US Army Corps of Engineers

ENVIRONMENTAL IMPACT RESEARCH PROGRAM

TECHNICAL REPORT EL-92-35

# INCREMENTAL EFFECTS OF LARGE WOODY DEBRIS REMOVAL ON PHYSICAL AQUATIC HABITAT

by


Roger H. Smith

Center for River Studies
Memphis State University
Memphis, Tennessee 38152

F. Douglas Shields, Jr.

USDA Agricultural Research Service
National Sedimentation Laboratory
Oxford, Mississippi 38655-1157

Elba A. Dardeau, Jr., Thomas E. Schaefer, Jr., Anthony C. Gibson

Environmental Laboratory

DEPARTMENT OF THE ARMY
Waterways Experiment Station, Corps of Engineers
3909 Halls Ferry Road, Vicksburg, Mississippi 39180-6199



November 1992

Final Report



Approved For Public Release; Distribution Is Unlimited



Prepared for DEPARTMENT OF THE ARMY
US Army Corps of Engineers
Washington, DC 20314-1000

Under EIRP Work Unit 32555

# PART V: SUMMARY, CONCLUSIONS, AND RECOMMENDATIONS

## Summary

LWD plays an important role as a component of aquatic habitat. Although LWD enters food webs as it decays, the major importance of debris lies in its structural characteristics and the way it influences channel flow patterns. Physical processes associated with debris in streams include the formation of pools and retention of fine sediment and organic matter.

Awareness of the adverse effects of complete LWD removal on channel stability and aquatic habitat has led to the development of guidelines for selective removal of LWD as a means of balancing habitat and conveyance objectives. These guidelines (Appendix A) involve the use of manual labor and small equipment to remove only the LWD that causes significant flow obstruction. Removal of bank vegetation and disturbance to stream habitats is minimized. Personnel within some Corps districts have already completed or are in the process of classifying the streams under their jurisdiction according to these guidelines. Use of these guidelines for project planning and design requires quantification of the hydraulic and environmental impacts of incremental LWD removal.

In this study, a simple method for quantifying LWD density and computing associated friction factors was developed and tested using data collected during an LWD removal project on the South Fork Obion River in western Tennessee. Physical conditions of both cleared and uncleared stream reaches were measured by collecting three types of data: LWD density, dye tracer tests (for computing reach mean hydraulic parameters), and physical habitat (depth, velocity, bed type, and cover) at selected transects. The LWD density was the important independent variable, while the dye tracer and physical habitat data were used to study macroscale and microscale effects of LWD, respectively. Macroinvertebrate samples were also collected at low flow conditions, and the results are presented in a companion report to this study (Payne and Miller in preparation).

## Conclusions

Removal of LWD from the study reach decreased near-bank-full friction factor by about one third. Impacts on physical aquatic habitat at base flow

were measurable and statistically significant, even though the Stream Obstruction Removal Guidelines (IAFWA 1983) were applied throughout project planning and implementation. Benefits of proposed LWD removal projects should be carefully analyzed in light of costs and environmental impacts. Findings of this study generally agreed with work by others in different types of streams. The simple procedure developed in this study for quantifying LWD density and its effect on channel resistance may be used for environmental impact assessment and hydraulic engineering analyses. Considerable refinement and site-specific adaptation may be in order, however. The method for prediction of channel roughness coefficients does not account for local losses because of bends or flow expansion and contraction at bridges, debris dams, or riffles.

## Recommendations

To refine the methodology used in this study, additional data should be collected from two more stream LWD removal projects. Streams with higher LWD density and different types of bed sediment from that encountered in this study would be preferable. Physical data should be collected over a range of flows varying from normal low-flow to bank-full conditions. Concurrent biological data should be collected at base flow. Data should be collected to document preproject and postproject conditions. Investigation of additional methods of determining LWD density, such as using video recorders or low altitude aerial photography to count and measure the LWD formations, is recommended.

## APPENDIX B: BEST MANAGEMENT PRACTICES (BMPs) FOR SELECTIVE CLEARING AND SNAGGING*

Trees and brush that shade streams and stabilize the banks should not be disturbed. In new channel construction, existing trees and brush should be left in place along the tops of banks. No stream work, including bank clearing and excavation or removal of materials, "snags," or other channel obstructions, should be allowed except at specific locations where significant blockages in streams occur. Channel excavation and snag removal should be accomplished with the minimum streambank clearing needed to provide access to the stream and should not be undertaken unless it is absolutely necessary. The following BMPs prescribe the manner in which snag removal and stream channel clearing should be undertaken:

a. Practices for snagging.

(1) Logjam removal. Only those log accumulations that are obstructing flows to a degree that results in flooding or significant ponding or sediment deposition should be removed.

(2) Removal of other logs.

- Affixed logs. Isolated or single logs should not be disturbed if they are embedded, jammed, rooted, or waterlogged in the channel or the floodplain, if they are not subject to displacement by current, and if they are not presently blocking flows. Generally, embedded logs that are parallel to the channel are not considered to cause blockage problems and should not be removed. Affixed logs that are crossways to the flow of waters in the channel and are trapping debris to the extent that could result in significant flooding or sedimentation may be removed.

- Free logs. All logs that are not rooted, embedded, jammed, or sufficiently waterlogged to resist movement by stream currents may be removed from the channel.

(3) Protecting riparian vegetation. No rooted trees, whether alive or dead, should be cut unless:

- They are leaning over the channel at an angle greater than 30 deg of vertical and they are dead or severely undercut, or damaged root systems are relying upon adjacent vegetation for support and it appears they will fall into the channel within 1 year and create blockage to flows; or

- Their removal from the floodplain is required to secure access for equipment to a point where a significant blockage has been selected for removal.

---

* Source: State of New York (1986). The citation for this reference is included with those following the main text of this report.

Trees selected for removal should be cut well above the base, leaving the stump and roots undisturbed. Procedures for removing the felled portion should be the same as for other logs as discussed below.

(4) Equipment for log removal. First consideration should be given to the use of hand-operated equipment to remove log accumulations. When the use of hand-operated equipment is infeasible, vehicular equipment should be used in accordance with the following guidelines:

- Water-based equipment (e.g., a crane or winch mounted on a small, shallow draft barge or other vessel) should be used for removing material from the stream. A small crawler tractor with winch or similar equipment may be used to remove debris from the channel to selected disposal points.
- When stream conditions are inadequate for the use of water-based equipment, the smallest feasible equipment with tracking systems that minimize ground disturbance should be specified for use. Larger equipment may be employed from nonwooded areas where cables could be stretched down to the channel to drag out materials to be removed.
- Access routes for equipment should be selected to minimize disturbance to existing floodplain vegetation, particularly in the riparian zone. Equipment should be selected which will require little or no tree removal in forested areas.

(5) Log disposal practices. All logs or trees designated for removal from a stream or floodplain should be removed or secured in such a manner as to preclude their reentry into the channel by floodwaters. Generally, they should be transported well away from the channel and floodway and positioned parallel to the stream channel so as to reduce flood flow impediment. When large numbers of logs are removed at one location (e.g., logjams), their use for firewood may be most appropriate. Burying of removed material should not be permitted.

b. Practices for stream channel clearing.

(1) Small debris accumulation. Small debris accumulations should be left undisturbed unless they are collected around a log or blockage that should be removed. (Small debris accumulations will not constitute a significant blockage to flows. Upon removal of logs and other blockages under these BMPs and the following completion of the project, the changed water velocities will remove and disperse these small debris accumulations so that no significant blockage of water flows will result.)

(2) Removal of sediment and soils. Major sediment plugs in the channel may be removed if they are presently blocking the channel to a degree that results in ponding and dispersed overland flow through poorly defined or nonexistent channels and, in the opinion of appropriate experts, will not be removed by natural stream or river forces after logs and other obstructions have been removed.

(3) Disposal of spoil material. Conventional excavating equipment may be required for sediment blockages. This equipment should be employed in a manner which will minimize environmental damages as follows:

- Access routes for equipment should be selected to minimize disturbance to existing floodplain vegetation, particularly in the riparian zone.
- Material disposal and necessary tree removal should be limited to one side of the original channel at any given location.
- To the maximum extent possible, excavating equipment should not be employed in the stream channel bed.
- Where feasible, excavated materials should be removed from the floodplain. If floodplain disposal is the only feasible alternative, the spoil material should be placed on the highest practical elevation and no material should be placed in any tributary or distributary channels which provide for ingress and egress of waters to and from the floodplain.
- No continuous spoil pile should be created. It is suggested that no pile exceed 50 ft in length or width and a gap of equal or greater length should be left between adjacent spoil piles.
- Spoil piles should be constructed as high as sediment properties allow.
- The placement of spoil material around the bases of mature trees should be avoided where possible.
- All disturbed areas should be reseeded or replanted with plant species which will stabilize soils and benefit fish and wildlife. Revegetation should be in accordance with County Soil and Water Conservation District recommendations.
- All disturbed areas should be reseeded or replanted with plant species which will stabilize soils and benefit fish and wildlife. Revegetation should be in accordance with County Soil and Water Conservation District recommendations.