water quality (Figure 2).

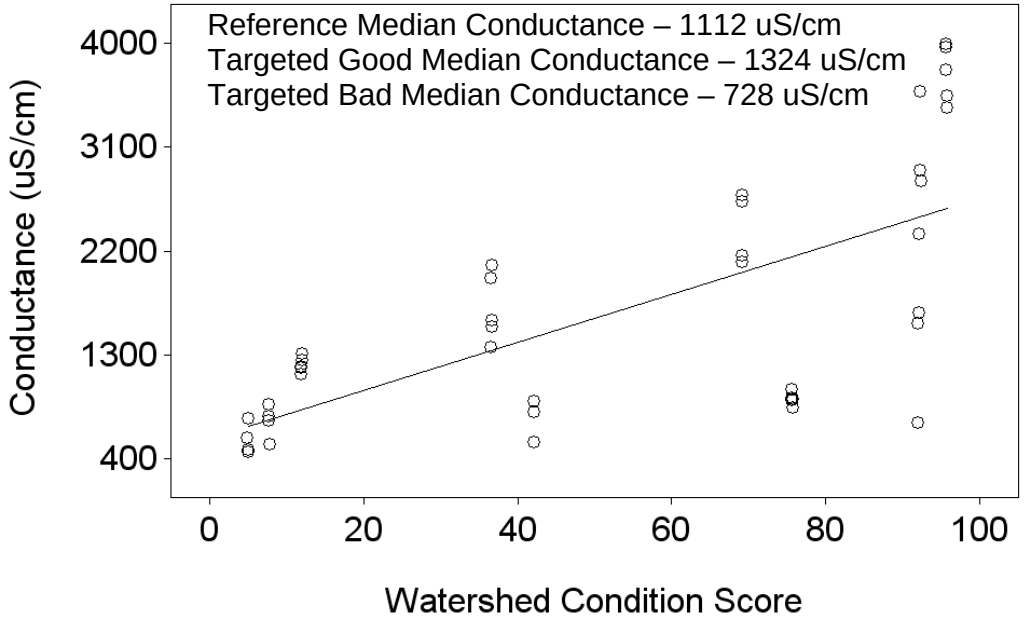

Figure 2. Relationship between specific conductance of stream water and ATtILA generated watershed condition scores for random sites within Level III ecoregion 46.

Invertebrate Community Observations

Processed samples have been dominated by insects (>50% by number) and Chironomidae (Diptera) comprise more than 75% of total abundance from samples sorted so far. Samples collected early during the season have noticeably few invertebrates. Numbers and diversity appear to increase substantially during the May-June period. Several invertebrate taxa described as intermittent stream fauna have already been identified. Notable among these is *Perlesta dacota* (Plecoptera: Perlestidae) and *Hydrobaenus lugubris* (Diptera: Chironomidae). The later species constructs desiccation resistant cases within which the 2nd instar larvae aestivate.

Appended Support Materials

Attached to this report is a presentation summarizing project activities and data collected through the 2008 sampling season. These materials are included to clarify and support statements made above in our annual progress report. Questions regarding these materials should be directed to Dr. Nels H. Troelstrup, Jr., Principle Investigator.

Budget Overview

This project was supported by funds totaling $291,756. Allocation of this amount by expenditure category and amount spent by category over the project to September 30, 2008 are shown below (Table 3).

Table 3. Budget summary for South Dakota intermittent stream project as of September 30, 2008.

Budget Category	**Allocated Amount**	**Total Expenditures**
Salaries	$122,399.00	$58,784.04
Fringe Benefits	4,153.00	2,776.39
Travel	30,000.00	16,273.31
Contractual	28,500.00	19,541.97
Supplies	20,500.00	19,749.75
Tuition Remission	6,000.00	3,286.26
Equipment	20,000.00	11,535.00
Indirect Costs	60,204.00	33,598.27
Total Costs	$291,756.00	$162,822.38