702. Name of Study: Effects of sediment traps on Michigan river channels

A. Problem: Sediment, or sand traps, are widely used to remove excess sand bedload in Michigan rivers. However, little information exists to evaluate the effectiveness of sediment trapping efforts in restoring desirable river substrates and channel habitats. This is especially problematic considering the diverse array of river habitats in Michigan. Effectiveness of sediment removal efforts likely varies among river reaches with results ranging from beneficial to benign. However, inappropriate use of sand traps has the potential to harm to channel habitats. Data are needed to quantify the effect of sediment removal efforts on river channel characteristics and substrates, and relate them to river hydrology and valley characteristics.

B. Objective: The objective of this study is to quantify the effect of sediment removal efforts on the channel morphology of select Michigan streams. Specifically, we will identify the rate and spatial extent of change in riverbed elevation and substrate conditions. We will relate these data to hydrologic, gradient, and valley characteristics of each stream. We will assess suitability of different river types for sediment traps, and provide recommendations for spacing sand traps along rivers to better achieve desired results.

C. Justification: Protection and management of Michigan's aquatic resources is the mission of the Fisheries Division (Anonymous 1997). Sedimentation is a major problem in many Michigan rivers, and has been recognized as the major pollutant of the United States because of both the quantity released and the miles of stream affected (Waters 1995). The devastating effects of sediment on the trout population in a Michigan river was well-documented via an experiment conducted on Hunt Creek, a small tributary to the Thunder Bay River in northeast Michigan. Here, a 4-5 fold increase in sand bedload reduced the creek's brook trout population to less than half of its normal abundance (Alexander and Hansen 1988). Findings such as this have heightened awareness of sedimentation as a major fishery management issue on Michigan rivers.

Hansen et al. (1983) introduced many Michigan fisheries managers to the use of sediment traps as a tool for removing sand bedload from streams. They found that down-cutting occurred downstream of sediment basins and produced deeper pools and improved substrate composition, providing cleaner gravel for spawning. Their work demonstrated that sand traps functioned effectively, and that trout populations responded positively to sediment removal efforts (Alexander and Hansen 1983, 1986). Since then, Michigan's sand trap program has grown considerably. In 5 years following publication of Hansen et al. (1983), 110 sand traps were constructed on Michigan rivers (MDNR Fisheries Division records). By 1993, 166 traps were operating and being maintained in Michigan, and biologists wanted to install 63 additional sand traps on Michigan streams. In 1993, the annual cost of maintaining the 166 traps was estimated at $158,100 (MDNR Fisheries Division records). Additional sand traps have been dug since 1993, and more are scheduled for construction. Annual cost of maintaining sand traps in Michigan today is likely over $200,000.

Except for the studies described above, there has been little scientific evaluation of the effectiveness of sand trapping efforts in Michigan. Techniques developed and applied on two small trout streams by Hansen and Alexander have since been used on nearly all types of trout waters in Michigan. Hansen et al. (1983) stated that sediment basins should not be used on all streams, particularly those without natural controls (e.g. bedrock, clay, boulders, etc.), because bedload removal could "upset the stream-sediment equilibrium and create excessive

downcutting". However, they did not think that typical midwestern streams (having low gradients, frequent hydrologic controls, and small bedloads) were apt to suffer serious consequences from sediment basin construction. Still, there is concern among some fisheries researchers that this may be occurring on some Michigan streams.

Data are needed to assess the effects of sand trapping efforts on Michigan rivers. These data will help managers to better determine: 1) if sand trapping efforts and Michigan's sediment removal program are achieving desired changes in channel morphology; 2) if sand trapping efforts may be causing excessive downcutting and harming river habitat; 3) conditions where sediment traps are an effective management tool; 4) the extent to which sand traps alter upstream and downstream river channels.

D. Status: Background of sediment removal efforts and sand trap evaluation was discussed in the Justification section. The effectiveness of sand trapping efforts in Michigan for enhancing trout populations is a subject of debate since management use of sand traps is less intensive than what occurred in previous studies. Evaluation of effects of sand traps by Alexander and Hansen (1988) may represent a "best case" scenario for the positive effects of sediment basins. For example, three sand traps were installed in the one-mile reach of Hunt Creek affected by sediment. This intensive level of sediment removal restored channel morphology to pre-sedimentation conditions relatively quickly throughout the entire impact zone. The sediment traps themselves also provided additional deep pool habitat, something relatively scarce in the reach. As a result, trout biomass in the impact zone returned to pre-sedimentation levels fairly quickly. In Poplar Creek, excavation of a sediment basin enhanced trout populations in a 1-mile stream reach immediately downstream of the trap (Alexander and Hansen 1983).

Extrapolating fish population findings from Hunt and Poplar Creeks to rivers in Michigan with different size, gradient, or hydrologic characteristic may be inappropriate. Sediment basins are presently excavated on many different types of rivers. For example, sediment basins occur on a range of different sized streams. Though much sand trapping effort occurs on rivers of similar size as Hunt and Poplar creeks (where Alexander and Hansen worked), sediment basins have been installed on rivers 5 or more times larger than these study creeks. Evaluation is needed to determine if sand traps are an appropriate treatment for such an array of streams.

Little is known of the upstream and downstream extent to which effects of sediment trap effects are evident. Hansen et al. (1983) showed that Poplar Creek's bedload was greatly reduced ½ mile downstream of a sediment basin. Single sediment basins occur on many Michigan rivers, and when there is more than one, the sand traps are often >10 miles apart. Long-term data are needed to assess whether effects of sand traps remain localized, or eventually spread many miles upstream or downstream.

Recent river valley classification efforts by Seelbach et al. (1997) will provide a broader spatial context to our findings and help in statewide extrapolation of our findings. Their classification includes qualitative description of river valley segment attributes, including hydrology and gradient, which would be useful in this study. This information, in combination with data we will collect on river response to sand traps will allow prediction of how different rivers throughout Michigan may respond to sand traps. These data may also aid in identifying streams types with the potential to excessively downcut if sand traps are installed.

An evaluation of sediment basins is a timely project as several new traps have been recently dug, and others are scheduled for digging. River systems where such activities are occurring include important coldwater rivers such as the Au Sable, Little Manistee, and Boardman.

Literature cited:

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E. Procedures: This study will involve approximately 20 rivers, of which 5 will be visited each year on a 4-year rotation. We propose to use permanent transects upstream and downstream of sand traps that will be surveyed every 3-5 years to document changes in channel bed elevation and substrate conditions. Permanent transects would also be established on “control” reaches without sand traps. Details regarding study design will be addressed in the first year via consultation with other Midwestern fluvial geomorphologists (e.g. Dr. Peter Whiting, Case Western Reserve University). We anticipate each year’s field work will occupy 3-4 weeks of time for 2 state workers or fisheries technicians, and 1-2 weeks of time for research biologists.

Job 1. Identify study rivers and develop sampling design.

Job 2. Survey bed elevations and substrate conditions.

Job 3. Analyze data.

Job 4. Write progress report.

Job 5. Write final report.

Job 6. Publish final report.

G. Geographic Location: Lewiston, Michigan.

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