Stressor Identification Technical Guidance

Major Watershed Restoration and Protection Projects

Stressor Identification

Stressor identification is a formal and rigorous process that identifies stressors causing biological impairment of aquatic ecosystems, and provides a structure for organizing the scientific evidence supporting the conclusions (EPA, 2000). In simpler terms, it is the process of identifying the major factors causing harm to fish and other river and stream life. Stressor identification is a key component of the major watershed restoration and protection projects being carried out under Minnesota's Clean Water Legacy Act.

What is the relationship between biological monitoring and assessment, and stressor identification?

Over the past few years, the Minnesota Pollution Control Agency has substantially increased the use of biological monitoring and assessment as a means to determine and report the condition of rivers and streams. The basic approach is to look at fish and aquatic invertebrates (mostly insects), and related habitat conditions, at sites throughout a major watershed. The resulting information is used to produce an index of biological integrity (IBI). IBI scores can then be compared to standards. Segments of streams and rivers with low IBI scores are deemed "impaired."

The purpose of stressor identification is to explain the results of the biological monitoring and assessment process. The information obtained answers the questions of why one stream has a low IBI score, while another has a high score. It looks at causal factors – negative ones harming fish and insects, and positive ones leading to healthy biology. Stressors may be physical, chemical, or biological.

Two very simplified examples follow:

1. Poor IBI score → lack of fish that can tolerate low dissolved oxygen levels → measurement of low dissolved oxygen levels in the stream → documented input of organic pollution at levels sufficient to reduce stream oxygen levels.
2. Poor IBI score → low insect abundance and diversity → preferred gravely habitat is covered with silt → substantial portion of the silt is coming from slumping stream banks → banks slumping due to increasing flows → increasing flows a result of increased runoff from additional impervious surfaces in areas upstream.

Professional judgment, and consideration of multiple lines of evidence, are important in stressor identification, and could be applied at every step in the "chains" shown above. Complexity increases with multiple stressors or causal factors influencing biological conditions. This is typically the case for streams and rivers in Minnesota.

What type of work does stressor identification entail?

Stressor identification usually begins with a review of existing and available data. This review includes the results of, and details behind, the biological monitoring and assessment. It also includes basic information about the watershed and its streams and rivers:

- Land use,
- Soils,
- Geology,
- Stream length,
- Stream slope,
- Historic channel modifications,
- Hydrology, and
- Other factors.

Much of this material can be obtained from existing GIS layers, or documents such as Minnesota Department of Natural Resources stream survey reports.

Candidate stressors will begin to emerge during the review of existing and available data. The next step in the process is to determine if additional data is required to validate or eliminate some candidate stressors. Data collection may include further biological sampling, stream physical or geomorphology surveys, water quality testing, and aerial photography.

Next, existing and newly collected data are organized and analyzed in a manner designed to characterize the causes of impairments – to eliminate or support candidate stressors. Tools and guidance, including EPA's online application CADDIS, are available to help work through the technical aspects of the process.

Of equal importance to the technical dimensions of stressor identification is the need to provide an opportunity for knowledgeable partners, experts, and stakeholders to offer information and professional judgment. Such forums require careful planning, organization, and facilitation.

Does stressor identification only address biological impairments?

Many streams, rivers, and lakes in Minnesota are listed as impaired due to violations of "chemical" water quality standards. In some cases, these chemical standards are surrogates for the protection of biology. In other cases, they are designed to protect a use such as body-contact recreation (swimming). Although stressor identification is geared toward biological impairments, in the context of a major watershed project, some aspects of the stressor identification process may be used to evaluate the nature of chemical impairments. Indeed, some "chemicals" are stressors.

At what stage in a major watershed project is stressor identification carried out?

Some aspects of stressor identification, such as a review of existing data, can begin at the earliest stages of the watershed project, even as the initial biological monitoring is being conducted. Other aspects will need to wait until the IBI scoring is finished. The final identification of stressors will be needed for completion of Total Maximum Daily Load (TMDL) calculations, priority management zone identification, and implementation strategy development. For a four-year watershed project, the stressor identification process should be complete by the end of year three.

What is the scale and scope of stressor identification in a major watershed project?

Much of the work in a major watershed project, from the initial assessment to modeling and TMDL calculations, will be conducted around the 12-digit hydrologic unit code (HUC) scale. In most cases it will also make sense to organize stressor identification around this scale. It may be the case that only a few 12-digit HUC sub-watersheds will be analyzed intensely. Results from the stressor identification in the selected sub-watersheds may be translated to other similar sub-watersheds.

How does stressor identification relate to the implementation of restoration and protection activities?

In the major watershed projects, stressor identification falls under the umbrella of watershed study. The intent of the study work is to drive targeted and effective restoration and protection activities. Ideally, stressor identification is carried out in a manner that is strongly linked to the identification of priority management zones. These priority management zones, in turn, become the sound basis for targeted and precise implementation of restoration and protection activities. This can be illustrated by carrying Example 2 on the previous page a couple steps further:

Poor IBI score → low insect abundance and diversity

→ preferred gravely habitat is covered with silt

→ substantial portion of the silt is coming from slumping stream banks

→ banks slumping due to increasing stream flows

→ increasing flows a result of increased runoff from additional impervious surfaces in areas upstream

→ impervious areas that are connected to the stream are identified, quantified, and ranked according to runoff potential

→ impervious areas with high runoff potential are designated as priority management zones

→ priority management zones are communicated to landowners and other stakeholders, and included in local water management plans and Clean Water Legacy funding requests

→ restoration and protection activities are carried out with a strong focus on priority management zones.

Resources

MPCA Stressor ID webpage: http://www.pca.state.mn.us/rprk9fa

MPCA Biological Monitoring webpage: www.pca.state.mn.us/wfhy8c6

U.S. Environmental Protection Agency Stressor ID webpage: www.epa.gov/caddis/si_home.html

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