WILD TROUT V:

WILD TROUT IN THE 21ST CENTURY

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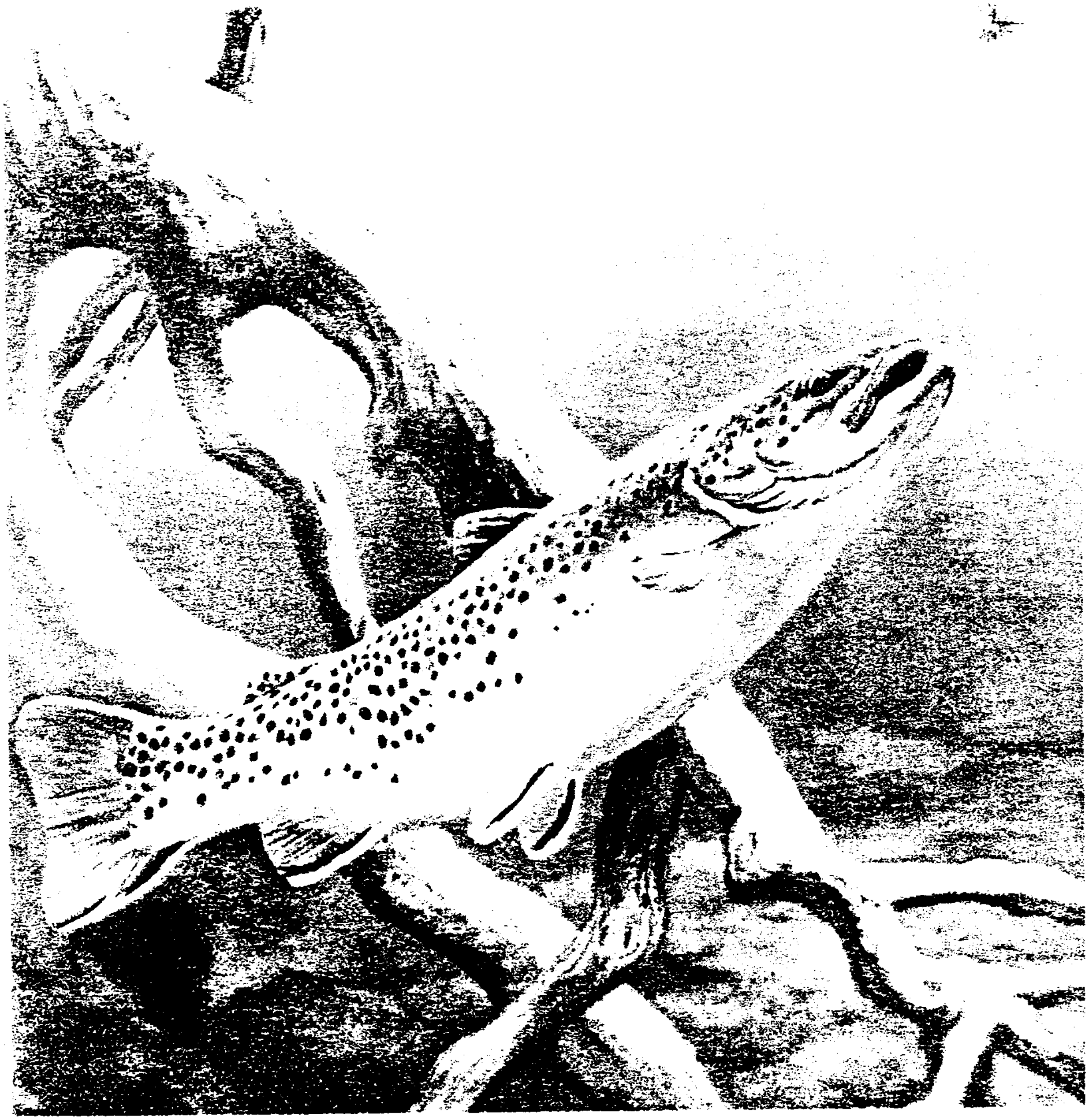

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Impacts of Historic Land Use on Trout Habitat in the Southern Appalachians

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Land use has had a major impact on habitat structure in the Southern Appalachians. One of the most conspicuous changes has been the loss of large woody debris (LWD). Human use has so changed the structure and composition of most forested watersheds that it is difficult for average citizens to understand why LWD matters. Research is underway to determine the effect of adding LWD on trout, trout habitat, and macroinvertebrates in two southwest Virginia streams.

Trout in the Southeast depend upon the continuous supply of high quality water and habitat provided by streams originating in the Appalachian Mountains. Historically, much of the land over which many Appalachian streams flow has been used for a variety of purposes including timber production; livestock grazing and other agricultural activities, mining, and recreation (Mastran and Lowerre 1983). During the past 100 years in particular, the combination of intensive land use, exploitive fishing, and deliberate introduction of exotic species has greatly altered stream ecosystems.

The most direct way to determine the structure and function of undisturbed trout habitats is to locate and survey habitat types and the sequencing of habitat units in pristine streams. Unfortunately, few streams in the eastern United States are in a pristine condition. As an alternative, a conceptual model of undisturbed streams can be constructed Gom careful analysis of the historical record. Coupled with present day descriptions of land use and habitat condition, knowledge of the probable undisturbed condition gained through a historical reconstruction should enable managers to suggest appropriate rehabilitative or enhancement measures.

Limited available historical evidence suggests that stream habitats in the Southeast, like those in other parts of the country (Sedell and Luchessa 198 1), were structurally more complex than at present. Larger stream channels were cleared to provide corridors for transportation, and the demand for homesteads, agriculture, and mining lead to the clearing of forests and abuse of small streams in the southern Appalachians (Mash-an and Lowerre 1983). Although most of the easily exploited forest in the southeastern U.S. had already been cut by 1880, vast reserves of high quality timber remained deep in the southern mountains. Over 20,000 square miles of forest lay mostly untouched in Kentucky alone, all within easy reach of the Mississippi and its numerous tributaries (Sargent. 1884). Early loggers depended on streams to expedite transportation of logs to sawmills (Anonymous 19 12; Scalf 1966). As timber supplies from readily accessible lowlands adjacent to larger rivers were exploited, lumber companies pushed into the mountains where they “improved” numerous streams for log transportation (Clark 198 1).

Splash dams were built across many Appalachian mountain streams (Figure 1).

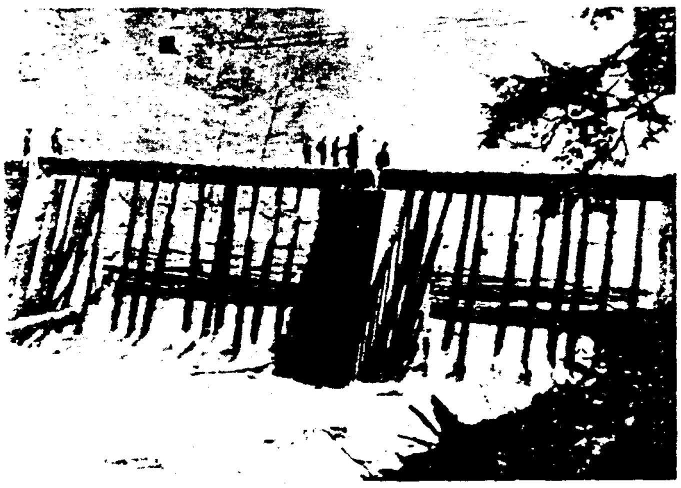

Figure 1. - Splash dam erected about 1910 on the Russell Fork Big Sandy River, Southwest Virginia.

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Logs were piled in the stream and when sufficient volumes of water were backed up, the dams were breached. Logs and anything else in the channel were flushed downstream with the ensuing torrent. In later years, railroad grades and roads were constructed along the contours of hillslopes and all too often in the stream channels where they displaced riparian vegetation, contributed excessive amounts of sediments, removed stable accumulations of woody debris, and ultimately decreased the complexity of habitat structure (Figure 2).

Figure2. – Appalachian stream corridor used for log transportation.

Although published reports are rare, there is widespread agreement that the distribution of native brook trout *Salvelinus fontinalis* in the southeastern United States began to decline around the turn of the century (Larson and Moore 1985), coincident with the era of intensive logging and land clearing. Anecdotal accounts tell of catching "20 or more brook trout up to 13 inches long in under 15 minutes" in the days preceding logging (Clarkson 1964). Early surveys by Burrows (1934) in the Nantahala National Forest (an area occupied by the present day Nantahala and Chatahoochee National Forests) and King (1937) in the Great Smoky Mountains National Park suggest that exploitive fishing combined with loss of habitat caused by destructive farming, logging, and mining practices resulted in the loss of trout from much of their former range.

In response to the decline of native trout populations, rainbow *Oncorhynchus mykiss* and brown trout *Salmo trutta* and nonindigenous stocks of brook trout were widely introduced to supplement existing trout stocks and to provide trout in waters thought to be unsuited to production of native fishes (King 1937). After nearly a century of stocking, trout populations in many southeastern streams are composed of at least two of these three species.

Today trout populations in the southeastern United States are largely confined to headwater streams in the Appalachian Mountains. Strictly enforced regulations and heighten4 public awareness now prevent most of the destructive fishing practices (dynamite, nets, etc.) once common in the Appalachians (Kelly et al. 1980). Trout populations, however, have not returned to former levels of abundance. Many streams still exhibit the effects of past land and water use practices such as splash damming (Anon. 1912; Sedell and Duvall 1985), stream "improvement" for transportation of logs (Brown 1936), and erosion associated with roads and the removal of streamside vegetation. Although habitats in most streams on public lands are protected from these types of activities, rehabilitation or enhancement of trout stocks remains hampered by a lack of information on the historical condition (pre-disturbance) of trout habitats in Southern Appalachian streams.

EXPERIMENTAL ADDITION OF LARGE WOODY DEBRIS TO APPALACHIAN MOUNTAIN WATERSHEDS

One of the most conspicuous changes in southern Appalachian watersheds has been the loss of large woody debris (LWD) (e.g. trees, large branches, and root wads) from riparian zones and stream channels (Dolloff 1994). Woody debris accumulates naturally in forest streams where it strongly influences the storage and movement of sediments, increases stream channel stability, and provides cover for fish and living places for other aquatic species. Despite the growing awareness of its importance, the relationship of LWD, macroinvertebrates, and fish has received little attention in the southeast.. The specific amount, type, and function of LWD and the distribution of fish populations and macroinvertebrates relative to LWD and sediment accumulations are largely unknown in the forested streams of the southern Appalachians. The need for research linking LWD, fish, and macroinvertebrates is clear; restoration and protection of fish habitats depend on our ability to understand and eventually manipulate factors such as LWD that both directly and indirectly influence stream biota.

In 1993, researchers from the Southeastern Station and Virginia Tech began a series of experiments to document the amount, probable role, and relation of LWD to fish and macroinvertebrates in southern Appalachian streams. The specific objectives are to: inventory and characterize LWD and associated physical habitat components and fish and macroinvertebrate communities in southern Appalachian watersheds, evaluate changes in stream channel configuration and habitat resulting from addition of LWD, and describe influences of LWD on fish and macroinvertebrate natural history and populations.

Approach

LWD debris loading, physical habitat features, and fish and macroinvertebrate distribution and abundance were inventoried in North Fork Big Stony and North Fork Barbours Creek, two small streams on the Jefferson National Forest. All habitat units (e.g. pools, riffles) were identified and mapped (plan-view map). Woody debris was tallied by size (length, diameter), approximate location (bridging the channel, partially submerged, compass orientation, etc.), and dominant function (cover, habitat formation, or channel stability) in streams of sufficient size to support wild trout. Sediment accumulations associated with LWD were characterized (particle size, probable geologic origin) and measured (area, depth). Fish abundance and biomass were assessed by diver counts and electrofishing. Macroinvertebrates were sampled with portable invertebrate box samplers (PIBS) in both riffle and pool habitats.

Information from the initial surveys was used to develop field experiments involving selected additions of key LWD to influence channel formation processes (e.g. changes in habitat characteristics, sediment dynamics). In each of two streams, three reaches of about 250 m (each separated by a "control zone" of 50 m) were established. Proceeding from upstream to downstream, the first reach functions as a reference; no LWD was added but habitat and biota, and "phantom" logs (places in the stream measured as if a log had been placed) is being monitored concurrent with monitoring in the two experimental reaches. The middle 250 m reaches received pieces of LWD (diameter at least 20 cm and length at least 1.5 times channel width) placed according to the judgement of at least two resource professionals experienced in the manipulation of stream habitats. The downstream-most reach received logs of similar size but placed randomly. Logs were not "keyed' or otherwise pinned to the stream banks. North Fork Big Stony received 50 logs per section and North Fork Barbours 25 logs per section. All logs were manufactured from live trees of eight species, located at least 15 m from either stream bank, to prevent the confounding influence of opening the streamside canopy (Table 1). Data are being analyzed with a Geographic Information System to better understand spatial relations at both local (individual pools and riffles) and stream reach scales and to account for natural variation related to stream size and location.

Table 1. -- Species and *number* of pieces of large woody debris added to two Southwest Virginia streams.

Tree Species	Big Stony	Barbours
Poplar	3	5
Red oak	2	22
White oak	1	6
Chestnut oak		12
Scarlet oak		2
Sugar maple		3
Cherry	4	
Hemlock	16	
White pine	27	
Yellow pine	47	
Total	100	50

All sites were labeled and serve as the foundation for long-term monitoring of interactions among LWD inputs, channel mechanics, and stream biota.

One year after adding LWD, the sequence of pools and riffles changed substantially (Figure 3 .).

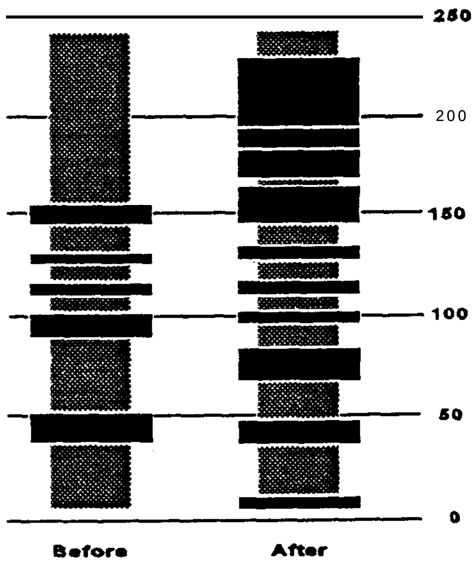

Figure 3. - Pool (dark r&tangles) -riffle (light. rectangles) sequence in the controlled placement section of a Southwest Virginia stream before and after addition of LWD.

The number and surface area of individual pools increased while that of riffles decreased. Preliminary results indicate that brook trout use a greater proportion of the total available habitat (Kelly Harpster, personnel communication) and that the macroinvertebrate community composition has shifted from pool to mostly rime-oriented species (Robert Hilderbrand, personal communication). The results of this study will give managers a more complete understanding of the amounts, distribution, inputs and relations to fish and other stream biota of LWD and associated habitat features in southern Appalachian streams.

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