George Washington and Jefferson National Forests

Detailed Monitoring and Evaluation Report

Of the Land Management Plans

From

Fiscal Year 2004 to 2007

August 2008

SUMMARY OF RESULTS

Introduction

The George Washington and Jefferson National Forest monitors and evaluates sample programs and projects to determine whether these activities are meeting the management direction shown in the two Forest Plans.

Monitoring and evaluation are specifically designed to ensure (1) Forest Plan goals and objectives (outputs) are being achieved, (2) Plan Standards and Guidelines are being properly implemented, and (3) environmental effects are occurring as predicted. The evaluation of monitoring results, at five year intervals (next 5-year interval will be 2009), allows the Forest Supervisor to initiate action to improve compliance with standards and guidelines where needed, prepare out-year budget requests, and determine if any amendments to the Forest Plan are needed to improve resource management.

Plan Amendments

No amendments were issued to either the Jefferson or George Washington Forest Plan between 2005 and 2007 inclusively.

Jefferson Forest Plan Revision Effort

The Jefferson National Forest finished revising its 1985 Forest Plan when Regional Forester Robert T. Jacobs signed a new Record of Decision on January 15, 2004. This monitoring and evaluation report is the first report from implementing this revised plan. This report documents some of the monitoring items in the Jefferson's Revised Forest Plan Appendix E. Other items will be discussed at the time of the 5-year evaluation in 2009.

ADMINISTRATIVE REVIEW

American Electric Power Litigation On December 30, 2002 , Forest Supervisor William Damon, Jr. issued a Record of Decision (ROD) and Final Environmental Impact Statement (FEIS) for the American Electric Power 765 kV Transmission line. Alternative 1 (Proposed Action) was selected from the accompanying FEIS. Alternative 1 authorized AEP to construct, operate and maintain a 765 kV transmission line across approximately 11 miles of the Jefferson National Forest.

On May 11, 2004, Plaintiff Sierra Club challenged this decision. Plaintiffs alleged that the agency failed to 1) discuss reasonably foreseeable environmental impacts and reasonable range of alternatives, 2)consider alternative routes, 3) complete an adequate Biological Assessment, and 4) enter into formal consultation with U.S. Fish and Wildlife Service (FWS), 5). Furthermore, plaintiffs alleged that the U.S. Fish and Wildlife Service (USFWS) violated the Endangered Species Act for concurring with the "not likely to adversely affect" determination in the Forest Service's Biological

Assessment. Finally, plaintiff's alleged that the Forest Service violated 16 U.S.C. § 497 for authorizing AEP over 200 acres of National Forest System Land.

On December 15, 2004, plaintiff amended their complaint adding Alliance for the Preservation and Protection of Appalachian Lands as a second plaintiff. On January 22, 2005 Plaintiff abandoned their claims regarding an inadequate Biological Assessment and the USFWS concurrence of the Biological Assessment.

On August 1, 2007, the case was dismissed by the courts. All parties to this case had agreed and stipulated that this case was to be dismissed with prejudice, with all parties to bearing their own attorneys fees and costs.

Summary Of Research Findings

Research conducted on the Forests from Fiscal Year 2005 to present is reflected in the findings that follow as well as in the appendices.

Congressional Acts

No Congressional Acts specific to either Forest were passed from 2005 to 2007 inclusive.

CHAPTER 1. MONITORING OF SELECT COMPONENTS

Water Quality

In FY 2007 a number of timber sales (including salvage sales) were monitored for implementation of Best Management Practices.

Of 98 BMP monitoring elements, 96 percent showed that implementation met or exceeded BMP requirements. Four percent showed only minor departures from the intent of the BMP. These departures were (1) minor incursions into filter strips and vehicle exclusion zones and (2) the inadequate reseeding of a skid trail.

The Virginia Department of Forestry conducted water quality monitoring in association with timber harvests from 1989 to 1996 (VA. Dept. of Forestry, 1998). At sites in the mountains, Piedmont, and coastal plain, water temperatures were taken at 10-minute intervals, and water samples were collected automatically before, during, and after storm events, both upstream and downstream from logging. Aquatic macroinvertebrates were also sampled periodically. This monitoring showed that, when forestry BMP's are properly implemented, timber harvests can be accomplished without a large or persistent increase in sediment, an increase in stream water temperatures, or a shift in macroinvertebrate species composition. Since the Forests' monitoring indicates that forestry BMP's were properly implemented, it can be concluded that these practices were effective in protecting water quality.

REFERENCES

Virginia Department of Forestry. 1998. Conclusions suggested by water quality monitoring near private timber harvests: 1989-1996.

James Spinymussel

NOTE: This discussion that follows is basically an update to the February 2007 Draft Comprehensive Evaluation Report for Revising the GW 1993 Forest Plan.

The GWJNF developed a Federally Listed Fish and Mussel Conservation Plan with the USFWS in 2004 that is applied in 6th level HUC watersheds that contain a federally listed fish or mussel species. See the 2004 M&E report for previously documented population trend information on the James spinymussel on the GWNF. In 2004-2007, FS biologists worked with VDGIF and FWS biologists and did extensive surveys on any FS portions of streams with potential for spinymussel occurrences. These streams include: Craig Creek, Potts Creek, Catawba Creek, Patterson Creek, Little Patterson Creek, Johns Creek, Pedlar River, Cowpasture River, Calfpasture River, Little Calfpasture River, Bullpasture River, Mill Creek, and Little Mill Creek. Spinymussels were found in Craig Creek, Potts Creek, Johns Creek, Pedlar River, Cowpasture River, Bullpasture River, and Mill Creek, however, NOT on FS property. There are no current documented occurrences of P. collina in streams on the GWJNF. The Forest will continue to work with the US Fish and Wildlife Service and VDGIF to locate spinymussel populations on National Forest and habitat suitable for augmentation.

This species is inherently rare and not naturally well distributed across the Forest due to its historic distribution (restricted to the James River drainage) and the limited amount of suitable habitat on the Forest. It apparently is now extirpated from approximately 90 percent of its range (Clarke, 1984).

The Forest is has developed a conservation strategy for all federally listed mussels and fish in conjunction with the USFWS, VDGIF, and universities to proactively contribute to providing ecological conditions that maintain or increase mussel populations.

The GWNF encompasses no known populations of the James spinymussel on NFS land. The species does occur in watersheds that contain NFS land and occurs both upstream and downstream from the Forest. Current management provides for water quantity and quality from the Forest that contributes to population viability (persistence over time) of mussel populations within the watersheds where they occur.

Overall, viability remains a concern for the James spinymussel on the GWNF, yet management has little ability to affect its overall viability. Factors outside the authority of this agency affect the viability of the James spinymussel. Agency management activities can only contribute to the viability of the James spinymussel.

REFERENCES

Clarke, A. 1984. Status Survey of the James River Spinymussel, Canthyria collina (Conrad), in the James River Drainage System (contract no. 4107). Final Report to Virginia Tech, Office of Sponsored Programs, Blacksburg, Virginia.

Environmental Protection Agency (EPA) 1989, Rapid Bioassement Protocols for use in Streams and Rivers: Benthic Macroinvertebrates and Fish. US EPA Report 444/4-89/001. Office of Water Regulations and Standards. US EPA. Washington, DC.

Hove, M. 1990. Distribution and Life History of the Endangered James Spinymussel, (Pleurobema collina (Bivalvia: Unionidae). Masters Thesis submitted to Virginia Tech, Blacksburg, Virginia.

Hove, M., and R. Neves. 1994. Life History of the Endangered James Spinymussel. American Malacological Bulletin, Vol. 11 (1):29-40.

U.S.D.I. Fish and Wildlife Service. 1990. James Spinymussel (Pleurobema collina) Recovery Plan. Annapolis Field Office, Annapolis, MD.

USDA Forest Service. 2004. Federally Listed Threatened And Endangered Mussel And Fish Conservation Plan

Blackside Dace

The blackside dace is found on the Jefferson NF in only one stream in the Poor Fork of the Cumberland River, Kentucky. The Butler Tract is managed as Management Prescription 4D, Special Biological Area, and no FS management activities have occurred or are planned. Illegal ATV use continues to be a problem in the area.

The Forest will manage and protect populations and historical habitats of blackside dace. Protection and active management will be implemented where the species is on, or historically occurred on, the Forest. Protection, monitoring, and augmentation will be the primary recovery objectives. Actions will be taken in order to identify additional suitable habitat and restore fish to areas on the Forest where appropriate. In addition, the GWJNF developed a Federally Listed Fish and Mussel Conservation Plan with the USFWS that is applied in 6th level HUC watersheds that contain a federally listed fish or mussel species to proactively contribute to providing ecological conditions that maintain or increase fish or mussel populations.

REFERENCES

U.S.D.I. Fish and Wildlife Service. 1988. Blackside Dace (Phoxinus cumberlandensis) Recovery Plan. Asheville Field Office, Southeast Region, Atlanta, GA.

Brook Trout and Wild Trout

See also the 2004 M&E report for previously documented population trend information on the brook trout and wild trout on the GWJ NF.

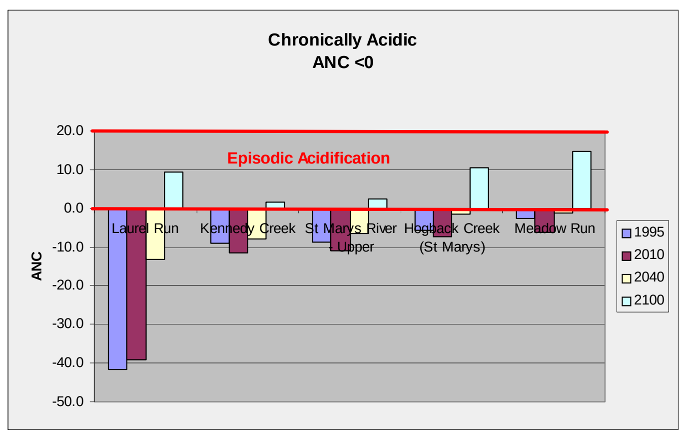
Over 942 miles of streams have been surveyed for large woody debris and pool/riffle ratios (ecologically important physical stream characteristics as described in the desired future condition for GWNF and JNF Forest Plans) on the GWJNF since 1995. Ninety-two miles were surveyed in the years of 2004-2005 (see Table 1). Approximately 81% of the streams surveyed did not meet the desired future conditions of 78 to 186 pieces of large woody debris per kilometer. Approximately 84% of the streams surveyed did not meet the desired future condition of pool habitat between 35% and 65%. Limiting factors for meeting the physical desired future conditions were predominately historic land use practices of the last 150 years. Historically, until the last 20 to 30 years, riparian areas have been logged to the stream banks. It takes over 100 years for riparian trees to grow to large size, die and fall into streams as large woody debris. Managing riparian areas for riparian dependant resources aids the slow progress towards meeting the large woody debris desired condition of riparian areas.

Table 1. Miles Of Stream Habitat Surveyed In 2004-2005, George Washington And Jefferson National Forests

year surveyed	# of stream miles surveyed	% of streams below minimum pool area DFC	% of streams below minimum LWD DFC
2004	35	71	78
2005	57	96	83
Total/ave:	92	83.5	80.5

Water quality has been systematically monitored on Forest streams since 1987. Approximately 100-200 streams were monitored for water quality each year in 2004, 2005, 2006 and 2007. As expected, the general water quality of any given stream is strongly tied to the underlying geology coupled with prevailing air quality. The collected data has been used to determine trends and changes in stream water composition, and to develop a model for projecting the future status of native trout streams. A 1998 report (Bulger et al. 1998) found that of the study streams in non-limestone geology, 50 percent are "non-acidic." An estimated 20 percent are extremely sensitive to further acidification. Another 24 percent experience regular episodic acidification at levels harmful to brook trout and other aquatic species. The remaining 6 percent of streams are "chronically acidic" and cannot host populations of brook trout or any other fish species. Modeling conducted by the Southern Appalachian Mountain Initiative (SAMI) and reported in their 2002 publication on acid deposition showed that even with the sulfate deposition declining considerably, as new air regulations are implemented, stream recovery will be slow or non-existent over the next 100 years. Chronically acidic streams may improve slightly and be only episodically acidic by 2100, but they will still be marginal for brook trout (see Figure 1).

Figure 1. SAMI Modeling Results For Selected Streams



Due to the lengthy recovery time anticipated for acidified streams on the Forest, selective liming to improve water chemistry will continue to be considered.

There are 10 trout streams that have been monitored extensively between 1976 and 2007 by the VDGIF and GWJNF (see Figure 2). These streams are used to elucidate trends in native brook trout and naturalized (wild) rainbow and brown trout populations across the Forest (see Table 2).

Figure 2. Location Of Selected Trout Streams Monitored On GWJ National Forest

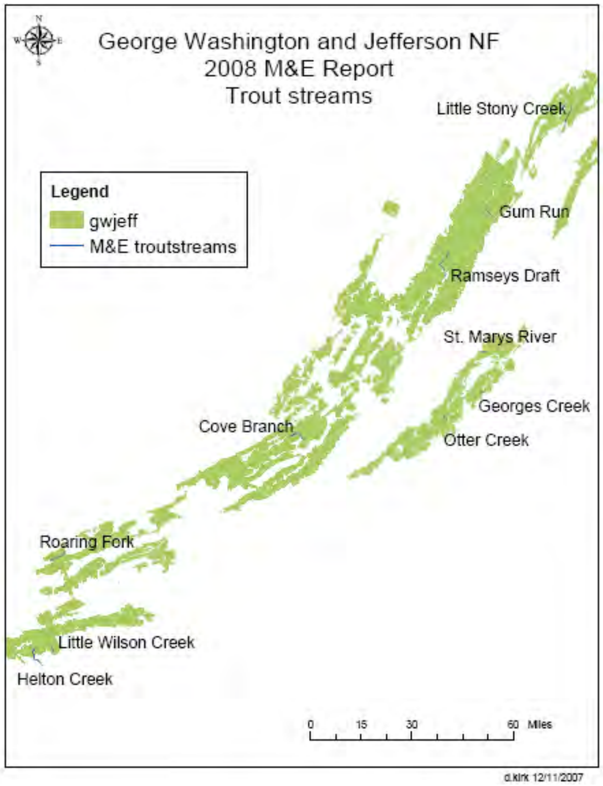


Table 2. Wild Trout Biomass from Selected Streams in kilograms/hectare (to convert to lbs/acre, multiply by .8923)

	Cove Branch	Gum Run (mean)	Little Wilson	Roaring Fork	Helton	Little Stony	St. Marys (mean)	Ramsys Draft (lower)	Georges	Otter
Year	(bt)*	(bt)*	(bt/rt)*	(bt)*	(bt/rt)*	(bt)*	(bt)*	(bt)*	(bt)*	(bt)*
1974				bt						
1975						bt				
1976		bt					bt/rt/bw	bt	bt	
1977	bt				bt/rt					
1978			0/20.1						bt	
1983			0/0							
1984				bt				bt		bt
1985			bt							bt
1986							6.4			
1987									18	
1988					bt/rt	12.1	6.2			
1989	30.5					6.9			51	15.5
1990	66.9		14/15		80/17	17.6	17.1	75	73	12.25
1991	50.9			bt		32.6				
1992	22.6		11.4/8		52/12	14.6	17.1	65	81	12.25
1993	20.2					15.4				
1994	16.5	44.1	19/8.7	0	60/37	13.3	7.9	47	65	10
1995	15.8	19.1				9.8				
1996	25.2	22	26/11	0	39/59	6.5	8	81	30	5
1998	20.5	67.1				27.4	22.1	46	121	
1999							27.9			
2000	7	10.8		21	14/2	39.5	36.5	70.7	92.3	0
2001							31.8			
2002	10.6	30.6	19.2/5.2	7.3	36/30	29	25.2	70.5	122.7	0
2003							19			
2004	14.3	77.02	30.4/2.7	13.3	82/7.3	22.2	13.4	23	59.3	1.2
2005							15.1			
2006	15.1	87	34.5/9.6	39.1	65.8/9.8	34.3	16.9	62	85.8	2.3

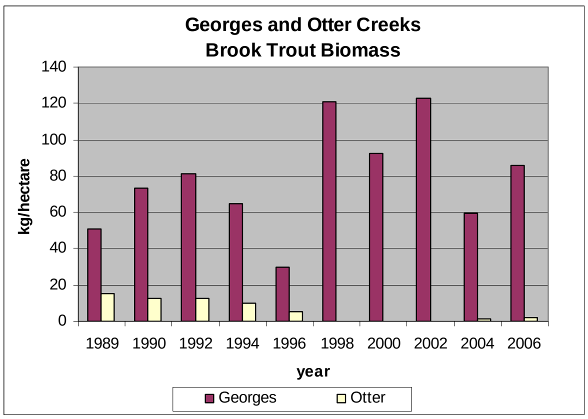
*: "bt" denotes brook trout, "rt" denotes rainbow trout, and "bn" denotes brown trout. Where these initials are found in a tabular cell, only presence was noted; biomass was not calculated.

Trout population trends can be broken into several categories that are strongly related to water quality:

1.) Good water quality, circum-neutral pH (non-acidic)

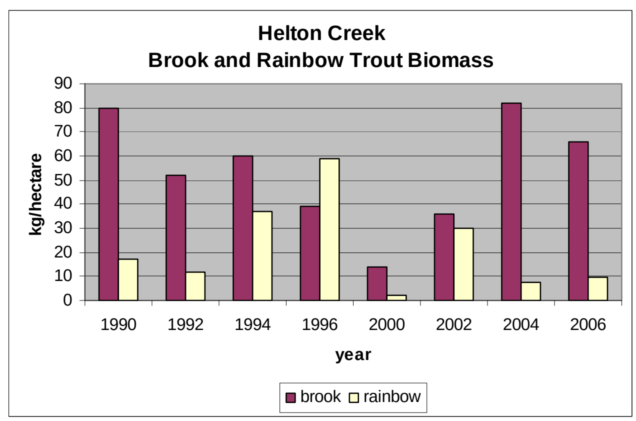
Where native brook trout are the only trout species in the stream, their populations generally fluctuate. Brook trout numbers from year to year are naturally variable and tend to respond to climatic extremes such as droughts or floods (i.e. Georges Creek, Otter Creek, see Figure 3). As an example, the lack of brook trout found in Otter Creek in 2000 and 2002 reflects the extreme drought that occurred during 1999-2002, and the subsequent drying up of the stream during the summer months. Approximately 70 wild brook trout of various sizes were stocked in Otter Creek in 2003, a non-drought year. Brook trout were found again in Otter Creek in 2004 and 2006.

Figure 3. Brook Trout Biomass in Georges Creek and Otter Creek, 1989 to 2006 (Data from S. Smith, VDGIF 2007).



Where brook trout and wild rainbow trout are found in the same stream with good water quality, there is competition between rainbow trout and brook trout, resulting in rainbow trout occupying lower reaches of the stream and brook trout occupying upper reaches of the stream. In some of the streams sampled that fit this category, there are middle reaches where both species are found (see Figure 4). Rainbow trout adults are found in moderate numbers, while brook trout numbers fluctuate from moderately high, to low with a large percentage of young fish in the sample.

Figure 4. Brook Trout And Rainbow Trout Biomass For Helton Creek, 1990 To 2006 (Data From G. Palmer, VDGIF 2007).



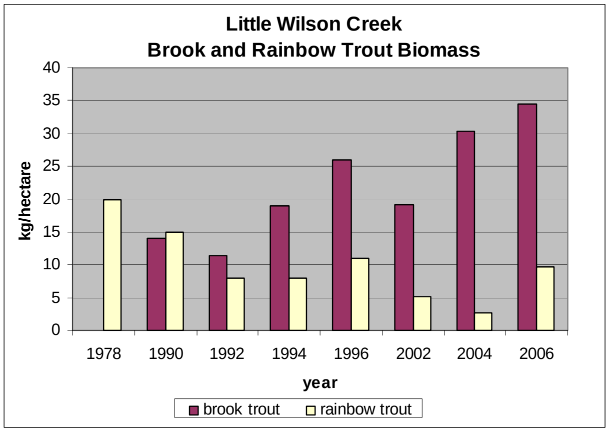
A small number of streams on the Forest have stream conditions suitable to support reproducing brown trout. These populations fluctuate in response to natural events.

2.) Water quality with low acid neutralizing capacity (ANC) and variable pH (acid sensitive)

Because brook trout are fairly acid-tolerant, native brook trout populations in these streams are similar to the populations found in non-acidic streams, except the fish have an additional extreme to contend with in the form of acid pulses, or periods of flow with low pH, generally associated with storm events in the winter or spring.

Where rainbow trout are present, their populations are declining, and brook trout populations are expanding. This category of stream seems to be reverting from wild rainbow back to brook trout (e.g., Little Wilson Creek, see Figure 5).

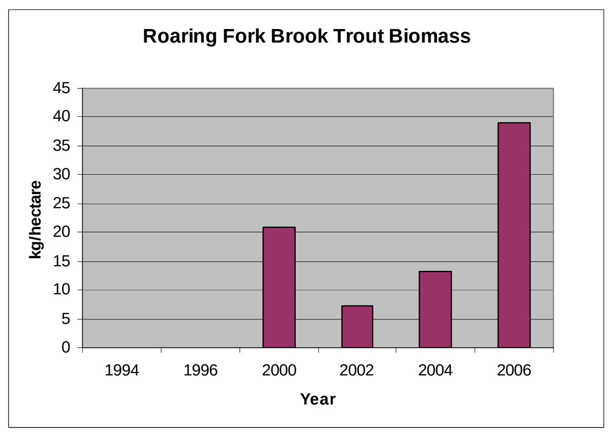
Figure 5. Brook And Rainbow Trout Biomass Of Little Wilson Creek, 1978 To 2006 (Data From G. Palmer, VDGIF 2007).



3.) Water quality with no ANC and low pH (acidified)

If streams in this category once harbored rainbow trout, they are now gone. Brook trout numbers are low. The population is chiefly made of older fish, and there is generally low recruitment. Some of these streams have had all fish extirpated. An example would be Roaring Fork prior to 1999. Several years of no spring floods carrying acidic pulses gave brook trout a chance to re-colonize the upper reaches of Roaring Fork. Brook trout are among the most acid tolerant fish and have somewhat recovered in the past few years in this stream (see Figure 6).

Figure 6. Brook Trout Biomass Of Roaring Fork, 1994 To 2006 (Data From G. Palmer, VDGIF 2007).



Several chronically acidic streams on the Forest have been treated with high-grade limestone sand (see Table 3). Brook trout populations in these streams have increased dramatically following treatment. If population trends continue upward for several years, relatively stable populations can be maintained through periodic liming. If the stream is not re-limed, brook trout numbers will return to their pre-liming condition within 5 to 8 years. Thus, Forest Service management activities such as liming (e.g., Little Stony Creek, Fridley Gap (Hudy et al, 1999), and St. Marys; see Figures 7 & 8) and watershed restoration are increasing brook trout populations within selected watersheds. Since brook trout are among the most acid-tolerant of native fish, they are the last species to disappear from acidic waters, and an overall declining trend will be seen when streams gradually move from episodically acidic to chronically acidic.

Table 3. Streams limed on the GWJNF since 1989

Date	Stream	County
2001	Burns Creek (right fork)	Wise
2002	Burns Creek (left fork)	Wise
1990, 1997	Cedar Creek	Shenandoah
1993, 1994, 1997	Laurel Run	Shenandoah
1997, 2000, 2003, 2006	Little Passage Creek	Shenandoah
1989, 1990,1991, 1998, 2001, 2004, 2007	Little Stony Creek	Shenandoah
1990, 1998, 2001, 2007	Mill Creek	Shenandoah
1993,1997, 1999, 2002, 2005	Mountain Run	Rockingham
1999	St. Mary's River & 5 tribs	Augusta
2005	St. Mary's River & 6 tribs	Augusta
1995, 1996, 1997, 1998, 1999	Trout Pond Run	Hampshire, WV

Figure 7. St. Mary's River Brook Trout Biomass Before and After Liming Treatment, 1986 to 2006 (Data from P.Bugas, VDGIF 2007).

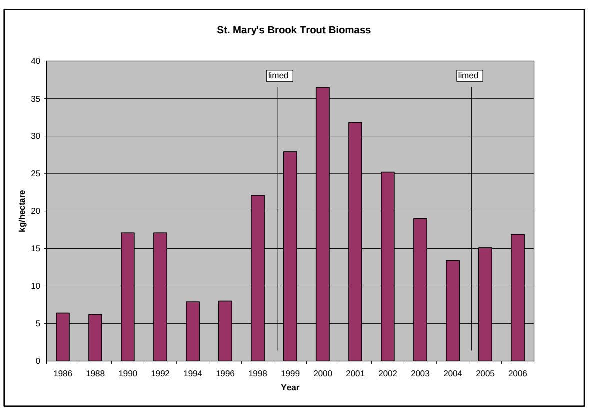
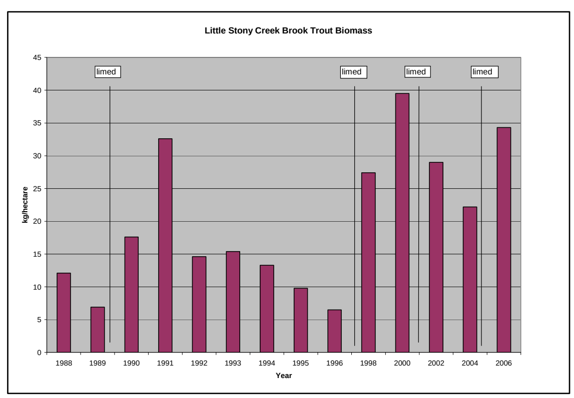


Figure 8. Little Stony Creek Brook Trout Biomass Before and After Liming Treatment, 1988 to 2006 (Data from S.Reeser, VDGIF 2007).



As shown in Table 2, populations of wild trout tend to fluctuate greatly over time. These findings do not necessarily suggest negative impacts to those streams from management activities, but rather that trout numbers are often highly variable due to natural occurrences (drought, floods, high temperatures, etc). Hakala (2000) showed that low flows related to drought conditions, overpowered other mechanisms that could potentially influence juvenile trout abundance (i.e. fine sediment), and that adult trout abundance was principally a function of stream discharge. He also showed that the critical fine sediment size for brook trout in his study is between 0.063 mm and 1.0 mm, and that fine sediment (<0.063mm) should not exceed 0.6-1.0% of spawning substrate, or negative population effects may be incurred. Documented sediment shifts from extreme events that result in altered Rosgen channel types have involved median particle sizes (D50) much larger (i.e. D50 shift from 78 mm to 52 mm) than those that have been scientifically linked to biological effects (FY 97/98 Monitoring and Evaluation Report, GWJNF). Therefore, although extreme channel-altering events may be significant enough to change the stream morphology and hydrology, they may not necessarily affect stream biota in the short term.

Vegetation management activities, such as timber harvesting or prescribed burning, are not affecting water temperatures. Timber harvesting does not occur in riparian areas as documented in site-specific project-level analyses. Prescribed burning does not affect over-story vegetation and thus does not increase the amount sunlight reaching the stream. Timber harvesting introduces short-term (4-7 years or less) sediment increases, but properly implemented Best Management Practices have been shown to mitigate effects on water quality and biota that may result from timber harvest (Austin, 1998). These activities are being monitored Forest-wide using aquatic macroinvertebrates as an indicator of effects to the aquatic biological community.

Aquatic macroinvertebrate communities integrate the physical, chemical, and biological components of the riparian ecosystem and have been successfully used as bioindicators to monitor change and impacts (EPA 1989). A Macroinvertebrate Aggregated Index for Streams (MAIS) (range of scores 0 to 18) incorporates nine ecological aspects (metrics) of the aquatic macroinvertebrate community to evaluate the current condition of a stream relative to others within that ecological section (Smith and Voshell 1997). A Rapid Bioassessment report provides raw data on the taxa collected in addition to the metric scores and the overall MAIS score. Adjectives of “very good” (MAIS = 17-18), “good” (MAIS = 13-16), poor/fair (MAIS - 7-12), and “very poor” (MAIS = 0-6) are added to the report to make it user friendly to non-technical managers and decision makers. The GWJNF uses the MAIS score as “coarse filter” screening tool on some projects to establish current “stream health” and to establish a baseline to evaluate effectiveness of standards, guidelines and mitigation measures in preventing changes and impacts to the aquatic community. When the MAIS score is low or has changed from previous monitoring, biologists examine the individual metric scores and/or raw data to identify limiting factors. The individual metrics often point to a limiting factor or trigger a more rigorous and quantitative monitoring effort.

Sample sites were selected downstream of management activity areas to monitor the impacts on stream health of projects including but not limited to timber sales and prescribed burns. Other samples were collected to create a baseline of stream conditions within the forest. Only samples collected from March through the first week in June were compared to minimize seasonal variability in structure of macroinvertebrate communities. Across the Forest, 728 samples were collected, analyzed and assigned an overall MAIS score (0-18). Of these samples, 84% were in the “good” and “very good” categories.

A paired t-test was used to compare the MAIS scores of 18 streams before and after timber harvests that occurred at various locations across the Forest. There was no significant difference between the pre and post timber harvest MAIS scores; both the pre and post mean scores were in the “Good” category (see Table 4).

Table 4. Paired samples t-test on pre and post MAIS scores from 18 different timber sales.

Mean MAIS pre	16
Mean MAIS post	15
95% CI	-0.365 to 2.365
P value	0.140

A paired t-test was used to compare the MAIS scores of 7 streams before and after prescribed burn that occurred at various locations across the Forest. There was no significant difference between the pre and post prescribed burn MAIS scores; both the pre and post mean scores were in the "Good" category (see Table 5).

Table 5. Paired samples t-test on pre and post MAIS scores from 7 different prescribed burns.

Mean MAIS pre	16
Mean MAIS post	16
95% CI	-1.098 to 1.669
P value	0.631

Based on the above monitoring analysis, timber harvesting and other management activities are not significantly decreasing habitat or populations of wild trout or brook trout.

Recent discussions on the effects of climate change on trout habitat have identified the possibility of less flow and warmer water in the summer and flashier intense flow in the winter (Trout Unlimited 2007). Actions that could mitigate the resulting changes to stream channels include 1) protecting riparian zones which would maximize shading, provide bank integrity and a source for large wood, and 2) allow natural processes such as meandering channels and development of wetlands (including beavers) to increase groundwater recharge and provide refuge during extreme droughts or floods. Through Forest Plan emphasis on riparian structure and function, the GWNF has already laid the groundwork for addressing this issue in the future.

The trout is a game fish that is harvested throughout Virginia and West Virginia, and therefore, viability is not a concern. Overall, viability is sustained for trout on the GWJNF. Trout populations are expected to remain relatively stable in the near future. Based on the results of our monitoring and evaluation, this species has the abundance and distribution across the Forests that will provide for its persistence into the foreseeable future.

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Trout Unlimited. 2007. Healing Troubled Waters, Preparing Trout and Salmon Habitat for a Changing Climate. Arlington, VA.

Sunfish Family

1.) Warmwater Streams (data from S. Reeser, VDGIF, 2007)

See the 2004 M&E report for previously documented population trend information on the sunfish family on the GWNF.

The South Fork Shenandoah River has been used as a representative of warm water streams in the M&E reports since 1997. Fish kills have been occurring from 2004-2007 in the entire North Fork Shenandoah, South Fork Shenandoah, Main stem Shenandoah River, and main tributaries of the South Fork Shenandoah River (North River, Middle River, South River). In 2007 fish kills occurred in the Cowpasture River and Upper James River from Lick Run downstream to Lynchburg.

The main kills were seen in the spring of the year from March-June. There have been some kills involving suckers in November and December in the Main stem Shenandoah River. Fish affected are primarily smallmouth bass, redbreast sunfish, and rock bass. Small numbers of white suckers, northern hogsuckers, largemouth bass, chubs, fallfish, and a few bullhead catfish have also been affected. A few additional species have been reported by anglers.

Syptoms may include physical problems, however, some dead fish have no visual external problems. Dying or stressed fish sometimes are covered in a heavy layer of mucus, have "blotched" coloration, are extremely dark in color, have external patches of fungus or protozoans on them that appear to be fuzzy-like cotton, bloody spots under the scales, or open bloody lesions caused by bacteria. Some fish may be lethargic and found swimming near the surface, while others may be acting normally and are even caught by anglers.

Regarding the impact to the fish population in the Shenandoah River, the smallmouth bass and sunfish population has been significantly reduced in some sections of the river. The impact to the fish population is not uniform throughout the river. This change in the population has been noticeable by anglers, as the have experienced reduced catch rates. However, biologists have not yet seen a reduction in the fish community that would be severe enough to keep any one species from sustaining its own population (see Figures 1 & 2)

Figure 1. South Fork Shenandoah Smallmouth Bass Relative Abundance

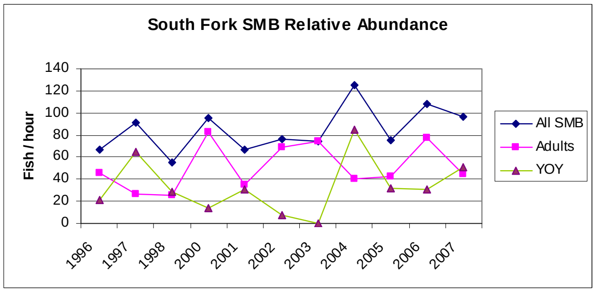
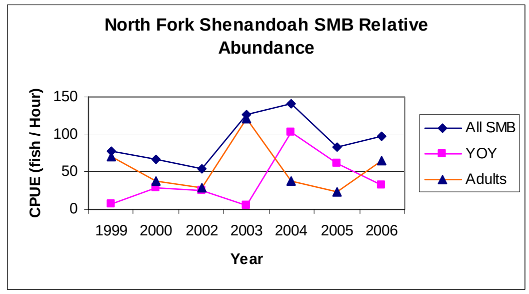


Figure 2. North Fork Shenandoah Smallmouth Bass Relative Abundance



Impact to fish population in the Cowpasture and James River: With the kills and stress events still occurring, it will be early Fall before DGIF biologists will be able to assess the impacts of these fish kills by comparing the 2007 data to previous years fish population data. Recently, staff biologists have observed up to 40% of selected species showing signs of stress in the Cowpasture and James River, and anglers have reported seeing low numbers of dead and stressed fish. These observations by staff biologists and anglers are very similar to what is also being currently reported on the Shenandoah River.

While there is not yet enough supporting data/evidence to link these events to any one cause, researchers are focusing on two main areas: a biological agent like a virus, bacteria or other pathogen; or some type of contaminant.

This is an extremely complex situation as investigators working on the Shenandoah kills have learned. Much of the information that has been collected to date on the Shenandoah River suggests multiple stressors acting collectively. More data collection and analysis will need to be preformed before the cause(s) of this problem can be narrowed-down.

2.) Reservoirs (data from P.Bugas, VDGIF, 2007)

Lake Moomaw has been used as the GWNF reservoir example in the M&E report since 1997. Lake Moomaw is a 2,530 acre impoundment located in Bath and Alleghany Counties, Virginia. Gathright Dam was authorized by the U. S. Congress in 1946 and completed by the U. S. Army Corps of Engineers in 1981. Operation and maintenance of the recreation area was transferred to the U. S. Forest Service in July, 1982. The reservoir was constructed for downstream water quality augmentation, flood control, and recreation. Recreational pool level is at 1,582 feet above sea level and there is over 43 miles of shoreline. Lake Moomaw is surrounded by the 13,482 acre Gathright Wildlife Management Area and thousands of acres owned by the U. S. Forest Service. The lake's unique intake tower consists of nine portals, designed to release water at any level from 12 – 87 feet below recreation pool. This allows for maximizing optimum temperature and flow regimes in Jackson River below Gathright Dam. The average depth of the reservoir is 80 feet, with the maximum depth at 150 feet near the dam.

Lake Moomaw's geographic location and its operational procedure lends itself to thermal stratification in the summer. As much as 60,000 acre-feet of coldwater fisheries habitat is available in later summer for species such as brown and rainbow trout. Coldwater habitat varies annually depending on flow into the lake and downstream release loads. In summer 1993, the Corps of Engineers changed the way they released water out of the impoundment during summer/early fall. The Corps is required to provide 210C.water at Covington, 30 km downstream of Gathright Dam, throughout this period. Currently, water from the epilimnion is mixed with cold, anoxic water from the hypolimnion, meeting downstream temperature requirements and preserving summer trout habitat in the lake. Alewives, the primary forage base, also thrive in the lake's two-story environment. Trout are the only sport fish that are stocked annually.

Changes in the physical habitat have focused primarily on black bass populations. Warmwater fish species such as black bass, black crappie, rock bass, sunfish, chain pickerel, channel catfish, and yellow perch reproduce and grow in the flats, drop-offs, brush, and standing timber afforded to them along the lake's shoreline. Common carp found their way into the reservoir through bait introductions in the late 1990's. Artificial habitat such as tire reefs, artificial grass, cedar tree shelters, crappie stakes, pallet structures, log cribs, hinge trees, brush/tree piles, concrete structures, and PVC attractors have been deployed at various times in Lake Moomaw since 1981. Prior to impoundment, the Corps of Engineers left 40 hectares of standing timber in several coves and a few boulder piles in deep sections of the lower lake. Hundreds of stumps were also left along the shoreline, providing exceptional cover/nesting habitat for channel catfish. Addition of physical habitat has been accomplished jointly by DGIF, USFS, and local angling clubs. An inventory of past projects is maintained by USFS at the Warm Springs Ranger District office. A lake management plan was also jointly developed by DGIF and USFS in 1993.

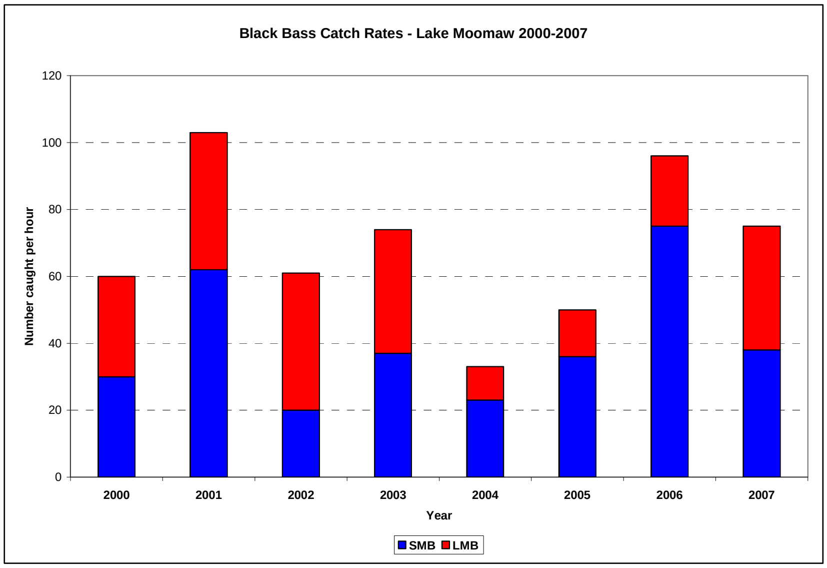
Black bass relative abundance is estimated with annual nighttime electrofishing surveys conducted at established stations throughout the lake. Additional black bass(particularly smallmouth bass)data are periodically sampled with fall/winter daytime horizontal gill net sets. Black crappie have been periodically targeted with spring or fall trap net sets, but no permanent sampling protocol has been established for this species. Channel catfish, yellow perch, and chain pickerel are collected incidentally with gill nets and by electrofishing.

Fishing regulations were set years ago and have changed little in the past decade. Black bass regulations have remained unchanged since 1982, with an aggregate (smallmouth and largemouth bass) of five per day, 12 inches or larger. Fifty sunfish of any size can be creeled daily and 25 each of rock bass and black crappie of any size can be taken daily. Five chain pickerel daily of any size and 20 channel catfish of any size can be harvested daily. There is no size or creel limit on yellow perch or common carp.

In summary, the black bass fishery at Lake Moomaw is representative of a western Virginia impoundment. Bass densities (see Figure 3) and growth are very good for smallmouth bass, and moderate for largemouth bass. Sunfish are plentiful and large redears and bluegill are creeled from deep, shady cover. Yellow perch have established themselves as a favorite quarry in early spring for those looking for excellent table fare. The state record yellow perch was creeled from

Lake Moomaw. Black crappie are moderately abundant and can be found in the one-pound size range in woody cover. Large chain pickerel are active in early spring and trophy channel catfish are scattered throughout the lake.

Figure 3. Black Bass Catch Rates at Lake Moomaw.



Although the addition and maintenance of underwater structures in Forest reservoirs is necessary for healthy self-sustaining warm water fish populations, these populations are heavily manipulated through fishing regulations and harvest pressure. Forest Service activities, such as the creation of structures in reservoirs, are beneficial to members of the sunfish family.

Sunfish are game fish that are harvested throughout Virginia and West Virginia; and, therefore, viability of these populations is not a concern. Overall, numbers and distribution of sunfish species on the GWNF is sufficient to support viable populations and sustained recreational use. Sunfish populations are expected to remain relatively stable or increase in the near future. Based on the results of our monitoring and evaluation, this species has the abundance and distribution across the Forests that will provide for its persistence into the foreseeable future.

Large Woody Debris Within Streams

NOTE: This discussion that follows is basically an excerpt from the February 2007 Draft Comprehensive Evaluation Report for Revising the GW 1993 Forest Plan.

Forest personnel surveyed stream habitat to measure Large Woody Debris (LWD) parameters identified in the 1993 Revised GWNF Forest Plan. Surveys were conducted on portions of the Pedlar Ranger District in 1995 and 2005, Lee District in 2001, Dry River District in 2002, 2003, 2004 and 2005, and the Warm Springs in 2005. Overall, 631 km (392 miles) of streams were surveyed using a modified Basinwide Visual Estimation Technique (BVET [Dolloff et. al. 1993]) to estimate woody debris loading, percentage of pool and riffle area, and the width of the riparian area of streams. The distribution of woody debris was also mapped. See Table 1 for a summary of LWD and % pool area.

Table 1. Miles Of Stream Habitat Surveyed In 1995-2005 on the GWNF

Year Surveyed	# of Stream Miles Surveyed	% of Streams Below Minimum Pool Area DFC	% of Streams Below Minimum LWD DFC
1995	113	48	44
2001	75	75	35
2002	57	62	33
2003	55	70	19
2004	35	71	78
2005	57	96	83

A comparison of individual streams surveyed in 1995 and again in 2005 on the Pedlar District showed a decrease in the median number of pools, number of riffles, and total LWD per km, while the median pool and riffle surface area increased. This report suggests that in 1995 only 25% of streams met the DFC for stream area in pools and less than half of streams met the DFC for total LWD. By 2005 no streams met the DFC for pool area and 75% of streams did not meet the DFC for total LWD. The changes in pool/riffle ratio, number of pools and riffles per km, and pool and riffle surface area are all consistent with decrease in total LWD. The largest decrease of LWD was in the smallest size class. These pieces most often form pool habitat by combining with other small woody debris to form debris jams. In general the smallest size classes are the most easily dislodged and transported downstream or out of the active stream channel during high flows (Hilderbrand et al. 1998, Montgomery et al. 2003). Loss of debris accumulations from long riffle areas following flood events could result in the changes in stream habitat observed. The median amount of the largest size classes of LWD either remained the same or increased in the reaches between 1995 and 2005.

Management actions such as adding large woody debris and other types of in-stream structures moved particular streams toward meeting the DFC. However, the vast majority of the Forest's streams received no direct management action. Although comparisons of 1995 and 2005 stream surveys showed a decrease in streams meeting the desired future conditions for pool/riffle ratio and total LWD, the median amount of the largest size classes of LWD either remained the same or increased during that time period. The largest size classes (size 3: > 5 m long, 10-50 cm diameter; size 4: >5 m long, >50 cm diameter) are most stable and can easily have residence times of greater than 10 years in Appalachian streams with relatively little movement (Andy Dolloff, unpublished data). Continued supply of these size classes to the stream may result in increases in total pool habitat in the future.

Such differences highlight the fact that LWD dynamics are governed by a wide array of chronic and acute events, both natural and anthropogenic, including flooding, fires, stand maturation, riparian composition, and timber harvest (Dolloff and Warren 2003, Benda et al. 2003). For example, insect infestations such as gypsy moth or hemlock wooly adelgid can result in the relatively rapid death of many trees. Smaller size classes of LWD are added to the stream as dead trees standing in the riparian area begin to shed branches, and larger size classes are added as these trees continue to decompose and eventually fall across the stream channel. Natural additions of LWD can come through slow attrition or in large pulses if stands are impacted by events such as hurricanes. It is expected that streams will move toward the DFC through natural process if riparian forests are allowed to mature and more trees are left in the vicinity for recruitment of future LWD.

Specific objectives for instream habitat from the 1993 Plan were: Pool habitats occupy 35% to 65% of available habitat. Streams supporting cold water habitats have 125 to 300 pieces of large woody debris (LWD) per stream mile, while streams supporting cool water habitats have 75 to 200 pieces of LWD per mile.

Following the extensive logging that occurred over much of the Forest in the past 200 years, slash and debris could persist for 20 to 50 years in streams before declining to lower levels. Wood loading in streams would then gradually increase over many years as the riparian forest matured and provide a source of large wood (Dolloff and Webster 2000). This last process may require centuries (Hornbeck and Kochenderfer 2000). As stated in the previous section, it is expected that streams will move toward the DFC through natural process if riparian forests are allowed to mature and more trees are left in the vicinity for recruitment of future LWD. Managing for big trees in riparian areas can speed the accrual of woody debris to streams, including intermittent and ephemeral channels (Richards and Hollingsworth 2000). Although it has long been recognized that LWD is important in perennial streams as a source of habitat complexity, and is positively correlated with increased fish production (Richards and Hollingsworth 2000); the importance of allochthonous matter (leaves and wood) increases as stream size decreases. In addition to leaves and twigs being the basis of the food chain in headwater streams, large pieces of wood influence flow velocity, channel shape, and sediment storage and routing. The stairstep profile created by woody debris dams dissipates much of the energy in small, high-gradient streams (Dolloff and Webster 2000). Research indicates that one-third of the biomass of litter in a stream comes from distances beyond 100 ft. This distance exceeded the mean maximum tree height for the study system of approximately 72 ft (Palik et al. 2000). Welsch et al. (2000) recommend riparian forest buffer widths equal to at least two tree lengths.

In the CER for Revising the GW Forest Plan, the agency has recommended adopting the Jefferson Forest Plan Riparian Corridor and Forest-wide Channeled Ephemeral standards into the GWNF Plan. Similar to the GWNF Plan, the revised Jefferson Plan manages riparian areas as a separate Management Prescription (Riparian Corridor) with a focus on riparian resources. However, in contrast to the GWNF Plan, the revised Jefferson Plan incorporated wider management zones, recognizing riparian values other than, and in addition to, aquatic resources and buffering streams. The Jefferson Forest Plan Riparian Corridor does not completely prohibit timber management, but does have the specific objective that streamsides are managed in a manner that restores and maintains amounts of LWD sufficient to maintain habitat diversity for aquatic and riparian-dependent species (approximately 200 pieces per stream mile).

2005 Summary of VDGIF Coldwater Report Trout Stream Classification Review

Fisheries data were collected on 58 streams to evaluate stream classifications. No streams were re-classified as a result of the 2004 surveys. Results of surveys generally showed that the effects of the 1998 through 2002 drought have generally abated. Flows the past two years were above average throughout the year with good summer flows resulting in holdover of adult fish. Most streams had an excellent recruitment year in 2004 and wild trout populations should fully recover by 2005 if favorable flows continue.

2006 Summary of VDGIF Coldwater Report Trout Stream Classification Review

Fisheries data were collected on 117 streams to evaluate stream classifications. Two new streams were classified for the first time as a result of the 2005 surveys (Little Valley Run in Bath Co., near FS, was listed as a Class III wild brook trout stream, and Red Oak Spring in Augusta Co., on FS, was listed as a Class II wild brook trout stream) and two streams were upgraded in classification (Barbours Creek 4 miles below Cove Br. to SR 609, near FS, was upgraded from a VI to a II with wild brook, brown, and rainbow trout, and Little Indian Creek in Floyd Co., not near FS, was upgraded from unsuitable to Class II). Generally trout populations are in good condition after above average recruitment in both 2004 and 2005. Populations appear to be fully recovered from the drought that ended in 2002.

2007 Summary of VDGIF Coldwater Report Trout Stream Classification Review

Fisheries data were collected on 80 streams to evaluate stream classifications. No streams were re-classified as a result of the 2006 surveys.

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Cow Knob Salamander

NOTE: This discussion that follows is basically an update to the February 2007 Draft Comprehensive Evaluation Report for Revising the GW 1993 Forest Plan.

See also the 2004 M&E report for previously documented population trend information on the Cow Knob Salamander on the GWNF.

In 2002 William Flint, a graduate student at James Madison University, began studying the Cow Knob salamander for his Master's thesis with financial support from the Forests (Flint 2004). This research is contained in his thesis "Ecology and Conservation of the Cow Knob Salamander, *Plethodon punctatus*" and is summarized here. The following table contains the data that was available from Mr. William Flint.

Location and Survey Year	Adult Population Number	Juvenile Population Number	Total Population
Sugar Grove, VA			
2005	14	20	34
2006	17	27	44
2007	27	27	54
Tomahawk, WV			
2004	1	9	10
2006	1	2	3

Since Flint completed his Master's thesis in 2004 he has conducted additional field surveys. These surveys have extended the range of the Cow knob salamander even farther south to Wallace Peak and east to Elliot Knob, however, it is not clear how much of that area is actually occupied by the salamander.

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Eastern Tiger Salamander

NOTE: This discussion that follows is basically an update to the February 2007 Draft Comprehensive Evaluation Report for Revising the GW 1993 Forest Plan.

See also the 2004 M&E report for previously documented population trend information on the Eastern Tiger Salamander on the GWNF.

In 2006 Forest Service biologists found eastern tiger salamander adults and eggs in four ponds in the Loves Run Pond Complex and adults and eggs in an additional pond between Maple Flats and Loves Run. In 2007 Forest Service biologists found one adult eastern tiger salamander at Pine Chapel Pond.

Prior to 2001, the Maple Flats Ponds Special Biological Area containing the eastern tiger salamander appeared to have encompassed much, if not all, habitat used by this species on the GWNF. Since 2001 eastern tiger salamanders have been located at several other ponds. Most of those ponds are already in Special Biological Areas (Loves Run Ponds and Pines Chapel Ponds). Observations made since this species was discovered on the Forest indicate that this species is still present at all locations where previously found. Population size and trend studies are on going, as are inventories of potential habitat. As new information on population trends and habitat use surface, management activities will be adjusted to protect eastern tiger salamanders where they occur on the Forest. Forest Service management activities are having no effect on the eastern tiger salamander since all sinkhole ponds and associated upland habitat are avoided and buffered from management activities. Illegal ATV use is a continuing problem in and around the sinkhole ponds. Illegal ATV use has the potential to directly impact this species along with federally listed plant species and their habitat. The 1999-2002 Monitoring and Evaluation Report suggested increased law enforcement efforts. Forest Service law enforcement has apprehended several illegal ATV users in the Maple Flats area and they were successfully prosecuted in court. In 2001, the Glenwood-Pedlar Ranger District placed boulders to restrict illegal ATV activity. As a result of increased law enforcement and making access more difficult, illegal ATV activity seems to have greatly decreased in the area. In 2007 signs were placed at several of the ponds where ATV use has been a problem to inform the public that motor vehicles are prohibited.

As noted in the CER of 2/15/07, the agency believes the GW Forest Plan should be modified to expand existing, or create additional, Special Biological Areas to encompass the newly found eastern tiger salamander populations. Additionally, a guideline should be developed that says habitat should be maintained between sinkhole ponds and sink hole pond complexes in a mature forest condition to allow movement of salamanders between ponds and pond complexes.

Shale Barren Rockcress

NOTE: This discussion that follows is basically an update to the February 2007 Draft Comprehensive Evaluation Report for Revising the GW 1993 Forest Plan.

See also the 2004 M&E report for previously documented population trend information on the shale barren rockcress on the GWJNF.

Habitat has not changed since the 2004 report except through natural processes. In 2005 West Virginia Department of Natural Resources (WVDNH) reported a new record on the Forest north of Sugar Grove U.S. Naval Radio Station. Tom Wieboldt from Virginia Tech, Forest Service personnel, and Va. Natural Heritage personnel found five plants in 2007 at a new location on a shale barren near the Cowpasture River, upstream from the community of Griffith VA. The current total of known rockcress locations on the Forest is now 80. Of the 80 occurrences, 17 were known in 1993 when the GWNF Plan took effect, so there has been an increase of 63 occurrences. The number of individual plants in shale barren rockcress populations is known to fluctuate greatly from year to year, so the inability to find plants in a given year is not necessarily indicative of loss of a population (Jarrett, et al. 1996). Overall, given that habitat is stable and protected and field studies have located new populations, shale barren rockcress populations appear stable on the GWNF. Reflecting this trend, in 2003 the West Virginia Department of Natural Resources changed the S rank for shale barren rockcress from S1 (1 to 5 occurrences) to S2 (6 to 20 occurrences.

Swamp Pink

NOTE: This discussion that follows is basically an update to the February 2007 Draft Comprehensive Evaluation Report for Revising the GW 1993 Forest Plan.

See also the 2004 M&E report for previously documented population trend information on the shale barren rockcress on the GWJNF.

In 2004 another large population, possibly several thousand plants, was discovered in St. Mary's Wilderness near an unnamed tributary. This population was surveyed in 2005. Due to the large number of plants and the terrain an exact count was not possible, but the population is between 2000 and 3000 plants. Because the majority of the Forest's swamp pink habitat is in Wilderness or Special Biological Areas it is being conserved and protected from potentially damaging activities. Basically, natural processes are operating in these areas. The habitat trend for this species is stable or increasing.

Northeastern Bulrush

NOTE: This discussion that follows is basically an update to the February 2007 Draft Comprehensive Evaluation Report for Revising the GW 1993 Forest Plan.

See also the 2004 M&E report for previously documented population trend information on the shale barren rockcress on the GWJNF.

Cast Steel Run Pond = Morning Knob Site

No change in habitat has occurred except natural succession. On June 20, 2007, personnel from the U.S. Forest Service and the U.S. Fish and Wildlife Service visited this site and found that the habitat was stable.

Pond Run Pond Site

Pond Run Pond is monitored by the West Virginia Department of Natural Resources. Their 2002 report to the Forest indicated concern about increasing canopy closure over the pond that may negatively affect the Northeastern bulrush. They also noted the possible hydrologic connection between Pond Run Pond and a bog uphill. A trail runs between the pond and the bog and may be interfering with the normal movement of water between the two areas. A field review by U.S. Forest Service, WV Division of Natural Resources, and U.S. Fish and Wildlife Service personnel was conducted on May 25, 2004. The decision was made to try daylighting the pond to slowly increase sunlight reaching the pond. A 6 inch diameter red maple on the south side of the pond was girdled. No evidence of damage from horses was seen. On September 24, 2004 WVDNR returned and noted that the girdled red maple was alive and the wound had healed over. They suggest repeating the girdling and cutting deeper. On May 5, 2007 Jim Smalls, District Ranger, Fred Huber, Forest Botanist, and Mike Donahue, Biological Technician, visited the pond to see if horse use in the area had caused any damage to the pond or the NE bulrush. No evidence of damage was seen, but higher water level at the time may have covered horse tracks that had been reported. Logs were placed around the pond to discourage entry by horses and creation of water sources for horses away from the pond was discussed.

Recreational Opportunities

NOTE: This discussion that follows is basically an update to the February 2007 Draft Comprehensive Evaluation Report for Revising the GW 1993 Forest Plan.

Contrary to the visions in both Forest Plans, funding is very limited to be able to increase recreational opportunities. With one rare exception, rather than increasing, the agency has closed the following facilities on the Jefferson National Forest:

- White Pine Horse Camp
- Bee Bottom Picnic Area
- New River Campground
- Natural Bridge Visitor Center
- Highlands Gateway Visitor Center
- Damascus Caboose Visitor Center
- Massanutten
- Buena Vista

The rare exception has been that the agency did construct a new recreation facility: White Cedar Horse Camp including prefab vault toilets (non-flush) and corrals at each campsite. Likewise, the agency did expand the developed camping facilities at Bolar Mountain Campground at Lake Moomaw. The new Sugar Ridge camping loop includes a new bathhouse with flush toilets and showers.

Table 1. Motorized and Non-Motorized Trail Maintenance
(Miles Maintained Across Both Forests)

Fiscal Year	Trail Maintenance
2005	974
2006	835
2007	618

Virginia Northern Flying Squirrel

NOTE: This discussion that follows is basically an update to the February 2007 Draft Comprehensive Evaluation Report for Revising the GW 1993 Forest Plan.

See also the 2004 M&E report for previously documented population trend information on the squirrel on the GWJNF.

The Virginia northern flying squirrel (Glaucomys sabrinus fuscus) was listed as endangered in 1985 by the USFWS. On December 19, 2006, the U.S. FWS published a proposed rule to remove the Virginia northern flying squirrel from the List of Threatened and Endangered Species, due to recovery (71 FR 75924). At the present time, this proposal has not been finalized. Overall, a low but stable trend has been observed for this species on the GWJNF.

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Peregrine Falcon

NOTE: This discussion that follows is basically an update to the February 2007 Draft Comprehensive Evaluation Report for Revising the GW 1993 Forest Plan.

See also the 2004 M&E report for previously documented population trend information on the falcon on the GWJNF.

On August 8, 1999, the USFWS removed the peregrine falcon from the List of Threatened and Endangered Species (64 FR 46541 to 46558). Due to the continuing need for conservation of this species and its habitat, the Regional Forester has added the peregrine falcon to the Regional Forester's Sensitive Species List. Several pairs of peregrine falcons have been nesting in Shenandoah National Park and have been occasionally sighted on adjacent National Forest.

Bald Eagle

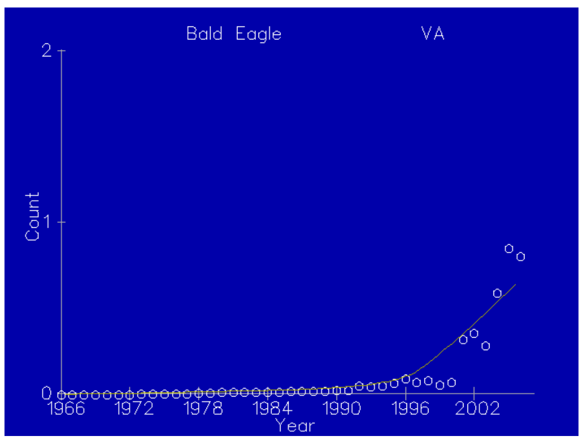
NOTE: This discussion that follows is basically an update to the February 2007 Draft Comprehensive Evaluation Report for Revising the GW 1993 Forest Plan.

See also the 2004 M&E report for previously documented population trend information on the eagle on the GWJNF.

On August 8, 2008, the US Fish and Wildlife Service removed the bald eagle (*Haliaeetus leucocephalus*) from the Federal List of Threatened and Endangered Species (72 FR 37346). Due to the continuing need for conservation of this species and its habitat, the Regional Forester has added the Bald Eagle to the Regional Forester's Sensitive Species List, effective August 8, 2008 (Regional Forester 2670 Official Memorandum, July 17, 2007). The bald eagle continues to be protected by the Bald and Golden Eagle Protection Act (Eagle Act) and the Migratory Bird Treaty Act (MBTA). The Eagle Act and MBTA protect bald eagles from a variety of harmful actions and impacts. The U.S. Fish and Wildlife Service developed National Bald Eagle Management Guidelines (Guidelines) (http://www.fws.gov/migratorybirds/baldeagle.htm) to provide information that will minimize or prevent violations of federal laws governing bald eagles.

The BBS data for Virginia is presented in Figure 4.

Figure 4. Average Number of Bald Eagles Seen or Heard Across Virginia, 1967 to 2006



Source: http://www.mbr-pwrc.usgs.gov/bbs/bbs.html

APPENDIX A

GEORGE WASHINGTON & JEFFERSON N.F.

FY 2005 to FY 2007 Expenditure Data

Summary Category	FY 2005 Expenditure*	FY 2006 Expenditure*	FY 2007 Expenditure*
Recreation	$3,729,699.61	$4,028,961.46	$4,326,780.03
Wildlife & Fish	$763,138.80	$852,354.10	$787,860.29
Range	$51,962.11	$45,387.67	$41,255.17
Forest Health	$170,339.68	$189,998.65	$184,060.31
Timber	$1,690,602.65	$1,574,790.05	$1,672,470.68
Soil, Water & Air	$53,523.80	$39,738.89	$25,767.81
Minerals	$475,363.72	$385,195.26	$379,491.58
Senior Citizens	$777,091.97	$711,142.04	$47,385.30
Lands	$509,507.02	$610,952.01	$571,636.54
Engineering	$7,442,116.19	$4,204,220.78	$2,930,273.16
Fire	$4,123,542.69	$7,508,522.79	$5,479,739.54
Law Enforcement	$0.00	$0.00	$0.00
General Admin	$0.00	$4,322,857.32	$4,864,967.67
Planning and Inventory	$887,104.24	$1,104,803.57	$1,007,893.71
Timber, Range, & Soil, Water, Air	$778,936.71	$515,393.50	$727,543.89
Timber, Wildlife & Fish, Water, Air	$824,366.97	$1,101,900.12	$987,008.64
Misc	$419,182.44	$302,981.06	$307,701.68
Total	**$22,696,478.60**	**$27,499,199.27**	**$24,341,836.00**

*Expenditure by Summarized EBLI

APPENDIX B
George Washington and Jefferson National Forests
2005 to 2007 Payment to States by County

COUNTY	2005	2006	2007
LETCHER	$535.43	$540.79	$539.68
PIKE	$0.00	$0.00	$0.00
KY. STATE TOTAL	$535.43	$540.79	$539.68
ALLEGHENY	$83,313.46	$84,146.59	$83,973.90
AMHERST	$33,732.31	$34,069.64	$33,999.72
AUGUSTA	$114,475.69	$115,620.45	$115,383.17
BATH	$102,267.81	$103,290.48	$103,078.49
BEDFORD	$10,387.41	$10,491.28	$10,469.75
BLAND	$40,157.52	$40,559.09	$40,475.85
BOTETOURT	$44,548.07	$44,993.55	$44,901.21
CARROLL	$3,748.03	$3,785.52	$3,777.75
CRAIG	$63,930.76	$64,570.07	$64,437.55
DICKENSON	$4,604.73	$4,650.78	$4,641.24
FREDERICK	$2,891.34	$2,920.25	$2,914.26
GILES	$35,017.35	$35,367.53	$35,294.95
GRAYSON	$18,204.74	$18,386.79	$18,349.06
HIGHLAND	$34,053.57	$34,394.11	$34,323.52
LEE	$6,211.03	$6,273.14	$6,260.27
MONTGOMERY	$4,251.08	$2,214.06	$3,759.42
NELSON	$11,029.93	$11,140.23	$11,117.37
PAGE	$15,955.92	$16,115.48	$16,082.41
PULASKI	$10,708.67	$10,815.76	$10,793.56
ROANOKE	$1,713.39	1,730.52$	$1,726.97
ROCKBRIDGE	$38,551.21	$38,936.73	$38,856.82
ROCKINGHAM	$82,028.42	$82,848.70	$82,678.67
SCOTT	$19,061.43	$19,252.05	$19,212.54
SHENANDOAH	$44,655.16	$45,101.71	$45,009.15
SMYTH	$40,800.04	$41,208.04	$41,123.47
TAZEWELL	$5,247.25	$5,299.72	$5,288.84
WARREN	$2,225.72	$1,485.47	$1,689.22
WASHINGTON	$12,314.97	$12,438.12	$12,412.59
WISE	$19,918.13	$20,117.31	$20,076.02
WYTHE	$31,804.75	$32,122.80	$32,056.88
VA. STATE TOTAL	$937,809.89	$944,345.97	$944,164.628
HAMPSHIRE	$2,141.73	$2,163.15	$2,158.71
HARDY	$34,160.66	$34,502.27	$34,431.46
MONROE	$11,993.71	$12,113.65	$12,088.79
PENDLETON*	$208,840.35	$211,231.75	$210,798.23
WEST VA. STATE TOTAL	$126,777.27	$128,045.05	$127,676.62
George Washington Total	$675,071.23	$681,059.45	$679,762.88
Jefferson Total	$390,051.36	$391,872.36	$392,618.04
GRAND TOTAL	$1,065,122.59	$1,072,931.81	$1,072,380.92

2005 to 2007 Payment in Lieu of Taxes

STATE	FOREST	COUNTY	2005	2006	2007
KENTUCKY	Jefferson	LETCHER	$935.00	$966.00	$956.00
KENTUCKY	Jefferson	PIKE	$22,532.00	$22,903.00	$22,798.00
KENTUCKY	Jefferson	KY. STATE TOTAL	$23,467.00	$23,869.00	$23,754.00
VIRGINIA	George Washington	ALLEGHENY	$147,180.00	$150,530.00	$150,295.00
VIRGINIA	George Washington	AMHERST	$46,239.00	$47,618.00	$47,645.00
VIRGINIA	George Washington	AUGUSTA	$219,232.00	$224,122.00	$223,709.00
VIRGINIA	George Washington	BATH	$180,380.00	$172,010.00	$184,200.00
VIRGINIA	Jefferson	BEDFORD	$29,466.00	$29,375.00	$28,719.00
VIRGINIA	Jefferson	BLAND	$83,080.00	$81,932.00	$79,500.00
VIRGINIA	GW/JEFF	BOTETOURT	$91,462.00	$90,932.00	$88,667.00
VIRGINIA	Jefferson	CARROLL	$16,444.00	$16,056.00	$15,682.00
VIRGINIA	Jefferson	CRAIG	$125,259.00	$123,755.00	$120,017.00
VIRGINIA	Jefferson	DICKENSON	$20,964.00	$3,421.00	$20,321.00
VIRGINIA	George Washington	FREDERICK	$5,063.00	$5,178.00	$5,173.00
VIRGINIA	Jefferson	GILES	$71,743.00	$70,883.00	$68,845.00
VIRGINIA	Jefferson	GRAYSON	$36,848.00	$36,280.00	$35,198.00
VIRGINIA	George Washington	HIGHLAND	$55,335.00	$56,623.00	$56,551.00
VIRGINIA	Jefferson	LEE	$22,896.00	$22,926.00	$22,503.00
VIRGINIA	Jefferson	MONTGOMERY	$26,276.00	$25,244.00	$23,997.00
VIRGINIA	George Washington	NELSON	$27,613.00	$28,194.00	$28,120.00
VIRGINIA	George Washington	PAGE	$83,704.00	$85,263.00	$84,901.00
VIRGINIA	Jefferson	PULASKI	$20,086.00	$19,821.00	$19,203.00
VIRGINIA	Jefferson	ROANOKE	$10,355.00	$10,599.00	$10,217.00
VIRGINIA	GW/JEFF	ROCKBRIDGE	$71,540.00	$72,350.00	$71,583.00
VIRGINIA	George Washington	ROCKINGHAM	$197,052.00	$201,215.00	$200,716.00
VIRGINIA	Jefferson	SCOTT	$36,762.00	$36,300.00	$35,186.00
VIRGINIA	George Washington	SHENANDOAH	$78,158.00	$79,942.00	$79,820.00
VIRGINIA	Jefferson	SMYTH	$80,913.00	$79,905.00	$77,520.00
VIRGINIA	Jefferson	TAZEWELL	$11,124.00	$11,002.00	$10,683.00
VIRGINIA	George Washington	WARREN	$29,221.00	$29,451.00	$29,109.00
VIRGINIA	Jefferson	WASHINGTON	$23,861.00	$23,566.00	$22,846.00
VIRGINIA	Jefferson	WISE	$38,910.00	$38,414.00	$37,189.00
VIRGINIA	Jefferson	WYTHE	$62,318.00	$61,537.00	$59,651.00
VIRGINIA	GW/JEFF	VA. STATE TOTAL	$1,949,484.00	$1,934,444.00	$1,937,766.00
WEST VA.	George Washington	HAMPSHIRE	$5,017.00	$5,102.00	$5,076.00
WEST VA.	George Washington	HARDY	$74,125.00	$75,383.00	$75,002.00
WEST VA.	GW/JEFF	MONROE	$28,628.00	$29,114.00	$29,198.00
WEST VA.	GW/MON	PENDLETON	$122,624.00	$122,995.00	$123,500.00
WEST VA	GW/JEFF/MON	WEST VA. STATE TOTAL	$230,394.00	$232,594.00	$232,776.00
		GW Forest	$1,462,573.00	$1,476,022.00	$1,483,265.00
		Jefferson Forest	$932,402.00	$907,281.00	$900,479.00
		GRAND TOTAL	$2,203,345.00	$2,190,907.00	$2,194,296.00

* Botetourt and Monroe Counties assumed to be totally on the Jefferson. Rockbridge County assumed to be totally on the GW.

APPENDIX C. TABLES RELATED TO BOTH NATIONAL FORESTS

Table 1. Timber Sold Within Plan Management Prescriptions

(Acres Sold by Forest by Year)

2004 Jefferson Code	2004 Jefferson NF Description	1993 George Washington Code	1993 George Washington NF Description	2004		2005		2006		2007	
				GW	JEFF	GW	JEFF	GW	JEFF	GW	JEFF
4D, 9F	Botanical - Zoological Area	04A	Special Interest Area - Biologic		17						
4E	Cultural - Heritage Area	04B	Special Interest Area - Historic								
4C1	Geologic Area	04C	Special Interest Area - Geologic								
N/A	N/A	04D	Existing Research Natural Area								
N/A	N/A	04E	Cow Knob Sal. Conservation Area								
8E4a	Indiana Bat Primary Protection Area	N/A	Not Applicable								
8E4b	Indiana Bat Secondy Protection Area	N/A	Not Applicable		1						
4A	Appalachian National Scenic Trail Corridor	6	Appalachian Trail								
7B	Scenic Corridors and Viewsheds	05B, 07A, 07B, 07C	Scenic Corridors				15				
7A, 7F	Scenic Byway Area, Blue Ridge Parkway	07D, 07E, 07F (7X)	Highland Scenic Tour								
1A	Designated Wilderness	8A	Designated Wilderness								
1B	Wilderness Study Area	08B	Wilderness Study Area								
12	Remote Backcountry	09	Remote Highlands								
2C	Eligible Recreational River Corridors	10	Eligible Scenic and Recreational Rivers		25						
7C	ATV Use Areas	11	ATV Use Area					68			
7D	Concentrated Recreation Areas	N/A	N/A								
7E1, 7E2	Dispersed Recreation Areas	13	Dispersed Recreation Areas	138		0	65		176		
8C	Remote Habitats for Wildlife	14	Remote Habitat for Wildlife	113		0	51		14		245
8A1	Mix of Successional Habitats	15	Mosaics of Wildlife Habitat	597		448		480	188	356	
8B, 8E1	Early Successional Habitats	16	Early Successional Forested Habitats for Wildlife	60	301	234	66	153	138	96	
10B	Timber Production Areas	17	Timber Production Areas	384		123		406		157	136
5C	Utility Corridor	20	Utility Corridor								
N/A	Not Applicable	21A	Big Schloss Special Management Area								
N/A	Not Applicable	21B	Laurel Fork Special Management Area								
N/A	Not Applicable	21C	Mt. Pleasant Special Mgmt Area								
N/A	Not Applicable	21D	Little River Special Management Area								
N/A	Not Applicable	22	Small Game & Watchable Wildlife								
4F	Scenic Area on Clinch	N/A	Not Applicable								
4J	Urban/Suburban Interface	N/A	Not Applicable								
4K1	North Creek Special Area	N/A	Not Applicable								
4K2	Hoop Hole Special Area	N/A	Not Applicable								
4K3	Mount Rogers Crest Zone Special Area	N/A	Not Applicable								
4K4	Whitetop Mountain Special Area	N/A	Not Applicable		3						
4K5	Whitetop Laurel Creek Special Area	N/A	Not Applicable								
4K6	North Fork of Pound Special Area	N/A	Not Applicable								
6	Old Growth Forest Communities	N/A	Not Applicable								
7G, 8E6	Pastoral Landscapes	N/A	Not Applicable								
8E2	Peaks of Otter Sal. Conservation Area	N/A	Not Applicable								
9A1	Source Water Protection Area	N/A	Not Applicable				370		227		
9A2	Reference Watersheds	N/A	Not Applicable								
9A3	Watershed Restoration Area	N/A	Not Applicable								
9A4	Aquatic Habitat Areas	N/A	Not Applicable								
9G1, 9H	Restoration Communities	N/A	Not Applicable								
Various*		Various*	Not Applicable	0	146	0	110	0	14	0	0
			Totals	1,292	493	805	677	1,107	757	609	381

* Acres associated with settlement sales (e.g. powerlines, gas wells, state highway projects, etc.) that cross myriad communities and are not tracked by Management Area or Prescription.

Table 2. Timber Harvested Within Plan Management Prescriptions

(Acres Harvested by Forest by Year)

2004 Jefferson Code	2004 Jefferson NF Description	1993 George Washington Code	1993 George Washington NF Description	2004		2005		2006		2007	
				GW	JEFF	GW	JEFF	GW	JEFF	GW	JEFF
4D, 9F	Botanical - Zoological Area	04A	Special Interest Area - Biologic						17		
4E	Cultural - Heritage Area	04B	Special Interest Area - Historic								
4C1	Geologic Area	04C	Special Interest Area - Geologic								
N/A	N/A	04D	Existing Research Natural Area								
N/A	N/A	04E	Cow Knob Sal. Conservation Area								
8E4a	Indiana Bat Primary Protection Area	N/A	Not Applicable								
8E4b	Indiana Bat Secondy Protection Area	N/A	Not Applicable						1		
4A	Appalachian National Scenic Trail Corridor	6	Appalachian Trail								
7B	Scenic Corridors and Viewsheds	05B, 07A, 07B, 07C	Scenic Corridors	10							17
7A, 7F	Scenic Byway Area, Blue Ridge Parkway	07D, 07E, 07F (7X)	Highland Scenic Tour								
1A	Designated Wilderness	8A	Designated Wilderness								
1B	Wilderness Study Area	08B	Wilderness Study Area								
12	Remote Backcountry	09	Remote Highlands								
2C	Eligible Recreational River Corridors	10	Eligible Scenic and Recreational Rivers				25				
7C	ATV Use Areas	11	ATV Use Area							66	
7D	Concentrated Recreation Areas	N/A	N/A								
7E1, 7E2	Dispersed Recreation Areas	13	Dispersed Recreation Areas							97	
8C	Remote Habitats for Wildlife	14	Remote Habitat for Wildlife			22		70			
8A1	Mix of Successional Habitats	15	Mosaics of Wildlife Habitat	628	185	678	68	421	76	397	50
8B, 8E1	Early Successional Habitats	16	Early Successional Forested Habitats for Wildlife	55	53	174	314	40	40	50	153
10B	Timber Production Areas	17	Timber Production Areas	87		202		293		122	
N/A	Not Applicable	21A	Big Schloss Special Management Area								
N/A	Not Applicable	21B	Laurel Fork Special Management Area								
N/A	Not Applicable	21C	Mt. Pleasant Special Mgmt Area								
N/A	Not Applicable	21D	Little River Special Management Area								
N/A	Not Applicable	22	Small Game & Watchable Wildlife								
4F	Scenic Area on Clinch	N/A	Not Applicable								
4J	Urban/Suburban Interface	N/A	Not Applicable								
4K1	North Creek Special Area	N/A	Not Applicable								
4K2	Hoop Hole Special Area	N/A	Not Applicable								
4K3	Mount Rogers Crest Zone Special Area	N/A	Not Applicable								
4K4	Whitetop Mountain Special Area	N/A	Not Applicable								
4K5	Whitetop Laurel Creek Special Area	N/A	Not Applicable								
4K6	North Fork of Pound Special Area	N/A	Not Applicable								
6	Old Growth Forest Communities	N/A	Not Applicable								
7G, 8E6	Pastoral Landscapes	N/A	Not Applicable								
8E2	Peaks of Otter Sal. Conservation Area	N/A	Not Applicable						24		33
9A1	Source Water Protection Area	N/A	Not Applicable								227
9A2	Reference Watersheds	N/A	Not Applicable								
9A3	Watershed Restoration Area	N/A	Not Applicable								
9A4	Aquatic Habitat Areas	N/A	Not Applicable								
9G1, 9H	Restoration Communities	N/A	Not Applicable								
Various*		Various*			6	100			234		
			Totals	780	244	1,176	407	824	392	732	480

* Acres associated with settlement sales (e.g. powerlines, gas wells, state highway projects, etc.) that cross myriad communities and are not tracked by Management Area or Prescription.

Table 3. Timber Volume Offered, Sold, and Harvested By Forest By Year

(Million Board Feet = MMBF)

Forest	Fiscal Year	Volume Offered (MMBF)	Volume Sold (MMBF)	Volume Harvested (MMBF)
George Washington NF	2004	14.7	12.4	17.4
	2005	11.2	10.4	15.6
	2006	12.8	11.6	11.7
	2007	12.2	8.2	10.8
Jefferson NF	2004	8.2	6.1	4.1
	2005	6.5	6.5	5.8
	2006	13.3	12.0	4.0
	2007	10.5	7.3	9.0
Totals For Both Forests	2004	22.9	18.5	21.5
	2005	17.7	16.9	21.4
	2006	26.1	23.6	15.7
	2007	22.7	15.5	19.8

Table 4. ANNUAL SOLD ACRES BY METHOD OF CUT BY FOREST

(Acres Sold)

Forest	Fiscal Year	Clearcut	Shelterwood	Selection	Thinning	Salvage	Other	Total
George Washington NF	2004	0	746	27	378	130	11	1,292
	2005	134	312	0	232	119	8	805
	2006	89	346	7	660	0	5	1,107
	2007	0	580	0	24	0	5	609
Jefferson NF	2004	0	86	0	200	61	146	493
	2005	0	93	2	469	0	113	677
	2006	0	314	93	333	0	17	757
	2007	0	136	0	0	245	0	381
Totals For Both Forests	2004	0	832	27	578	191	157	1785
	2005	134	405	2	701	119	121	1482
	2006	89	660	100	993	0	22	1864
	2007	0	716	0	24	245	5	990

Table 5. 2004 ANNUAL SOLD ACRES by COMMUNITY TYPE ON THE JEFFERSON NF

(Acres Sold)

Community Type	Forest Types within Community Type	Clearcut	Shelterwood	Selection	Thinning	Salvage	Other	Total
Northern Hardwood Forest	Sugar maple-Beech-Yellow birch (CISC 81)	0	0	0	0	0	0	0
Montane Spruce-Fir Forest	Fraser fir (CISC 6), Red spruce-Fraser fir (CISC 7), Red spruce-Northern hardwood (CISC 17)	0	0	0	0	3	0	3
Mixed Mesophytic Forest	Cove hardwood-White pine-Hemlock (CISC 41), Yellow poplar (CISC 50), Yellow poplar-White oak-Red oak (CISC 56), Black walnut (CISC 82)	0	24	0	34	0	0	58
Conifer-Northern Hardwood Forest	White pine (CISC 3), White pine-Hemlock (CISC 4), Hemlock (CISC 5), Hemlock-Hardwood (CISC 8), White pine-Cove hardwood (CISC 9), White pine-Upland hardwoods (CISC 10)	0	34	0	0	0	0	34
Dry-Mesic Oak Forest	Post oak-Black oak (CISC 51), White oak-Red oak-Hickory (CISC 53), White oak (CISC 54), Northern red oak-Hickory (CISC 55)	0	28	0	166	58	0	252
Dry and Dry-Mesic Oak-Pine Forest	Upland hardwoods-Yellow pine (CISC 42), Oaks-Eastern red cedar (CISC 43), Southern red oak-Yellow pine (CISC 44), Chestnut oak-Scarlet oak-Yellow pine (CISC 45), Bottomland hardwoods-Yellow pine (CISC 46), White oak-Black oak-Yellow pine (CISC 47), Northern red oak-Hickory-Yellow pine (CISC 48).	0	0	0	0	0	0	0
Dry and Xeric Oak Forest, Woodland, and Savanna	Chestnut oak (CISC 52), Scrub oaks (CISC 57), Scarlet oak (CISC 59), Chestnut oak-Scarlet oak (CISC 60)	0	0	0	0	0	0	0
Xeric Pine and Pine-Oak Forest and Woodland	Eastern red cedar-Hardwoods (CISC 11), Shortleaf pine-oaks (CISC 12), Pitch pine-oaks (CISC 15), Virginia pine-oaks (CISC 16), Table Mountain pine-Hardwoods (CISC 20), Longleaf pine (CISC 21), Virginia pine (CISC 33), Pitch pine (CISC 38), Table Mountain pine (CISC 39), Eastern red cedar (CISC 35), Black locust (CISC 88).	0	0	0	0	0	0	0
Eastern Riverfront and River Floodplain Hardwood Forests	Sweet gum-Yellow poplar (CISC 58), River birch-Sycamore (CISC 72), Cottonwood (CISC 73), Sugarberry-American elm-Green ash (CISC 63), Beech-Magnolia (CISC 69), Willow (CISC 74), Sycamore-Pecan-American elm (CISC 75)	0	0	0	0	0	0	0
Various*		0	0	0	0	0	146	146

* Acres associated with settlement sales (e.g. powerlines, gas wells, state highway projects, etc.) that cross myriad communities and are not tracked by forest community.

Table 6. 2005 ANNUAL SOLD ACRES by COMMUNITY TYPE ON THE JEFFERSON NF

(Acres Sold)

Community Type	Forest Types within Community Type	Clearcut	Shelterwood	Selection	Thinning	Salvage	Other	Total
Northern Hardwood Forest	Sugar maple-Beech-Yellow birch (CISC 81)	0	0	0	0	0	0	0
Montane Spruce-Fir Forest	Fraser fir (CISC 6), Red spruce-Fraser fir (CISC 7), Red spruce-Northern hardwood (CISC 17)	0	0	0	0	0	0	0
Mixed Mesophytic Forest	Cove hardwood-White pine-Hemlock (CISC 41), Yellow poplar (CISC 50), Yellow poplar-White oak-Red oak (CISC 56), Black walnut (CISC 82)	0	0	0	21	0	0	21
Conifer-Northern Hardwood Forest	White pine (CISC 3), White pine-Hemlock (CISC 4), Hemlock (CISC 5), Hemlock-Hardwood (CISC 8), White pine-Cove hardwood (CISC 9), White pine-Upland hardwoods (CISC 10)	0	0	0	0	0	0	0
Dry-Mesic Oak Forest	Post oak-Black oak (CISC 51), White oak-Red oak-Hickory (CISC 53), White oak (CISC 54), Northern red oak-Hickory (CISC 55)	0	93	2	448	0	3	546
Dry and Dry-Mesic Oak-Pine Forest	Upland hardwoods-Yellow pine (CISC 42), Oaks-Eastern red cedar (CISC 43), Southern red oak-Yellow pine (CISC 44), Chestnut oak-Scarlet oak-Yellow pine (CISC 45), Bottomland hardwoods-Yellow pine (CISC 46), White oak-Black oak-Yellow pine (CISC 47), Northern red oak-Hickory-Yellow pine (CISC 48).	0	0	0	0	0	0	0
Dry and Xeric Oak Forest, Woodland, and Savanna	Chestnut oak (CISC 52), Scrub oaks (CISC 57), Scarlet oak (CISC 59), Chestnut oak-Scarlet oak (CISC 60)	0	0	0	0	0	0	0
Xeric Pine and Pine-Oak Forest and Woodland	Eastern red cedar-Hardwoods (CISC 11), Shortleaf pine-oaks (CISC 12), Pitch pine-oaks (CISC 15), Virginia pine-oaks (CISC 16), Table Mountain pine-Hardwoods (CISC 20), Longleaf pine (CISC 21), Virginia pine (CISC 33), Pitch pine (CISC 38), Table Mountain pine (CISC 39), Eastern red cedar (CISC 35), Black locust (CISC 88).	0	0	0	0	0	0	0
Eastern Riverfront and River Floodplain Hardwood Forests	Sweet gum-Yellow poplar (CISC 58), River birch-Sycamore (CISC 72), Cottonwood (CISC 73), Sugarberry-American elm-Green ash (CISC 63), Beech-Magnolia (CISC 69), Willow (CISC 74), Sycamore-Pecan-American elm (CISC 75)	0	0	0	0	0	0	0
Various*		0	0	0	0	0	110	110

* Acres associated with settlement sales (e.g. powerlines, gas wells, state highway projects, etc.) that cross myriad communities and are not tracked by forest community.

Table 7. 2006 ANNUAL SOLD ACRES by COMMUNITY TYPE ON THE JEFFERSON NF

(Acres Sold)

Community Type	Forest Types within Community Type	Clearcut	Shelterwood	Selection	Thinning	Salvage	Other	Total
Northern Hardwood Forest	Sugar maple-Beech-Yellow birch (CISC 81)	0	0	0	0	0	0	0
Montane Spruce-Fir Forest	Fraser fir (CISC 6), Red spruce-Fraser fir (CISC 7), Red spruce-Northern hardwood (CISC 17)	0	0	0	0	0	0	0
Mixed Mesophytic Forest	Cove hardwood-White pine-Hemlock (CISC 41), Yellow poplar (CISC 50), Yellow poplar-White oak-Red oak (CISC 56), Black walnut (CISC 82)	0	75	56	45	0	0	176
Conifer-Northern Hardwood Forest	White pine (CISC 3), White pine-Hemlock (CISC 4), Hemlock (CISC 5), Hemlock-Hardwood (CISC 8), White pine-Cove hardwood (CISC 9), White pine-Upland hardwoods (CISC 10)	0	0	0	0	0	0	0
Dry-Mesic Oak Forest	Post oak-Black oak (CISC 51), White oak-Red oak-Hickory (CISC 53), White oak (CISC 54), Northern red oak-Hickory (CISC 55)	0	196	37	288	0	0	521
Dry and Dry-Mesic Oak-Pine Forest	Upland hardwoods-Yellow pine (CISC 42), Oaks-Eastern red cedar (CISC 43), Southern red oak-Yellow pine (CISC 44), Chestnut oak-Scarlet oak-Yellow pine (CISC 45), Bottomland hardwoods-Yellow pine (CISC 46), White oak-Black oak-Yellow pine (CISC 47), Northern red oak-Hickory-Yellow pine (CISC 48).	0	0	0	0	0	3	3
Dry and Xeric Oak Forest, Woodland, and Savanna	Chestnut oak (CISC 52), Scrub oaks (CISC 57), Scarlet oak (CISC 59), Chestnut oak-Scarlet oak (CISC 60)	0	43	0	0	0	0	43
Xeric Pine and Pine-Oak Forest and Woodland	Eastern red cedar-Hardwoods (CISC 11), Shortleaf pine-oaks (CISC 12), Pitch pine-oaks (CISC 15), Virginia pine-oaks (CISC 16), Table Mountain pine-Hardwoods (CISC 20), Longleaf pine (CISC 21), Virginia pine (CISC 33), Pitch pine (CISC 38), Table Mountain pine (CISC 39), Eastern red cedar (CISC 35), Black locust (CISC 88).	0	0	0	0	0	0	0
Eastern Riverfront and River Floodplain Hardwood Forests	Sweet gum-Yellow poplar (CISC 58), River birch-Sycamore (CISC 72), Cottonwood (CISC 73), Sugarberry-American elm-Green ash (CISC 63), Beech-Magnolia (CISC 69), Willow (CISC 74), Sycamore-Pecan-American elm (CISC 75)	0	0	0	0	0	0	0
Various*		0	0	0	0	0	14	14

* Acres associated with settlement sales (e.g. powerlines, gas wells, state highway projects, etc.) that cross myriad communities and are not tracked by forest community.

Table 8. 2007 ANNUAL SOLD ACRES by COMMUNITY TYPE ON THE JEFFERSON NF

(Acres Sold)

Community Type	Forest Types within Community Type	Clearcut	Shelterwood	Selection	Thinning	Salvage	Other	Total
Northern Hardwood Forest	Sugar maple-Beech-Yellow birch (CISC 81)	0	0	0	0	0	0	0
Montane Spruce-Fir Forest	Fraser fir (CISC 6), Red spruce-Fraser fir (CISC 7), Red spruce-Northern hardwood (CISC 17)	0	0	0	0	0	0	0
Mixed Mesophytic Forest	Cove hardwood-White pine-Hemlock (CISC 41), Yellow poplar (CISC 50), Yellow poplar-White oak-Red oak (CISC 56), Black walnut (CISC 82)	0	126	0	0	45	0	171
Conifer-Northern Hardwood Forest	White pine (CISC 3), White pine-Hemlock (CISC 4), Hemlock (CISC 5), Hemlock-Hardwood (CISC 8), White pine-Cove hardwood (CISC 9), White pine-Upland hardwoods (CISC 10)	0	0	0	0	0	0	0
Dry-Mesic Oak Forest	Post oak-Black oak (CISC 51), White oak-Red oak-Hickory (CISC 53), White oak (CISC 54), Northern red oak-Hickory (CISC 55)	0	10	0	0	200	0	210
Dry and Dry-Mesic Oak-Pine Forest	Upland hardwoods-Yellow pine (CISC 42), Oaks-Eastern red cedar (CISC 43), Southern red oak-Yellow pine (CISC 44), Chestnut oak-Scarlet oak-Yellow pine (CISC 45), Bottomland hardwoods-Yellow pine (CISC 46), White oak-Black oak-Yellow pine (CISC 47), Northern red oak-Hickory-Yellow pine (CISC 48).	0	0	0	0	0	0	0
Dry and Xeric Oak Forest, Woodland, and Savanna	Chestnut oak (CISC 52), Scrub oaks (CISC 57), Scarlet oak (CISC 59), Chestnut oak-Scarlet oak (CISC 60)	0	0	0	0	0	0	0
Xeric Pine and Pine-Oak Forest and Woodland	Eastern red cedar-Hardwoods (CISC 11), Shortleaf pine-oaks (CISC 12), Pitch pine-oaks (CISC 15), Virginia pine-oaks (CISC 16), Table Mountain pine-Hardwoods (CISC 20), Longleaf pine (CISC 21), Virginia pine (CISC 33), Pitch pine (CISC 38), Table Mountain pine (CISC 39), Eastern red cedar (CISC 35), Black locust (CISC 88).	0	0	0	0	0	0	0
Eastern Riverfront and River Floodplain Hardwood Forests	Sweet gum-Yellow poplar (CISC 58), River birch-Sycamore (CISC 72), Cottonwood (CISC 73), Sugarberry-American elm-Green ash (CISC 63), Beech-Magnolia (CISC 69), Willow (CISC 74), Sycamore-Pecan-American elm (CISC 75)	0	0	0	0	0	0	0

Table 9. ANNUAL HARVEST ACRES BY METHOD OF CUT BY FOREST

(Acres Harvested)

Forest	Fiscal Year	Clearcut	Shelterwood	Selection	Thinning	Salvage	Other	Total
George Washington NF	2004	0	625	0	111	44	0	780
	2005	0	962	29	104	81	0	1,176
	2006	25	459	36	247	50	7	824
	2007	22	364	6	340	0	0	732
Jefferson NF	2004	0	127	0	111	0	6	244
	2005	0	153	0	214	40	0	407
	2006	29	41	3	61	24	234	392
	2007	36	165	2	277	0	0	480
Totals For Both Forests	2004	0	752	0	222	44	0	1,024
	2005	0	1,115	29	318	121	0	1,583
	2006	54	500	39	308	74	241	1,216
	2007	58	529	5	617	0	0	1,212

Table 10. Management Activities Trend on George Washington National Forest Only

Year	Timber Harvest (Acres)	Timber Cut (Million Bd. Ft.)	Prescribed Burning (Acres)	Gypsy Moth Aerial Spraying (Acres)	Road Construction (Miles)
2004	780	17.4	7,103	0	1.0
2005	1,176	15.6	9,285	0	0.0
2006	824	11.7	4,914	0	0.5
2007	732	10.8	3,335	0	0.2

N/A: Information Not Available

Table 11. Management Activities Trend on Jefferson National Forest Only

Year	Timber Harvest (Acres)	Timber Cut (Million Bd. Ft.)	Prescribed Burning (Acres)	Gypsy Moth Aerial Spraying (Acres)	Road Construction (Miles)
2004	244	4.1	6,516	5,510	1.0
2005	407	5.8	6,782	10,812	1.4
2006	392	4.0	1,762	7,063	3.7
2007	480	9.0	7,120	33,963	1.6

N/A: Information Not Available

Table 12. Combined Management Activities Trend across Both Forests

Year	Timber Harvest (Acres)	Timber Cut (Million Bd. Ft.)	Prescribed Burning (Acres)	Gypsy Moth Aerial Spraying (Acres)	Road Construction (Miles)
2004	1,024	21.5	13,619	5,510	2.0
2005	1,583	21.4	16,067	10,812	1.4
2006	1,216	15.7	6,676	7,063	4.2
2007	1,212	19.8	10,455	33,963	1.8

N/A: Information Not Available

Table 13. GWJNF Age Class Distribution for All Forested Land 1989 and 2007

(Changes over last 18 years)

	Jefferson National Forest				George Washington National Forest				Combined GWJNF's			
Age	1989	%	2007	%	1989	%	2007	%	1989	%	2007	%
0-10	26269	3.9	2146	0.3	44367	4.3	7576	0.7	70636	4.1	9722	0.6
11-20	25682	3.8	12322	1.7	32524	3.1	27124	2.6	58206	3.4	39446	2.2
21-30	13122	1.9	17253	2.4	22987	2.2	26705	2.6	36109	2.1	43958	2.5
31-40	6967	1.0	26349	3.7	3309	0.3	40328	3.9	10276	0.6	66677	3.8
41-50	29840	4.4	10622	1.5	5490	0.5	11503	1.1	35330	2.1	22125	1.3
51-60	121277	17.9	8352	1.2	31822	3.1	3681	0.4	153099	8.9	12033	0.7
61-70	173584	25.6	39544	5.5	101660	9.8	8332	0.8	275244	16.1	47876	2.7
71-80	115851	17.1	148865	20.8	214257	20.7	44620	4.3	330108	19.3	193485	11.0
81-90	55392	8.3	176672	24.7	218002	21.1	133311	12.8	273394	16.0	309983	17.6
91-100	29911	4.4	115216	16.1	115456	11.2	228543	21.9	145367	8.5	343759	19.5
101-110	43927	6.5	51595	7.2	79291	7.7	203317	19.5	123218	7.2	254912	14.5
111-120	17835	2.6	26551	3.7	63294	6.1	90055	8.6	81129	4.7	116606	6.6
121-130	9499	1.4	48507	6.8	33702	3.3	75189	7.2	43201	2.5	123696	7.0
131-140	4860	0.7	17983	2.5	26012	2.5	55786	5.3	30872	1.8	73769	4.2
141-150+	3149	0.5	14726	2.1	42546	4.1	88445	8.5	45695	2.7	103171	5.9
TOTAL	677165	100	716703	100	1034719	100	1044515	100	1711884	100	1761218	100

(Source: Continuous Inventory of Stand Conditions (CISC) for GWJNF dataset of 12-1-89 and FSVeg for GWJNF dataset of 12/21/2007.)

Table 14. Total Wildfires and Hazardous Fuel Treatment by Activity by Year, by Forest

(Acres Treated)

Forest	Fiscal Year	Wildland Fire Use	Prescribed Fire	Mechanical Treatment	Wildfires (Number)	Wildfires (Acres Burned)
George Washington NF	2004	0	7,103	0	10	27
	2005	0	9,285	0	15	368
	2006	0	4,914	0	14	2,027
	2007	0	3,335	0	22	743
Jefferson NF	2004	0	6,516	0	8	186
	2005	0	6,782	0	11	53
	2006	0	1,762	0	22	5,840
	2007	407	7,120	0	25	3,808
Totals For Both Forests	2004	0	13,619	0	18	213
	2005	0	16,067	0	26	421
	2006	0	6,676	0	36	7,867
	2007	407	10,455	0	47	4546

Table 15. Trend in Land Acquisitions and Conveyances across Both Forests

Year	Land Acquired Thru Exchange, Purchase or Donation (Acres)	Federal Land Conveyed Thru Selling or Exchanges (Acres)	Land Acquired Thru Exchange, Purchase or Donation (Acres)	Federal Land Conveyed Thru Selling or Exchanges (Acres)	Land Acquired Thru Exchange, Purchase or Donation (Total Acres)	Federal Land Conveyed Thru Selling or Exchanges (Acres)	Net Increase in National Forest System Land (Acres)
Forest	GW	GW	Jefferson	Jefferson	GWJEFF	GWJEFF	
2004	0	0	1806	-54	1,806	-54	1,752
2005	120	-1	80	0	200	-1	199
2006	0	0	13	0	13	0	13
2007	14	25	0	5	14	30	-16

Table 16. Private Land Boundary Location, Maintenance, and Title Claims Resolved, by Year, by Forest

Forest	Fiscal Year	Boundaries Located (Miles)	Boundaries Maintained (Miles)	Title Claims and Encroachments Resolved (Number)
George Washington NF	2004	6.5	75	2
	2005	0.0	103	1
	2006	0.0	33	0
	2007	2.5	45	1
Jefferson NF	2004	2.3	79	0
	2005	5.4	74	2
	2006	0.0	33	1
	2007	0.0	33	2
Totals For Both Forests	2004	8.8	154	2
	2005	5.4	177	3
	2006	0.0	66	1
	2007	2.5	78	3

Table 17. Road Activities by Year, by Forest

(Miles)

Forest	Fiscal Year	Road Construction	Road Reconstruction	Road Maintenance
George Washington NF	2004	1.0	2.9	860
	2005	0.0	0.9	845
	2006	0.5	0.0	746
	2007	0.2	0.3	635
Jefferson NF	2004	1.0	1.7	455
	2005	1.4	0.9	422
	2006	3.7	2.5	373
	2007	1.6	7.5	365
Totals For Both Forests	2004	2.0	4.6	1,315
	2005	1.4	1.8	1,267
	2006	4.2	2.5	1,119
	2007	1.8	7.8	1,000

Table 18. Bat Population Trend in Clark's Cave

(Number of Bats Counted)

Bat Species	1990	1992	1994	1995	1999	2001	2003	2005	2007
Big Brown	3	10	1	0	4	12	1	6	8
Little Brown	202	742	255	200	309	463	541	612	658
Northern Myotis	0	1	0	0	0	0	0	0	0
Indiana Bat	22	0	20	0	1	47	47	50	49
Eastern Pipistrelle	27	210	18	4	36	216	98	196	377
TOTAL	254	963	294	204	350	738	687	864	1092

Table 19. Bat Population Trend in Hupman's Saltpetre Cave

(Number of Bats Counted)

Bat Species	1990	1991	1992	1994	1996	2001	2003	2005	2007
Big Brown Bat	128	174	58	34	29	18	10	34	*
Eastern Small Footed Myotis	56	55	64	27	22	44	37	32	*
Little Brown	1360	3082	3342	4571	2750	2611	3564	3168	*
Northern Myotis	2	1	0	0	0	0	2	0	*
Indiana Bat	26	0	220	300	225	5	4	0	*
Eastern Pipistrelle	149	319	272	172	217	240	128	101	*
TOTAL	1721	3631	3956	5104	3243	2918	3745	3335	*

* = cave not surveyed in 2007

Table 20. Bat Population Trend in Mountain Grove Saltpetre Cave

(Number of Bats Counted)

Bat Species	1990	1992	1994	1998	2001	2003	2005	2007
Big Brown Bat	9	27	22	29	24	*	*	X
Eastern Small Footed Myotis	1	5	5	2	8	*	*	X
Little Brown	10	3	19	36	0	*	*	X
Indiana Bat	5	23	1	2	2	*	*	X
Eastern Pipistrelle	27	34	81	51	52	*	*	X
TOTAL	52	92	128	120	86	*	*	X

* = not surveyed due to snow cover and inaccessability X = cave not surveyed in 2007

Table 21. Bat Population Trend in Starr Chapel Cave

(Number of Bats Counted)

Bat Species	1990	1992	1994	1995	1997	1999	2001	2003	2005	2007
Big Brown Bat	4	18	16	15	9	10	13	9	9	19
Eastern Small Footed Myotis	3	11	7	8	12	21	22	13	12	29
Little Brown	718	1292	1407	1393	1552	1689	1872	1727	1695	1652
Northern Myotis	0	1	3	4	3	13	28	13	9	2
Indiana Bat	37	38	42	60	54	55	47	67	57	68
Eastern Pipistrelle	34	326	146	95	73	128	264	111	115	247
TOTAL	796	1686	1621	1575	1703	1916	2246	1940	1897	2017

Table 22. Trend in Indiana Bat Habitat Required by USFWS Biological Opinion

Year of CISC/GIS Data	CISC/GIS Total Forest Acres	> 60% of All Forest Types > 70 Years Old (Acres/Percent)	Total 53/56 Forest Acres	>40% of 53/56 Forest Types > 80 Years Old (Acres/Percent)
3/12/98*	1,707,112	1,300,681 / 76.2	701,925	352,250 / 50.2
4/1/99	1,743,546	1,358,995 / 77.9	720,382	388,094 / 53.9
3/16/00	1,742,489	1,369,028 / 78.6	720,777	397,646 / 55.2
5/31/02	1,747,991	1,425,660 / 81.6	724,438	442,888 / 61.1
3/29/04	1,721,795**	1,440,357 / 83.6	716,235	459,077 / 64.1
6/30/05	1,753,505	1,481,318 / 84.4	731,079	479,646 / 65.6
12/27/07	1,772,451	1,519,381 / 85.7	743,598	508,656 / 68.4

* Indiana Bat EA dated 3/12/98, page 32.

** 22,769 acres not included in GIS age class report

Table 23. Indiana Bat Populations in Hibernacula On or Near the GWJNF

(Caves with Primary and Secondary Cave Protection Areas on land managed by GWJNF as noted in USFWS Biological Opinions of 1997 for GW and 2005 for JNF)

(Number of Bats Counted)

Winter Survey Year	Starr Chapel Cave	Mt. Grove Cave	Clarks Cave	Hupman's Saltpetre Cave	Shires Cave	Kelly Cave	Rocky Hollow Cave	Newberry-Bane Cave	Patton Cave (WV)
1985	30						270		
1986		0	21			1		90	
1987	5		52						
1988			31	0	13				0
1989	36				13				
1990	37	5	22	26	3			120	
1991	23			0			202		
1992	38	23	0	220				100	
1993	31	0			20	18	241	107	
1994	42	1	20	300					
1995	60							110	
1996			0	225	27				
1997	54					10*			
1998		2							17
1999	55		1		23	10		120	
2000								235	8
2001		2		5	36	3	166		
2002									10
2003	67		47	4	19	9	325	189	
2004									8
2005	57		50	0	33	0*	156	237	
2006									
2007	68		49		16		170	232	

Blank cells = no survey done that winter. *Incomplete survey of Kelly Cave was done in 1997 and 2005 number of “0” likely due to gate vandalism and subsequent human disturbance.

Table 24. Trend in "Take" as Expressed by Vegetation Disturbance in Indiana Bat Habitat

By Forest Management Activity

(Acres)

Year (fiscal)	Timber Harvest GWNF	Timber Harvest JNF	Total Timber Harvested	Road Const.	Rx Burn Line Const**.	Rx Burn Acreage (JNF only)	Recreation Develop.	Wildlife Opening Develop.	Special Use Develop.	Total "Take" Acreage for Year	Allowed Acreage of "Take" per BO	"Take" Acres Not Used but Allowed
1998*	1,449	1,293	2,742	3.15	15.8	N/A	40	7.5	5.8	2,814.3	4,500	1,685.7
1999*	1,284	942	2,226	3.2	10.2	N/A	23	9.0	15.5	2,286.9	4,500	2,213.1
2000*	1,254	1,115	2,369	0.1	12.7	N/A	11	14.4	12.3	2,419.5	4,500	2,080.5
2001*	1,162	795	1,957	2.8	13.8	N/A	15	12.5	7.1	2,008.2	4,500	2,491.8
2002*	881	332	1,213	0.3	15.1	N/A	10.5	8.0	4.2	1,251.1	4,500	3,248.9
2003*	789	226	1,015	0.2	12.3	N/A	6.2	10.1	8.3	1,052.1	4,500	3,447.9
2004 (GW)	780	N/A	780	2.4	3.4	N/A	0.3	4.4	4.6	795.1	4,500	3,705.8
2004 (JNF)	N/A	244	244	2.4	3.8	6,516	0.4	2.5	2.2	6,771.3	16,800	10,029.6
2005 (GW)	1,176	N/A	1,176	0.0	6.9	N/A	0.0	11.2	0.0	1,194.1	4,500	3,704.9
2005 (JNF)	N/A	407	407	3.4	5.2	6,782	0.0	4.7	0.0	7,202.3	16,800	9,597.7
2006 (GW)	824	N/A	824	1.2	4.3	N/A	0.0	32.5	0.0	862.0	4,500	3,638.0
2006 (JNF)	N/A	392	392	9.0	4.8	1,762	0.0	0.0	0.0	2,167.8	16,800	14,632.2
2007 (GW)	732	N/A	732	0.5	5.1	N/A	4.0	19.0	0.0	760.6	4,500	3,739.4
2007 (JNF)	N/A	480	480	3.9	4.7	7,120	8.1	2.4	0.0	7,619.1	16,800	9,180.9

* = acres for both GW & JNF unless column Title indicates otherwise.

** = Correction to BO by USFWS letter of February 11, 1999, prescribed burning is a conservation recommendation in BO to improve bat habitat, only tree cutting for control-line construction is considered to be an negative disturbance factor.

Table 25. Old Growth Trend across the George Washington NF

(Acres)

Year	01 - Northern Hardwood Forests	2a-Hemlock-North. Hardwd Subgroup	2b-Wh. Pine-North. Hardwd Subgroup	2c-Spruce-North. Hardwood Subgroup	05 - Mixed Mesophytic Forests	10 - Hardwood Wetland Forests	21 - Dry-mesic Oak Forests	22 - Dry and Xeric Oak Woodlands	24 - Xeric pine & Pine-oak Forests	25 - Dry & Dry-mesic Oak-pine Forests	28 - Eastern Riverfront Forests	37 – Rocky, Thin-soil Conifer Wood.	Total All Old Growth
1993	0	1,364	0	71	680	0	70,416	0	78,239	3,814	5	0	154,589
1994	0	1,364	0	71	708	0	72,460	0	82,316	4,268	5	0	161,192
1995	0	1,364	0	71	727	0	75,986	0	86,009	4,343	5	0	168,505
1996	0	1,364	0	71	727	0	77,406	0	88,820	4,581	5	0	172,974
1997	0	1,364	0	71	727	0	79,060	0	91,295	4,666	5	0	177,188
1998	0	1,364	0	71	727	0	81,904	0	94,991	5,100	5	0	184,162
1999	0	1,364	0	71	727	0	85,432	0	97,384	5,133	5	0	190,116
2000	0	1,411	0	255	838	0	99,189	56	101,759	6,201	22	0	209,731
2001	0	1,411	0	255	838	0	102,264	56	104,011	6,431	22	0	215,288
2002	0	1,411	0	255	838	0	106,069	56	105,588	6,602	22	0	220,841
2003	0	1,411	0	275	984	0	108,310	85	107,240	6,686	22	0	225,013
2004	0	1,411	0	275	984	0	111,342	85	108,080	6,836	22	0	229,035
2005	0	1,411	0	275	1,060	0	118,492	85	109,287	7,227	22	0	237,859
2006	0	1,411	0	308	1,060	0	122,000	85	110,801	7,635	22	0	243,322
2007	0	1,411	0	308	1,060	0	125,840	85	111,568	7,901	22	0	248,195
2008	0	1,411	19	308	1,060	0	129,202	85	112,581	8,685	22	0	253,373

* Names and associated identification numbers are from Forestry Report R8-FR 62. Three OGFT groups were added in the 2000 CISC inventory as meeting the minimum age necessary to be considered old growth. These stands were not reflected in earlier years due to their stand ages in CISC. These OGFT groups are: 1) Northern Hardwood Forests, 2) Hardwood Wetland Forests, and 3) Dry & Xeric oak Woodlands & Savannas. Two OGFT group still have no acreage that meets the minimum age criteria. All data for years updated in July and August 2008 to reflect different data base set.

Table 26. Gypsy Moth Defoliation by Year, by Forest

(Acres)

Year	George Washington National Forest Gypsy Moth Defoliation	Jefferson National Forest Gypsy Moth Defoliation	Grand Totals Across Both Forests
2004	0	0	0
2005	0	3,030	3,030
2006	0	2,950	2,950
2007	26,548	18,897	45,445

Table 27. Gypsy Moth Treatment Applications by Year, by Forest

(Acres Treated)

Forest	Fiscal Year	Pheromone Flake Application	Bt	Dimiln	Yearly Total
George Washington NF	2004	0	0	0	0
	2005	0	0	0	0
	2006	0	0	0	0
	2007	0	0	0	0
Jefferson NF	2004	5510	0	0	5510
	2005	10573	239	0	10812
	2006	6905	158	0	7063
	2007	28423	5540	0	33963
Totals For Both Forests	2004	5510	0	0	5510
	2005	10573	239	0	10812
	2006	6905	158	0	7063
	2007	28423	5540	0	33963

Table 28. Soil and Watershed Restoration by Year, by Forest

(Acres Treated)

Forest	Fiscal Year	NFVW	KV and K2	Yearly Total
George Washington NF	2004	31	0	31
	2005	33	0	33
	2006	25	0	25
	2007	27	6	33
Jefferson NF	2004	29	0	29
	2005	27	0	27
	2006	35	0	35
	2007	13	5	18
Totals For Both Forests	2004	60	0	60
	2005	60	0	60
	2006	60	0	60
	2007	40	11	51

Table 29. Noxious Weed Control on the GWJEFF NF

(Acres Treated)

Year	Noxious Weeds (Range Only) (Entire GWJ)	Noxious Weeds (NFVW Only) (Entire GWJ)	Noxious Weeds (CWKV, CWK2, RTRT Only) (Entire GWJ)	Grand Total GWJEFF
2004	301	0	0	301
2005	52	265	0	317
2006	0	200	465	665
2007	0	751	73	824

APPENDIX D

Post-Suppression and Forest Health Evaluation of Gypsy Moth Infestations on the New River Valley Ranger District and Mount Rogers National Recreation Area of the George Washington and Jeffersn National Forest in Virginia In The Slow the Spread Project

Year 2006

February 2006

Forest Health Protection
Asheville Field Office

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Post-Suppression and Forest Health Evaluation Of Gypsy Moth Infestations on the New River Valley Ranger District and Mount Rogers National Recreation Area of the George Washington and Jefferson National Forest in Virginia In the Slow the Spread Project Year 2006

SLOW THE SPREAD OF THE GYPSY MOTH

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Post Suppression and
Forest Health Evaluation of Gypsy Moth Infestations on the
New River Valley Ranger District and Mount Rogers National Recreation Area of the
George Washington and Jefferson National Forest
In Virginia

Fiscal Year 2006

Patricia A. Sellers

Abstract

2005 male moth trapping revealed gypsy moth populations that if left untreated could result in the spread and ultimate establishment of gypsy moth populations in un-infested areas. Proposed areas for treatment are listed as the following:

- Bastian – 1,291 acres of private land and 535 acres of national forest land (total 1,826 acres) in Bland County on Rich Mountain between State Route 61and State Road 614.

- Big Bend – 3,340 acres of private land and 4,346 acres of national forest land (total 7,686 acres) in Bland County. This area contains part of Brushy Mountain and Crab Orchard to the north and west and extends to near State Road 42 on the south and east. Other open roads within the block include Forest Development Road 288 and State Road 615. The Appalachian Trail runs through the northern section of this block. Approximately 1,886 acres of national forest land in the proposed Big Bend treatment block are in the Little Wolf Creek Rx1B area (Recommended wilderness study area).

- Austinville – 1,698 acres of private land and 2,024 acres of national forest land (total 3,722 acres) in Wythe, Carroll, and Grayson Counties. This block runs primarily north south with the northern boundary near State Road 644 in Wythe County and the southern boundary near State Road 604 in Carroll and Grayson Counties.

To reduce the spread of gypsy moth, Forest Health Protection recommends that the National Forest in conjunction with the Virginia Department of Agriculture and Consumer Services (VDACS) consider treatment of these areas in 2006.

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INTRODUCTION

The gypsy moth, Lymantria dispar (L.), is an exotic defoliator of North American hardwood forests. It was first introduced from Europe into Massachusetts in 1869 by a French naturalist who was trying to develop a silk industry based on a hybrid cross of the gypsy moth and a native silkworm moth. The experiment failed and several gypsy moths escaped from the laboratory and thrived in its new environment of New England hardwood forests adjacent to the laboratory. Since its introduction, the gypsy moth has spread and become established in the deciduous forest areas throughout the northeastern United States and Canada, and isolated infestations have been found in Colorado, Utah, Arkansas, Tennessee, and Georgia. The generally infested area extends from New England, south into Virginia, and west into Wisconsin.

A Review of Eradication and Slow the Spread activities on the George Washington and Jefferson National Forest

1987-1989

Gypsy moth was first discovered on the Blacksburg Ranger District in 1985, when a single male moth was trapped in Giles County, Virginia as part of an annual detection-trapping grid. In 1986, a total of 11 moths were caught. In 1987, 222 moths were caught and three viable egg masses were found in the vicinity of the high trap catches. Based on the 1987 male moth trap catches and egg mass surveys, an eradication effort was initiated on approximately 12,500 acres of the Blacksburg Ranger District and intermixed private lands within Giles county. In 1987, part of the area was treated with the biological insecticide, Bacillus thuriengensis var kurstaki (Btk) and in the spring of 1988 some areas were treated with the chemical insecticide, diflubenzuron (Dimilin ®). Trapping results indicated that the 1988 treatment was successful in reducing gypsy moth populations. The infestation had extended beyond the 1988 treatment area when two viable egg masses were found in the vicinity of the highest trap catches in the fall of 1988. During the environmental analysis, it was discovered that the study area of the dark-eyed junco, Junco hyemalis hyemalis was located within the proposed 1989 treatment area. Because a major part of the bird's diet consists of lepidoptera larvae, the application of Btk or diflubenzuron would adversely impact the study. The decision was made to treat 2,550 acres surrounding the junco area with the gypsy moth-specific tactic, mating disruption, pheromone flakes. The remainder of the 1989 treatment block would be treated with diflubenzuron. No moths were trapped in the pheromone flake block in the year of treatment and only one moth was trapped in the second year post-treatment. All of these areas were trapped with 1 kilometer (km) or 0.5 km grids in 1993 in conjunction with the Slow the Spread Pilot Project (STS). A portion of the Giles county 1989 diflubenzuron block was treated with pheromone flakes as part of the 1993 STS treatments.

Year-1992

In 1992, on the New Castle Ranger District two isolated low-density populations of gypsy moth were detected in the Back Valley and Potts Creek (Turkey Tracks) areas in Monroe County, West Virginia. Approximately 450 acres (97 acres were National Forest lands) were treated with one application of the pheromone flakes, Disrupt II formulation, in conjunction with the West Virginia Department of Agriculture (WVDA) as part of the Appalachian Integrated Pest Management (AIPM) gypsy moth demonstration project. Post-Treatment evaluation trapping revealed no moth captures thus the treatments were considered successful.

Year 1993

In 1993, approximately 2,248 acres on the Blacksburg Ranger District in conjunction with 575 acres of intermixed private lands (Virginia and West Virginia) were treated with one application of pheromone flakes. Male moth trap captures in the first year (post-treatment) indicates the pheromone application failed to disrupt moth communication. Male moths were found in all the pheromone flake blocks except the Ridge Top block (Virginia and West Virginia). Possibly, these pheromone treatments were unsuccessful in disrupting mating due to undetected residual populations that exceeded the population thresholds where mating disruption is not as effective.

Year 1994

In 1994, approximately 494 acres (Gypchek®), 755 acres (Btk), 188 acres (diflubenzuron), and 766 acres (pheromone flakes) were treated on the Blacksburg and New Castle Ranger Districts in conjunction with 2,280 acres of intermingled private lands were treated in Virginia and West Virginia. The Btk was aerially applied in two applications (24 BIU at 0.5 gallon rate twice) with each application timed 3 to 7 days apart. Gypchek® was aerially applied in two applications (2 gallon rate, twice) 3 to 4 days apart. The Btk, diflubenzuron, and Gypchek® treatment blocks and surrounding areas were monitored in 1994 with a 0.5km trapping grid. Portions of the Btk and diflubenzuron blocks would require re-treatment in 1995 as a result of male moth trap captures. Populations were significantly reduced in these areas; however, residual populations would require the re-treatment of approximately 2,272 in 1995. The Laurel Branch and Rocky Gap pheromone flake blocks (766 acres) treated in 1994 were considered successful with no male moth catches detected in the 0.5km trapping grid in the second year post-treatment

Year 1995

In 1995, approximately 685 acres (pheromone flakes) and 1,990 acres (Btk) were treated on the New River Valley Ranger District (NRVRD) formerly the Blacksburg Ranger District in Virginia in conjunction with 8,629 acres of intermixed private lands in Virginia and West Virginia. All areas treated with two applications of Btk (24 BIU at 0.5 gallon rate applied twice). The Btk treatment blocks were monitored with a 0.5km evaluation, trapping grid. Post-treatment trapping results showed residual populations of gypsy moth adjacent to the Btk block. This area and a portion of the Cascades block were recommended for re-treatment in 1996. A 0.5 km post-treatment trapping grid was placed in the 1995 pheromone flake treatment blocks (Narrows and Peters Mountain Wilderness); the second year of post-treatment trapping revealed no male moth trap catches and considered successful treatments.

Year 1996

In 1996, approximately 119 acres of Btk and 3,769 acres of pheromone flakes were treated on the NRVRD and New Castle Ranger Districts in conjunction with 5,206 acres of intermixed private lands in Virginia and West Virginia. The pheromone flake blocks on the National Forest were identified as North Mountain and Gap Mills. All areas treated with Btk received two applications (24 BIU at the 0.5 gallon rate twice); each application was applied approximately 3-7 days apart. The 1996 Btk treatments were considered successful. In the first year of post-treatment monitoring in the North Mountain and Gap Mills (7,465 acres) pheromone flake blocks, no male moths were detected The Gap Mills and North Mountain blocks (7,465 acres) trapping results in the second year post-treatment show adequate suppression of male moths in and around the blocks. These mating disruption treatments were considered successful and no further treatment is recommended at this time.

Year 1997

In 1997, approximately 374 acres on the James River Ranger District (Big Branch) in Virginia in conjunction with 952 acres of intermixed private lands in Virginia and West Virginia were treated with one application of the mating disruptant, pheromone flakes, Disrupt II. Trapping results in the second year post-treatment show adequate suppression of male moths in and around the blocks. This mating disruption treatment was considered successful and no further treatment is recommended at this time.

Year 1998

In 1998, 381 acres of forested land on the James River Ranger District and 304 acres of forested land on the New Castle Ranger District on the George Washington and Jefferson National forests in Virginia, in conjunction with 1,038 acres of intermixed private forested lands in Virginia and West Virginia were treated with oue application of the gypsy moth-specific tactic, mating disruption, using pheromone flakes. In the first year of post-treatment evaluation in the Glace Block (706 acres) and the Paint Bank Block (1,017 acres), no male moths were detected. Trapping results for two year's post-treatment show adequate suppression of male moths in and around the blocks; the evaluation trapping results in the second year (post-treatment) further supports suppression of the gypsy moth population. These mating disruption treatments were considered successful and no further treatment is recommended at this time.

Year 1999

In June 1999, the USDA- Forest Service and Forest Health Protection in cooperation with Virginia Department of Agriculture and Consumer Services (VDACS) treated 350 acres (Lindside Block) of National Forest and intermixed private lands in Virginia with the gypsy moth-specific tactic, mating disruption, using pheromone flakes. One application of the pheromone flakes was applied at the rate of 30.4 grams of active ingredient per acre. Application of the pheromone flakes was made by a private contractor using a Turbine Air Tractor (fixed-wing) with a specially designed pod dispersal system mounted under each wing of the planes. Post-evaluation trapping in the second year of evaluation showed the treatment was successful. No follow-up treatments are recommended for this area in 2000.

In 2000, there were no treatments conducted in the Slow the Spread Project area on the GWJNF.

Year 2001

In 2001, 3,450 acres (Brush Mountain Block) on the New River Valley Ranger District and associated private lands in Virginia was treated as part of the Slow the Spread Project with the mating disruption tactic, pheromone flakes. The pheromone flakes were applied at the rate of 15 gram active ingredient per acre. Post-treatment evaluation trapping in 2002 determined that the treatment was successful. Moth captures in the treatment block were reduced to the background level as in neighboring areas. No further treatments are recommended for this area and will continue to be monitored with a 2 km trapping grid.

Year 2002

In 2002, an area covering 54,000 (Wytheville Block) acres was treated with pheromone flakes (6 gram); 34,300 acres consisted of Federal Lands on the New River Valley Ranger District and 19,700 acres were private lands in Bland, Pulaski, and Wythe counties in Virginia. Post treatment evaluation trapping in the second year showed the treatment to be successful.

Year 2003

In 2003, the George Washington and Jefferson National Forest treated low-density gypsy moth populations on the New River Valley Ranger District and intermingled private lands in Narrows block (23,822 acres NF and 25,114 acres private) in Giles and Bland counties; Rocky Gap block (3,474 acres NF and 7,681 acres private) in Bland county; Draper Mountain block (115 acres NF and 1,134 acres private) in Wythe county and on the Mount Rogers Natural Recreation Area with intermingled private lands in the Cripple Creek block (578 acres NF and 358 acres private) in Grayson county were treated with one application of the pheromone flakes at the 6 gram rate per acre.. All of the treatment areas are in Virginia. In the second year of post-treatment trapping, the Narrows block, Rock Gap block, and Cripple Creek block showed the treatments to be successful. The Draper mountain block was not successful in reducing populations.

Year 2004

In 2004, four blocks were treated on the New River Valley Ranger District made up of intermingled private and National Forest Lands. Rocky Gap block – 2,655 acres of private land and 2,390 acres of National Forest land (total 5,045 acres) located in central Bland County was treated with a 15 gram rate per acre of the pheromone flakes. Bland block – 2,383 acres of private and 88 of National Forest land (total 2,471 acres) located in south central Bland County, Mechanicsburg block - 823 acres of private land and 216 acres of National Forest land (total 1,039 acres) located along in Bland and Giles Counties near the Falls of Dismal and Long Spur block – 8,397 acres of private land and 2,243 acres of National Forest land (total 10,640 acres) located along Little and Walker Mountains south of Walker Creek in Pulaski, Bland and Giles Counties were all treated with a 6 gram per acre rate of the pheromone flakes. Post evaluation trapping in the second year after treatment indicated that all four blocks were successful treatments.

Year 2005

In 2005, the following areas with the exception of the Bastian block were treated with the mating disruption tactic on the New River Valley Ranger District made up of intermingled private and National Forest Lands. Hutchinson Rock Area – 1,149 acres of private and 91 acres of national forest land (total 1,240 acres) in the Garden Mountain area of Tazewell County. The area includes Hutchinson Rock and the northern-most finger of the Beartown Wilderness Area. All 91 acres of national forest land are in the Beartown Wilderness. Hutchinson Rock 2 Area – 164 acres of private and 947 acres of national forest land (total 1,111 acres) in the Chestnut Ridge/Heninger Gap area along the Bland/ Tazewell County line. Approximately 622 acres of the 947 acres of national forest land are in the Beartown Wilderness. Garden Mountain – 375 acres of private land and 838 acres of national forest land (total 1,213 acres) on Garden Mountain where State Route 623 crosses the mountain top at the Bland/Tazewell County line. All national forest land in this area is a "Recommended Wilderness Study Area". Rocky Gap 3 – 465 acres of private land and 1,240 acres of national forest land (total 1,705 acres) in Bland County. Approximately 730 acres of the 1,240 acres of national forest land are in the Kimberling Creek Wilderness. Rocky Gap 4 – 870 acres of national forest, all of which are in the Kimberling Creek Wilderness in Bland County. Bland – 2,109 acres of private land and 347 acres of national forest land (total 2,456 acres) in Wythe County. Mechanicsburg 2 – 5,201 acres of private land and 535 acres of national forest land (total 5,736 acres) in Bland County. Mechanicsburg 3 – 780 acres of private land and 780 acres of national forest land (total 1,560 acres) along the Bland/Giles County line. Narrows 2 – 2,493 acres of private land and 4,251 acres of national forest land (total 6,744 acres) in Giles County. White Gate – 5,242 acres of private land and 352 acres of national forest land (total 5,594 acres) in Giles County. Pearisburg – 7,142 acres of private land and 322 acres of national forest land (total 7,464 acres) in Giles County. Treatment efficacy for mating disruption treatments will be determined in the second year post-treatment.

Bastian – (BTk treatment) 720 acres of private land and 239 acres of national forest land (total 959 acres) in Bland County mainly southwest of Clear Fork, from State Route 61 up to Rich Mountain. This treatment was evaluated using post treatment trapping and considered successful in managing the population in this block.

More detailed information regarding pre-treatment moth captures, resnlts of evalnation trapping and analysis of treatment efficacy for treatments blocks in the Slow the Spread Project area can be viewed at: **http://www.gmsts.org**

Gypsy Moth Slow The Spread (STS) Project

History, Rationale and Strategy

Ever since the gypsy moth was accidentally introduced into Massachusetts in 1869, it has steadily expanded its range west and southward. Today the quarantine or regulated area that is considered generally infested by this hardwood defoliator occupies all or parts of 16 northeastern states. Prior to 1965 the rate of spread of this pest was estimated at 3 to 9 kilometers per year (2 to 6 miles per year). This spread of 3 to 9 kilometers per year is consistent with the natural dispersal capabilities of gypsy moth, whieh is accomplished only via wind dispersal of the small caterpillars, because the adult female moth cannot fly. Since 1965, the spread of the gypsy moth has been estimated at the increased rate of 21 kilometers per year (13 miles per year). Increased rate of spread may be influenced by the increased mobility of humans, which may result in more frequent short and long range artificial movement of the various life stages of this pest and the abandonment of the early USDA and State programs which aggressively worked to slow the moth's spread. This apparent increase in the rate of spread over the past 30 years is of concern because the first outbreak of gypsy moth, as it moves through a previously un-infested area, is usually the most severe and often results in large-scale suppression projects.

Gypsy Moth Spread:

Gypsy moth populations do not spread continuously along the population front. Instead, numerous isolated colonies become established beyond the population front. Some of these colonies are the result of natural means of spread but most become established because of inadvertent, short-range artificial movement of life stages by humans. The zone where spread occurs near the leading edge of the infested area can be classified into three areas:

- The generally infested area that is continuonsly occupied,
- The transition area where isolated colonies become established,
- The un-infested area where the probability of colony establishment is close to zero

The population front is the line that divides the infested and transition areas. In general, the area that is quarantine regulated for gypsy moth coincides with the infested area. However, the quarantine line does not always exactly track the population front because of administrative (e.g. county lines) or political considerations.

As isolated colonies grow, they coalesce and contribute to the expansion of the population front. Theoretically, the rate of spread could be reduced if isolated colonies in the transition area are detected and eradicated before they grow too large. Slowing the spread of gypsy moth by managing populations in the transition area would delay the damage and management costs that are associated with infestation of new areas. It was not until 1999, that USDA national strategy for managing the gypsy moth included management in the transition area. Prior to 1999, the national strategy only included suppression in the infested area to minimize impacts associated with outbreak populations, and eradication, which is implemented in the un-infested area to minimize long-range artificial spread.

The Slow the Spread pilot project (STS) was initiated in 1992 to demonstrate that spread rates can be reduced in a cost-effective manner using existing technology by managing isolated populations in the transition area. An economic analysis was conducted to determine the benefits of reducing the rate of spread. The estimated potential benefits would range from 6 to 32 million dollars per year, depending on how much the rate of spread is reduced. In the Southern Appalachians, STS has demonstrated that implementation of comprehensive survey and treatment over a large geographic area in the transition area has reduced spread by at least 50%. The benefits associated with a 50% reduction in the rate of spread exceed costs by a factor of 3 to 1. The accrued benefits are primarily due to the avoidance and delay of future suppression costs as gypsy moth moves through new areas.

National Implementation of STS:

In 1999 and following a successful pilot project initiated in 1992, the USDA Forest Service along with State and Federal cooperators, implemented the National Gypsy Moth Slow the Spread (STS) Project across the 1,200 mile gypsy moth frontier from North Carolina through the upper Peninsula of Michigan. The STS project has moved westward to include Minnesota and southward into North Carolina. The goal of the project is to use integrated pest management (IPM) strategies to reduce the rate of spread of gypsy moth into un-infested areas. STS does not replace traditional USDA suppression or eradication programs; rather it works to complement these programs by filling the gap in management that formerly existed in the transition area. This new IPM strategy is dependent upon intensive monitoring of moth populations coupled with timely control of growing isolated populations.

The STS Project is composed of two types of management areas: the Action Area, where STS management strategies are applied, and the Monitoring Area, where the normal state and Federal management strategies are maintained. Male moth trap catch data from the Action Area are used in determining appropriate management activities for the subsequent year as well as in the analysis of the treatment efficacy and in project evaluation. Data from the monitoring Area and from state gypsy moth survey areas used to assess the efficacy of the STS management strategies in the Action Area.

The STS program goals are:

- To reduce the average rate of gypsy moth spread in the USA by at least 50% relative to the uncontrolled rate of spread by detecting and treating isolated colonies in the transition area

- To test and implement new pest-management technologies for managing isolated colonies in order to make the program more cost-effective or environmentally friendly

Setting Project Boundaries:

The STS project area is located along the expanding population front. Boundaries of the project are set relative to the smoothed 10-moth line. Moth lines for various thresholds are estimated from season-long moth captures (moth counts) in grids of pheromone-baited traps (Sharov et al. 1995). Sharov et al (1997) showed that the moth line established using the 10 moth count threshold is the most stable in space and time when compared to moth lines estimated using other thresholds (1 to 300 moth counts). Therefore, the 10-moth line is used as a gange when deciding where to establish the STS program boundaries and when to shift these boundaries in response to pressure from the population front.

The STS project area is located on both sides of the 10-moth line, beginning approximately 50 km before the line and extending approximately 120 km beyond the line. This includes the area where the majority of the isolated gypsy moth colonies become established (Sharov and Liebhold 1997). However some colonies do become established at greater distances from the 10-moth line as a result of long distance artificial movement of life stages of the gypsy moth. The area beyond the STS project area will continue to be monitored and treated as part of the cooperative eradication programs that are jointly implemented by the states and USDA.

Technical Information

Life Cycle

The gypsy moth has one generation per year. Larvae (caterpillars) emerge from egg masses in April or early May. Newly hatched larvae are less than 2 millimeters (mm) in length and possess long setae (hairs). If the weather is unfavorable or cold (below 40° F or 4° C), they remain on or near the egg masses for several days. When conditions improve, the larvae leave the egg masses during the daylight hours and climb trees, trailing silken threads. When the larvae reach the branch tips, they drop on silken threads and disperse on the wind. Some larvae may be carried long distances by the wind (Taylor and Reling 1986), but most are dispersed within the local area. Larvae may repeat this dispersal process many times before settling down to feed. Male larvae usually pass through five instars (growth stages), and the female larvae pass through six instars. Each instar lasts 4 to 10 days, depending on the prevailing environmental conditions during each stage of development. During the first three larval instars, the larvae alternate feeding and resting during the day. After the larvae molt to the fourth instar, they feed at night and descend the trees at dawn, where they rest in protected sites for the remainder of the day. At dusk, the larvae climb into the canopy to feed. This behavior can vary in high populations where the larvae feed continuously. Larvae usually complete their development by late June and then seek shelter for pupation. The pupal stage lasts about two weeks. In dense populations, clumps of pupae can be found at the base of branches, in bark fissures, attached to bark surfaces, or in protected areas on the ground. The male moth is dark brown and has several dark bands across the front wings. Females have wings but cannot fly due to the excessive body weight but may crawl short distances from their place of pupation. Females release a potent sex attractant (pheromone) to attract the male moths. Soon after mating, the female deposits her eggs in a single mass and dies. The eggs are coated by a dense coating of hairs sloughed from the abdomen of the female moth. The egg mass may contain from 75 to 1,000 eggs. The egg masses are buff-colored when first deposited, but develop a bleached appearance when exposed to direct sunlight and weathering during the winter months. Within 4 to 6 weeks, the embryos develop into the larvae that over-winter in the eggs and hatch the following spring.

Early instar gypsy moth caterpillars can spread naturally by short distances by ballooning on wind currents, but may be spread artificially by humans over greater distances. Two ways artificial spread may be achieved is through the transportation of caterpillars or through the transportation of the egg masses. Transportation of caterpillars occurs when visitors pick up the larvae in heavily infested areas and carry them on their vehicles or clothing to un-infested forested areas; gypsy moths are introduced to the un-infested areas when caterpillars crawl off the vehicle or individual's clothing. The transportation of gypsy moths via egg masses occurs when vehicles or furniture infested with egg masses are brought into the area; in the spring, visitors may introduce the gypsy moth into the area when caterpillars hatch from the egg masses on their vehicles or belongings.

Hosts

Gypsy moths feed on approximately 500 species of trees, shrubs, and vines. Preferred hosts include oak, apple, birch, basswood, witch hazel, and willow. Some less preferred hosts include maple, hickory, beech, black cherry, elm, and sassafras. Least favored hosts include ash, yellow-popular, American sycamore, hemlock, pine, spruce, and black locust. Late instar larvae can feed on species that early instar larvae avoid, such as hemlocks, pines, and spruces. This usually occurs when high larval populations have defoliated the favored tree species and attack adjacent trees to complete their development. It has been documented that larvae feeding on less preferred host is an indication of population decline.

The Forest

It can take several years from the time when gypsy moth first invades an area to the time that it causes noticeable levels of mortality. Eventually, populations reach levels where defoliation can be severe. The first outbreak is usually the worst and most devastating to the forest. A certain amount of mortality can be expected following severe defoliation. The exact amount depends on a number of factors other than gypsy moth, such as species composition, stand vigor and age, and other environmental factors. As a rule, gypsy moth outbreaks result in mortality losses of less than 15 percent of the total basal area. Losses of 15 to 35 percent are not uncommon, and occasionally levels of greater than 50 percent are reported (Gasner and others 1987).

Campbell and Sloan (1977), in an analysis of data collected in New England from 1911 to 1931, found that differential loss among species tended to create residual stands less susceptible to defoliation than original stands. Over time, the composition of the forest will change to favor the species less preferred by the gypsy moth. This will undoubtedly result in a reduction in the oak component and an increase in some of the less susceptible species such as maple. However, oak will still be a major component of the resulting forest.

Population Dynamics

At low population levels, such as those found throughout the STS area, it is believed that gypsy moth populations may be regulated but not eliminated by natural enemies such as parasitic insects and predaceous vertebrates, particularly small mammals. In areas considered geuerally infested, gypsy moth population densities fluctuate widely from year to year resulting in episodes of dramatic and severe defoliation followed by periods of relative innocuousness. High population levels of gypsy moth may be impacted by naturally occurring pathogens. One of these pathogens is the nucleopolyhedrosis virus (NPV) that is found throughout the range of gypsy moth. NPV can result in significant mortality in high-density gypsy moth populations stressed by climatic conditions or the lack of food. The virus epizootic reaches its peak late during caterpillar development, usually as caterpillars enter the fifth and sixth instars. As a result, the collapse usually develops only after severe defoliation has occurred (Witcosky 2001). Populations of gypsy moth in the STS area are considered low-density. The NPV virus is dependent on high population densities for virus transmission from the early instars to later instars that result in larval mortality. Therefore, due to low-density, scattered populations, it is highly unlikely that enough of the naturally occurring NPV would be present in the STS area to bring about larval mortality and result in a reduction in the spread of gypsy moth.

A relatively new natural enemy, Entomophaga maimaiga (E. maimaiga), is established and spreading throughout the northeastern United States, Pennsylvania, Michigan, and Virginia. Where high-density populations are present this fungal pathogen is causing epizootics (disease outbreaks in animals) in gypsy moth populations. Epizootics of the fungus develop to their fullest extent when cool, moist, conditions occur. Although all instars are believed to be susceptible to the fungus, the third and fourth instars appear to be more vulnerable. Because the epizootics of E. maimaiga develop during early caterpillar development and intensify progressively during the third through the sixth instars, damaging populations of gypsy moth may collapse before they are able to cause severe defoliation. In periods of drought, the fungus spores remain inactive and enhance the survival of the gypsy moth caterpillar (Witcosky 2001). E. maimaiga is prevalent throughout low-to-high density gypsy moth populations. Although the fungus has been associated with the complete collapse of gypsy moth populations, it is highly variable, and as yet unpredictable. In low-density populations and even in fungal releases in isolated areas, population collapses do not always take place (Reardon et al. 1998).

Monitoring

Monitoring Zone

Pheromone traps are set in grids with inter-trap distances of 5 km and 8 km across most of the Monitoring Zone (MZ). An inter-trap distance of 8 km was shown to be sufficient for estimating population boundaries and for evaluating the effect of the STS project on the rate of spread (Sharov et al. 1997). The inter-trap distance should be reduced to 5 km across a narrow band (20 km deep) adjacent to the Action Zone (AZ).

A higher trap density is recommended in this area because this data is used in the decision algorithm. Milk carton style traps are used throughout the Monitoring Zone because moth counts often exceed 15 per trap.

Action Zone

A 2 km base grid of pheromone-baited traps throughout the action area is used for detecting isolated gypsy moth colonies. Trapping data provides the STS Decision Algorithm with information to: (1) detect potential problem areas, and (2) provides background data for evaluation of the potential problem areas and determining the action to be taken.

Delimiting grids

These grids are used in the Action Zone to delineate the spatial extent of a gypsy moth colony prior to treatment. These grids are set with an inter-trap distance of 0.5 km or at reduced density of traps of 1km. In addition, the size of the delimiting grid would be determined by its proximity to other colonies and budget constraints.

Post-treatment evaluation grids

These grids are set to determine if the treatment was effective. These grids are set with an inter-trap distance of 0.5 km. If the trap catches are <50 male moths, Delta style traps can be used for the evaluation grid. Evaluation grids are set in the same year of treatment, except in mating disruption treatments. Saturating an area with pheromone not only disrupts mating but also disrupts communication rendering the pheromone traps useless as an evaluation method in the year of treatment. Therefore, mating disruption treatments are evaluated in the year following treatment (i.e. a 2 km base grid in the year of treatment and a 0.5 km evaluation grid in the next year).

Post-treatment success is determined by a comparison of the moth captures in the treatment block with the moth capture in the 'control' area around it. Success will also vary depending on the location of the treatment area in regards to the population front.

Treatment Alternatives

(1) No treatment: No treatments would be used to slow the rate of spread of gypsy moth; consequently, populations would increase and spread via natural or artificial means to un-infested areas or add to the size of the infested area. Eventually populations would reach levels where defoliation could be severe. A certain amount of tree mortality, especially among the favored host, oak, could be expected following severe defoliation with a concurrent reduction in hard mast (Quimby 1987). With the reduction of favored gypsy moth hosts, the composition of the forest would ultimately change to favor tree species less preferred by the gypsy moth.
With the no treatment, existing predators, parasites, virus and pathogenic fungus would come into play as biological control factors for gypsy moth in the forest ecosystem.

(2) Integrated Pest Management: The STS Project uses the Integrated Pest Management (IPM) approach to gypsy moth management. This approach uses survey, detection, and monitoring activities to determine where populations are established and how populations change in response to treatment. With this approach, gypsy moth populations are evaluated with respect to density and trend, economic impact on the area being considered for intervention, cost of intervention, and ecological and geological factors that may be impacted by the insect population or by the suppression of the population. Treatment recommendations are made based on the appropriateness of the tactic for each situation. The biological insecticide, Bacillus thuriengensis var kurstaki (Btk), and the chemical insecticide diflubenzuron (Dimilin®) have proven to be the most effective in reducing high-density gypsy moth populations. The gypsy moth nucleopolyhedrosis virus insecticide or Gypchek® is most effective in reducing moderate to high population densities. The gypsy moth mating disruptant or Disrupt II (pheromone flakes) is effective in suppressing low-density populations. The flakes release a scent that is similar to the natural pheromone released by the female gypsy moth to attract the male moth to initiate mating. Mating disruption is achieved when the male moth is confused by the flake scent and is unable to locate the female moth to mate.

The flakes are capable of releasing enough scent to disrupt mating throughout the entire male moth flight period. To help in the dispersal and adherence of the flakes in the forest canopy, a sticker (Gelva 2333) is added. The IPM approach proposes to use a combination of Btk, diflubenzuron, Gypchek® and Disrupt II (pheromone flakes) because all of these insecticides used according to the label are safe to humans and the environment and effective in reducing gypsy moth populations

Results and Discussion

Post-Suppression Discussion for MD blocks treated in 2005

Treatment Area Name	Treatment	Proposed Dose	Area Size (acres)	Acres by Ownership	
				Private	National Forest Total (Wilderness)
Hutchinson Rock	Pheromone Flakes	15 g	1,240	1,149	91 (91)
Hutchinson Rock 2	Pheromone Flakes	15 g	1,111	164	947 (622)
Garden Mountain	Pheromone Flakes	6 g	1,213	375	838 (838)
Bastian	Btk	25.1 BIU x 2 applications	959	720	239
Rocky Gap 3	Pheromone Flakes	15 g	1,705	465	1,240 (730)
Rocky Gap 4	Pheromone Flakes	6 g	870	0	870 (870)
Bland	Pheromone Flakes	6 g	2,456	2,109	347
Mechanicsburg 2	Pheromone Flakes	6 g	5,736	5,201	535
Mechanicsburg 3	Pheromone Flakes	6 g	1,560	780	780
Narrows 2	Pheromone Flakes	15 g	6,744	2,493	4,251
White Gate	Pheromone Flakes	6 g	5,594	5,242	352
Pearisburg	Pheromone Flakes	6 g	7,464	7,142	322
TOTAL			36,652	25,840	10,812 (3,151)

In 2005, all mating disruption treatments were made using Air Tractors (Al's Aerial Spraying) equipped with modified Hercon pods calibrated to dispense Disrupt II at the 6 or 15 gram per acre rate over a 100 foot swath at 135 miles per hour. All blocks were treated with on application of the Disrupt II product prior to first male moth flight in June 2005. Treatment efficacy for mating disruption blocks will be determined in the second year post treatment trapping.

Two applications of BTK were applied to the Bastian block at the rate of 24 BIU's in a half gallon of product per acre per application. Applications were made during the early larval stage in May 2005. The aerial applicator for the BTK applications were contracted through VDACS.

Recommendations for FY 2006

Proposed Treatments:

Evaluation of the 2005 trap catch data on the National Forest lands and associated private lands and applying the Integrated Pest Management alternative, Forest Health Protection recommends the following areas for treatment in 2006 using the gypsy moth specific tactic, mating disruption:

- Bastian – 1,291 acres of private land and 535 acres of national forest land (total 1,826 acres) in Bland County on Rich Mountain between State Route 61and State Road 614.

- Big Bend – 3,340 acres of private land and 4,346 acres of national forest land (total 7,686 acres) in Bland County. This area contains part of Brushy Mountain and Crab Orchard to the north and west and extends to near State Road 42 on the south and east. Other open roads within the block include Forest Development Road 288 and State Road 615. The Appalachian Trail runs through the northern section of this block. Approximately 1,886 acres of national forest land in the proposed Big Bend treatment block are in the Little Wolf Creek Rx1B area (Recommended wilderness study area).

- Austinville – 1,698 acres of private land and 2,024 acres of national forest land (total 3,722 acres) in Wythe, Carroll, and Grayson Counties. This block runs primarily north south with the northern boundary near State Road 644 in Wythe County and the southern boundary near State Road 604 in Carroll and Grayson Counties.

All of the areas are ranked as "potential problem areas" with a high treatment priority by the STS Decision Algorithm and recommended for treatment in 2006 due to: (1) location in relation to the 10-moth line and (2) high male moth trap catches in an area where the trap catches were zero to several moths in the previous year. The gypsy moth-specific tactic, mating disruption (pheromone flakes), is recommended in areas where populations are considered low-density and relatively isolated. One aerial application of the flakes at a rate of 6 gram or 15 gram of active ingredient per acre would be applied prior to first male moth flight sometime in June 2006.

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APPENDIX E

Project Accomplishment Summaries for Fiscal Years 2005, 2006 and 2007

George Washington and Jeffersn National Forest

WorkPlan

Accomplishment Summary
Report ID: Accomp1

Unit: 0808 GEORGE WASHINGTON/JEFFERSON
Fiscal Year: 2005

Date: 11/20/2006
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Code	Description	Units	Target Amount	Planned Amount	Planned Balance	Actual Amount	Actual Balance
CR-RD-RECONS-FN	Miles of Road Improved	MILE	5	2	3	2	3
EC-ECAP-AML-FN	Manage ECAP/AML	ACTIVITIES	4	4	0	4	0
FC-FAC-MNT-FN	Number of facilities maintained to standard	FACILITIES	314	0	314	314	0
FC-FCS-MF-FN	Facility Condition Surveys performed as scheduled	PERCENT	0	40	-40	95	-95
FM-DOC-ALL	Approved Timber Management NEPA documents thru appeal & litigation, all funding sources.	DOCUMENT	28	20	8	12	16
FM-FUELS-BD-FN	Treatment of Harvest-Related Woody Fuels (Brush Disposal - BDBD)	ACRE	0	18	-18	18	-18
FM-FV-FN	Improve Forest Vegetation	ACRE	0	95	-95	95	-95
FM-IV-FN	Improve Forest Vegetation	ACRE	1,900	1,088	812	1,082	818
FM-REF-ALL	Reforestation	ACRE	0	240	-240	240	-240
FM-REF-STWD	Reforestation under stewardship contracting	ACRE	0	36	-36	36	-36
FM-RV-FN	Improve Range Vegetation	ACRE	593	593	0	593	0
FM-STEWARD-FN	Number of acres brought into stewardship contracts (acres of stewardship contracts/agreements awarded)	ACRE	0	0	0	0	0
FM-TSI-ALL	Timber Stand Improvement	ACRE	0	357	-357	357	-357
FM-TSI-STWD	Timber Stand Improvement under stewardship contracting	ACRE	0	228	-228	228	-228
FM-VOL-HAR-ALL	Timber Volume Harvested -- all funding sources	CCF	33,778	6,000	27,778	1,908	31,870
FM-VOL-OFF-FN	Timber volume offered for sale -- Appropriated	CCF	45,000	35,000	10,000	19,129	25,871
FM-VOL-OFF-SS-FN	Timber volume offered for sale -- Salvage Sale	CCF	2,000	2,000	0	1,500	500
FM-VOL-OFF-STWD	Timber volume offered for sale under stewardship contracting -- Appropriated	CCF	0	6,015	-6,015	6,015	-6,015
FP-FFPC-FN	Firefighting production capability	CHAINS/HR	0	100	-100	100	-100
FP-FUEL-NONWUI-FN	Non-wildland/urban interface (non-WUI) high-priority hazardous fuels treated	ACRE	6,254	3,880	2,374	5,800	454
FP-FUELS-ACRES-FN	Acres treated in condition class 2 or 3 in fire regimes 1,2, or 3 outside the wildland urban interface (subset of non-WUI)	ACRE	1,300	0	1,300	395	905
FP-FUELS-WUI-FN	Wildland/urban interface (WUI) high-priority hazardous fuels treated	ACRE	10,800	10,974	-174	10,266	534
FP-SUP-COST-FN	Unplanned and unwanted fires controlled during initial attack	PERCENT	0	0	0	0	0
IM-ABV-PRJ-FN	Above Project Integrated Inventories	ACRE	448,322	442,337	5,985	512,147	-63,825
IM-AQRV-M-FN	Air Quality Related Value Monitoring	SITE	0	1	-1	1	-1
IM-AS-BRD-FN	Broadscale Ecosystem Assessments underway	ASSESSMENT	1	1	0	1	0

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Code	Description	Units	Target Amount	Planned Amount	Planned Balance	Actual Amount	Actual Balance
IM-AS-WA-FN	Conduct Watershed Assessments	ASSESSMENT	6	6	0	6	0
IM-GIS-MAP-FN	GIS Resource Mapping	QUARTER QUADS	390	390	0	390	0
IM-LMP-M&E-FN	Land Management Plan (LMP) Monitoring and Evaluation Reports	REPORT	2	2	0	2	0
LA-LND-PURCH-FN	Acres Acquired	ACRE	56	161	-105	170	-114
LM-BL-MAINT-FN	Boundary Line Maintained	MILE	200	215	-15	212	-12
LM-ENG-EXC-FN	Number of Energy facility applications processed that exceeded prescribed timeframes	APPLICATIONS	0	0	0	0	0
LM-ENG-FAC-FN	Number of energy facility applications processed within prescribed timeframes	APPLICATIONS	0	0	0	0	0
LM-FERC-FN	Hydropower Projects	PROJECT	0	1	-1	0	0
LM-LND-CLASS-FN	Cases resolved through litigation or processed through administrative procedure	CASE	2	4	-2	4	-2
LM-OWNER-ADJ-FN	Acres Adjusted	ACRE	25	25	0	0	25
LM-OWNER-ADJ-FNOTH	Acres Adjusted (In EXEX/EXSL)	ACRE	0	1	-1	1	-1
LM-ROW-ACQ-FN	Rights-of-way acquired	NUMBER	4	5	-1	1	3
LM-SUP-APPL-FN	Land use proposals and applications processed	APPLICATIONS	46	42	4	35	11
LM-SUP-STD-FN	Authorizations Administered to Standard	AUTHORIZATIONS	80	84	-4	84	-4
MG-ENG-OP-AD-FN	Energy Operations Administered	OPERATIONS	0	0	0	140	-140
MG-ENG-OP-PR-FN	Energy Operations Processed	OPERATIONS	0	0	0	2	-2
MG-GEO-MA-AD-FN	Manage Geologic Resources and Hazards	ASSESSMENT	60	58	2	60	0
MG-GEO-PER-FN	Geologic Permits and Reports Completed	REPORT	0	0	0	0	0
MG-OG-APP-FN	Oil and gas applications processed in prescribed timeframes	APPLICATIONS	0	0	0	0	0
MG-OG-EXC-FN	Oil and gas applications not processed in or pending longer than prescribed time frames	APPLICATIONS	0	0	0	6	-6
MG-OP-ADM-FN	Administer Minerals Operations	OPERATIONS	208	208	0	230	-22
MG-OP-PRO-FN	Process Mineral Operations	OPERATIONS	103	103	0	97	6
RD-DECOMM-FN	Miles of Road Decommissioned	MILE	5	0	5	2	4
RD-HIGH-FN	Total miles of high clearance road maintained at objective maintenance level (Level 1 & 2)	MILE	455	308	147	300	155
RD-HIGH-MTC-FN	Miles of high clearance roads receiving maintenance	MILE	215	0	215	0	215
RD-PASS-FN	Total miles of passenger car road maintained at objective maintenance level (Level 3, 4, & 5)	MILE	167	725	-558	761	-594
RD-PASS-MTC-FN	Miles of passenger car roads receiving maintenance	MILE	418	0	418	0	418

Accomplishment Summary
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Code	Description	Units	Target Amount	Planned Amount	Planned Balance	Actual Amount	Actual Balance
RG-GZ-ADM-ST-FN	Grazing allotment administration to Standard	ACRE	3,935	3,935	0	3,935	0
RG-GZ-CA-HOR-FN	Grazing - Cattle & Horses	AUM	0	0	0	0	0
RG-GZ-NEPA-FN	Grazing Allotment Decisions Signed (Analyzed/NEPA)	ALLOTMENT	3	3	0	0	3
RG-MON-EVAL-FN	Rangeland Monitored and Evaluated (Effectiveness Monitoring)	ACRE	0	0	0	0	0
RG-N-STR-IMP-FN	Range Non-Structural Improvements Completed	ACRE	0	0	0	0	0
RG-N-STR-IMP-STWD	Range Non-Structural Improvements Completed	ACRE	0	0	0	0	0
RG-RLRP-NEPA-FN	Rangelands Restored/Protected by Implementation of NEPA Based Decisions	ACRE	0	0	0	0	0
RG-STRUC-IMP-C	Range Structural Improvements	STRUCTURE	0	0	0	1	-1
RM-GA-STD-FN	Manage General Forest Areas	DAY	103,077	103,077	0	103,073	4
RM-HR-STD-FN	Heritage Resources managed to standard	SITE	1	1	0	1	0
RM-PAOTS-STD-FN	Operation of Developed sites to standard	PAOTS	903,732	903,732	0	903,921	-189
RM-PROD-STD-FN	Communication/Education/Interpretati on in all recreation programs	PRODUCT	60	61	-1	62	-2
RM-SU-ADMIN-FN	Administering recreation special use permits	PERMIT	9	9	0	11	-2
RM-TRV-PLN-FN-NUM	Acres of NFS lands on administrative units or ranger districts for which a motor vehicle use map has been published in conformance with new travel management regulation in 36 CFR 212.56	ACRE	0	0	0	0	0
TL-IMP-STD-FN	Miles of trail improved to standard	MILE	17	12	6	17	1
TL-MTC-STD-FN	Miles of Trails receiving maintenance	MILE	974	974	0	1,008	-34
TL-SYS-STD-FN-NUM	Total trail system miles meeting standard	MILE	1,096	0	1,096	0	1,096
VW-AQ-PSD-FN	Manage Air Quality	PSD Applications Eval	5	5	0	5	0
VW-AQ-SERV-FN	Manage Air Quality	SERVICES PROVIDED	0	62	-62	62	-62
VW-INV-WFF-STWD	Stewardship contracting watershed condition contribution	NUMBER	8	0	8	0	8
VW-NOX-WD-TR-C	Noxious Weed Treatment	ACRE	0	0	0	25	-25
VW-NOX-WD-TR-FN	Noxious Weed Treatment	ACRE	298	298	0	292	6
VW-NOX-WD-TR-FNKV	Noxious Weed Treatment	ACRE	0	0	0	0	0
VW-RES-IMP-FN	Soil & Water Resource Improvements	ACRE	60	60	0	60	0
VW-RES-IMP-FNKV	Soil & Water Resource Improvements	ACRE	0	7	-7	6	-6
VW-RES-IMP-FNOTH	Soil & Water Resource Improvements	ACRE	0	0	0	0	0
VW-RES-IMP-STWD	Soil & Water Resource Improvements	ACRE	0	0	0	0	0

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Code	Description	Units	Target Amount	Planned Amount	Planned Balance	Actual Amount	Actual Balance
VW-RPO-COM-FN	Regional Haze Planning Groups	GROUP	0	1	-1	1	-1
WL-HAB-FN	Terrestrial Wildlife Habitat Restored or Enhanced	ACRE	4,019	4,159	-140	4,531	-512
WL-HAB-FNOTH	Terrestrial Wildlife Habitat Restored or Enhanced	ACRE	0	165	-165	1,606	-1,606
WL-HAB-STWD	Terrestrial Wildlife Habitat Restored or Enhanced under stewardship contracting	ACRE	0	57	-57	57	-57
WL-LAK-RE-FN	Lakes Restored or Enhanced	ACRE	33	35	-2	36	-3
WL-LAK-RE-FNOTH	Lakes Restored or Enhanced	ACRE	0	5	-5	5	-5
WL-PROD-PROV-FN	Provide Wildlife Interpretation and Education	NUMBER	24	30	-6	37	-13
WL-PRT-CNT-FN	The value of partnership contributions that support habitat enhancement	DOLLAR US	150,000	148,458	1,542	186,050	-36,050
WL-STR-RE-FN	Streams Restored or Enhanced	MILE	60	72	-12	70	-10

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Code	Description	Units	Target Amount	Planned Amount	Planned Balance	Actual Amount	Actual Balance
ABV-PROJ-INTGRT-INV	Acres of above project integrated inventories	ACRE	0	0	0	0	0
ADM-UNITS-EXTL-AUDT	Number of administrative units where external audits were conducted	UNITS	0	0	0	0	0
ADM-UNITS-INTL-AUDT	Number of administrative units where internal audits were conducted.	UNITS	0	0	0	0	0
AML-SIT-MITG	Number of safety risk abandoned mine site features mitigated to	SITE	0	0	0	1	-1
AML-SIT-MITG-CERCLA	Number of contaminated AML sites which have been mitigated using CERCLA authority and procedures.	SITE	0	0	0	1	-1
ANAD-INLND-LAK-HBT-E	Acres of lake habitat enhanced	ACRE	0	0	0	0	0
ANAD-INLND-STRM-HBT-	Miles of stream habitat enhanced	MILE	0	0	0	0	0
ANAD-LAK-HBT-ENH	Acres of anadromous lake habitat enhanced	ACRE	88	86	2	88	0
ANAD-STRM-HBT-ENH	Miles of anadromous stream habitat enhanced	MILE	40	40	0	40	0
ANN-EVAL-RPT-CMPLT	Number of annual evaluation reports completed	REPORT	0	1	-1	0	0
APL-DRL-GEO-PROC	Number of applications for permit to drill and geothermal permits to drill processed	APPLICATIONS	0	0	0	0	0
AQ-MGMT	Number of air quality services provided	SERVICES PROVIDED	9	9	0	11	-2
AQ-SIT-MON	Number of air quality sites monitored	SITE	1	1	0	1	0
BDSCL-ECSYS-ASSES-UW	Number broadscale ecosystem assessments underway	ASSESSMENT	0	0	0	0	0
BIO-NRG	Green Tons of total biomass from low-value and small diameter trees used for energy	GREEN TONS	0	0	0	0	0
BIO-NRG-STWD	Green Tons of total biomass from low-value and small diameter trees used for energy with stewardship contracts	GREEN TONS	0	0	0	0	0
BLDG-WWS-DAM-DECOM	Number of buildings, water/wastewater systems, and dams decommissioned	NUMBER	0	0	0	0	0
BRDG-INSP-SCHD	Number of bridges that were inspected on schedule.	BRIDGE	0	0	0	0	0
DEF-MAINT-BKLG-RED	Dollars of deferred maintenance backlog reduction	DOLLAR US	0	0	0	0	0
DEF-MAINT-PROJ-CMPLT	Number of deferred maintenance projects completed	PROJECT	0	0	0	0	0
DFCNT-BRDG-CMPLY	Number of deficient bridges brought into compliance.	BRIDGE	0	0	0	0	0
DIST-AML-MITG-NON-CE	Number of disturbed AML sites mitigated (non-CERCLA)	SITE	0	0	0	1	-1
ECAP-AML-FNDGS-RSLVD	Number of significant or major ECAP audit findings resolved.	NUMBER	0	0	0	0	0
EST-FOR-VEG	Acres of forest vegetation established	ACRE	13	15	-2	12	1
EST-FOR-VEG-STWD	Acres of forest vegetation established under stewardship contracting	ACRE	0	0	0	0	0
EVAL-RPT-CMPLT	Number of comprehensive evaluation reports completed	REPORT	1	1	0	1	0

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Code	Description	Units	Target Amount	Planned Amount	Planned Balance	Actual Amount	Actual Balance
FAC-IMP	Improve Facilities	FACILITIES	0	0	0	0	0
FAC-MAINT	Number of facilities maintained to standard	FACILITIES	475	312	163	438	37
FAC-REC-PROJ-CMPLT	Number of facilities and recreation projects completed.	NUMBER	0	0	0	0	0
FGDC-FRMWK-VEG-LYR-C	Number of FGDC framework & vegetation layers completed	LAYERS	0	0	0	0	0
FOR-REHB-RSTR	Number of National Fire Plan rehabitation projects.	PROJECT	0	0	0	0	0
FP-FFPC	Firefighting production capability	CHAINS/HR	86	86	0	86	0
FP-FUELS-BRSH-DSPSL	Acres of Harvest-Related Woody Fuels treated	ACRE	0	0	0	0	0
FP-FUELS-CHGD-CC23	Acres treated in condition class 2 or 3 that result in a desired change in condition class (WUI and Non-WUI)	ACRE	0	0	0	0	0
FP-FUELS-CHGD-CC23-S	Acres treated in condition class 2 or 3 that result in a desired change in condition class (WUI and Non-WUI) under stewardship contracting	ACRE	0	0	0	0	0
FP-FUELS-NONWUI	Non-wildland/urban interface (non-WUI) hazardous fuels treated	ACRE	1,903	1,903	0	730	1,173
FP-FUELS-NONWUI-STWD	Acres non-WUI hazardous fuels treated under stewardship contracting	ACRE	0	0	0	0	0
FP-FUELS-WUI	Acres wildland/urban interface (WUI) high-priority hazardous fuels treated	ACRE	16,064	17,251	-1,187	5,946	10,118
FP-FUELS-WUI-STWD	Acres WUI high priority hazardous fuels treated under stewardship contracting	ACRE	0	0	0	0	0
GEO-RSRC-HZDS-MGD	Number of geologic (ground water, cave and karst, paleontology, etc.) resource and hazard (landslide, debris flow, volcanic, etc.) assessments completed	NUMBER	75	75	0	74	1
HRTG-MGD-STD	Number of heritage resources managed to standard	SITE	3	3	0	3	0
IF-MIG-RSTR	Acres of Migratory Bird Habitat Restored	ACRE	0	0	0	0	0
IMP-FOR-VEG	Acres of forest vegetation improved	ACRE	1,846	2,712	-866	1,910	-64
IMP-FOR-VEG-STWD	Acres of forest vegetation improved with stewardship contracting	ACRE	0	0	0	0	0
IMP-RG-VEG	Acres of rangeland vegetation improved	ACRE	624	635	-11	932	-308
IMP-S&W-RSRC	Acres of soil and water resources improved	ACRE	60	60	0	72	-12
INLND-LAK-HBT-ENH	Acres of inland Lake habitat enhanced	ACRE	0	100	-100	0	0
INLND-STRM-HBT-ENH	Miles of inland stream habitat enhanced	MILE	0	10	-10	0	0
INV-DAT-ACQ	Acres of inventory data collected/acquired	ACRE	75,000	75,000	0	75,077	-77
LDSCP-ECSYS-ASSES-CM	Number of landscape scale ecosystem assessments completed	ASSESSMENT	3	3	0	3	0
LE-ENF-LAW	Enforce Laws and Regulations	PERCENT	0	0	0	0	0
LE-INVSTGT-CRM	Investigate Crime	PERCENT	0	0	0	0	0

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Code	Description	Units	Target Amount	Planned Amount	Planned Balance	Actual Amount	Actual Balance
LGCY-DAT-2B-MIG-NUM	Number of legacy datasets to be migrated	DATASETS	0	0	0	0	0
LGCY-DAT-MIG-AC	Acres of legacy data migrated	ACRE	0	0	0	0	0
LGCY-DAT-MIG-NUM	Number of legacy datasets migrated to ISO Architecture	DATASETS	0	0	0	0	0
LMP-AMND-CMPLT	Number of LMP amendments completed	AMENDMENT	0	0	0	0	0
LMP-AMND-UW	Number of land management plan (LMP) amendments underway	AMENDMENT	0	0	0	0	0
LMP-M&E-RPT-CMPLT	Number of land management plan (LMP) monitoring and evaluation reports completed	REPORT	1	1	0	0	1
LMP-PLN-CMPLT	Number of LMP revisions/creations completed	PLAN	0	0	0	0	0
LMP-PLN-INIT	Number of LMP revisions/creations initiated	PLAN	1	1	0	0	1
LMP-PLN-UW	Number of land management plan (LMP) revisions or creations underway	PLAN	0	0	0	0	0
LND-ADJ	Number of acres Acquired or Conveyed	ACRE	20	20	0	1	19
LND-BL-MAINT-STD	Miles of property boundary maintained to standard	MILE	70	150	-80	109	-39
LND-BL-MRK-STD	Miles of land ownership boundary marked to standard	MILE	4	30	-26	30	-26
LND-CASES-CMPLT	Number of land acquisition cases completed	CASE	0	0	0	0	0
LND-PURCH	Number of acres acquired or donated	ACRE	0	0	0	0	0
LND-PURCH-CONTR	Acres acquired through cooperators	ACRE	0	0	0	0	0
LND-SUP-ADM-STD	Number of land use authorizations administered to standard	AUTHORIZATIONS	93	93	0	84	9
LND-TTL-MGMT-CASES-R	Number of title management cases resolved or completed to standard	CASE	2	2	0	1	1
LND-USE-PROP-APL-PRO	Number of land use proposals and applications processed	APPLICATIONS	40	40	0	32	8
MGMT-NXWD-INVSPE	Acres managed for noxious weeds & invasive plants	ACRE	680	680	0	645	35
MGMT-NXWD-INVSPE-STW	Acres treated for selected invasive species under stewardship contracting	ACRE	0	0	0	0	0
MIN-CNTRCT-PRMT-SIT-	Number of existing saleables contracts, free-use permits, and active mineral collection sites and community use pits	NUMBER	0	0	0	101	-101
MIN-CNTRCT-PRMT-SIT-	Number of new saleables contracts, free-use permits and mineral collection sites and community use pits opened	NUMBER	0	0	0	101	-101
MIN-NOI-PROC	Number of mineral notices of intent processed	NOTICE	0	0	0	0	0
MIN-NON-CMPLY-ACT	Number of mineral non-compliance actions.	ACTIONS	0	0	0	0	0
MIN-PLN-OP-ADM	Number of mineral plans of operations administered	OPERATIONS	210	210	0	285	-75

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MIN-PLN-OP-PROC	Number of mineral plans of operations processed	PLAN	85	85	0	145	-60
MIN-RTS-ACT	Number of reserved or outstanding mineral rights actions	ACTIONS	0	0	0	4	-4
MIN-RTS-ACT-ADM	Number of reserved or outstanding mineral rights actions administered	ACTIONS	0	0	0	55	-55
MON-REQ-ANN	Number of monitoring requirements for the year	NUMBER	0	0	0	0	0
MON-REQ-CMPLT	Number of annual monitoring requirements completed	NUMBER	18	18	0	7	11
NFS-LND-TVL-MGMT-PLN	Acres of national forest system lands covered by travel management implementation plans	ACRE	0	0	0	0	0
NON-AML-SIT-MITG	Number of non-AML sites which have been mitigated	SITE	0	0	0	0	0
NON-NRG-LEAS-ACT-ADM	Number of non-energy leasable actions administered	ACTIONS	0	0	0	1	-1
NON-NRG-LEAS-ACT-PRO	Number of non-energy leasable actions processed	ACTIONS	0	0	0	0	0
NON-T&E-HBT-ENH	Acres of non-threatened/endangered terrestrial habitat enhanced	ACRE	4,019	5,055	-1,036	3,340	679
NRG-FAC-APL-PROC-PST	Number of energy facility applications processed that exceeded prescribed timeframes	APPLICATIONS	0	0	0	0	0
NRG-FAC-APL-PROC-TMF	Number of energy facility applications processed within prescribed timeframes	APPLICATIONS	0	0	0	0	0
OIL-GAS-APL-PROC-PST	Number of oil and gas applications not processed in or pending longer than prescribed time frames	APPLICATIONS	0	0	0	0	0
OIL-GAS-APL-PROC-TMF	Number of oil and gas applications processed in prescribed timeframes	APPLICATIONS	0	0	0	0	0
OIL-GAS-GEO-OP-ADM	Number of oil, gas and geothermal operations administered	OPERATIONS	0	0	0	5	-5
OIL-GAS-GEO-PRMT-PRO	Number of oil and gas and geothermal leases processed.	APPLICATIONS	0	0	0	39	-39
OTH-NRG	Number of other energy leasables actions	ACTIONS	0	0	0	2	-2
OTH-NRG-OP-ADM	Number of other energy leasables actions administered	ACTIONS	0	0	0	2	-2
PLN-NFS-SCE-BYWY	Number of corridor/transportation planning projects for NF scenic byways	NUMBER	0	0	0	0	0
PROJ-COOR-TECH-IMPL-	Number of projects in the coordinated technology implementation progam	PROJECT	0	0	0	0	0
QUAD-MAPS-RVSD-STD	Number of topographic quadrangle maps titles revised to standard	MAP	0	0	0	0	0
RD-3YR-FATAL-PC	Three year average fatalities occurring on passenger car road network.	FATALITIES	0	0	0	0	0
RD-CNSTR	Miles of road constructed.	MILE	1	1	0	1	0
RD-CNSTR-PURCH-STWD	Miles of purchaser and stewardship road constructed.	MILE	0	0	0	0	0
RD-CNSTR-RCNSTR	Miles of road constructed or reconstructed	MILE	0	0	0	0	0
RD-DECOM	Miles of road decommissioned	MILE	1	1	0	1	0

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RD-DECOM-STWD	Miles of road decommissioned through stewardship contracting	MILE	0	0	0	0	0
RD-HC-CMPLY-MGMT-OBJ	Miles of high clearance road in compliance with road management objectives (RMO's)	MILE	0	0	0	0	0
RD-HC-MAINT	Miles of high clearance roads maintained	MILE	421	385	36	355	66
RD-HC-ML2-PASSBL	Miles of ML 2, High Clearance road miles passable to high clearance vehicles	MILE	0	0	0	0	0
RD-HC-STO-BMP	Miles of high clearance and stored road treated to meet soil and water BMP's.	MILE	0	0	0	0	0
RD-PC-MAINT	Miles of passenger car roads maintained	MILE	785	821	-36	827	-42
RD-PC-OP-PC	Miles of passenger car road operated for passenger cars.	MILE	0	0	0	0	0
RD-PC-RD-MGMT-OBJ	Miles of passenger car road in compliance with road management objectives (RMO's)	MILE	0	0	0	0	0
RD-RCNSTR	Miles of road reconstructed.	MILE	0	0	0	0	0
RD-RCNSTR-PURCH-STWD	Miles of purchaser and stewardship road reconstructed.	MILE	0	0	0	0	0
RD-RCNSTR-STWD	Miles of road improved through stewardship contracting	MILE	0	0	0	0	0
RD-RSTR-RPLCD	Miles of road restoration/ replacement	MILE	0	0	0	0	0
REC-ED-PROD-STD	Number of recreation interpretation & education products provided to standard	PRODUCT	30	30	0	30	0
REC-PAOT-DAYS-ADM-ST	Number of PAOT days administered to Standard	PAOT DAYS	2,800,000	2,800,000	0	2,800,000	0
REC-SIT-FCI-FR-GD	Number of recreation sites whose facility condition rating is good or fair	SITE	0	0	0	0	0
REC-SIT-OP-STD	Number of Recreation days managed to standard (General Forest Areas)	DAY	149,868	149,868	0	149,868	0
REC-SUP-ADM	Number of recreation special use authorizations administered to standard	PERMIT	10	10	0	10	0
RES-FIA-PLTS-MEAS	Number of Target Plots Measured	NUMBER	0	0	0	0	0
RES-INVNTN-EST	Number of Rights Inventions Established	NUMBER	0	0	0	0	0
RES-NON-RP	Number of non-Refereed Publications	NUMBER	0	0	0	0	0
RES-PAT	Number of Patents Granted	NUMBER	0	0	0	0	0
RES-RP	Number of Refereed Publications	NUMBER	0	0	0	0	0
RG-GZ-ADM-STD	Number of allotment acres administered to 100% of standard	ACRE	3,738	3,828	-90	3,828	-90
RG-GZ-HOR-CTL	AUM's of grazing - cattle & horses	AUM	0	0	0	0	0
RG-GZ-NEPA	Number of grazing allotments with signed decision notices	ALLOTMENT	1	2	-1	1	0
RG-GZ-SHP-GTS	AUM's of grazing - sheep & goats	AUM	0	0	0	0	0

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RG-M&E	Acres of rangeland monitored and evaluated (effectiveness monitoring)	ACRE	0	0	0	0	0
RG-NON-STRU-IMP	Acres of range non-structural improvements completed	ACRE	0	0	0	0	0
RG-RSTR-PROT-NEPA	Acres of Rangelands Restored/Protected by Implementation of NEPA Based Decisions	ACRE	0	0	0	0	0
RG-STRU-IMP	Number of range structural improvements	STRUCTURE	0	0	0	0	0
RG-STRU-IMP-CONTR	Number of range structural improvements by contributors	STRUCTURE	0	10	-10	8	-8
ROW-ACQ	Number of rights-of-way acquired	NUMBER	0	0	0	1	-1
SCE-BYWY-PROJ	Number or scenic byways projects	PROJECT	0	0	0	0	0
SIT-MITG-CERCLA	Number of sites mitigated using CERCLA authority	NUMBER	0	0	0	0	0
SP-CBU	Woody Biomass/Community Biomass Utilization	ENTITIES	0	0	0	0	0
SP-FIRE-ASST-COMM	State Fire Assistance to Communities	COMMUNITIES	0	0	0	0	0
SP-FIRE-ASST-VOL	Assistance to Volunteer Fire Departments	DEPARTMENT	0	0	0	0	0
SP-INVSPE-COOP	Cooperative acres protected - invasives	ACRE	0	0	0	0	0
SP-INVSPE-FED	Federal acres protected - invasives	ACRE	391	391	0	161	230
SP-LGCY-PROT	Acres of land adjustments to conserve the integrity of undeveloped lands and habitat quality.	ACRE	0	0	0	0	0
SP-NATIVE-COOP	Cooperative acres protected - native	ACRE	0	0	0	0	0
SP-NATIVE-FED	Federal acres protected - native	ACRE	0	0	0	0	0
SP-NFP-FIRE-ASST-COM	State Fire Assistance to Communities - National Fire Plan Component	COMMUNITIES	0	0	0	0	0
SP-NFP-FIRE-ASST-VOL	Number of volunteer Fire Departments assisted - National Fire Plan component.	DEPARTMENT	0	0	0	0	0
SP-NIPF-STWD-MGMT-PL	NIPF Stewardship Management Plans.	PLAN	0	0	0	0	0
SP-NIPF-STWD-MGMT-PL	Acres of NIPF lands under approved Stewardship Management Plans	ACRE	0	0	0	0	0
SP-UCF-COMM-DEV	Population of developing communities	PEOPLE	0	0	0	0	0
SP-UCF-COMM-MGD	Population of managing communities	PEOPLE	0	0	0	0	0
SPCL-PROD-PRMT-ADM	Number of forest special products permits administered	PERMIT	0	0	0	0	0
SPCL-PROD-PRMT-ISS	Number of forest special products permits issued	PERMIT	0	0	0	0	0
STIP-PROJ	Number of projects on State Transportation Improvement Plans	PROJECT	0	0	0	0	0
STRU-PROJ	Number of structures or projects	NUMBER	0	0	0	0	0
STWD-CNTRCT-AGR-AC	Acres covered by stewardship contracts/agreements awarded	ACRE	0	0	0	0	0

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STWD-CNTRCT-AGR-WTRS	Number of stewardship contracts/agreements contributing to forest and rangeland watersheds in fully functioning condition	NUMBER	0	0	0	0	0
T&E-HBT-ENH	Acres of threatened/endangered species terrestrial habitat enhanced	ACRE	0	68	-68	0	0
T&E-NON-T&E-HBT-ENH	Acres of terrestrial habitat enhanced	ACRE	0	0	0	0	0
TL-CNSTR	Miles of trail constructed	MILE	0	0	0	0	0
TL-IMP-STD	Miles of trail improved to standard	MILE	21	21	0	21	0
TL-IMP-STD-STWD	Miles of trail improved to standard through stewardship contracting.	MILE	0	0	0	0	0
TL-MAINT-STD	Miles of trail maintained to standard	MILE	835	835	0	841	-6
TL-RSTR-RPLCD	Miles of trail restoration/ replacement	MILE	0	0	0	0	0
TL-SYS-STD	Total trail system miles meeting standard	MILE	1,400	1,400	0	1,400	0
TMBR-NEPA-CMPT	Approved timber management NEPA documents through appeal and litigation, all funding sources	DOCUMENT	0	0	0	0	0
TMBR-TRT	Forestlands treated to achieve healthier conditions	ACRE	440	440	0	440	0
TMBR-VOL-HVST	Hundred cubic feet of timber volume harvested	CCF	0	0	0	0	0
TMBR-VOL-SLD	Hundred cubic feet of timber volume sold	CCF	41,000	41,000	0	45,191	-4,191
TMBR-VOL-SLD-SLVG	Hundred cubic feet of salvage sale timber volume sold	CCF	2,000	2,000	0	1,363	637
TMBR-VOL-SLD-STWD	Hundred cubic feet of timber volume sold with stewardship contracts	CCF	0	0	0	0	0
TRNS-PLN-PROJ-PUB-RD	Number of transportation planning projects associated with public roads	NUMBER	0	0	0	0	0
VRFY-ENV-MGMT-SYS	Number of verified environmental management systems	SYSTEM	0	0	0	0	0
VSTR-USE-MON-SIT-CMP	Number of visitor use monitoring site surveys completed	SURVEY DAYS	300	300	0	291	9
WL-HBT-STWD	Acres of terrestrial wildlife habitat restored or enhanced under stewardship contracting	ACRE	0	0	0	0	0
WL-I&E-PROD	Number of wildlife Interpretation and education products	PRODUCT	24	38	-14	33	-9
WL-LAK-ENH-STWD	Acres of lakes restored or enhanced under stewardship contracting	ACRE	0	0	0	0	0
WL-PRTNR-CONTR	Dollar value of partnership contributions that support habitat enhancement	DOLLAR US	194,670	0	194,670	0	194,670
WL-STRM-ENH-STWD	Miles of streams restored or enhanced under stewardship contracting	MILE	0	0	0	0	0
WLD-HOR-BUR-TERR	Acres of wild horse and burro territories meeting objectives	ACRE	0	0	0	0	0
WLD-MGD-STD	Number of wilderness areas administered to standard	NUMBER	0	0	0	0	0
WLD-SCE-RVR-MGD-STD	Number of Wild & Scenic Rivers managed to standard	NUMBER	0	0	0	0	0

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AML-SIT-MITG	Number of AML Safety Risk Features mitigated to no further action	NUMBER	4	5	-1	4	0
AML-SIT-MITG-CERCLA	Abandoned Mine Land sites mitigated using CERCLA authority	SITE	0	0	0	0	0
AML-SIT-MITG-NON-CERCLA	Abandoned Mine Land sites mitigated using non-CERCLA authority	SITE	0	0	0	0	0
ANAD-INLND-HBT-ENH-LAK	Anadromous and Inland lake habitat enhanced	ACRE	0	10	-10	0	0
ANAD-INLND-HBT-ENH-STRM	Anadromous and Inland stream habitat enhanced	MILE	1	4	-3	1	0
ANAD-LAK-HBT-ENH	Acres of anadromous lake habitat enhanced	ACRE	0	0	0	0	0
ANAD-STRM-HBT-ENH	Miles of anadromous stream habitat enhanced	MILE	0	0	0	0	0
ANN-EVAL-RPT-CMPLT	Number of annual evaluation reports completed	REPORT	0	0	0	0	0
ANN-MON-REQ-CMPLT	Annual monitoring requirements completed	REQUIREMENT	20	20	0	20	0
APL-DRL-GEO-PROC	Number of applications for permit to drill and geothermal permits to drill processed	APPLICATIONS	0	20	-20	18	-18
AQ-MGMT	Number of air quality services provided	SERVICES PROVIDED	0	0	0	0	0
BDSCL-ECSYS-ASSES-CMPLT	Ecosystem Assessments completed	ASSESSMENT	0	0	0	0	0
BLDG-WWS-DAM-DECOM	Buildings, water / waste water facilities, and dams decommissioned	NUMBER	0	0	0	0	0
DEF-MAINT-BKLG-RED	Reduction in dollars of deferred maintenance backlog	DOLLAR US	0	0	0	0	0
ECAP-AUDT-FNDGS-RSLVD	Number of significant or major ECAP audit findings resolved.	FINDING	0	0	0	0	0
FAC-MAINT-STD	Number of FA&O Facilities maintained to standard	NUMBER	195	195	0	195	0
FAC-PROJ-CMPLT	Major project list facilities accomplished on time and within budget	PROJECT	0	0	0	0	0
FOR-VEG-EST	Acres of forest vegetation established	ACRE	1,043	1,083	-40	529	514
FOR-VEG-IMP	Acres of forestland vegetation improved	ACRE	1,910	1,913	-3	1,054	856
FOR-VEG-IMP-STWD	Acres of forestland vegetation improved under stewardship contract/agreement	ACRE	0	0	0	0	0
FP-FUELS-ALL	Number of acres treated to reduce the risk of catastrophic wildland fire	ACRE	15,100	7,263	7,837	10,519	4,581
FP-FUELS-WUI	Number of WUI acres treated	ACRE	17,287	25,785	-8,498	2,785	14,502
GEO-RSRC-HZDS-MGD	Number of geologic resources and hazards managed	NUMBER	55	56	-1	56	-1
HBT-ENH-LAK	Acres of lake habitat restored or enhanced	ACRE	70	0	70	0	70
HBT-ENH-STRM	Miles of stream habitat restored or enhanced	MILE	36	0	36	0	36
HBT-ENH-STRM-STWD	Miles of stream habitat restored or enhanced under stewardship contract/agreement	MILE	0	0	0	0	0

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HBT-ENH-TERR	Acres of wildlife habitat (terrestrial) (TES and non TES) restored or improved	ACRE	2,655	0	2,655	0	2,655
HBT-ENH-TERR-STWD	Acres of wildlife habitat (terrestrial) (TES and non TES) restored or improved under stewardship contract/agreement	ACRE	0	0	0	0	0
HRTG-MGD-STD	Priority Heritage assets managed to standard	ASSET	8	8	0	8	0
IND-COSTS	Total indirect costs	DOLLAR US	1,879,225	0	1,879,225	0	1,879,225
IND-COSTS-CAP	Indirect Cost Cap	DOLLAR US	1,879,225	0	1,879,225	0	1,879,225
INLND-LAK-HBT-ENH	Acres of inland Lake habitat enhanced	ACRE	0	73	-73	61	-61
INLND-STRM-HBT-ENH	Miles of inland stream habitat enhanced	MILE	0	36	-36	27	-27
INV-DAT-ACQ	Acres of inventoried data collected and acquired	ACRE	0	683,315	-683,315	28,900	-28,900
INV-DAT-ACQ-STD	Acres of inventory data collected or acquired meeting corporate standards	ACRE	33,600	33,600	0	33,600	0
INVPLT-NXWD-FED-AC	Highest priority acres treated annually for noxious weeds and invasive plants on National Forest System lands	ACRE	723	699	24	824	-101
INVPLT-NXWD-FED-AC-STWD	Highest priority acres treated annually for noxious weeds and invasive plants on National Forest System lands under stewardship contract/agreement	ACRE	0	0	0	0	0
LMP-AMND-UW	LMP Amendments underway	AMENDMENT	0	0	0	0	0
LMP-PLN-INIT	Number of LMP revisions/creations initiated	PLAN	0	0	0	0	0
LMP-UW	LMP Revisions/Creations underway	PLAN	1	1	0	1	0
LND-ADJ	Acres of land adjustments to conserve the integrity of undeveloped lands and habitat quality	ACRE	0	0	0	13	-13
LND-BL-MAINT-STD	Miles of land ownership boundary maintained to standard	MILE	0	60	-60	52	-52
LND-BL-MRK-MAINT	Miles of boundary line marked/maintained to standard	MILE	86	0	86	0	86
LND-BL-MRK-STD	Miles of land ownership boundary marked to standard	MILE	0	26	-26	27	-27
LND-SUP-ADM-STD	Land use authorizations administered to standard	AUTHORIZATIONS	101	101	0	111	-10
LND-TTL-MGMT-CASES-RSLVD	Number of title management cases resolved or completed to standard	CASE	2	5	-3	3	-1
LND-USE-PROP-APL-PROC	Number of land use proposals and applications processed	NUMBER	24	20	4	25	-1
MIN-CNTRCT-PRMT-SIT-EXST	Number of existing salables contracts, free-use permits, and active mineral collection sites and community use pits administered.	NUMBER	0	82	-82	83	-83
MIN-CNTRCT-PRMT-SIT-NEW	Number of new saleables contracts, free-use permits and mineral collection sites and community use pits opened	NUMBER	0	82	-82	92	-92

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MIN-NOI-PROC	Number of mineral notices of intent processed	NUMBER	0	0	0	0	0
MIN-PLN-ADMINISTERED	Number of mineral operations administered to standard	NUMBER	210	0	210	0	210
MIN-PLN-OP-ADM	Number of mineral plans of operations administered	NUMBER	0	8	-8	8	-8
MIN-PLN-OP-PROC	Number of mineral plans of operations processed	NUMBER	0	8	-8	8	-8
MIN-PLN-PROCESSED	Number of mineral proposals processed	NUMBER	65	0	65	0	65
NFS-LND-TVL-MGMT-PLN	Acres of national forest system lands covered by a motor vehicle use map	ACRE	0	0	0	0	0
NON-NRG-LEAS-ACT-ADM	Number of non-energy leasable operations administered	NUMBER	0	0	0	0	0
NON-NRG-LEAS-ACT-PROC	Number of non-energy leasable actions	NUMBER	0	0	0	0	0
NON-T&E-HBT-ENH	Acres of non-threatened/endangered terrestrial habitat enhanced	ACRE	0	2,434	-2,434	2,949	-2,949
NRG-MIN-PROP-PROC-TMFRM	Energy-mineral proposals processed within prescribed timeframes	APPLICATIONS	0	17	-17	0	0
NRG-MIN-PROP-PSTDUE	Number of energy mineral proposals processed or pending outside of prescribed timeframes.	APPLICATIONS	0	0	0	13	-13
OIL-GAS-GEO-OP-ADM	Number of oil, gas and geothermal operations administered	NUMBER	0	127	-127	127	-127
OIL-GAS-GEO-PRMT-PROC	Number of oil and gas and geothermal leases processed.	APPLICATIONS	0	20	-20	13	-13
OTH-LEAS-OP-ADM	Number of other energy leasable mineral operations administered	NUMBER	0	0	0	0	0
OTH-NRG	Number of other energy leasables actions	ACTIONS	0	2	-2	2	-2
RD-DECOM	Miles of road decommissioned	MILE	1	1	0	1	0
RD-DECOM-STWD	Miles of road decommissioned	MILE	0	0	0	0	0
RD-HC-IMP	Miles of high clearance system roads improved	MILE	0	70	-70	70	-70
RD-HC-MAINT	Miles of high clearance system roads receiving maintenance	MILE	218	218	0	205	13
RD-PC-IMP	Miles of passenger car system roads improved	MILE	1	5	-4	0	1
RD-PC-MAINT	Miles of passenger car system roads receiving maintenance	MILE	732	576	156	709	23
RD-RSTR-RPLCD	Miles of road restoration/ replacement	MILE	0	0	0	0	0
REC-ED-PLN-IMPL	Number of interpretive and conservation education plans implemented	PLAN	0	4	-4	0	0
REC-PAOT-DAYS-ADM-STD	Recreation site capacity operated to standard	PAOT DAYS	1,700,000	1,700,000	0	1,843,133	-143,133
REC-SIT-STD	Recreation sites maintained to standard	SITE	94	39	55	26	68
REC-SUP-ADM	Recreation special use authorizations administered to standard	AUTHORIZATIONS	5	5	0	2	3
RG-GZ-ADM-STD	Grazing allotment acres managed to 100% standard	ACRE	3,738	3,670	68	3,670	68

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RG-GZ-NEPA	Grazing Allotments with signed decision notices	ACRE	3	2	1	1	2
RG-M&E	Acres of rangeland monitored and evaluated (effectiveness monitoring)	ACRE	0	0	0	0	0
RG-VEG-IMP	Acres of rangeland vegetation improved	ACRE	322	350	-28	325	-3
ROW-ACQ	Rights of way acquired to provide public access	EASEMENT	0	0	0	0	0
S&W-RSRC-IMP	Soil and water resource acres improved	ACRE	44	45	-1	41	3
SFTY-ACCDNT-INVSTG	Safety Recordkeeping & Accident Investigation Rating	RATING	0	0	0	3	-3
SFTY-ANLSIS	Safety Program Analysis & Evaluation Rating	RATING	0	0	0	3	-3
SFTY-HLTH-PROMTN	Safety & Health Promotion Rating	RATING	0	0	0	3	-3
SFTY-INSPCTN	Safety Inspections Rating	RATING	0	0	0	3	-3
SFTY-PRGM-MGMT	Safety Program Management Rating	RATING	0	0	0	3	-3
SFTY-TRNG	Safety Education & Training Rating	RATING	0	0	0	3	-3
SP-FUELS-PRTNR	Number of non-federal acres of hazardous fuels treated under partnership agreements to protect communities	ACRE	0	0	0	0	0
SP-NATIVE-FED-AC	Number of priority acres treated annually for native pests on Federal lands	ACRE	30	0	30	0	30
STIP-PROJ	Number of projects on State Transportation Improvement Plans	PROJECT	0	0	0	0	0
STRM-CROS-MITG-STD	Number of stream crossings constructed or reconstructed to provide for aquatic organism passage	CROSSING	0	0	0	0	0
STWD-CNTRCT-AGR-WTRSHD	Number of stewardship contracts/agreements contributing to forest and rangeland watersheds in fully functioning condition	NUMBER	0	0	0	0	0
T&E-ACT-COMPLT	Number of T&E Species for which recovery actions are accomplished	SPECIES	0	0	0	0	0
T&E-HBT-ENH	Acres of threatened/endangered species terrestrial habitat enhanced	ACRE	0	344	-344	314	-314
T&E-NON-T&E-HBT-ENH	T&E and non-T&E habitat enhanced	ACRE	1,414	2,300	-886	2,195	-781
TL-IMP-STD	Miles of system trail improved to standard	MILE	26	17	10	50	-24
TL-MAINT-STD	Miles of system trail receiving maintenance to standard	MILE	835	835	0	746	89
TMBR-VOL-HVST	Volume of Regular Timber harvested (CCF)	CCF	0	0	0	0	0
TMBR-VOL-SLD	Volume of Regular Timber sold (CCF)	CCF	28,972	38,328	-9,356	12,230	16,742
TMBR-VOL-SLD-SLVG	Volume of Salvage Timber sold (CCF)	CCF	3,500	3,500	0	3,500	0
TMBR-VOL-SLD-STWD	Volume of Timber sold (CCF) under stewardship contract/agreement	CCF	0	0	0	0	0
TRNS-PLN-PROJ-PUB-RD	Number of transportation planning projects associated with public roads	NUMBER	0	0	0	0	0

WorkPlan

Accomplishment Summary
Report ID: Accomp1

Unit: 0808 GEORGE WASHINGTON/JEFFERSON

Fiscal Year: 2007

Date: 01/07/2008
Time: 03:22 PM

Code	Description	Units	Target Amount	Planned Amount	Planned Balance	Actual Amount	Actual Balance
VRFY-ENV-MGMT-SYS	Number of verified environmental management systems	SYSTEM	1	0	1	0	1
VSTR-USE-MON-SIT-CMPLT	Visitor Use Monitoring Sites completed	SURVEY DAYS	0	0	0	0	0
WL-I&E-PROD	Number of wildlife interpretation and education products	PRODUCT	0	1	-1	2	-2
WLD-MGD-STD	Wilderness Areas managed to minimum stewardship level	NUMBER	0	1	-1	0	0
WLD-SCE-RVR-MGD-STD	Wild and Scenic Rivers meeting statutory requirements	NUMBER	0	0	0	0	0

APPENDIX F

Annual Fire Reports for Fiscal Years 2005, 2006 and 2007

George Washington and Jeffersn National Forest

CY 2005 Annual Fire Report
Forest/Unit: George Washington & Jefferson NFs

1. **Fire Season Highlights: Abnormal wildfire occurrence, major incidents, any item of significance.**

Narrative: The George Washington & Jefferson NFs experienced below-normal wildfire activity for the third consecutive year. While the 25 fires and 382 acres burned was an increase from the previous two years, this was still below the previous 10-year average of 49 fires and 2324 acres.

The first fire on the Forest ended up being the largest of the year. This was the 293-acre Camber Fire, which occurred on the Dry River Ranger District in March. However, frequent rains through the next two months kept fire danger fairly low, and the Forest had only 9 additional fires in the spring season.

The fall fire season was shaping up to be a different story. September was one of the driest on record in Virginia, with Blackburg NWS office recoring just 0.25". Abundant rains from Tropical Storm Tammy in early October provided temporary relief in all but the far southwest part of the state. The Forest was approved for severity funding and brought in some additional resources, including handcrews and a prevention team.

2. **Prescribed fire accomplishments (note: data for fires and acres must be the same as that contained in NFPORS.) Report Fire Use data and Rx data in separate tales (see following page:**

Narrative: In spite of another late winter and wet spring, the GWJeff was able to complete 28 prescribed fire projects totalling 16,067 acres, an all-time high for the forest. Most of this burning was accomplished in April, where crews took advantage of nearly every prescription window available. The largest burn of the year was 2800 acres conducted on the Lee RD.

Note: In the table below, of the 16,067 acres shown as "Other," 15,672 acres was hazardous fuels reduction (WFHF --- 11,652 WUI, 4020 other), and 395 acres was for yellow pine restoration (SPFH). Total cost for WFHF was $616,813, or $39.36/ac. Costs for SPFH was $19,950 (estimated), or $50.50/ac.

Prescribed Fire Data – 2005				
	Mechanical Treatment	Fire Treatment	Total Cost	Cost per Acre
BS				
SP				
R				
T&E				
WI				
Other		16,067	$636,763	$39.63
Total Acres		16,067	$636,763	$39.63

Navigate through tables by pressing TAB to go forward or shift-TAB to go backward.

Or use the mouse to place the cursor in any shaded area, click and begin typing.

Fire Use Fires by Size Class – CY 2005
Forest: George Washington & Jefferson NFs

Class	A	B	C	D	E	F	G	Total Fires	Total Acres
Fires	0	0	0	0	0	0	0	0	
Percent								0	
Acres									0
Percent									0

3. Examples of significant improvement in the cost effectiveness of the fire management program.

Narrative:

---

4. Noteworthy instances of cooperation with other Federal agencies (civilian and military), states, industrial concerns, groups, or individuals.

Narrative: The GWJeff continues to have a good working relationship with our partners. The Forests participated with the Virginia Department of Forestry on a number of fire prevention projects, including Smokey Night at the Salem Avalanche, a AA pro baseball team. Forest personnel continue working with the Shenandoah Vallley Interagency Wildfire Prevention and Education Team, joining VDOF and the National Park Service in that effort.

During the Fall Fire Season, the Forest hosted a Wildfire Prevetion Team that included Forest and VDOF personnel. The team concentrated its efforts in SW Virginia, which was expereincing the highest fire danger at the time.

5. Form FS-5100-8 – Personnel Employed on Fire Control Activities

Personnel Employed on Wildland Fire Suppression Presuppression and Suppression Activities		
Regular Appointed Personnel		
¤ Full-Time Fire Management (20 pay periods +)	19	
¤ Part-Time Fire Management	24	
¤ Others Used on Presuppression	60	
¤ Others Used on Suppression	30	
Regular Appointed Personnel – Total		133
Seasonal or Short-Term Personnel		
¤ Regular Fire Control (Crew, Firefighters, Patrol, Lookouts)	5	
¤ Others Who Spend Time on Fire Control Work		
¤ Emergency Firefighters	60	
Seasonal or Short-Term Personnel – Total		65
Total Number of Casuals Employed for the First Time		45
GRAND TOTAL		243

INSTRUCTIONS:

1. Data for items 1a, 1b, and 2b should be taken from planning and budget records in the Supervisor's Office.
2. Items 1c, 1d, 2b, and 2c may be obtained from actual records in the Supervisor's Office or from the Ranger District. If obtained from the Ranger having intimate knowledge on use of his/her personnel, these items may be estimated. ➔Complete accuracy is not required🡐.
3. Item 3 may be estimated where large numbers of casuals are employed. Since each reemployment counts as a new employment, sufficient accuracy can be obtained by sample counts and measurement of time slips.

---

6. Form FS-5100-9 – Land Ownership Protection Report (Summary of Acres by State).

Narrative (Optional):

STATE	LAND PROTECTION REPORT – CY 2005							S&P LAND PROTECTED BY STATE AND FS	NATIONAL FOREST LAND PROTECTED BY OTHERS
	INSIDE FOREST SERVICE PROTECTION BOUNDARIES								
	Protected by Forest Service								
	STATE AND PRIVATE				OTHER FEDERAL LAND	NATIONAL FOREST LAND	TOTAL		
	Fee	Offset	Reimburse Supp	Without Reimburse					
						1,781,449	1,781,449	1,654,489	

7. Summary of statistics from Individual Fire Reports, Form FS-5100-9

Narrative (Optional):

Wildfires by Size Class – CY 2005 Forest: George Washington & Jefferson NFs									
Class	A	B	C	D	E	F	G	Total Fires	Total Acres
Fires	4	17	3	1				25	
Percent	16	68	12	4					
Acres	0.5	48.5	40	293					382
Percent	0.1	12.6	10.5	76.7					

Wildfires by Cause – CY 2005 Forest: George Washington & Jefferson NFs				
CAUSE	**FIRES**	**PERCENT**	**ACRES**	**PERCENT**
Lightning	1	4	33	8.6
Equipment				
Smoking	1	4	2	0.5
Campfire	3	12	10	2.6
Debris	1	4	3	0.8
Railroad				
Arson	9	36	305	79.9
Children				
Miscellaneous	19	40	29	7.6
TOTAL:	25	100	382	100

Please double-check the math. These tables do not auto-sum.

Additional information or continuation

Narrative: The GWJeff continued to support incidents on Regional and National scales. GWJeff personnel filled numerous western fire and severity orders during the summer, and even more orders in support of the many hurricanes that impacted the gulf Coast States. In addition, GWJeff resources contiued to recovery efforts on the NFs in North Carolina following hurricane damage from the previous year. The GWJeff continued to support the Southern Area's Red and Blue IMTs, and Area Command Team, with 10 employees serving as memebers of those teams.

AUGUSTA IHC: The fire season for the Augusta IHC began slowly with no assignments in May and most of June. In late June the crew was deployed to Alaska for a fire on the Kenai Peninsula. This turned out to be a very good trip for the crew, as most of us have never been to that part of the country. Their most challenging assignment was the School Fire in Region 6 that involved long arduous shifts, heavy fuels, and highly technical burnout operations.

Enter additional information. Use separate document if necessary

After returning from western fire assignments in September, the crew reas fall to support Regional severity orders. The crew's last assignment was in Oklahoma in December.

The crew was instrumental in nearly 5,000 acres treated on the GW/Jeff NF. Prescribe Burn Program, in addition the crew completed numerous preparation projects on proposed burn projects on the forest as well.

In all, the crew spent nearly 100 days assigned to incidents. Most importanly, the crew had no serious accidents to report.

Additional information or continuation

Narrative:

Enter additional information. Use separate document if necessary

Save As: ForestName-AnnualFireReport-2005.doc [1/]

Examples: NCForests-AnnualFireReport-2005.doc; CherokeeNF-AnnualFireReport-2005.doc

[1/] – Ensure that the report is saved as a ".doc" file.

CY 2006 Annual Fire Report
Forest/Unit: George Washington & Jefferson NFs

Instructions: Use the Tab key to move forward through the document. Use Shift+Tab to move backward. Use the arrow keys to move in the direction of the arrow, or put the cursor where you want it to be by moving it with the mouse. Space is made available for additional narrative at the end of the form (page 9). Send additional documents if necessary. Send digital photographs by email.

1. Fire Season Highlights: Abnormal wildfire occurrence, major incidents, any item of significance.

Narrative: In 2006, dry winter and spring conditions led to the George Washington and Jefferson NF experiencing more wildfire activity than it had in several years. A total of 36 fires burned 6813 acres on the Forest. Those fires also burned an additional 1053 aces of non-Forest lands. The previous 10-year annual average (1996-2005) is 46 fires and 1794 acres burned.

Lightning and arson were the leading causes of fires during the year, accounting for 11 and 10 fires respectively.

The Forest had five large fires in 2006 that accounted for 97% of the total acreage burned. The Quarry Fire in March, and the Cardinal Fire in May, burned 1140 and 1935 acres respectively. The Southern Area “Blue” Type 1 Incident Management Team was mobilized to the Quarry Fire, while the Southern Area “Red” Type 1 IMT was mobilized to the Cardinal Fire.

The other three large fires occurred in December, when the fall fire season is generally ending. The Chestnut and Skeggs Branch fires burned 850 and 867 acres respectively. The Peavine Complex was caused by several arson fires that burned together for a total of 2871 acres. All three of these fires were managed by Forest Type 3 Incident Management organizations.

The Forest’s Augusta Interagency Hotshot Crew was busy once again this year. Of the 145 days the crew was available, the crew was committed to 21 different incidents for a total of 102 days. This included five 14-days assignments.

2. Prescribed fire accomplishments (note: data for fires and acres must be the same as that contained in NFPORS.) Report Fire Use data and Rx data in separate tales (see following page:

Narrative: While the forest averaged over 13,000 acres of prescribed burning accomplishment over the previous three years, the wildfire activity and dry conditions in the spring of 2006 hampered the Forest's prescribed fire program. Dry conditions set in during early March, causing many burn units to be out of prescription much of the burning season. Other burns were postponed and/or canceled because personnel were needed for wildfire suppression on the Forest. In all, 15 prescribed burns were completed for a total of 6676 acres.

Fire Use Fires by Size Class – CY 2006									
Class	A	B	C	D	E	F	G	Total Fires	Total Acres
Fires	0	0	0	0	0	0	0	0	0
Acres	0	0	0	0	0	0	0	0	0

Navigate through tables by pressing TAB to go forward or shift-TAB to go backward.

Or use the mouse to place the cursor in any shaded area, click and begin typing.

Prescribed Fire Data – 2006				
	Mechanical Treatment	Fire Treatment	Total Cost	Cost per Acre
BS				
SP				
R				
T&E				
WI				
Other				
WFHF		6676	475011	69.99
Total Acres				

3. Examples of significant improvement in the cost effectiveness of the fire management program.

Narrative:

---

4. Noteworthy instances of cooperation with other Federal agencies (civilian and military), states, industrial concerns, groups, or individuals.

Narrative: The GWJeff continues to have a good working relationship with our partners. The was exemplified during the spring fire season, when a multi-agency response occurred to severalo fires across the state. Multiple Type 3 Incidents occurred on USFS, NPS, USFWS, and VA Department of Forestry-protected lands that were managed and supressed by personnel from those agencies.

5. Personnel Employed on Fire Control Activities.

Form FS-5100-8 Instructions:

Item 1. Regular appointed personnel: Entries should include those persons with full-time or WAE appointments.

a. Include only those positions approved for 20 pay periods or more.

b. Exclude those shown in item 1a; however, be sure they are full-time or WAE.

c. Include any full-time or WAE employees in other functions (Range, Timber, Engineering, Job Corps, etc.).

d. All others used on line or off-line suppression work. Exclude those entered in items 1a, b, and c.

e. Total of 1a+b+c+d.

Item 2. Seasonal or short-term employees.

a. Regular fire control (crews, firefighters, patrol, lookouts, etc.)

b. Include those short-term summer employees employed on other functions.

c. Do not include approved supplemental protection positions.

d. Total of 2a+b+c.

Item 3. Include only casuals employed on fire suppression .

Item 4. Self-explanatory.

Item 5. Self-explanatory.

Overhead from other Forests or out-of-Region will not be entered, as they will be carried by their Forest.

USDA-Forest Service Personnel Employed on Wildfire Presuppression and Suppression Activities		VA-VAF CY: 2006	
ITEM NO.	**ITEM**	**Number**	
		SubTotal	**Total**
1. Regular Appointed Personnel			
a.	Full-time fire management (20 pay periods or more)	19	
b.	Part-time fire management	28	
c.	Others used on pre-suppression	20	
d.	Others used on suppression (exclude those reported under a, b, or c)	60	
e.	Total regular appointed personnel (a+b+c+d)		127
2. Seasonal or Short-term Personnel			
a.	Regular fire control (Crew, Firefighters, Patrol, Lookouts)	3	
b.	Others who spent time on fire control work (BD, KV, BR, R&T, etc.)	3	
c.	Emergency firefighters		
d.	Total emergency firefighters (a+b+c)		6
3. Total number of casuals employed on fire suppression (Each reemployment counts as an employment)			200
4. Number of casuals, included in Item 3, employed for first time (Estimate is adequate)		50	
5. Remarks (if necessary)			
Total			333

FS-5100-8

6. Form FS-5100-9 – Land Ownership Protection Report (Summary of Acres by State).

Narrative (Optional):

STATE	LAND PROTECTION REPORT – CY 2006							S&P LAND PROTECTED BY STATE AND FS	NATIONAL FOREST LAND PROTECTED BY OTHERS
	INSIDE FOREST SERVICE PROTECTION BOUNDARIES								
	Protected by Forest Service								
	STATE AND PRIVATE				OTHER FEDERAL LAND	NATIONAL FOREST LAND	TOTAL		
	Fee	Offset	Reimburse Supp	Without Reimburse					
						1,781,449	1,781,449	1,654,489	

7. Summary of statistics from Individual Fire Reports, Form FS-5100-9

Narrative (Optional):

Wildfires by Size Class

Class	A	B	C	D	E	F	G	Total Fires	Total Acres
Fires	7	19	5	0	2	3		36	
Acres	1	26	164	0	1530	5092			6813

FIRES by CAUSE

CAUSE	FIRES	ACRES
Lightning	11	117.8
Equipment	0	0
Smoking	0	0
Campfire	2	0.3
Debris	3	786.2
Railroad	0	0
Arson	10	5065.8
Children	1	0.1
Miscellaneous	9	842.8
Total Fires and Acres	36	6813

Note: Total fires and total acres must be the same values for both the *Fires by Class* table and the *Fires by Cause* table.

Additional information or continuation
Narrative:

Save As: *ForestName-AnnualFireReport-2005.doc* [1/]
Examples: NCForests-AnnualFireReport-2005.doc;
or CherokeeNF-AnnualFireReport-2005.doc
The report should be saved as a ".doc" file.

CY 2007 Annual Fire Report

Forest: George Washington/Jefferson

Include photos by copying and pasting them into the text area of the document, or send them under separate cover. Save report as "*name of forest*-2007 fire report."

1. **Fire Season Highlights: Abnormal wildfire occurrence, major incidents, any item of significance. Include a quantitative description of the weather and seasonal severity.**

   Narrative: Dry conditions in 2006 persisted into 2007, where the George Washington and Jefferson NF had more fire occurrence than it had experienced since 2002, with at least one fire occurring each month of the year.

   A total of 47 fires burned 3886 on Forest, and an additional 665 acres on non-Forest lands. Two fires were managed for resource benefit as wildfire use, burning a total of 407 acres. These were the first two WFU fires managed on the George Washington/Jefferson, and the 402-acre Straw Pond WFU was only the second WFU fire in Region 8. The previous 10-year annual average (1997-2006) is 47 fires and 2571acres burned.

   Lightning and arson were the leading causes of fires during the year, accounting for 12 and 10 fires respectively.

   In addition to the Straw Pond WFU, the Forest had 8 large fires (100+ acres) in 2007 that accounted for 96% of the total acreage burned. The Potts and Friar fires occurred on consecutive days in April, with each burning slightly over 1000 acres. Both were managed by Forest Type 3 organizations. The Smith Flats Fire was the last of the year, starting on December 1 and burning 681 acres.

   In January and February, two George Washington/Jefferson employees were fortunate to be selected to go to Australia as part of a 108-person US contingent sent to assist the state of Victoria with their bush fires. The detail lasted 33 days.

   The Forest's Augusta Interagency Hotshot Crew spent 121 days assigned to 29 different incidents in 2007. This included four 14-day assignments. They also logged a total of 2444 hours in training.

   The Forest's Flatwoods Job Corp Center, located in Coeburn, VA, mobilized seven fire crews during the year. These crews were deployed for nearly 100 total days on 11 fires in Virginai, North Carolina, Georgia, and Idaho. In June, leadership from the Forest and Flatwoods worked together to form two crews to be made available nationawide during the Center's summer break, when the students are not normally available. These two crews were mobilized to the Linville Complex in NC, where they spent a full two-week deployment.

2. **Prescribed fire accomplishments (Note: data for fires and acres must be the same as that contained in NFPORS.) Include Rx training accomplishments here. Report Fire Use data and Rx data in separate tables (see following page):**

Narrative: Because of continued dry conditions that persisted most of the year, the GW/Jeff was only able to complete about 10,000 acres of prescribed burning, or about 60% of planned activity for FY2007. Several wildfires in the late fall of 2006 forced several planned burns to be postponed. In the fall of 2007, the Forest was in severity funding, and the Governor issued a state-wide burning ban. Thus no fall burning was accomplished for the FY08 program.

The Forest added a full-time Fuels Technician on the Lee RD, with plans to add similar positions on the Forest in the future.

In September, the Forest entered into an agreement with The Nature Conservancy to work together on a joint fuels management project on and adjacent to the Warm Springs RD. The project will involve prescribed burning on about 25000 acres of USFS and TNC lands.

Fire Use Fires by Size Class – CY 2007									
Class	A	B	C	D	E	F	G	Total Fires	Total Acres
Fires		1			1				
Acres		5			402				

Navigate through tables by pressing TAB to go forward or shift-TAB to go backward.

Or use the mouse to place the cursor in any shaded area, click and begin typing.

Prescribed Fire Data – 2007				
	Mechanical Treatment	Fire Treatment	Total Cost	Cost per Acre
BS				
SP				
R				
T&E				
WI				
Other Haz. Fuels		10455	834903	79.86
Other				
Other				
Total Acres				

3. Examples of Significant Improvement in the Cost Effectiveness of the Fire Management Program.

Narrative: Contined to manage large fires with an appropriate management response (AMR), which significantly reduced suppression costs from what they would have been with with more aggressive strategies employed in the past. This included the first implentation of managing wildfire for resource benefits (WFU), which was done with two fires.

4. Noteworthy Instances Of Cooperation with other federal agencies (civilian and military), states, industrial concerns, groups, or individuals. Include education and fire prevention information under this item. Include wildland fire training under this item.

Narrative: The GWJeff continues to have a good working relationship with its partners. The Virginia Multi-Agency Coordingating Group re-established a Type 3 Incident Management Team, which was used on several fires during the year. The VA IMT even managed the Straw Pond WFU under the guidance of a Type 2 Fire Use Manager. Forest personnel again assisted with the Virginia Interagency Wildland Fire Academy at Fort Pickett, where over 400 firefighters attended nearly a dozen courses.

5. Personnel Employed on Fire Control Activities.

Form FS-5100-8 Instructions:

Item 1. Regular appointed personnel: Entries should include those persons with full-time or WAE appointments.

a. Include only those positions approved for 20 pay periods or more.

b. Exclude those shown in item 1a; however, be sure they are full-time or WAE.

c. Include any full-time or WAE employees in other functions (Range, Timber, Engineering, Job Corps, etc.).

d. All others used on line or off-line suppression work. Exclude those entered in items 1a, b, and c.

e. Total of 1a+b+c+d.

Item 2. Seasonal or short-term employees.

a. Regular fire control (crews, firefighters, patrol, lookouts, etc.)

b. Include those short-term summer employees employed on other functions.

c. Do not include approved supplemental protection positions.

d. Total of 2a+b+c.

Item 3. Include only casuals employed on fire suppression .

Item 4. Self-explanatory.

Item 5. Self-explanatory.

Overhead from other Forests or out-of-Region will not be entered, as they will be carried by their Forest.

USDA-Forest Service

Personnel Employed on Wildfire Presuppression and Suppression Activities

Forest: VA-VAF

CY: 2007

ITEM NO.	ITEM	Number SubTotal	Number Total
1. Regular Appointed Personnel			
a.	Full-time fire management (20 pay periods or more)	20	
b.	Part-time fire management	25	
c.	Others used on pre-suppression	36	
d.	Others used on suppression (exclude those reported under a, b, or c)	50	
e.	Total regular appointed personnel (a+b+c+d)		131
2. Seasonal or Short-term Personnel			
a.	Regular fire control (Crew, Firefighters, Patrol, Lookouts)	5	
b.	Others who spent time on fire control work (BD, KV, BR, R&T, etc.)	2	
c.	Emergency firefighters		
d.	Total emergency firefighters (a+b+c)		7
3. Total number of casuals employed on fire suppression (Each reemployment counts as an employment)			180
4. Number of casuals, included in Item 3, employed for first time (Estimate is adequate)		40	
5. Remarks (as necessary) 2a includes four "1890" students.			
Total			318

FS-5100-8

6. Form FS-5100-9 – Land Ownership Protection Report (Summary of Acres by State).

STATE	LAND PROTECTION REPORT – CY 2007							S&P LAND PROTECTED BY STATE AND FS	NATIONAL FOREST LAND PROTECTED BY OTHERS
	INSIDE FOREST SERVICE PROTECTION BOUNDARIES								
	Protected by Forest Service								
	STATE AND PRIVATE				OTHER FEDERAL LAND	NATIONAL FOREST LAND	TOTAL		
	Fee	Offset	Reimburse Supp	Without Reimburse					
VA						1,781,449	1,781,449	1,654,489	

Narrative (Optional):

7. Summary of statistics from Individual Fire Reports, Form FS-5100-9

VA-VAF Wildfires by Size Class 2007

Class	A	B	C	D	E	F	G	Total Fires	Total Acres
Fires	11	21	5	3	3	2		45	
Acres	1	56	80	432	815	2095			3479

VA-VAF **Fires By Cause**

CAUSE	FIRES	ACRES
Lightning	10	553
Equipment	1	1
Smoking	0	0
Campfire	9	140
Debris	0	0
Railroad	1	2
Arson	10	205
Children	0	0
Miscellaneous	14	2578
Total Fires and Acres	45	3479

Note: Total fires and total acres must be the same values for both the *Fires by Class* table and the *Fires by Cause* table. To insure accuracy use the accompanying Excel tables. They will auto-calculate as you type.
table.

Narrative (Optional):

Comparison of Stream Habitat Conditions on the Pedlar Ranger District George Washington-Jefferson National Forest 1995 vs. 2005

United States Department of Agriculture Forest Service
Southern Research Station
Center for Aquatic Technology Transfer
1650 Ramble Rd.
Blacksburg, VA 24060-6349

C. Andrew Dolloff, Project Leader

Report prepared by:
Chastine Kyger, Tomas Ivasauskus, and Craig N. Roghair
June 2005

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Background

In summer 1995, at the request of the George Washington-Jefferson National Forest (GWJNF), the USDA Forest Service, Southern Research Station, Center for Aquatic Technology Transfer (CATT) completed stream habitat inventories on several Pedlar Ranger District stream reaches (Underwood et al. 1995). The inventories were intended to provide baseline stream habitat data on attributes such as large woody debris (LWD) abundance and pool:riffle ratio. In summer 2005, the GWJNF requested that the CATT re-inventory 15 of the stream reaches initially inventoried in summer 1995. The data collected in summer 2005 were intended to provide information on changes in stream habitat on the Pedlar Ranger District between 1995 and 2005.

Methods

Inventories in both 1995 and 2005 were based on visual estimation of stream habitat attributes (Hankin and Reeves 1998), however in 2005 several of the original attributes were either modified or eliminated and new attributes were added to the inventory (Table 2). Here, we describe data collection methods used in 2005.

Two-stage visual estimation techniques were used to quantify habitat and DFCs[1] in selected Dry River Ranger District streams. During the first stage, habitat was stratified into similar groups based on naturally occurring habitat units including pools (areas in the stream with concave bottom profile, gradient equal to zero, greater than average depth, and smooth water surface), and riffles (areas in the stream with convex bottom profile, greater than average gradient, less than average depth, and turbulent water surface). Glides (areas in the stream similar to pools, but with average depth and flat bottom profile) were identified during the inventory but were grouped with pools for data analysis. Runs (areas in the stream similar to riffles but with average depth, less turbulent flow, and flat bottom profile) and cascades (areas in the stream with gradient greater than 2%, high velocity, and exposed bedrock or boulders) were grouped with riffles for data analysis.

[1]the George Washington portion of the GWJNF has a separate Forest plan and different DFCs than the Jefferson portion of the GWJNF

Habitat in each stream was classified and inventoried by a two-person crew. One crew member identified each habitat unit by type (as described above), estimated average wetted width, average and maximum depth, riffle crest depth (RCD), substrate composition, and percent fines. The length (0.1 m) of each habitat unit was measured with a hip chain. Average wetted width was visually estimated. Average and maximum depth of each habitat unit were estimated by taking depth measurements at various places across the channel profile with a graduated staff marked in 5 cm increments. The RCD was estimated by measuring water depth at the deepest point in the hydraulic control between riffles and pools. The RCD was subtracted from average pool depth to obtain an estimate of residual pool depth. Substrates were assigned to one of nine size classes (Appendix A). The dominant substrate (covered greatest amount of surface area in habitat unit) and subdominant substrate (covered 2nd greatest amount of surface area in habitat unit) within the wetted channel were visually estimated. Percent fines was the percent of surface area of the stream bed that consisted of sand, silt, or clay substrate particles (particles less than 2 mm diameter). In addition, several attributes of road-stream crossings (location, type, size, etc.) were recorded, where encountered.

The second crew member classified and inventoried large woody debris (LWD) within the bankfull stream channel, determined the Rosgen's channel type (Appendix A) associated with each habitat unit, and recorded data on a Husky fex21 data logger. LWD was assigned to one of four size classes (Appendix A). All woody debris less than 1.0 m long and less than 10 cm in diameter were omitted from the inventory. Rosgen's channel type was visually estimated using criteria found in Rosgen (1996).

The first unit of each habitat type selected for intensive (second stage) sampling (i.e. accurate measurement of wetted width) was determined randomly. Additional units were selected systematically (every 10^{th} habitat unit type for streams over 1000 m and every 5^{th} habitat unit type for streams under 1 km). The wetted width of each systematically selected habitat unit was measured with a meter tape across at least three transects and averaged. In each of the systematically selected (second stage) riffles we also estimated the bankfull stream channel width and riparian width, measured channel gradient and water temperature, and took a digital photograph. We estimated bankfull channel width by measuring the width of the bankfull channel perpendicular to flow. We estimated riparian width by measuring from the edge of the bankfull channel to the intersection with the nearest landform at an elevation equal to two-times maximum bankfull depth as described by Rosgen (1996). Gradient was estimated by using a clinometer to site from the downstream to the upstream end of the selected riffle. Water temperature was measured with a thermometer in flowing water out of direct sunlight.

We used the ratio of measured to estimated area to develop a calibration ratio, which allowed us to correct visual estimates and estimate stream area with confidence intervals (Hankin and Reeves 1988). BVET calculations were computed with a Microsoft Excel spreadsheet using formulas found in Dolloff et al. (1993). Data were summarized using Excel spreadsheets and SigmaPlot graphics software.

Results

We were able to compare attributes between 1995 and 2005 for 13 of 15 stream reaches. Dancing Creek and Maple Creek were excluded from comparisons due to differences in inventory locations between 1995 and 2005. Results for the 2005 inventories on Dancing Creek and Maple Creek are presented in Appendix A.

For the remaining 13 reaches we were able to compare total area covered in pools (i.e. pool:riffle ratio), number of pools and riffles per km, average pool and riffle surface area, and LWD loading between years. Between 1995 and 2005 the median surface area covered by pools, median number of pools per km, median number of riffles per km, and median total LWD decreased, while median surface area of individual pools and riffles increased (Tables 2 – 6; Figures 2 – 4). The largest decreases in LWD were in the smallest size class (size 1: 1-5 m long, 10-50 cm diameter).

Discussion

There are several possible explanations for the differences in results between the 1995 and 2005 stream inventories on the Pedlar Ranger District. Differences in water levels between years can affect BVET habitat inventory results. In past studies increased stream discharge resulted in decreased number of habitat units and increased average surface area of individual units (Herger et al. 1996, Hilderbrand et al. 1999). However, we found little difference in the average depth of riffles between inventories in1995 and 2005, suggesting that there was not a difference in discharge between inventories (Table 3). Analysis of discharge data from local stream gauges could be used to confirm that discharges were similar between time periods.

A second possible explanation for the differences in results may be differences in inventory technique between years. For example, crews in 1995 may have identified small pools within long riffles as separate habitat units more frequently than crews in 2005. If crews in 1995 tended to 'split' habitat units and crews in 2005 tended to 'lump' them, we would expect the types of changes we observed here; fewer and larger habitat units in 2005. However, if the 2005 crews were 'lumping' habitat units we would also expect an increase the maximum depth in riffles, which we did not find (Table 5), suggesting that crews were using similar techniques between inventories. This is expected given that crews received similar training prior to each group of inventories.

Given that the differences in results between years were not caused by water level fluctuations or changes in inventory technique, then we are left to assume that the changes were the result of actual changes in stream habitat. We found large decreases in size 1 LWD (1-5 m long, 10-50 cm diameter), resulting in an overall decrease in the total LWD. In 1995, 50% of stream reaches were below the DFC of 78 pieces per km, whereas in 2005, 75% of reaches did not meet the minimum (Tables 5 & 6, Figure 4). Changes in LWD loading can result in the changes in physical habitat characteristics we observed here (Dolloff and Warren 2003, Flebbe and Dolloff 1995, Naiman et al. 2002, Sweka and Hartman 2006).

The largest decrease was in the smallest size class of LWD (size 1: 1-5 m long, 10-50 cm diameter). These pieces most often form pool habitat by combining with other small pieces of woody debris to form debris jams (Naiman et al. 2002). Size of wood relative to the size of the stream channel is the primary factor in determining wood stability and in general the smallest size classes are the most easily dislodged and transported downstream or out of the active stream channel during high flows (Hilderbrand et al. 1998, Montgomery et al. 2003). Loss of debris jams from long riffle areas following flood events could result in the changes in stream habitat we observed here.

The largest size classes (size 3: > 5 m long, 10-50 cm diameter; size 4: >5 m long, >50 cm diameter) are most stable and can easily have residence times of greater than 10 years in Appalachian streams with relatively little movement (Andy Dolloff, unpublished data). The median amount of these size classes either remained the same (size 4) or increased (size 3) in the reaches between 1995 and 2005. Continued supply of these size classes to the stream may result in increases in total pool habitat in the future.

Several streams experienced notably large decreases in total LWD, including Belle Cove Creek, North Fork Bennetts Run, and Little Cove Creek, while others such as Loves Run and Big Marys Creek showed increases. All stream reaches had decreases in the smallest size class of LWD (size 1) while streams such as Little Cove Creek and Enchanted Creek had increases in the largest size classes. Such differences highlight the fact that LWD dynamics are governed by a wide array of chronic and acute events, both natural and anthropogenic, including flooding, fires, stand maturation, riparian composition, and timber harvest to name a few (Dolloff and Warren 2003, Benda et al. 2003). For example, insect infestations such as gypsy moth or hemlock wooly adelgid can result in the relatively rapid death of many trees. Smaller size classes of LWD are added to the stream as dead trees standing in the riparian area begin to shed branches, and larger size classes are added as these trees continue to decompose and eventually fall across the stream channel. Additions of LWD can come thru slow attrition or in large pulses if stands are impacted by events such as hurricanes.

The current management goal of the GWJNF is a LWD load of 78 – 186 total pieces per km for individual streams. Given the variable nature of LWD loading in individual streams it may also be useful to also examine the range of LWD loading within larger management areas such as watersheds or Ranger Districts. For example within a watershed one would expect to find some streams with relatively low amounts of LWD and others with higher amounts, but if a certain percentage of streams falls within the DFC the Forest may conclude that overall it is meeting its management goal. The GWJNF has baseline stream habitat data collected by the CATT between 1995 and 2005 for over 300 stream reaches covering all Ranger Districts except the James River. With a relatively simple GIS exercise the GWJNF could describe the current range of LWD loading with watersheds or Districts and use the information to guide the development of future LWD management goals.

In addition, repeating BVET habitat inventories on stream reaches in other Ranger Districts would provide valuable information on trends in stream habitat across the Forest. The present report suggests that in 1995 only 25% of streams met the DFC for stream area in pools and less than half of streams met the DFC for total LWD. By 2005 no streams met the DFC for pool area and 75% of streams did not meet the DFC for total LWD. Additional inventories are needed to determine if these trends are present on other Ranger Districts on the GWJNF.

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Table 1. Streams selected for BVET habitat inventories on the Pedlar Ranger District in 1995 and 2005.

Stream	Quad	Survey Length (km)	
		1995	2005
Dancing Creek	Big Island	2.6	2.6 – different section
Love Lady Creek	Big Island	2.0	2.4
Maple Creek	Big Island	0.8	0.6 – different section
Kennedy Creek	Big Levels	4.4	4.5
Loves Run	Big Levels	2.5	2.3
Enchanted Creek	Buena Vista	4.0	3.8
Pedlar Gap Run	Buena Vista	2.7	1.9
Little Cove Creek*	Forks Of Buffalo	1.7	1.2
Rocky Branch*	Forks Of Buffalo	1.0	1.0
Belle Cove Creek	Glasgow	5.9	4.0
North Fork (N. F.) Bennetts Run	Glasgow	1.8	2.4
Coxs Creek	Massies Mill	1.6	1.2
Greasy Springs	Montebello	1.8	1.9
King Creek	Montebello	1.7	1.7
Big Marys Creek	Vesuvius	7.2	7.9

*Little Cove Creek and Rocky Branch were surveyed in 1989.

Table 2. Attributes recorded during 1995 and 2005 BVET stream habitat inventories on the Pedlar Ranger District.

Attribute	1995	2005
Unit type	X	X
Unit number	X	X
Distance	X	X
Estimated width	X	X
Maximum depth	X	X
Average depth	X	X
Riffle crest depth		X
Substrate		X
Rosgen channel type		X
Percent fines		X
Large woody debris	X	X
Actual width	X	X
Bankfull width	X	X
Riparian width	X	X
Gradient		X
Water temperature		X
Photo		X
Features		X

Table 3. Percent of total stream surface area covered by pools, average pool depth, number of pools per km, and average surface area of individual pools for BVET stream inventories performed on the Pedlar Ranger District in 1995 and 2005. The DFC for pool surface area is 35% - 65% of total stream area.

	Pool Surface Area (%)			Ave. Pool Depth (cm)			Pools per km (n)			Ave. Pool Area (m^2)		
	1995	2005	t_2-t_1	1995	2005	t_2-t_1	1995	2005	t_2-t_1	1995	2005	t_2-t_1
Love Lady Creek	55	29	-26	28	21	-7	33	25	-8	39	34	-5
Kennedy Creek	27	23	-4	35	38	3	49	26	-23	18	30	12
Loves Run	25	19	-6	26	27	1	53	21	-32	11	22	11
Enchanted Creek	36	16	-20	23	32	9	60	22	-38	28	28	0
Pedlar Gap Run	31	10	-21	25	32	7	65	21	-44	11	15	4
Little Cove Creek*	26	24	-2	36	34	-2	69	42	-27	19	21	2
Rocky Branch*	33	21	-12	36	31	-5	72	39	-33	14	14	0
Belle Cove Creek	31	15	-16	35	28	-7	32	18	-14	22	21	-1
N. F. Bennetts Run	36	17	-19	30	36	6	64	21	-43	14	21	7
Coxs Creek	45	21	-24	35	34	-1	85	35	-50	18	24	6
Greasy Springs	18	13	-5	38	31	-7	43	36	-7	10	14	4
King Creek	27	21	-6	33	32	-1	68	33	-35	10	22	12
Big Marys Creek	25	15	-10	36	30	-6	37	14	-23	24	39	15
median	31	19	-12	35	32	-1	60	25	-32	18	22	+4

*Little Cove Creek and Rocky Branch were surveyed in 1989.

Table 4. Percent of total stream surface area covered by riffles, average riffle depth, number of riffles per km, and average surface area of individual riffles for BVET stream inventories performed on the Pedlar Ranger District in 1995 and 2005.

	Riffle Surface Area (%)			Ave. Riffle Depth (cm)			Riffles per km (n)			Ave. Riffle Area (m^2)		
	1995	2005	t_2-t_1	1995	2005	t_2-t_1	1995	2005	t_2-t_1	1995	2005	t_2-t_1
Love Lady Creek	45	71	26	10	9	-1	27	24	-3	37	87	50
Kennedy Creek	73	77	4	16	15	-1	43	25	-18	55	100	45
Loves Run	75	81	6	12	14	2	44	19	-25	38	102	64
Enchanted Creek	64	84	20	13	12	-1	60	23	-37	35	144	109
Pedlar Gap Run	69	90	21	12	13	1	56	29	-27	29	98	69
Little Cove Creek*	74	76	2	19	12	-7	72	42	-30	50	64	14
Rocky Branch*	67	79	12	15	11	-4	67	47	-20	31	44	13
Belle Cove Creek	69	85	16	12	14	2	25	18	-7	63	122	59
N. F. Bennetts Run	64	83	19	11	12	1	56	24	-32	28	88	60
Coxs Creek	55	79	24	15	21	6	58	34	-24	32	94	62
Greasy Springs	82	87	5	18	19	1	40	41	1	51	86	35
King Creek	73	79	6	15	15	0	55	28	-27	31	94	63
Big Marys Creek	75	85	10	14	14	0	33	14	-19	83	214	131
median	69	81	+12	14	14	+0	55	25	-24	37	94	+60

*Little Cove Creek and Rocky Branch were surveyed in 1989.

Table 5. Change in average maximum depth in riffles for BVET stream inventories performed on the Pedlar Ranger District in 1995 and 2005.

	Riffle Average Maximum Depth (cm)		
	1995	2005	t_2-t_1
Love Lady Creek	19	21	2
Kennedy Creek	33	29	-4
Loves Run	21	26	5
Enchanted Creek	22	26	4
Pedlar Gap Run	21	24	3
Little Cove Creek*	32	25	-7
Rocky Branch*	23	24	1
Belle Cove Creek	23	29	6
N. F. Bennetts Run	21	30	9
Coxs Creek	29	43	14
Greasy Springs	34	34	0
King Creek	26	25	-1
Big Marys Creek	25	29	4
median	23	26	+3

*Little Cove Creek and Rocky Branch were surveyed in 1989.

Table 6. Total large woody debris (LWD) per km from BVET habitat inventories performed on the Pedlar Ranger District in 1995 and 2005. The GWJNF DFC for total LWD is 78- 186 total pieces per km.

	Total Large Woody Debris (n/km)		
	1995	2005	t_2-t_1
Love Lady Creek	49	43	-6
Kennedy Creek	37	18	-19
Loves Run	32	62	30
Enchanted Creek	152	92	-60
Pedlar Gap Run	63	32	-31
Little Cove Creek*	142	72	-70
Rocky Branch*	78	82	4
Belle Cove Creek	287	52	-235
N. F. Bennetts Run	320	58	-262
Coxs Creek	91	45	-46
Greasy Springs	183	178	-5
King Creek	72	56	-16
Big Marys Creek	20	43	23
median	78	56	-19

*Little Cove Creek and Rocky Branch were surveyed in 1989.

Table 7. Large woody debris (LWD) per km by size class from BVET habitat inventories performed on the Pedlar Ranger District in 1995 and 2005. Size 1: 1-5 m long, 10-50 cm diameter; Size 2: 1-5 m long, >50 cm diameter; Size 3: >5 m long, 10-50 cm diameter; Size 4: >5 m long, >50 cm diameter.

	Size 1			Size 2			Size 3			Size 4		
	1995	2005	t_2-t_1	1995	2005	t_2-t_1	1995	2005	t_2-t_1	1995	2005	t_2-t_1
Love Lady Creek	24	16	-8	2	0	-2	20	19	-1	4	8	4
Kennedy Creek	15	5	-10	2	0	-2	15	12	-3	5	1	-4
Loves Run	21	13	-8	1	0	-1	19	44	25	0	5	5
Enchanted Creek	83	29	-54	14	0	-14	47	45	-2	8	17	9
Pedlar Gap Run	31	21	-10	1	0	-1	26	10	-16	5	1	-4
Little Cove Creek*	102	10	-92	8	2	-6	26	43	17	5	16	11
Rocky Branch*	33	15	-18	11	9	-2	20	49	29	14	9	-5
Belle Cove Creek	70	16	-54	15	0	-15	182	35	-147	21	1	-20
N. F. Bennetts Run	122	7	-115	13	10	-3	144	36	-108	42	5	-37
Coxs Creek	71	4	-67	4	0	-4	13	41	28	2	0	-2
Greasy Springs	41	25	-16	14	20	6	94	108	14	34	25	-9
King Creek	26	14	-12	2	0	-2	41	41	0	2	1	-1
Big Marys Creek	10	5	-5	3	0	-3	4	35	31	2	2	0
median	33	14	-16	4	0	-2	26	41	+0	5	5	-2

*Little Cove Creek and Rocky Branch were surveyed in 1989.

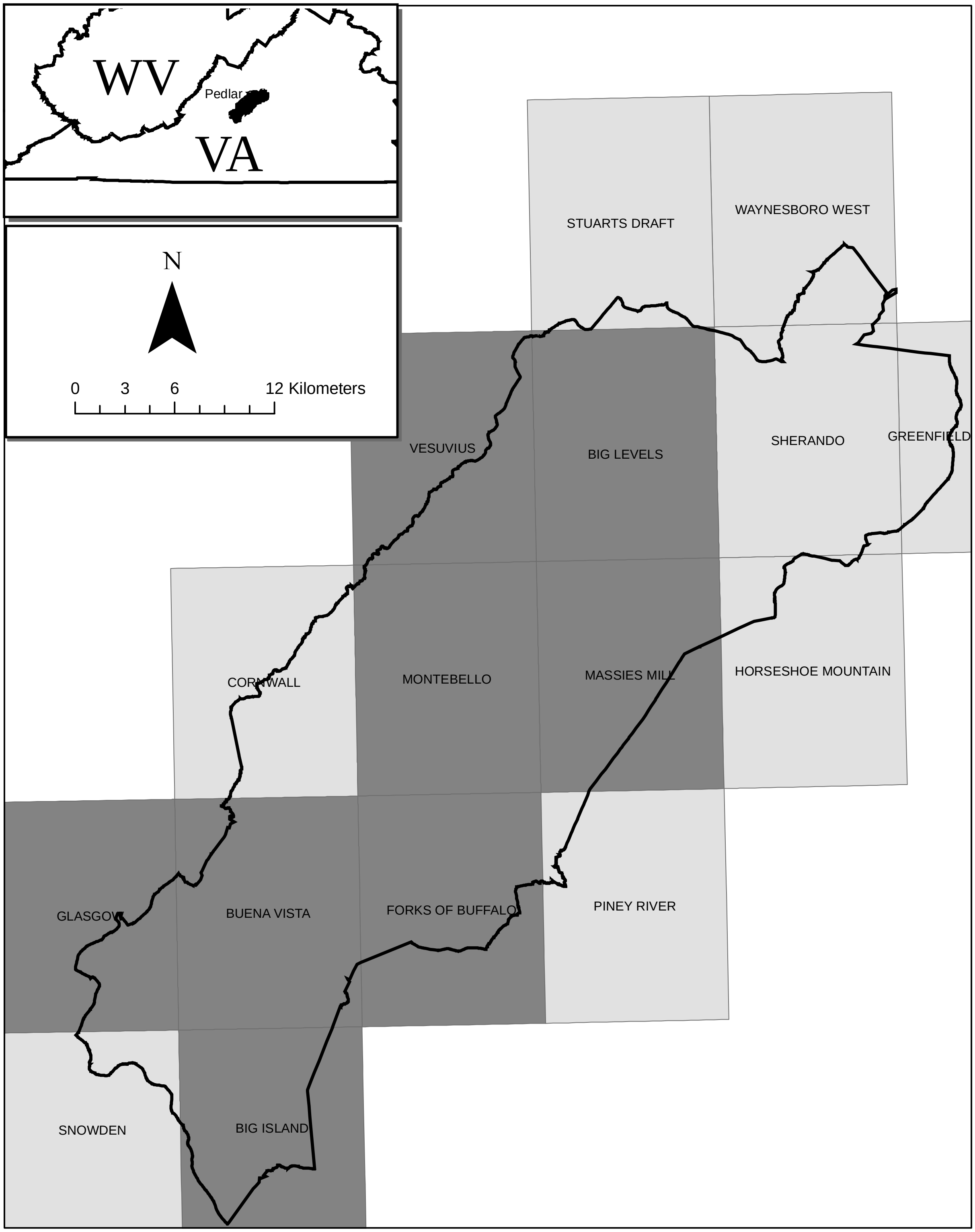


Figure 1. USGS 1:24000 quadrangle maps within the Pedlar Ranger District, GWJNF, VA. Dark shading indicates maps where inventories were completed in 1995 and 2005.

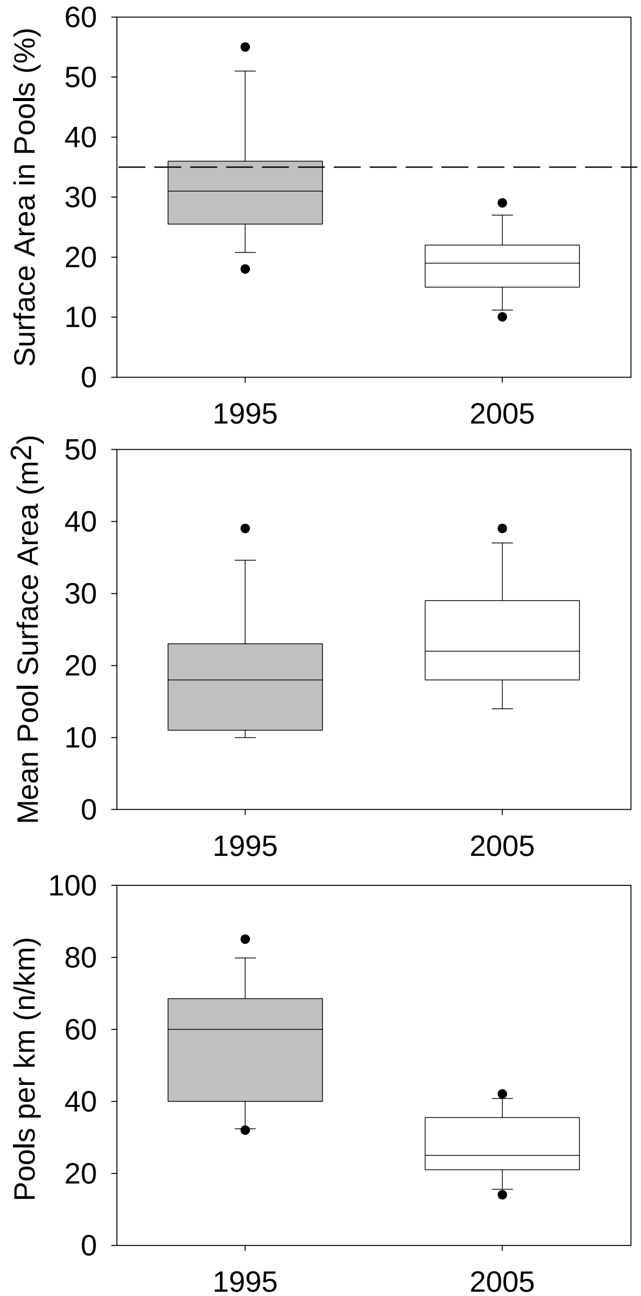


Figure 2. Range of pool habitat attributes in Pedlar Ranger District stream reaches (n = 13) in 1995 and 2005. The top and bottom of the boxes represent the 25th and 75th percentiles, the bar in the center of the box represents the median, whiskers represent the 10th and 90th percentiles, and closed circles represent the entire range of the data. The DFC for total surface area in pools is 35% - 65%.

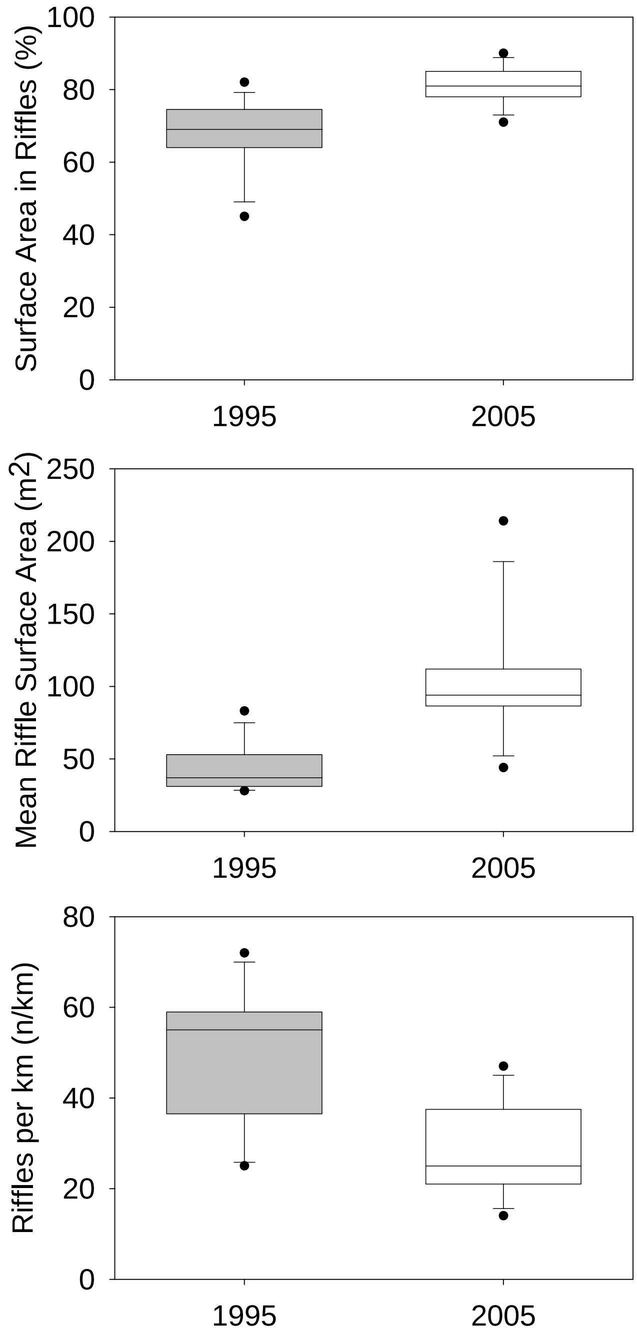


Figure 3. Range of riffle habitat attributes in Pedlar Ranger District stream reaches (n = 13) in 1995 and 2005. The top and bottom of the boxes represent the 25th and 75th percentiles, the bar in the center of the box represents the median, whiskers represent the 10th and 90th percentiles, and closed circles represent the entire range of the data.

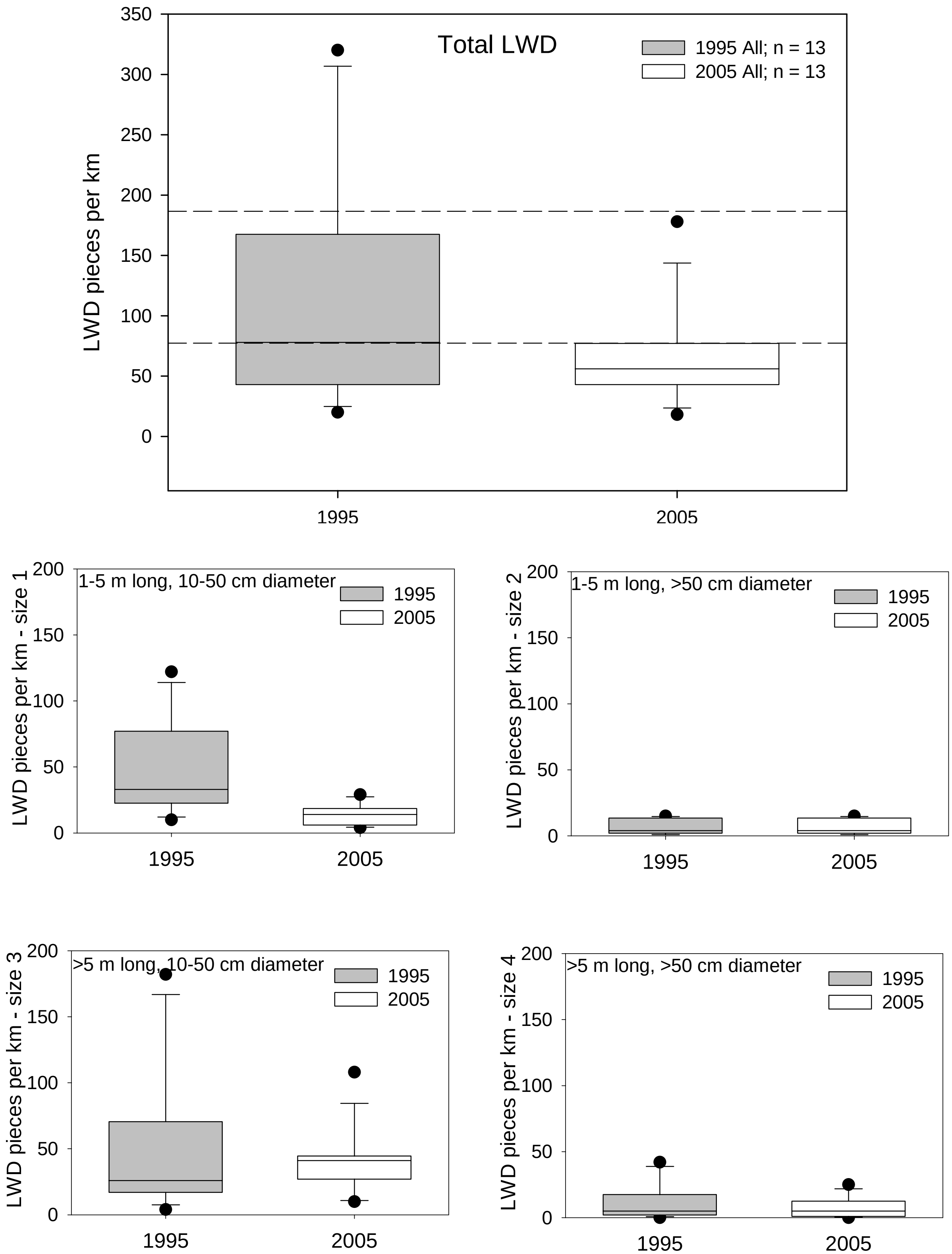
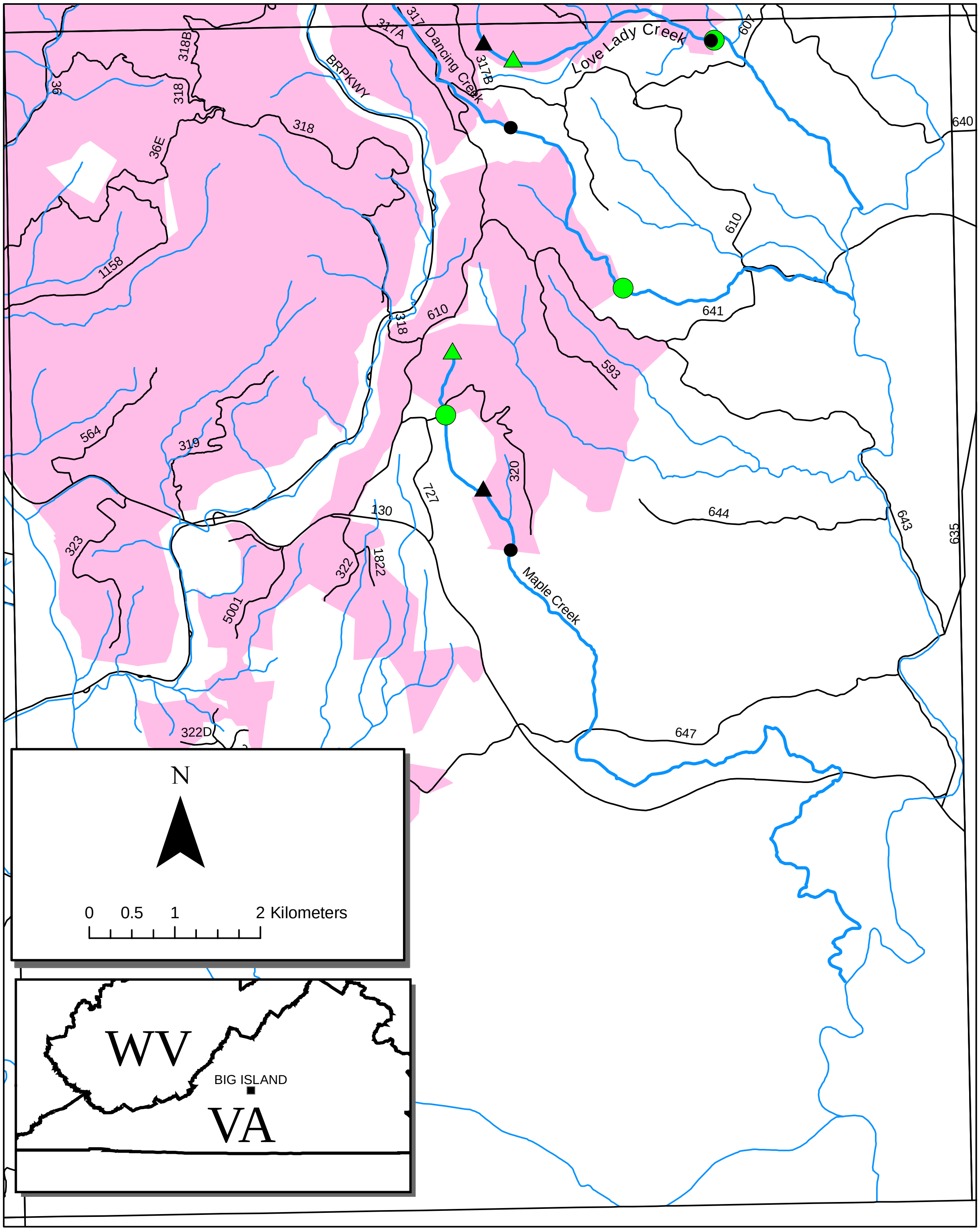


Figure 4. Range of total LWD per km (top) and LWD per km by size class (bottom) in Pedlar Ranger District stream reaches (n = 13) recorded during BVET habitat inventories in 1995 and 2005. Total LWD DFC = 78 – 186 pieces per km. The top and bottom of the boxes represent the 25th and 75th percentiles, the bar in the center of the box represents the median, whiskers represent the 10th and 90th percentiles, and closed circles represent the entire range of the data.

Appendix A: Stream Habitat 1995 vs. 2005

Index of Stream Summaries



Start (circle) and end (triangle) points for BVET stream habitat inventories performed on stream reaches on the Big Island quadrangle in 1995 (green) and 2005 (black).

Stream:	Dancing Creek	
District:	Pedlar	
USGS Quadrangle:	Big Island, Buena Vista	
	1995	**2005**
Survey Date:	8/16/2005	6/2/2005
Total Distance Surveyed (km):	2.6*	2.6

*Surveyed 4.3 km total in 1995; used last 2.6 km for comparison to 2005 data.

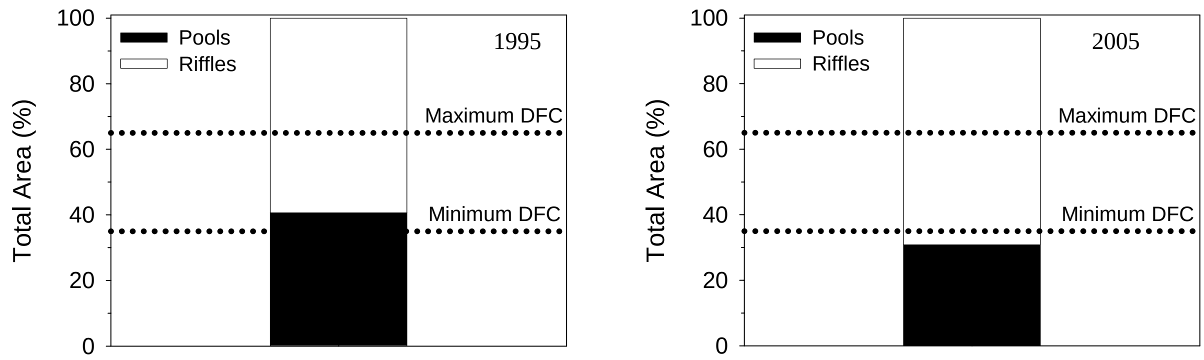
	Pools		Riffles	
	1995	**2005**	**1995**	**2005**
Percent of Total Stream Area:	52	31	48	69
Total Area (m^2):	8782 ± 2360	2433 ± 650	7985 ± 740	5417 ± 598
Correction Factor Applied:	1.23	0.88	1.10	1.04
Number of Paired Samples:	8	9	7	7
Total Count:	165	87	141	68
Number per km:	38	33	32	26
Mean Area (m^2):	53	28	57	80
Mean Maximum Depth (cm):	42	43	16	23
Mean Average Depth (cm):	26	34	8	12
Mean Residual Depth (cm):	NA	17	--	--
Percent Surveyed as Glides:	NA	39	--	--
Percent Surveyed as Runs:	--	--	NA	0
Percent Surveyed as Cascades:	--	--	NA	1
Percent with > 35% Fines:	0	11	0	0

	Pieces per km	
Large Woody Debris Size Classes	**1995**	**2005**
1 - 5 m long, 10 cm – 55 cm diameter:	50	19
1 - 5 m long, > 55 cm diameter:	5	1
> 5 m long, 10 cm – 55 cm diameter:	32	44
> 5 m long, > 55 cm diameter:	13	8
Total:	100	72

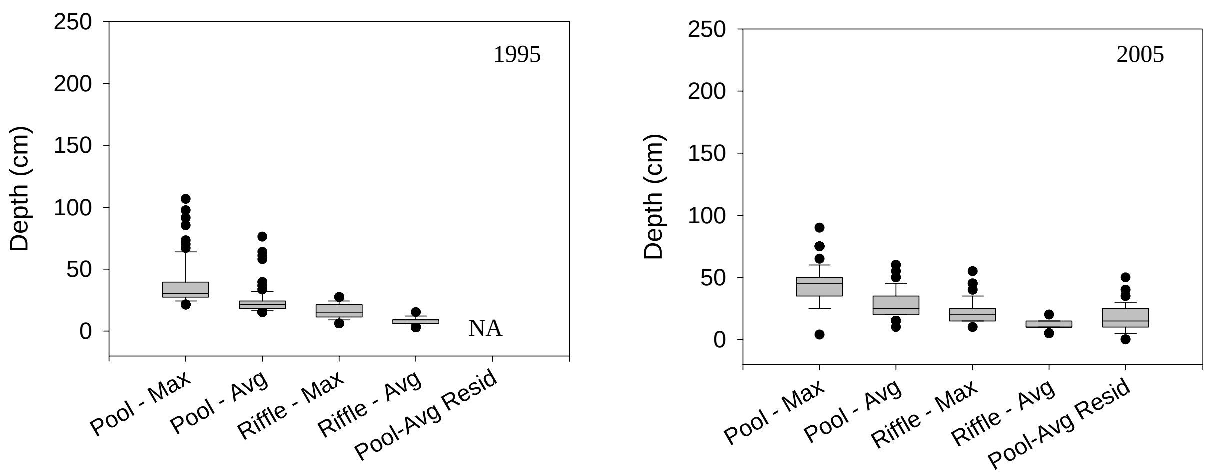
Rosgen's Channel Type*	Frequency (%)
A:	63
B:	37
C:	0
D:	0
E:	0
F:	0
G:	0

*recorded in 2005 only

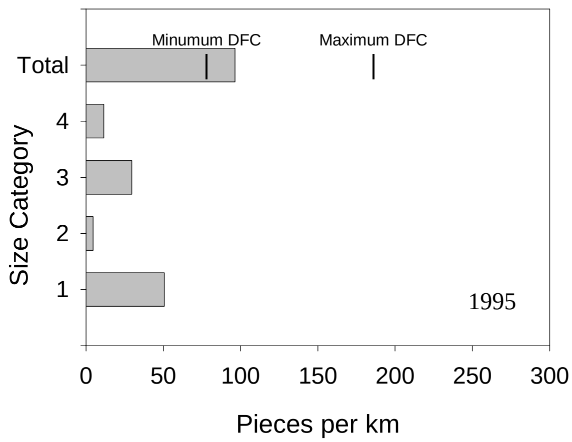
Other Stream Attributes	1995	2005
Mean Bankfull Channel Width (m):	8	6
Mean Channel Gradient (%):	NA	5
Median Water Temperature (C):	NA	15

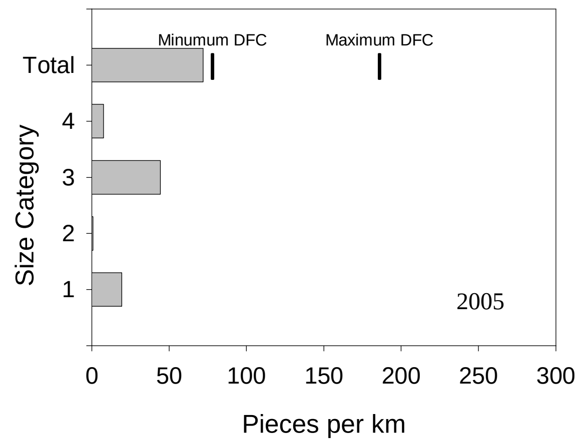


Estimated area of Dancing Creek in pools and riffles as calculated using BVET techniques. The GWJNF DFC for pool area is 35%-65% of total stream area.



Maximum and average depths for pools and riffles and residual depths in Dancing Creek. The top and bottom of the boxes represent the 25th and 75th percentiles, the bar in the center of the box represents the median, whiskers represent the 10th and 90th percentiles, and closed circles represent the entire range of the data.





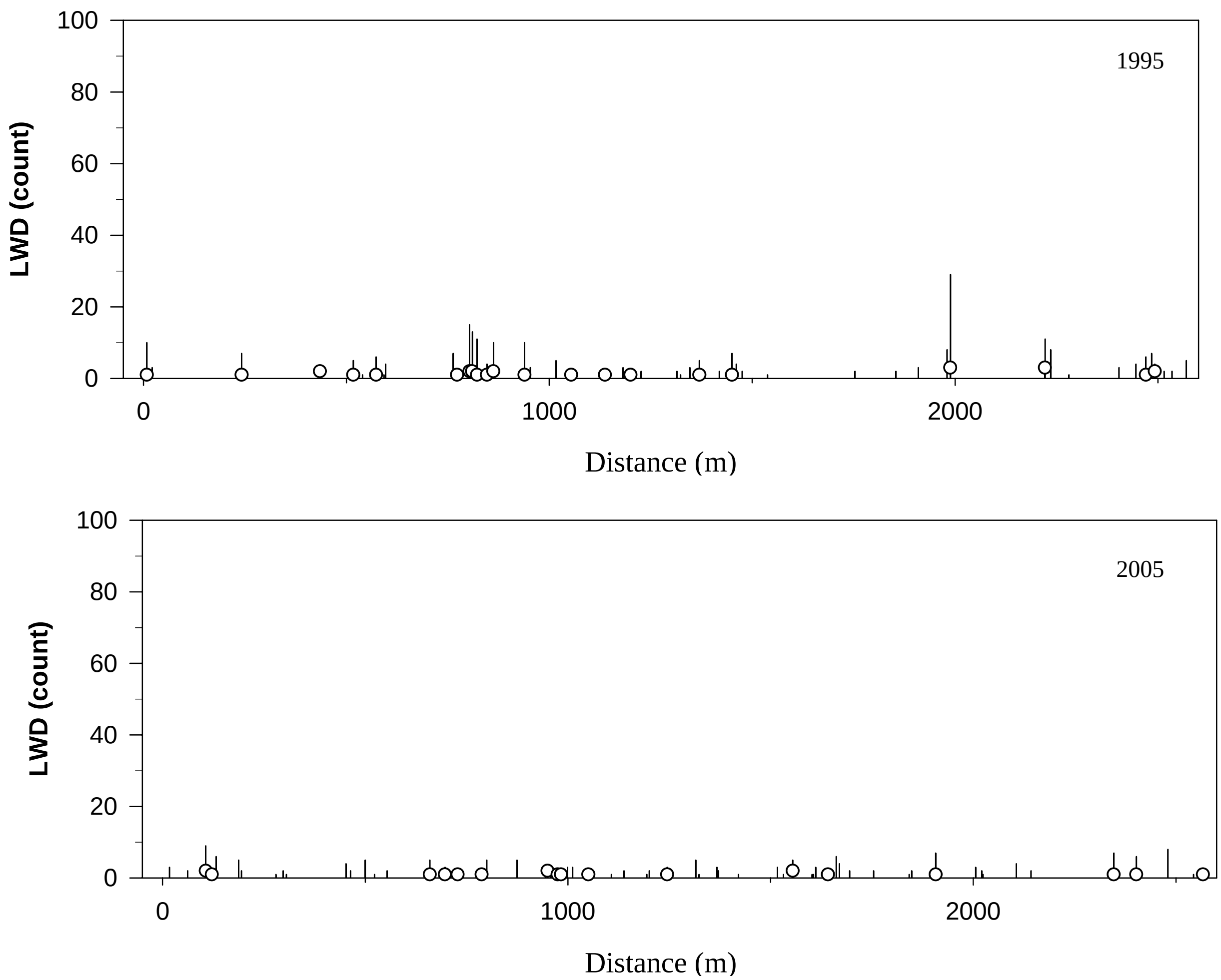
LWD per kilometer in Dancing Creek. LWD size classes: Size 1: < 5 m long, 10-55 cm diameter; Size 2: <5 m long, > 55 cm diameter; Size 3: > 5 m long, 10-55 cm diameter; Size 4: > 5 m long, > 55 cm diameter. The GWJNF DFC for LWD is 78-186 Total pieces per km.

Stream features recorded for Dancing Creek during BVET habitat survey, 1995. Distance is meters from start of survey.

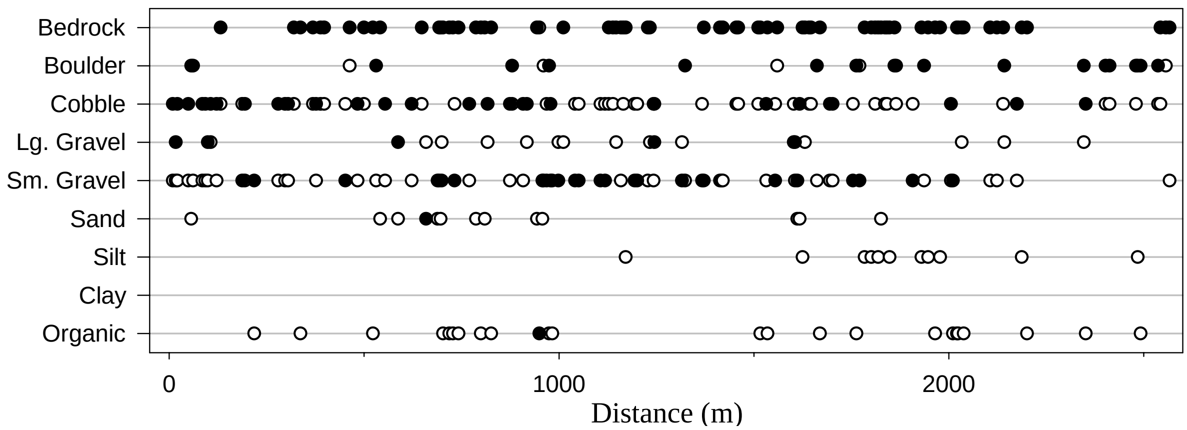
Stream Feature	**Distance (m)**	**Width (m)**	**Comments**
CULVERT	353.4	6.1	
FORD	559.5		
FORD	779.9		
TRIBUTARY	1288.3		RIGHT
TRIBUTARY	1429.7		LEFT
TRIBUTARY	1575.4		RIGHT
TRIBUTARY	1696.1		RIGHT
TRIBUTARY	1885.1		RIGHT, DRY
SEEP	2132.0		
FORD	2147.8		
FORD	2409.3		
FORD	2448.0		TRAIL CROSSING; PIPELINE

Stream features recorded for Dancing Creek during BVET habitat survey, 2005. Distance is meters from start of survey.

Stream Feature	**Distance (m)**	**Width (m)**	**Comments**
SIDE CHANNEL	36.9	0.7	RIGHT
SIDE CHANNEL	126.9	1.5	ON RIGHT
TRIBUTARY	161.8	1.0	ON LEFT
SIDE CHANNEL	187.4		COMES OUT
CULVERT	590.4		RT. 610. 23M LONG. 2.5M TALL. 6M WIDE. NATURAL SUBSTRATE
FORD	756.7		
FORD	908.1		LEFT
OTHER	945.0		VERY BIG LOG CREATES A DAM AND A POOL BEHIND IT
SIDE CHANNEL	960.1	0.5	LEFT
TRIBUTARY	1252.0	0.5	RIGHT
TRIBUTARY	1505.1	1.0	RIGHT
SIDE CHANNEL	1592.7	0.5	RIGHT
SIDE CHANNEL	1611.0		OUT
FORD	1786.0		
FORD	1990.0		
SIDE CHANNEL	2053.0	1.5	LEFT
OTHER	2265.2		PIPELINE
SIDE CHANNEL	2273.5	1.5	RIGHT



Distribution and abundance of LWD in Dancing Creek in 1995 and 2005. LWD were recorded for each habitat unit in the stream. X-axis indicates distance upstream from National Forest boundary. Dashed line indicates end of shorter survey.



Distribution of substrates in Dancing Creek 2005. LWD were recorded for each habitat unit in the stream. X-axis indicates distance upstream from National Forest boundary. Similar data are not available for the 1995 inventory.

Stream:	**Love Lady Creek**	
District:	Pedlar	
USGS Quadrangle:	Big Island, Buena Vista	
	1995	**2005**
Survey Date:	8/14/1995	5/31/2005
Total Distance Surveyed (km):	2.0	2.4

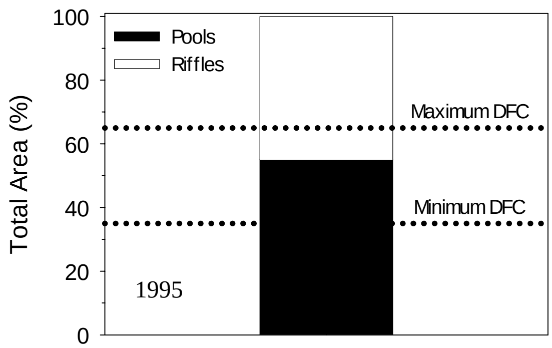
	Pools		**Riffles**	
	1995	**2005**	**1995**	**2005**
Percent of Total Stream Area:	55	29	45	71
Total Area (m^2):	2529 ± 18376	1981 ± 141	2062 ± 1975	4935 ± 1524
Correction Factor Applied:	1.03	1.08	0.93	1.22
Number of Paired Samples:	2	6	2	5
Total Count:	65	58	54	57
Number per km:	33	25	27	24
Mean Area (m^2):	39	34	37	87
Mean Maximum Depth (cm):	41	39	19	21
Mean Average Depth (cm):	28	21	10	9
Mean Residual Depth (cm):	NA	12	--	--
Percent Surveyed as Glides:	NA	0	--	--
Percent Surveyed as Runs:	--	--	NA	0
Percent Surveyed as Cascades:	--	--	NA	0
Percent with > 35% Fines:	0	10	0	2

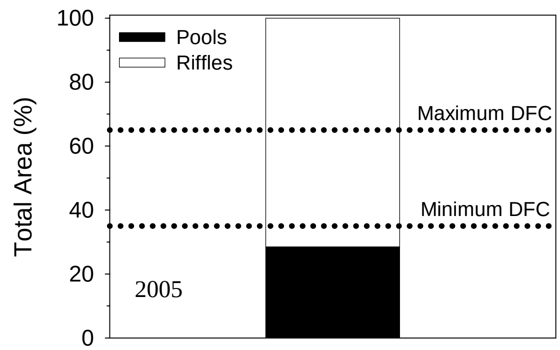
	Pieces per km	
Large Woody Debris Size Classes	**1995**	**2005**
1 - 5 m long, 10 cm – 55 cm diameter:	24	16
1 - 5 m long, > 55 cm diameter:	2	0
> 5 m long, 10 cm – 55 cm diameter:	20	19
> 5 m long, > 55 cm diameter:	4	8
Total:	49	43

Rosgen's Channel Type*	**Frequency (%)**
A:	30
B:	70
C:	0
D:	0
E:	0
F:	0
G:	0

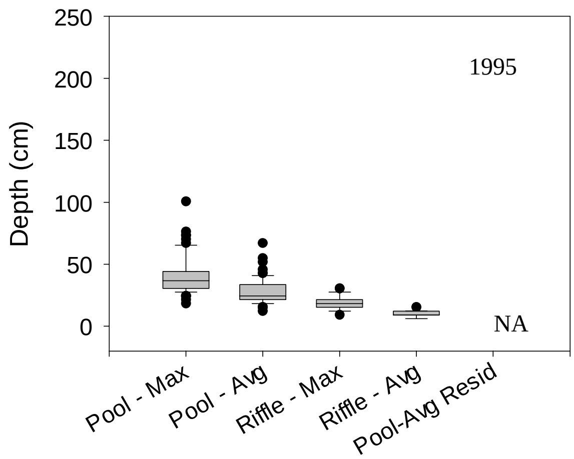
*recorded in 2005 only

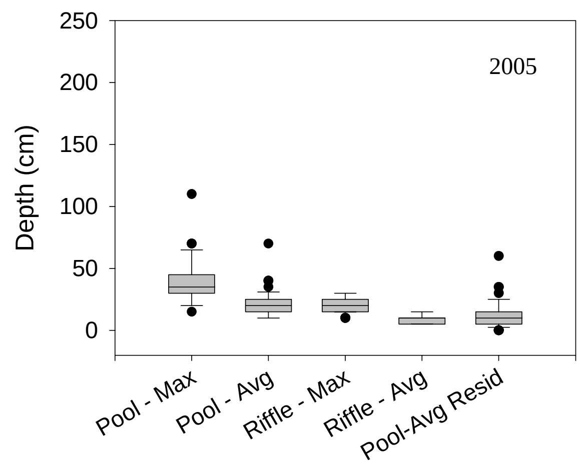
Other Stream Attributes	**1995**	**2005**
Mean Bankfull Channel Width (m):	6	6
Mean Channel Gradient (%):	NA	4
Median Water Temperature (C):	NA	15



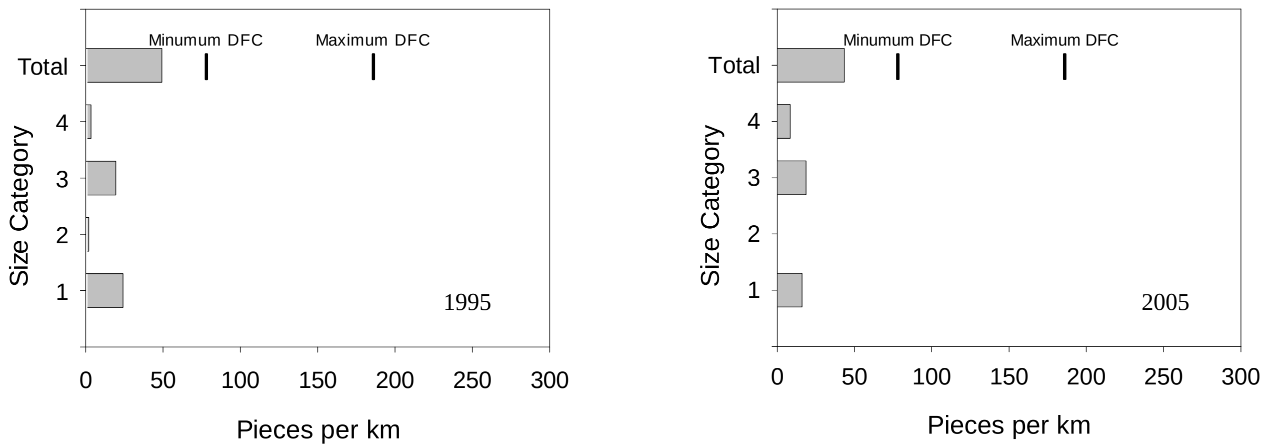


Estimated area of Love Lady Creek in pools and riffles as calculated using BVET techniques. The GWJNF DFC for pool area is 35%-65% of total stream area.





Maximum and average depths for pools and riffles and residual depths in Love Lady Creek. The top and bottom of the boxes represent the 25th and 75th percentiles, the bar in the center of the box represents the median, whiskers represent the 10th and 90th percentiles, and closed circles represent the entire range of the data.



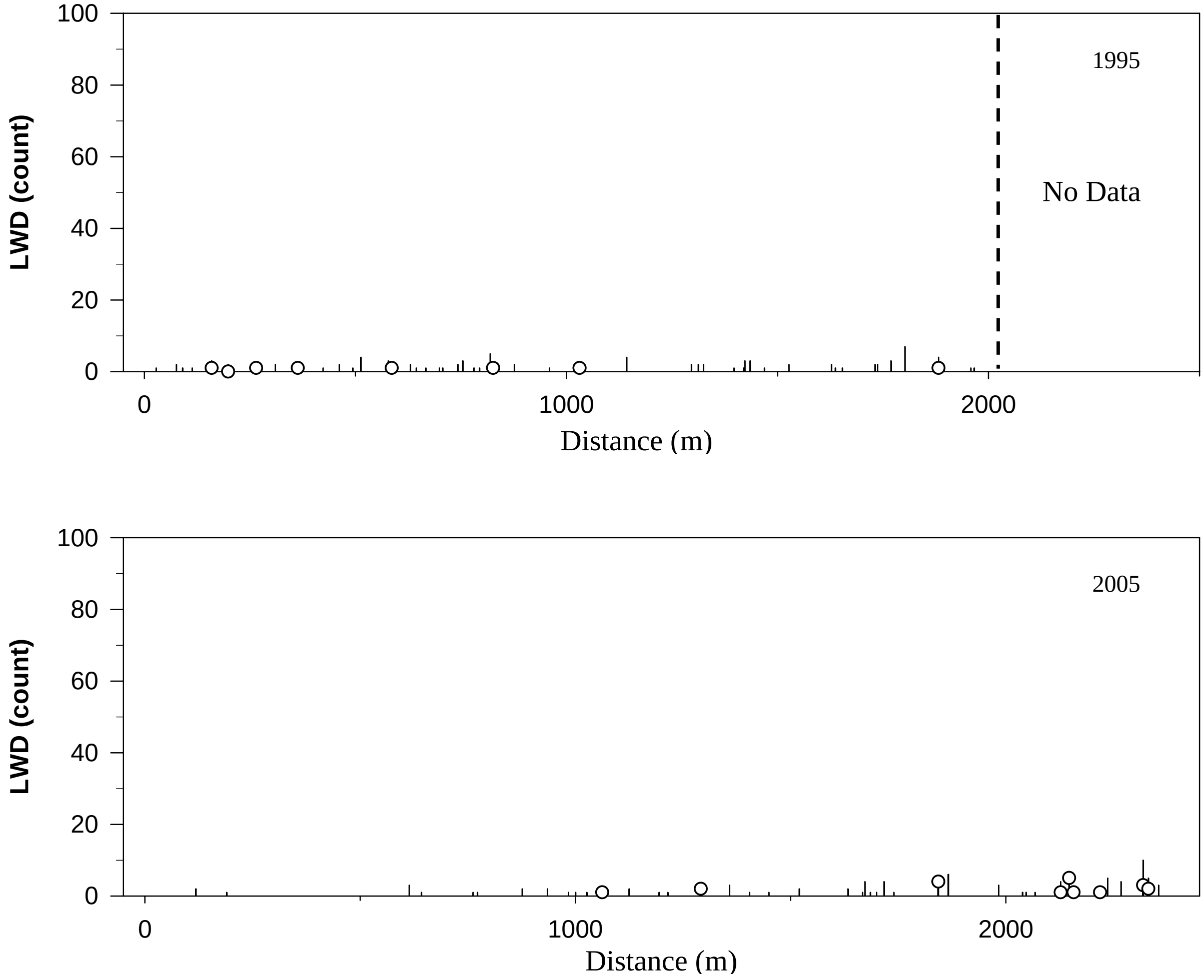
LWD per kilometer in Love Lady Creek. LWD size classes: Size 1: < 5 m long, 10-55 cm diameter; Size 2: <5 m long, > 55 cm diameter; Size 3: > 5 m long, 10-55 cm diameter; Size 4: > 5 m long, > 55 cm diameter. The GWJNF DFC for LWD is 78-186 Total pieces per km.

Stream features recorded for Love Lady Creek during BVET habitat survey, 1995. Distance is meters from start of survey.

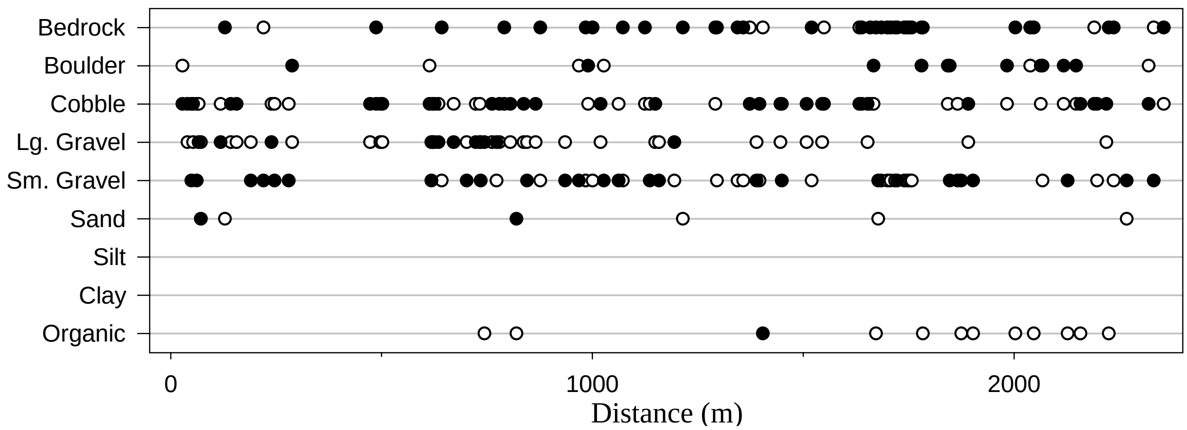
Stream Feature	Distance (m)	Width (m)	Comments
TRIBUTARY	145.6		ON LEFT
TRIBUTARY	322.7		ON RIGHT
SIDE CHANNEL	593.7		ON RIGHT
TRIBUTARY	1043.6		ON RIGHT
TRIBUTARY	1526.7		ON LEFT
TRIBUTARY	1576.4		ON RIGHT

Stream features recorded for Love Lady Creek during BVET habitat survey, 2005. Distance is meters from start of survey.

Stream Feature	Distance (m)	Width (m)	Comments
TRIBUTARY	743.4	1.0	RIGHT
SIDE CHANNEL	876.2		RIGHT
SIDE CHANNEL	922.9		RIGHT
TRIBUTARY	1133.9		RIGHT
TRIBUTARY	1428.9	1.0	RIGHT
SEEP	1487		RIGHT
TRIBUTARY	1614.6	1.5	LEFT
TRIBUTARY	1666.7	1.0	RIGHT
SIDE CHANNEL	1852.5	0.5	RIGHT
SIDE CHANNEL	2182.2	0.5	RIGHT
UNDERGROUND	2236.2		BEGIN
UNDERGROUND	2254		END UNDERGROUND
TRIBUTARY	2354.8	0.5	RIGHT



Distribution and abundance of LWD in Love Lady Creek in 1995 and 2005. LWD were recorded for each habitat unit in the stream. X-axis indicates distance upstream from National Forest boundary. Dashed line indicates end of shorter survey.



Distribution of substrates in Love Lady Creek in 2005. X-axis indicates distance upstream from National Forest boundary. Similar data are not available for the 1995 inventory.

Stream:	Maple Creek	
District:	Pedlar	
USGS Quadrangle:	Big Island	
	1995	**2005**
Survey Date:	8/17/1995	6/2/2005
Total Distance Surveyed (km):	0.8	0.6*

* Different reach inventoried in 2005

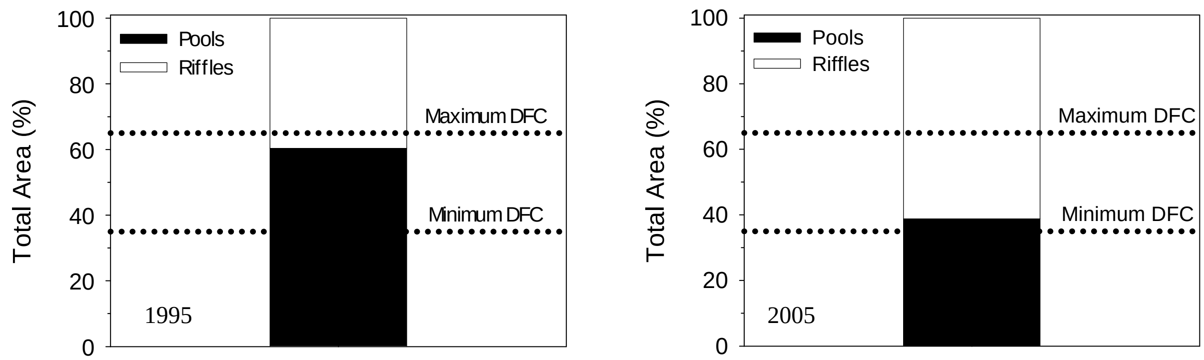
	Pools		Riffles	
	1995	**2005**	**1995**	**2005**
Percent of Total Stream Area:	60	39	40	61
Total Area (m^2):	770 ± 223	427	504 ± 1094	672
Correction Factor Applied:	1.03	1.00	1.02	1.20
Number of Paired Samples:	3	1	2	1
Total Count:	54	4	43	7
Number per km:	70	7	56	12
Mean Area (m^2):	14	107	12	96
Mean Maximum Depth (cm):	28	39	9	28
Mean Average Depth (cm):	17	25	4	9
Mean Residual Depth (cm):	NA	28	--	--
Percent Surveyed as Glides:	NA	50	--	--
Percent Surveyed as Runs:	--	--	NA	71
Percent Surveyed as Cascades:	--	--	NA	0
Percent with > 35% Fines:	0	75	0	100

	Pieces per km	
Large Woody Debris Size Classes	**1995**	**2005**
1 - 5 m long, 10 cm – 55 cm diameter:	125	8
1 - 5 m long, > 55 cm diameter:	0	0
> 5 m long, 10 cm – 55 cm diameter:	5	18
> 5 m long, > 55 cm diameter:	18	0
Total:	148	27

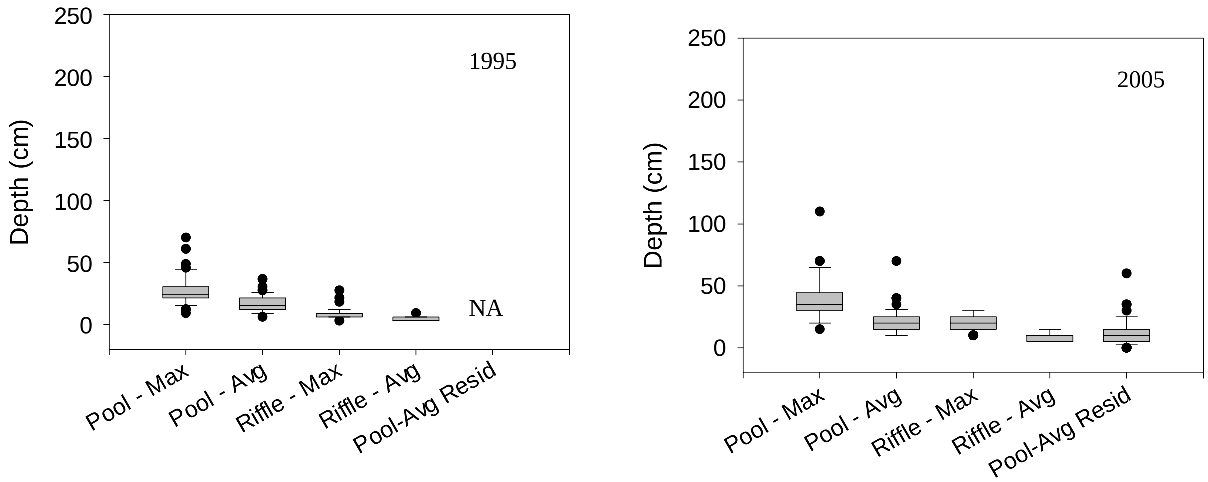
Rosgen's Channel Type*	Frequency (%)
A:	0
B:	0
C:	0
D:	0
E:	0
F:	0
G:	100

*recorded in 2005 only

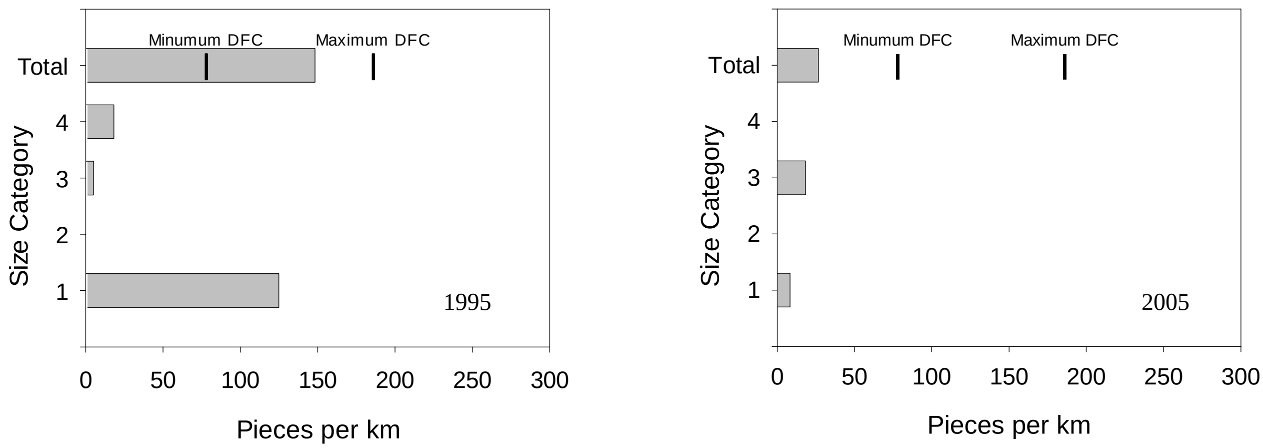
Other Stream Attributes	1995	2005
Mean Bankfull Channel Width (m):	1	4
Mean Channel Gradient (%):	NA	1
Median Water Temperature (C):	NA	18



Estimated area of Maple Creek in pools and riffles as calculated using BVET techniques. The GWJNF DFC for pool area is 35%-65% of total stream area.



Maximum and average depths for pools and riffles and residual depths in Maple Creek. The top and bottom of the boxes represent the 25th and 75th percentiles, the bar in the center of the box represents the median, whiskers represent the 10th and 90th percentiles, and closed circles represent the entire range of the data.



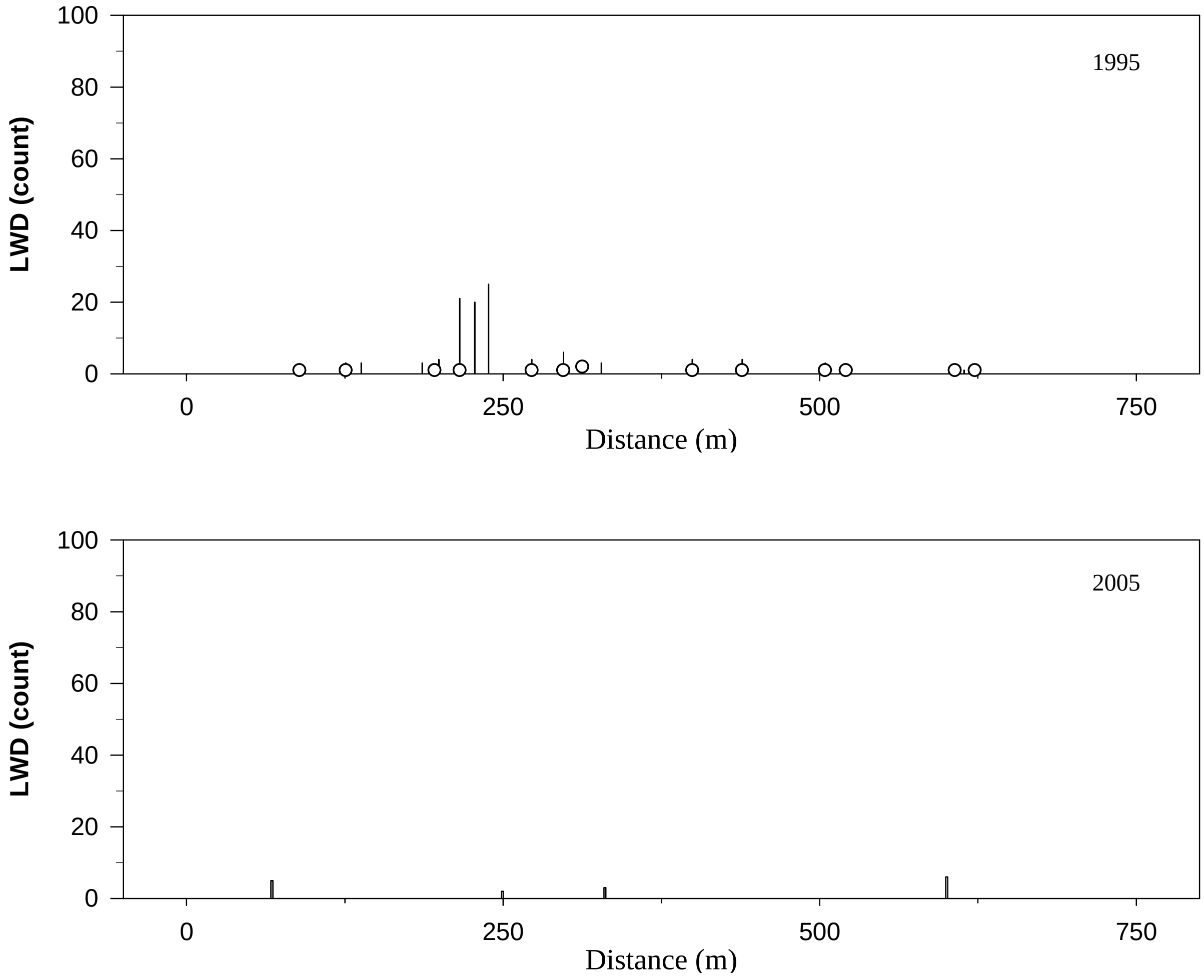
LWD per kilometer in Maple Creek. LWD size classes: Size 1: < 5 m long, 10-55 cm diameter; Size 2: <5 m long, > 55 cm diameter; Size 3: > 5 m long, 10-55 cm diameter; Size 4: > 5 m long, > 55 cm diameter. The GWJNF DFC for LWD is 78-186 Total pieces per km.

Stream features recorded for Maple Creek during BVET habitat survey, 1995. Distance is meters from start of survey.

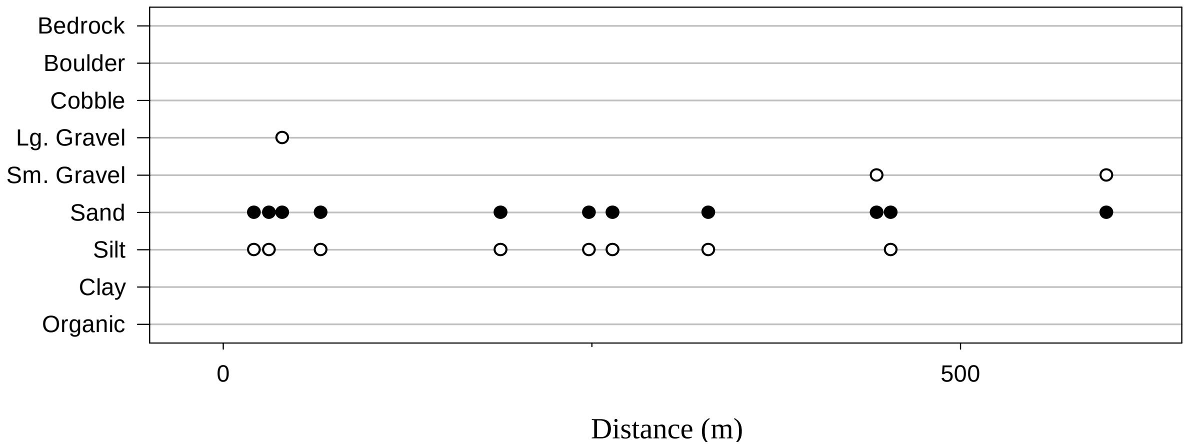
Stream Feature	Distance (m)	Width (m)	Comments
FORD	3.6		TRAIL CROSSING
TRIBUTARY	317.6		RIGHT

Stream features recorded for Maple Creek during BVET habitat survey, 2005. Distance is meters from start of survey.

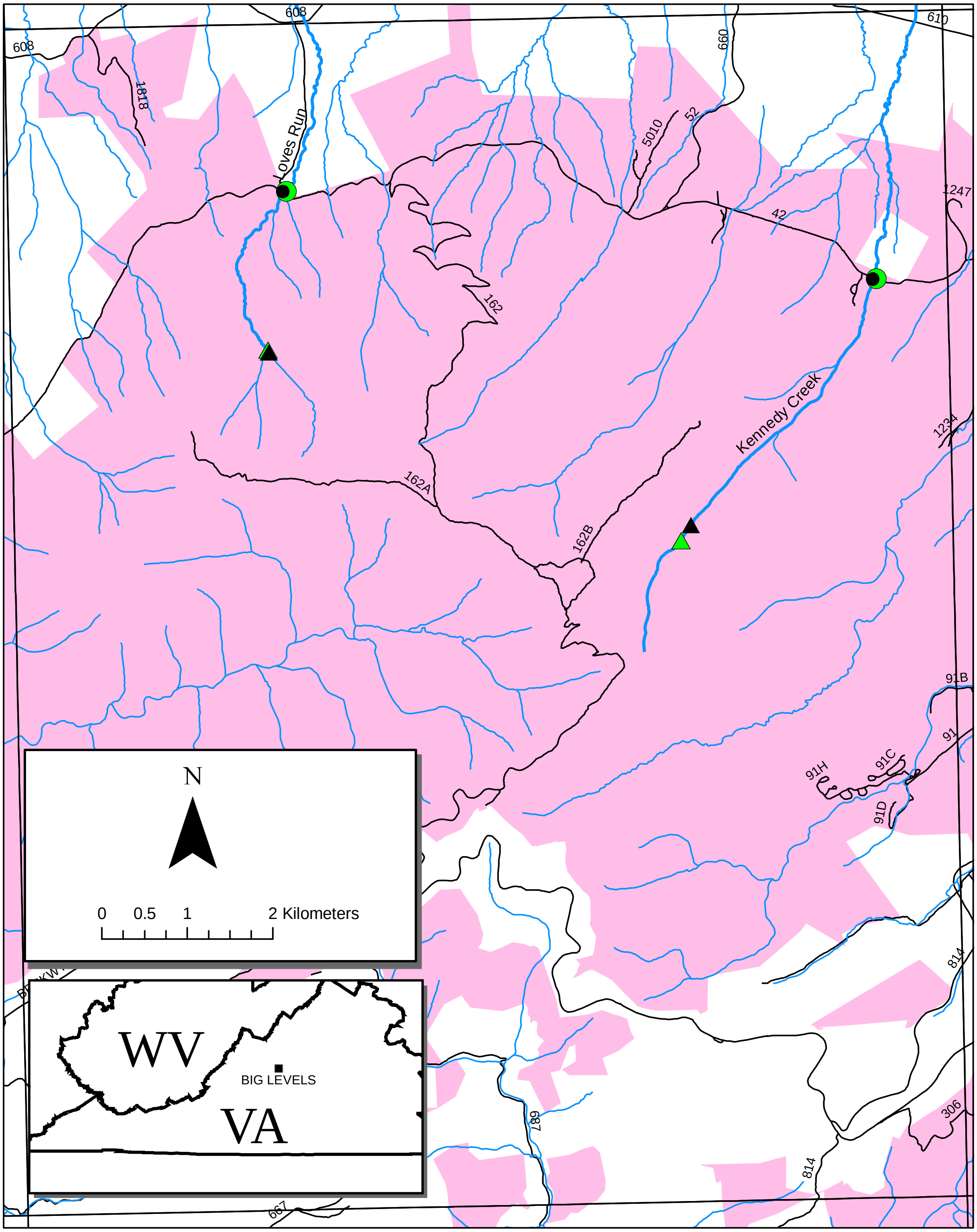
Stream Feature	Distance (m)	Width (m)	Comments
TRIBUTARY	53.0		DRY IN ON RIGHT
TRIBUTARY	152.0		IN ON RIGHT
TRIBUTARY	452.7	0.5	IN ON RIGHT
END	599.0		END AT BLAZES 17:00



Distribution and abundance of LWD in Maple Creek in 1995 and 2005. LWD were recorded for each habitat unit in the stream. X-axis indicates distance upstream from National Forest boundary. Dashed line indicates end of shorter survey.



Distribution of substrates in Maple Creek in 2005. X-axis indicates distance upstream from National Forest boundary. Similar data are not available for the 1995 inventory.



Start (circle) and end (triangle) points for BVET stream habitat inventories performed on stream reaches on the Big Levels quadrangle in 1995 (green) and 2005 (black).

Stream:	**Kennedy Creek**	
District:	Pedlar	
USGS Quadrangle:	Big Levels	
	1995	**2005**
Survey Date:	5/30/1995	6/2/2005
Total Distance Surveyed (km):	4.4	4.5

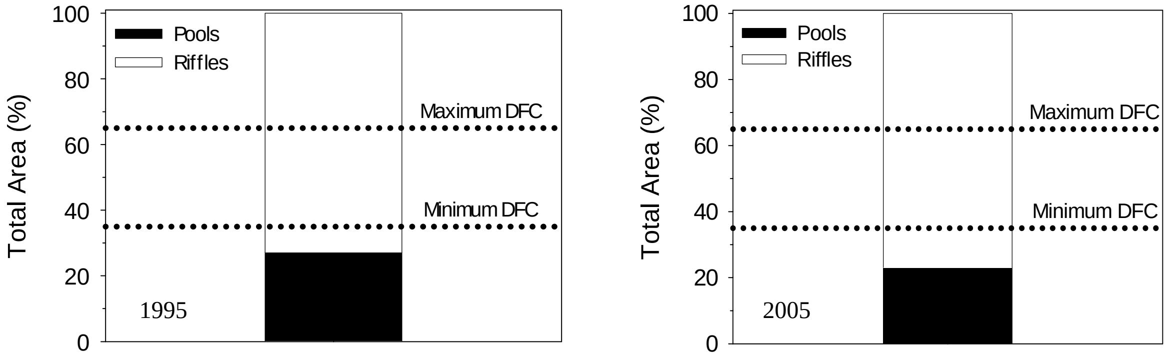
	Pools		**Riffles**	
	1995	**2005**	**1995**	**2005**
Percent of Total Stream Area:	27	23	73	77
Total Area (m^2):	3869 ± 372	3410 ± 324	10354 ± 1792	11365 ± 666
Correction Factor Applied:	1.09	1.00	0.93	1.14
Number of Paired Samples:	12	11	10	11
Total Count:	213	115	189	114
Number per km:	49	26	43	25
Mean Area (m^2):	18	30	55	100
Mean Maximum Depth (cm):	55	62	33	29
Mean Average Depth (cm):	35	38	16	15
Mean Residual Depth (cm):	NA	25	--	--
Percent Surveyed as Glides:	NA	0	--	--
Percent Surveyed as Runs:	--	--	NA	3
Percent Surveyed as Cascades:	--	--	NA	6
Percent with > 35% Fines:	0	0	0	0

	Pieces per km	
Large Woody Debris Size Classes	**1995**	**2005**
1 - 5 m long, 10 cm – 55 cm diameter:	15	5
1 - 5 m long, > 55 cm diameter:	2	0
> 5 m long, 10 cm – 55 cm diameter:	15	12
> 5 m long, > 55 cm diameter:	5	1
Total:	37	18

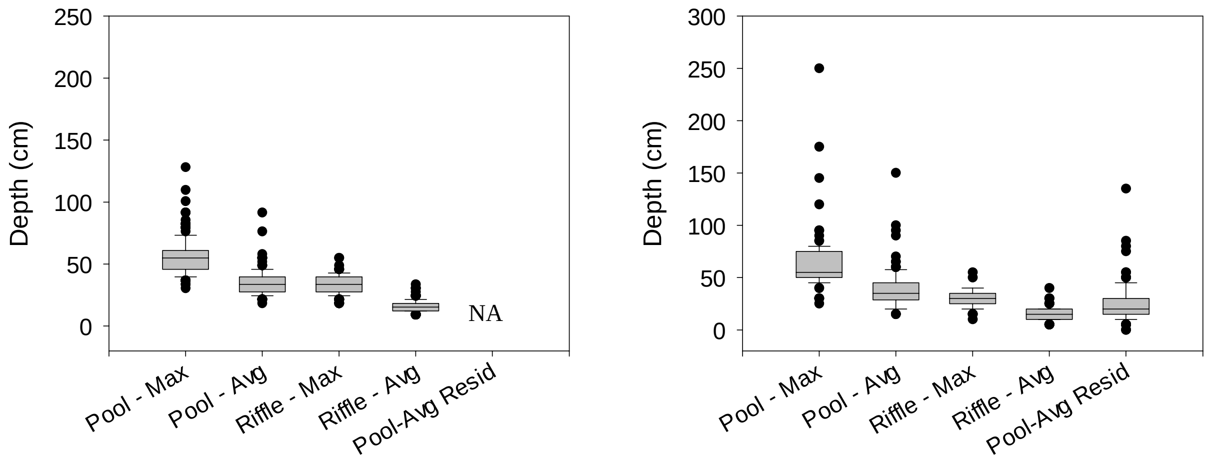
Rosgen's Channel Type*	**Frequency (%)**
A:	16
B:	84
C:	0
D:	0
E:	0
F:	0
G:	0

*recorded in 2005 only

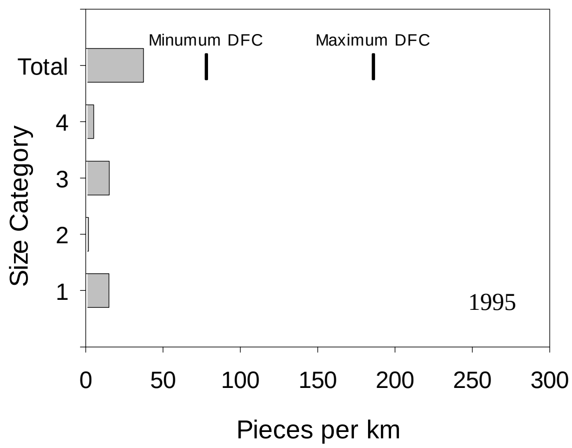
Other Stream Attributes	**1995**	**2005**
Mean Bankfull Channel Width (m):	6	6
Mean Channel Gradient (%):	NA	4
Median Water Temperature (C):	NA	14

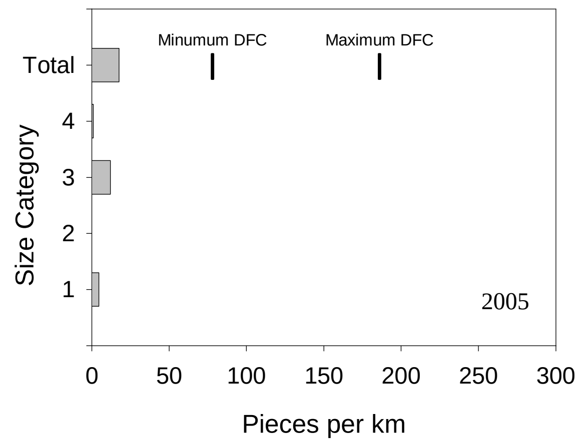


Estimated area of Kennedy Creek in pools and riffles as calculated using BVET techniques. The GWJNF DFC for pool area is 35%-65% of total stream area.



Maximum and average depths for pools and riffles and residual depths in Kennedy Creek. The top and bottom of the boxes represent the 25th and 75th percentiles, the bar in the center of the box represents the median, whiskers represent the 10th and 90th percentiles, and closed circles represent the entire range of the data.





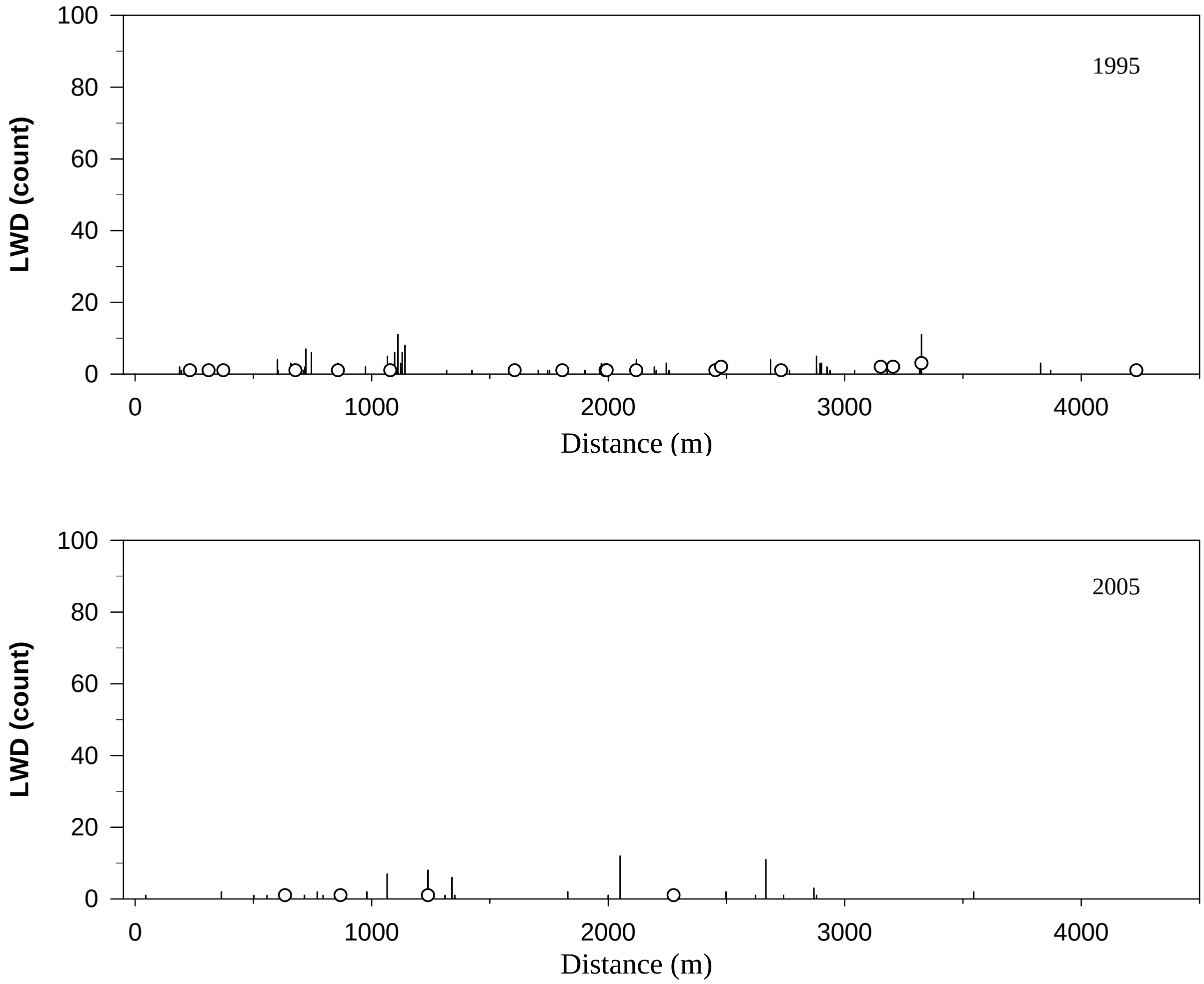
LWD per kilometer in Kennedy Creek. LWD size classes: Size 1: < 5 m long, 10-55 cm diameter; Size 2: <5 m long, > 55 cm diameter; Size 3: > 5 m long, 10-55 cm diameter; Size 4: > 5 m long, > 55 cm diameter. The GWJNF DFC for LWD is 78-186 Total pieces per km.

Stream features recorded for Kennedy Creek during BVET habitat survey, 1995. Distance is meters from start of survey.

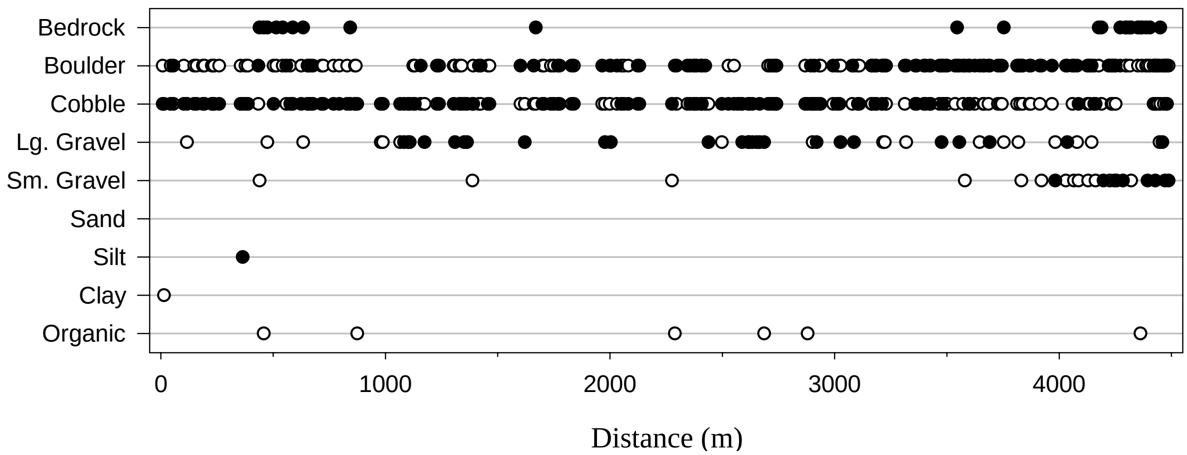
Stream Feature	Distance (m)	Width (m)	Comments
CULVERT	85.7		
SIDE CHANNEL	664.5		
SIDE CHANNEL	745.2		
SIDE CHANNEL	992.7		
SIDE CHANNEL	1147.3		
TRIBUTARY	1160.1		
FORD	1261.9		TRAIL CROSSING
TRIBUTARY	1827.6		
TRIBUTARY	1892.5		
SIDE CHANNEL	1947.4		
TRIBUTARY	2159.2		
FORD	2223.2		TRAIL CROSSING
SIDE CHANNEL	2654.2		
SIDE CHANNEL	2881.9		
SIDE CHANNEL	2895.3		
SIDE CHANNEL	2912.4		
TRIBUTARY	3301.9		
SIDE CHANNEL	3510.7		
SIDE CHANNEL	3555.8		
TRIBUTARY	3996.8		

Stream features recorded for Kennedy Creek during BVET habitat survey, 2005. Distance is meters from start of survey.

Stream Feature	Distance (m)	Width (m)	Comments
CULVERT	71.5		2.5 M TALL,ANGULAR CMP, CONCRETE ON BOTTOM, 40 CM PERCH
TRIBUTARY	893.8		1 M ON RIGHT
OTHER	1043.5		STREAM CHANNEL BLOWNOUT-LARGE PILE OF ROCKS
OTHER	1052.6		LARGE POOL ON RIGHT OFF MAIN CHANNEL
FORD	1157.1		TRAIL CROSSING NO NAME
OTHER	1935.0		DRY CHANNEL ON LEFT
SIDE CHANNEL	1960.0		SIDE CHANNEL OUT
SIDE CHANNEL	2314.7		SIDECHANNEL ON RIGHT
OTHER	2479.9		CHANNEL BLOWN OUT
SIDE CHANNEL	2602.0		SIDECHANNEL ON RIGHT
OTHER	2972.0		STREAM CHANNEL BLOWN OUT
SLIDE	3544.6		
TRIBUTARY	3613.7		
FALL	4450.0	6	
FALL	4480.0	2	



Distribution and abundance of LWD in Kennedy Creek in 1995 and 2005. LWD were recorded for each habitat unit in the stream. X-axis indicates distance upstream from National Forest boundary.



Distribution of substrates in Kennedy Creek in 2005. X-axis indicates distance upstream from National Forest boundary. Similar data are not available for the 1995 inventory.

Stream:	**Loves Run**	
District:	Pedlar	
USGS Quadrangle:	Big Levels	
	1995	**2005**
Survey Date:	8/14/1995	6/3/2005
Total Distance Surveyed (km):	2.5	2.3

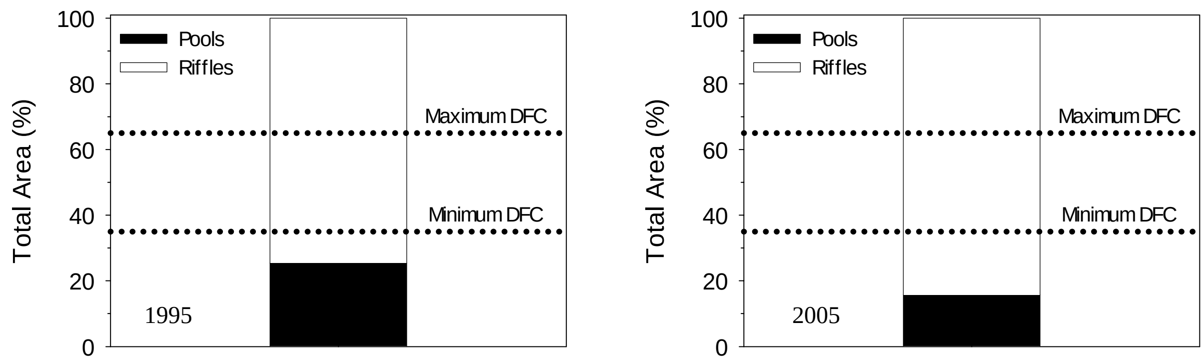
	Pools		**Riffles**	
	1995	**2005**	**1995**	**2005**
Percent of Total Stream Area:	25	19	75	81
Total Area (m^2):	1429 ± 2391	1056 ± 197	4203 ± 1040	4368 ± 2258
Correction Factor Applied:	0.91	1.07	0.94	0.97
Number of Paired Samples:	9	5	4	4
Total Count:	133	48	110	43
Number per km:	53	21	44	19
Mean Area (m^2):	11	22	38	102
Mean Maximum Depth (cm):	36	45	21	26
Mean Average Depth (cm):	26	27	12	14
Mean Residual Depth (cm):	NA	14	--	--
Percent Surveyed as Glides:	NA	31	--	--
Percent Surveyed as Runs:	--	--	NA	0
Percent Surveyed as Cascades:	--	--	NA	0
Percent with > 35% Fines:	0	2	0	0

	Pieces per km	
Large Woody Debris Size Classes	**1995**	**2005**
1 - 5 m long, 10 cm – 55 cm diameter:	21	13
1 - 5 m long, > 55 cm diameter:	1	0
> 5 m long, 10 cm – 55 cm diameter:	9	44
> 5 m long, > 55 cm diameter:	0	5
Total:	32	62

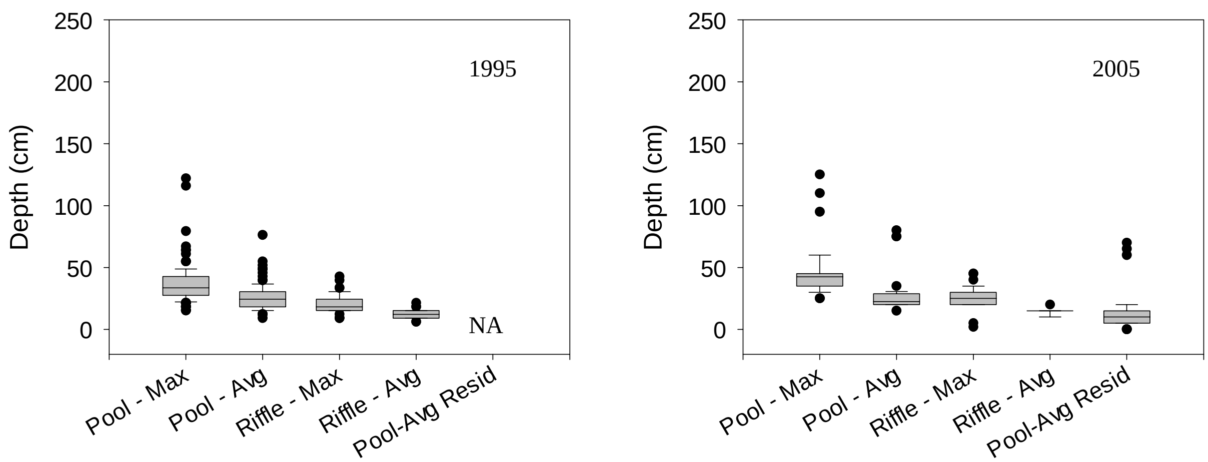
Rosgen's Channel Type*	**Frequency (%)**
A:	67
B:	0
C:	0
D:	0
E:	0
F:	0
G:	33

*recorded in 2005 only

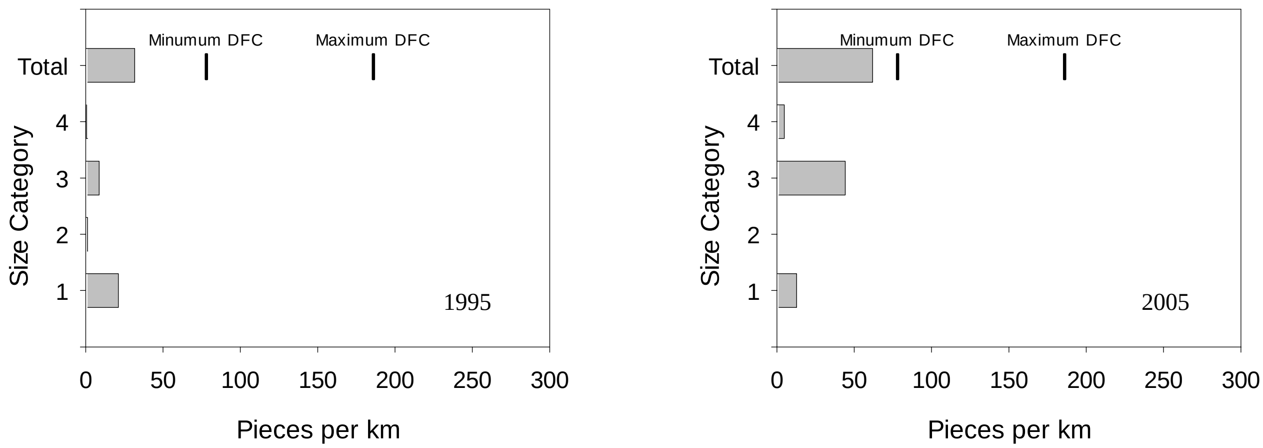
Other Stream Attributes	**1995**	**2005**
Mean Bankfull Channel Width (m):	4	4
Mean Channel Gradient (%):	NA	4
Median Water Temperature (C):	NA	12.5



Estimated area of Loves Run in pools and riffles as calculated using BVET techniques. The GWJNF DFC for pool area is 35%-65% of total stream area.



Maximum and average depths for pools and riffles and residual depths in Loves Run. The top and bottom of the boxes represent the 25th and 75th percentiles, the bar in the center of the box represents the median, whiskers represent the 10th and 90th percentiles, and closed circles represent the entire range of the data.



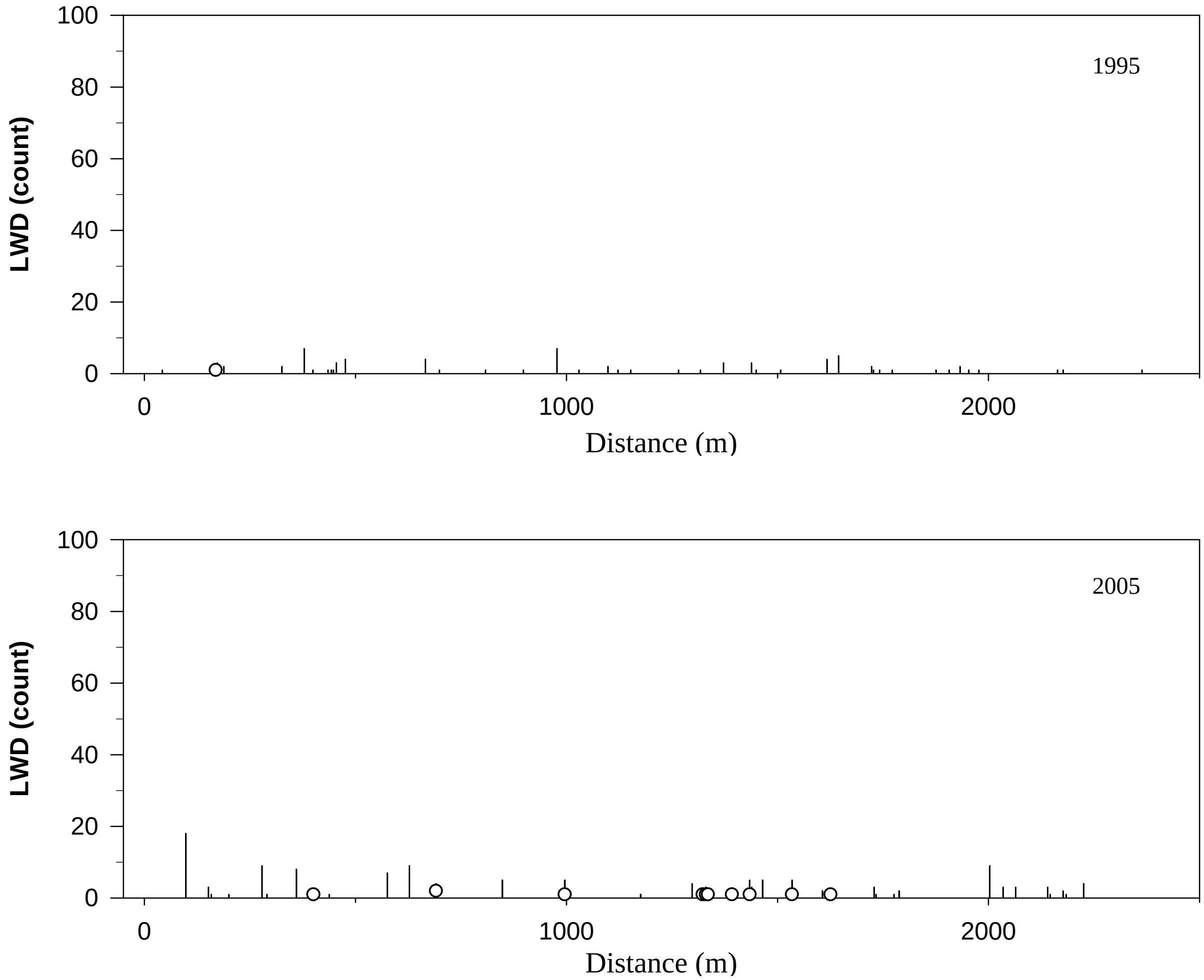
LWD per kilometer in Loves Run. LWD size classes: Size 1: < 5 m long, 10-55 cm diameter; Size 2: <5 m long, > 55 cm diameter; Size 3: > 5 m long, 10-55 cm diameter; Size 4: > 5 m long, > 55 cm diameter. The GWJNF DFC for LWD is 78-186 Total pieces per km.

Stream features recorded for Loves Run during BVET habitat survey, 1995. Distance is meters from start of survey.

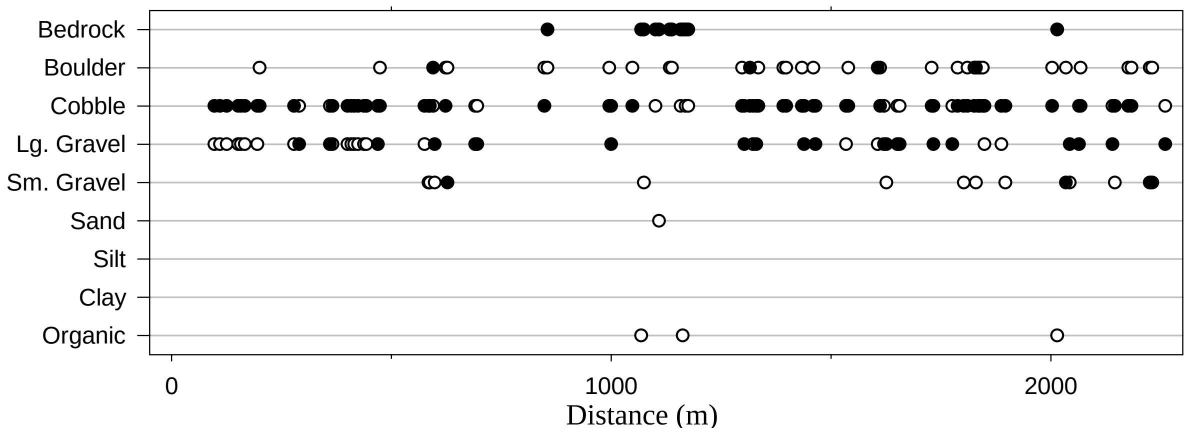
Stream Feature	Distance (m)	Width (m)	Comments
CULVERT	12.5		
TRIBUTARY	271.3		LEFT
SIDE CHANNEL	961.3		LEFT
SIDE CHANNEL	1554.8		IN
SIDE CHANNEL	1674.6		OUT

Stream features recorded for Loves Run during BVET habitat survey, 2005. Distance is meters from start of survey.

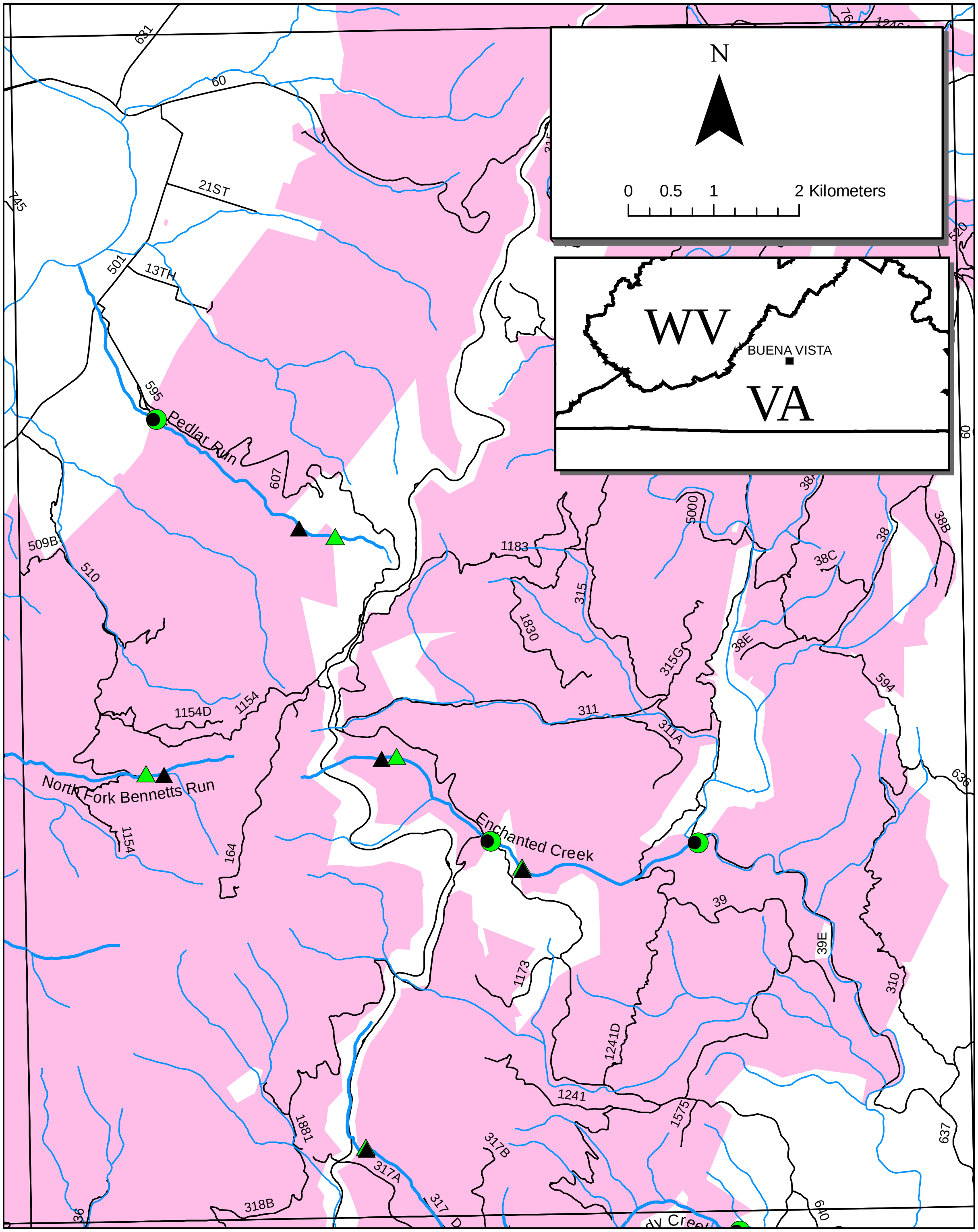
Stream Feature	Distance (m)	Width (m)	Comments
SIDE CHANNEL	85.4	1.0	ON RIGHT
SIDE CHANNEL	138.2	0.5	RIGHT
SIDE CHANNEL	151.0		BOTH OF THE PREVIOUS TWO
TRIBUTARY	232.2	2	LEFT
SIDE CHANNEL	250.1	1.5	LEFT
SIDE CHANNEL	261.7	0.5	RIGHT
SIDE CHANNEL	278.1		
SIDE CHANNEL	331.4	1.0	RIGHT
SIDE CHANNEL	357.2		
SIDE CHANNEL	390.0	0.5	RIGHT
SIDE CHANNEL	400.4		RIGHT
TRIBUTARY	577.8	0.5	LEFT
OTHER	623.0	1.0	LOG JAM
SIDE CHANNEL	708.2	0.5	LEFT
TRIBUTARY	711.3	1.0	RIGHT
SIDE CHANNEL	723.7		LEFT
SIDE CHANNEL	752.0	0.5	LEFT
SIDE CHANNEL	771.5		LEFT
SIDE CHANNEL	788.1	0.5	RIGHT
SIDE CHANNEL	802.9		RIGHT
SIDE CHANNEL	803.0	0.5	RIGHT
SIDE CHANNEL	920.9	1.5	LEFT
SIDE CHANNEL	1000.0		LEFT
TRIBUTARY	1394.3		
SIDE CHANNEL	1657.4	0.5	RIGHT
SIDE CHANNEL	1670.8		RIGHT
SIDE CHANNEL	1718.0		
SIDE CHANNEL	1744.7	0.5	LEFT
END SURVEY	2260.0		14:08 CONFLUENCE OFTWO SMALLER STREAMS WHICH FORM INTO LOVES RUN ENDED DUE TO INTERMITTANCE



Distribution and abundance of LWD in Loves Run in 1995 and 2005. LWD were recorded for each habitat unit in the stream. X-axis indicates distance upstream from National Forest boundary.



Distribution of substrates in Loves Run in 2005. X-axis indicates distance upstream from National Forest boundary. Similar data are not available for the 1995 inventory.



Start (circle) and end (triangle) points for BVET stream habitat inventories performed on stream reaches on the Buena Vista quadrangle in 1995 (green) and 2005 (black).

Stream:	Enchanted Creek	
District:	Pedlar	
USGS Quadrangle:	Buena Vista	
	1995	**2005**
Survey Date:	5/22/1995	6/30/2005
Total Distance Surveyed (km):	3.8	3.8

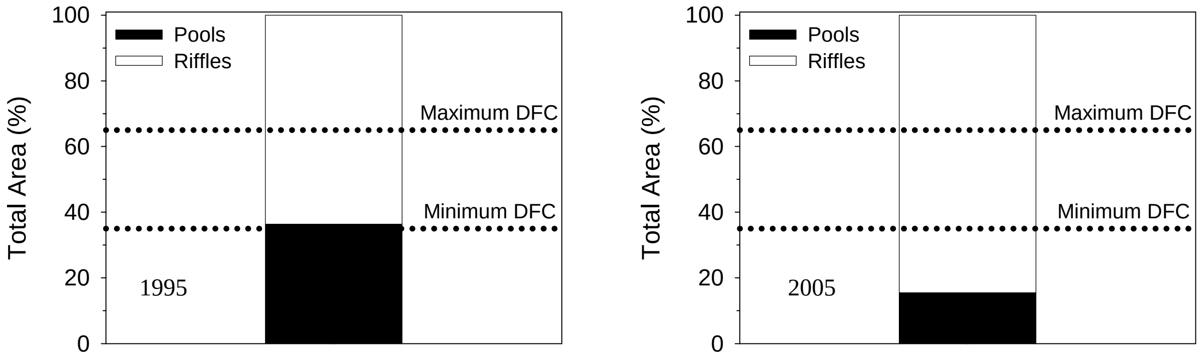
	Pools		Riffles	
	1995	**2005**	**1995**	**2005**
Percent of Total Stream Area:	36	16	64	84
Total Area (m^2):	4574 ± 325	2346 ± 293	7967 ± 764	12704 ± 1990
Correction Factor Applied:	1.09	0.98	0.99	1.17
Number of Paired Samples:	14	10	11	8
Total Count:	273	85	227	88
Number per km:	72	22	60	23
Mean Area (m^2):	17	28	35	144
Mean Maximum Depth (cm):	36	54	22	26
Mean Average Depth (cm):	23	32	12	12
Mean Residual Depth (cm):	NA	18	--	--
Percent Surveyed as Glides:	NA	1	--	--
Percent Surveyed as Runs:	--	--	NA	2
Percent Surveyed as Cascades:	--	--	NA	10
Percent with > 35% Fines:	0	22	0	2

	Pieces per km	
Large Woody Debris Size Classes	**1995**	**2005**
1 - 5 m long, 10 cm – 55 cm diameter:	84	29
1 - 5 m long, > 55 cm diameter:	14	0
> 5 m long, 10 cm – 55 cm diameter:	46	45
> 5 m long, > 55 cm diameter:	8	17
Total:	152	92

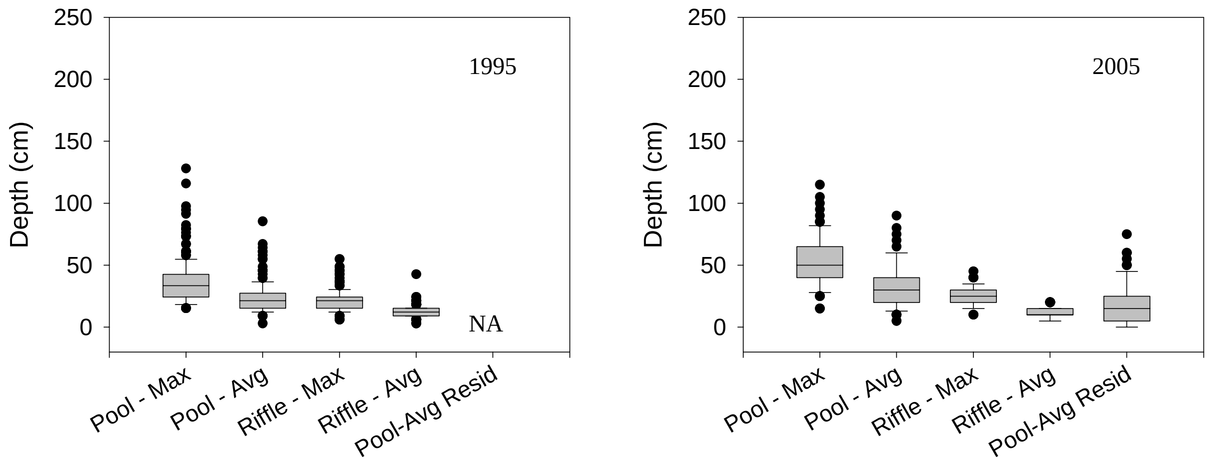
Rosgen's Channel Type*	Frequency (%)
A:	5
B:	92
C:	3
D:	0
E:	0
F:	0
G:	0

*recorded in 2005 only

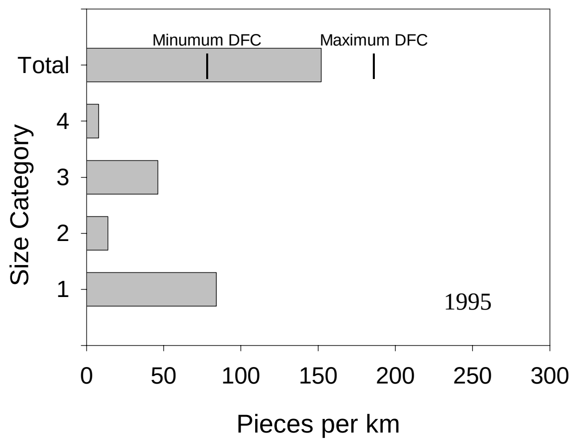
Other Stream Attributes	1995	2005
Mean Bankfull Channel Width (m):	6	6
Mean Channel Gradient (%):	NA	8
Median Water Temperature (C):	NA	15

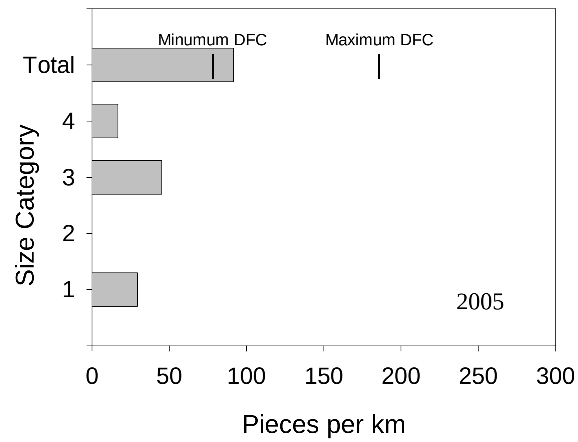


Estimated area of Enchanted Creek in pools and riffles as calculated using BVET techniques. The GWJNF DFC for pool area is 35%-65% of total stream area.



Maximum and average depths for pools and riffles and residual depths in Enchanted Creek. The top and bottom of the boxes represent the 25th and 75th percentiles, the bar in the center of the box represents the median, whiskers represent the 10th and 90th percentiles, and closed circles represent the entire range of the data.





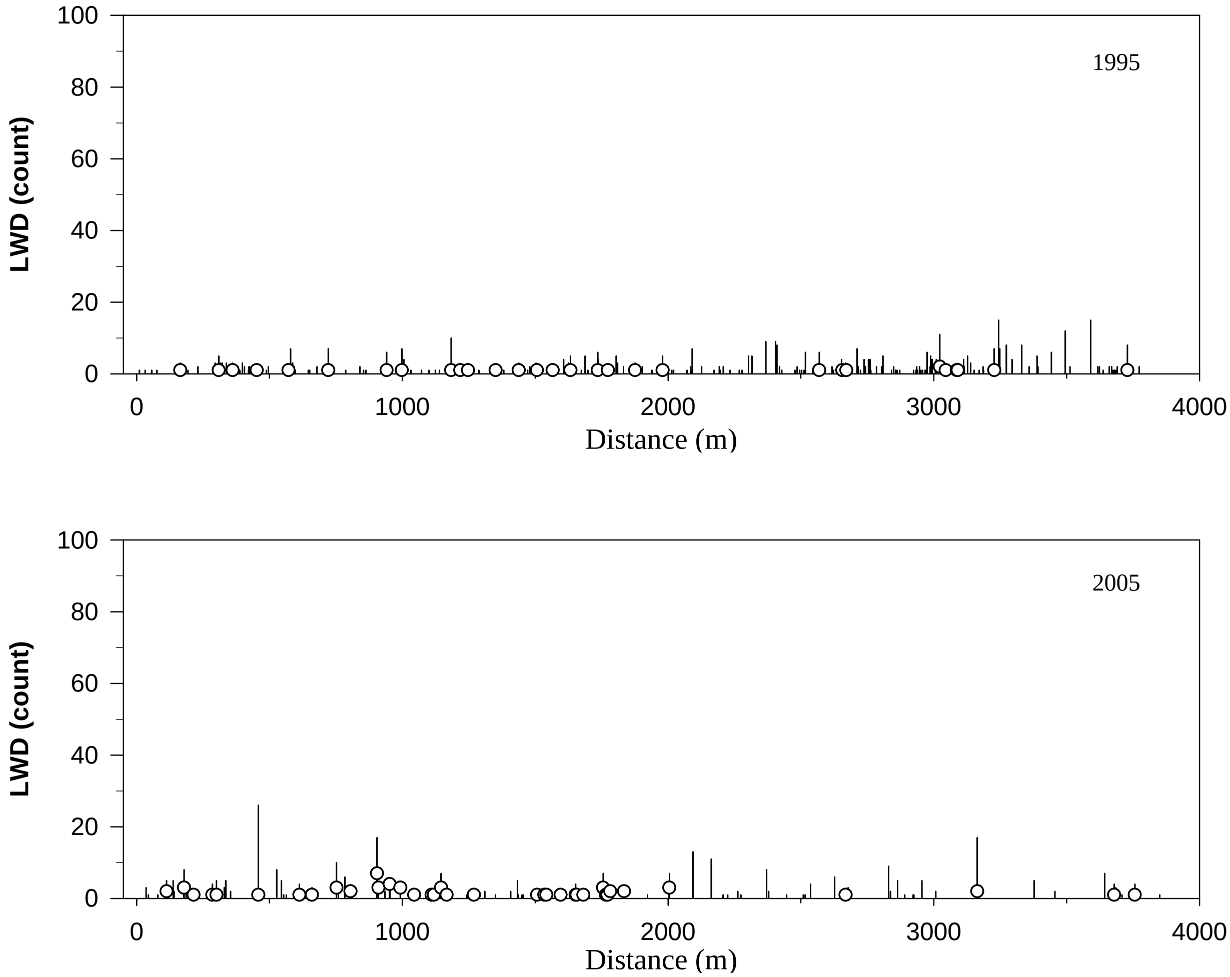
LWD per kilometer in Enchanted Creek. LWD size classes: Size 1: < 5 m long, 10-55 cm diameter; Size 2: <5 m long, > 55 cm diameter; Size 3: > 5 m long, 10-55 cm diameter; Size 4: > 5 m long, > 55 cm diameter. The GWJNF DFC for LWD is 78-186 Total pieces per km.

Stream features recorded for Enchanted Creek during BVET habitat survey, 1995. Distance is meters from start of survey.

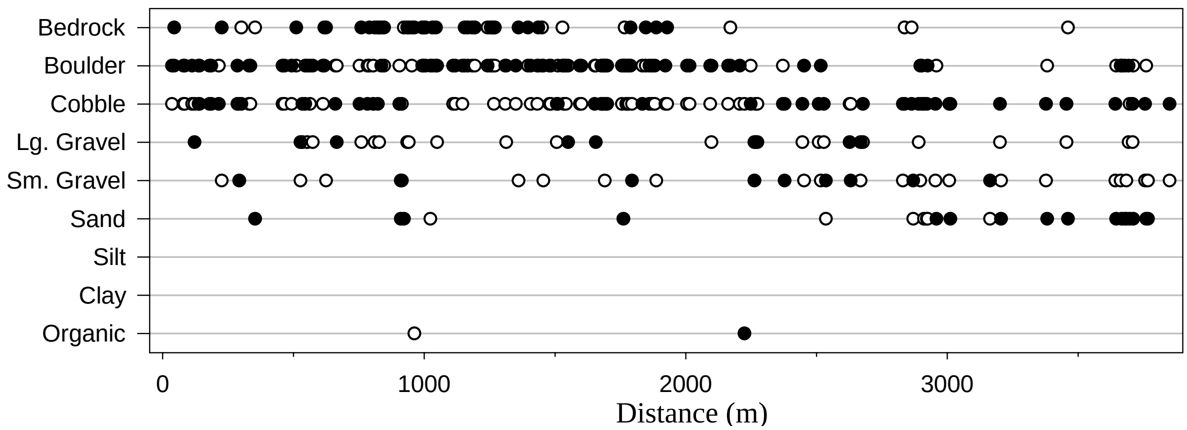
Stream Feature	Distance (m)	Width (m)	Comments
TRIBUTARY	227.7		
SIDE CHANNEL	302.1		
SIDE CHANNEL	311.2		
SEEP	373.7		
TRIBUTARY	1258.8		
TRIBUTARY	1702.9		
TRIBUTARY	1876.3		
OTHER	2031.8		FOREST BOUNDARY
OTHER	2031.8		RESUMED SURVEY
FORD	2031.8		TRAIL CROSSING
TRIBUTARY	2119.9		
TRIBUTARY	2301.5		
TRIBUTARY	2352.8		
FORD	2370.7		ROAD CROSSING
TRIBUTARY	2424.7		
FORD	2728.0		ROAD CROSSING
FORD	2922.4		ROAD CROSSING
TRIBUTARY	3053.5		
FORD	3059.0		ROAD CROSSING
TRIBUTARY	3205.6		
FORD	3378.4		ROAD CROSSING
SEEP	3849.9		
TRIBUTARY	227.7		

Stream features recorded for Enchanted Creek during BVET habitat survey, 2005. Distance is meters from start of survey.

Stream Feature	Distance (m)	Width (m)	Comments
TRIBUTARY	214.0		ON LEFT
OTHER	665.6		CHUB MOUND
CULVERT	857.3		ACROSS FS 39 RESERVOIR ROAD 2 1/2 M HIGH 3 M WIDE PERCH IS 40 CM
OTHER	904.9		LOG JAM
OTHER	1014.6		LOG JAM
SIDE CHANNEL	1388.4		RIGHT
BRAID	1731.7		
TRIBUTARY	1945.5		LEFT
TRIBUTARY	2103.0		LEFT
FORD	2152.0		ROAD CROSSING
OTHER	2169.9		MANMADE ROCK DAM, HOUSE ON LEFT
OTHER	2206.5		FOREST BOUNDARY, MOVED BY TRUCK TO UPPER SECTION
FORD			CONTINUED SURVEY AT FORD OF FS 1881 OF OFF ROUTE 607
TRIBUTARY	2264.0	0.5	ON LEFT
FORD	2541.5		
FORD	2761.3		
TRIBUTARY	2771.2	0.5	ON RIGHT
TRIBUTARY	2885.6	1.5	LEFT, BLUFF CREEK
FORD	2890.5		
SIDE CHANNEL	3017.9		LEFT
SIDE CHANNEL	3038.9		LEFT
SEEP	3504.0		LEFT
SIDE CHANNEL	3552.0		RIGHT
SEEP	3731.6		LEFT
END	3849.5		END SURVEY, STREAM SPLITS INTO 2 SMALL TRIBS AT 1654.3



Distribution and abundance of LWD in Enchanted Creek in 1995 and 2005. LWD were recorded for each habitat unit in the stream. X-axis indicates distance upstream from National Forest boundary.



Distribution of substrates in Enchanted Creek in 2005. X-axis indicates distance upstream from National Forest boundary. Similar data are not available for the 1995 inventory.

Stream:	Pedlar Run	
District:	Pedlar	
USGS Quadrangle:	Buena Vista	
	1995	**2005**
Survey Date:	8/14/1995	5/31/2005
Total Distance Surveyed (km):	2.7	1.9

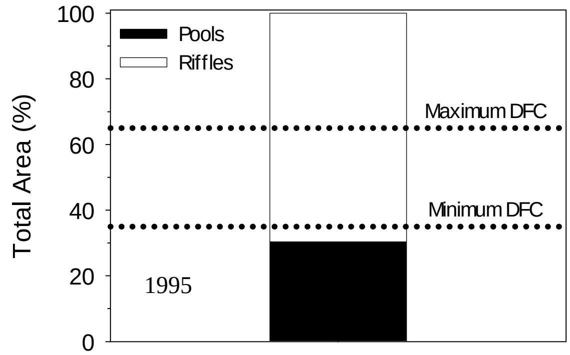
	Pools		Riffles	
	1995	**2005**	**1995**	**2005**
Percent of Total Stream Area:	31	10	69	90
Total Area (m^2):	1949 ± 77	602 ± 257	4436 ± 253	5273 ± 1218
Correction Factor Applied:	1.05	0.79	1.08	1.12
Number of Paired Samples:	9	4	8	7
Total Count:	176	39	153	54
Number per km:	65	21	56	29
Mean Area (m^2):	11	15	29	98
Mean Maximum Depth (cm):	38	41	21	24
Mean Average Depth (cm):	25	32	12	13
Mean Residual Depth (cm):	NA	18	--	--
Percent Surveyed as Glides:	NA	15	--	--
Percent Surveyed as Runs:	--	--	NA	20
Percent Surveyed as Cascades:	--	--	NA	7
Percent with > 35% Fines:	0	74	0	7

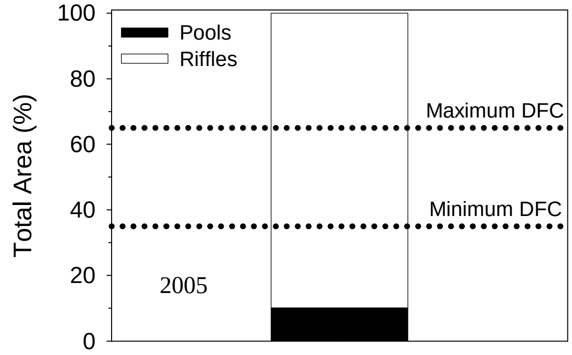
	Pieces per km	
Large Woody Debris Size Classes	**1995**	**2005**
1 - 5 m long, 10 cm – 55 cm diameter:	31	21
1 - 5 m long, > 55 cm diameter:	1	0
> 5 m long, 10 cm – 55 cm diameter:	26	10
> 5 m long, > 55 cm diameter:	5	1
Total:	63	32

Rosgen's Channel Type*	Frequency (%)
A:	35
B:	44
C:	0
D:	0
E:	20
F:	0
G:	0

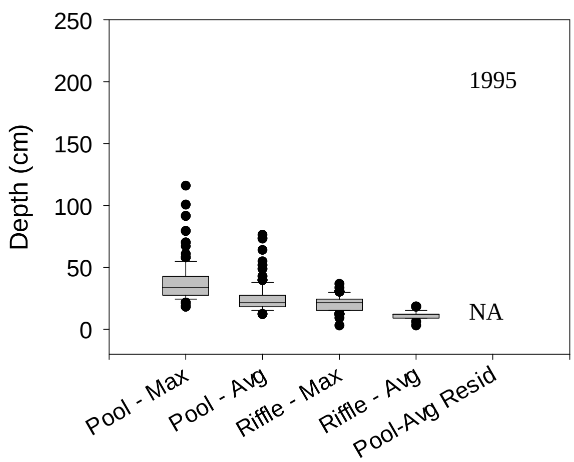
*recorded in 2005 only

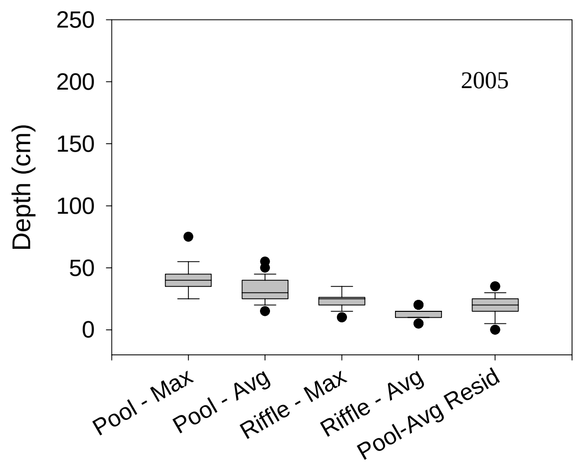
Other Stream Attributes	1995	2005
Mean Bankfull Channel Width (m):	5	5
Mean Channel Gradient (%):	NA	7
Median Water Temperature (C):	NA	16.5



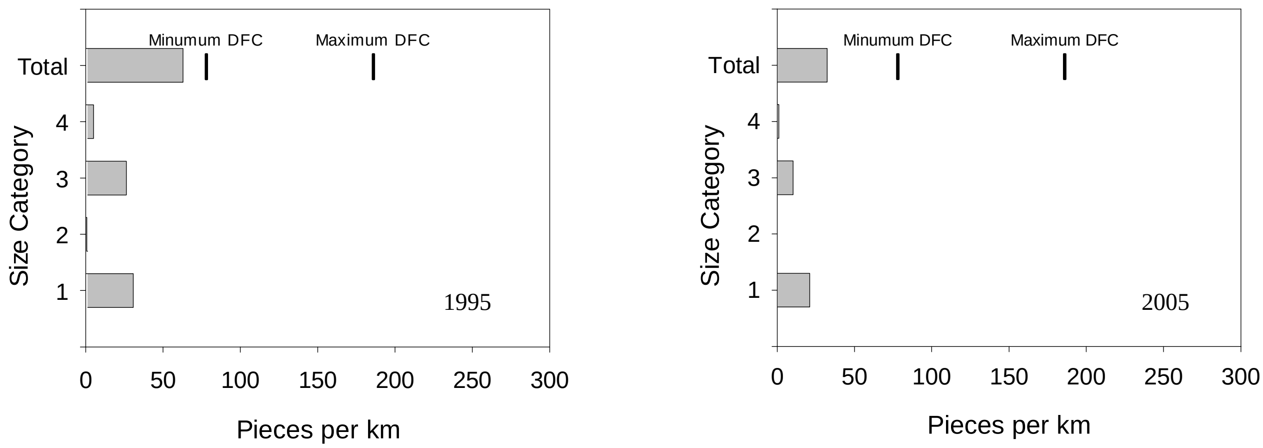


Estimated area of Pedlar Run in pools and riffles as calculated using BVET techniques. The GWJNF DFC for pool area is 35%-65% of total stream area.





Maximum and average depths for pools and riffles and residual depths in Pedlar Run. The top and bottom of the boxes represent the 25th and 75th percentiles, the bar in the center of the box represents the median, whiskers represent the 10th and 90th percentiles, and closed circles represent the entire range of the data.



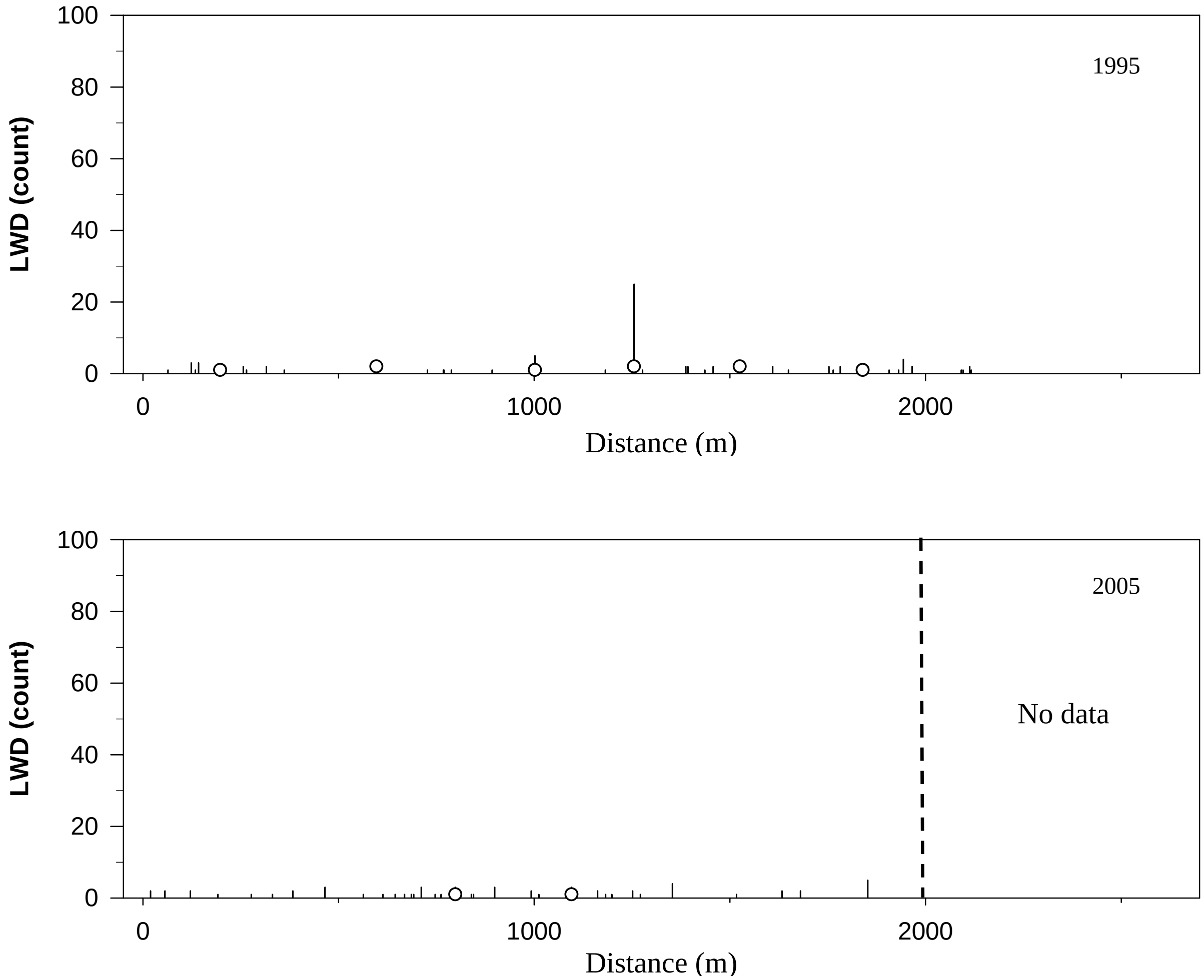
LWD per kilometer in Pedlar Run. LWD size classes: Size 1: < 5 m long, 10-55 cm diameter; Size 2: <5 m long, > 55 cm diameter; Size 3: > 5 m long, 10-55 cm diameter; Size 4: > 5 m long, > 55 cm diameter. The GWJNF DFC for LWD is 78-186 Total pieces per km.

Stream features recorded for Pedlar Run during BVET habitat survey, 1995. Distance is meters from start of survey.

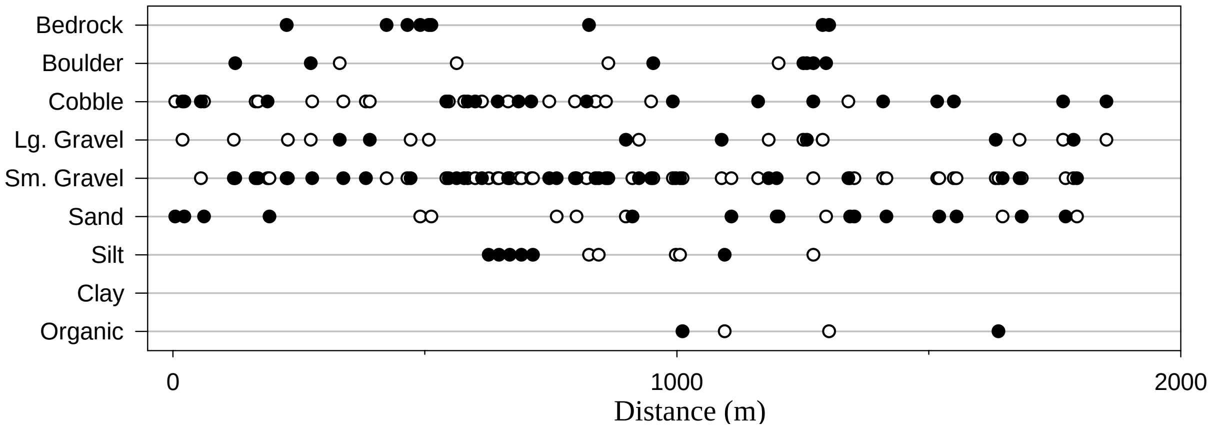
Stream Feature	Distance (m)	Width (m)	Comments
TRIBUTARY	426.4		LEFT
TRIBUTARY	1141.5		LEFT
FORD	1176.		TRAIL CROSSING
TRIBUTARY	1506.3		LEFT
TRIBUTARY	2429.6		LEFT
SEEP	2484.1		RIGHT

Stream features recorded for Pedlar Run during BVET habitat survey, 2005. Distance is meters from start of survey.

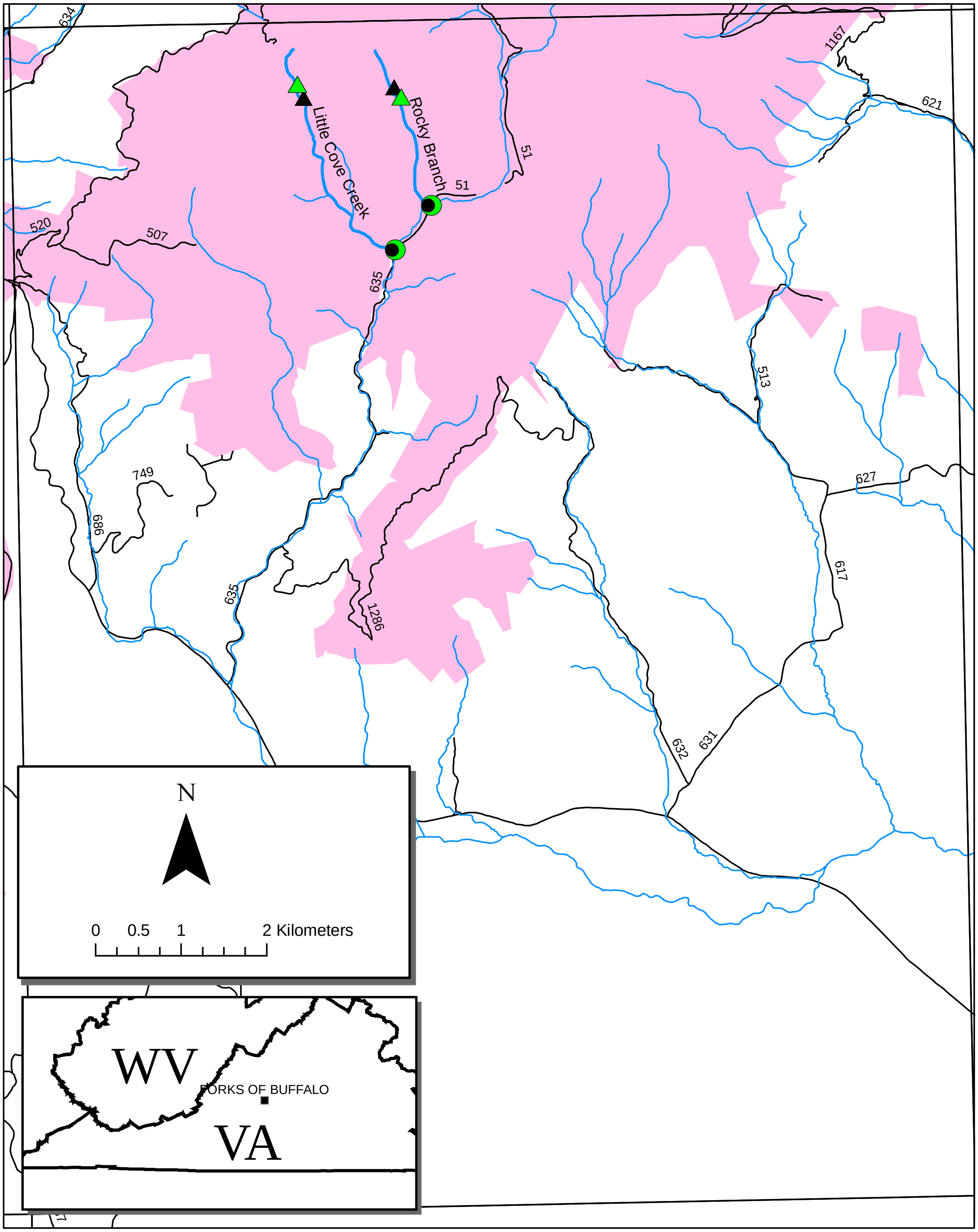
Stream Feature	Distance (m)	Width (m)	Comments
SIDE CHANNEL	1.0	0.6	IN ON RIGHT
SIDE CHANNEL	8.9		OUT ON RIGHT
OTHER	254.0		WHITE BUILDING TO LEFT OF STREAM. POWERLINE AND TRAIL END AT THIS BUILDING.
SEEP	473.0		ON LEFT
SLIDEE	473.0		ON LEFT
TRIBUTARY	546.0	1.2	IN ON RIGHT
TRIBUTARY	880.0	1.0	
TRIBUTARY	965.3	1.5	IN ON LEFT
SIDE CHANNEL	1024.0	1.0	IN ON RIGHT
SIDE CHANNEL	1032.0		OUT ON RIGHT
TRIBUTARY	1139.0	0.6	IN ON RIGHT
SIDE CHANNEL	1154.9	0.8	IN ON LEFT
SIDE CHANNEL	1161.3	0.8	OUT ON LEFT
TRIBUTARY	1221.0		IN ON LEFT. DRY.
FORD	1602.0		
FALL	1794.0		HEIGHT 1.5 M
END	1852.0		END SURVEY.NATIONAL FOREST BOUNDARY.



Distribution and abundance of LWD in Pedlar Run in 1995 and 2005. LWD were recorded for each habitat unit in the stream. X-axis indicates distance upstream from National Forest boundary. Dashed line indicates end of shorter survey.



Distribution of substrates in Pedlar Run in 2005. X-axis indicates distance upstream from National Forest boundary. Similar data are not available for the 1995 inventory.



Start (circle) and end (triangle) points for BVET stream habitat inventories performed on stream reaches on the Forks of Buffalo quadrangle in 1995 (green) and 2005 (black).

Stream:	**Little Cove Creek**	
District:	Pedlar	
USGS Quadrangle:	Forks of Buffalo	
	1989	**2005**
Survey Date:	7/21/1989	6/2/2005
Total Distance Surveyed (km):	1.7	1.2

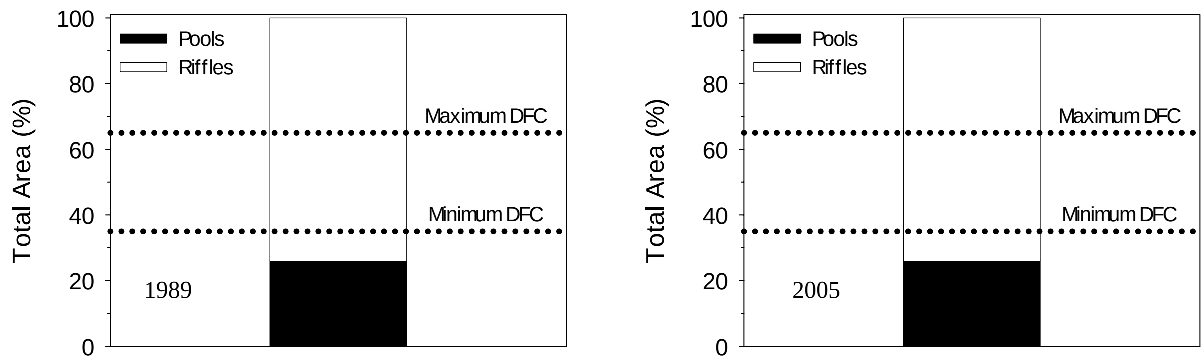
	Pools		**Riffles**	
	1989	**2005**	**1989**	**2005**
Percent of Total Stream Area:	26	24	74	76
Total Area (m^2):	2163 ± 285	1034 ± 161	6148 ± 454	3205 ± 389
Correction Factor Applied:	1.05	0.95	0.98	0.98
Number of Paired Samples:	21	5	11	5
Total Count:	116	50	122	50
Number per km:	69	42	72	42
Mean Area (m^2):	19	21	50	64
Mean Maximum Depth (cm):	56	60	32	25
Mean Average Depth (cm):	36	34	19	12
Mean Residual Depth (cm):	NA	20	--	--
Percent Surveyed as Glides:	38	0	--	--
Percent Surveyed as Runs:	--	--	0	0
Percent Surveyed as Cascades:	--	--	61	52
Percent with > 35% Fines:	0	0	0	0

	Pieces per km	
Large Woody Debris Size Classes	**1989**	**2005**
1 - 5 m long, 10 cm – 55 cm diameter:	102	10
1 - 5 m long, > 55 cm diameter:	8	2
> 5 m long, 10 cm – 55 cm diameter:	26	43
> 5 m long, > 55 cm diameter:	5	16
Total:	142	71

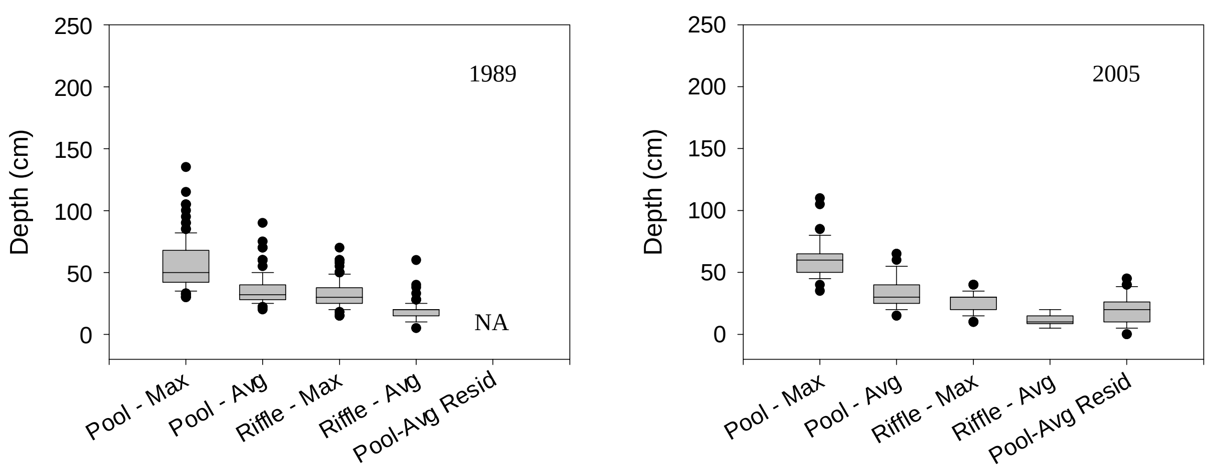
Rosgen's Channel Type*	**Frequency (%)**
A:	100
B:	0
C:	0
D:	0
E:	0
F:	0
G:	0

*recorded in 2005 only

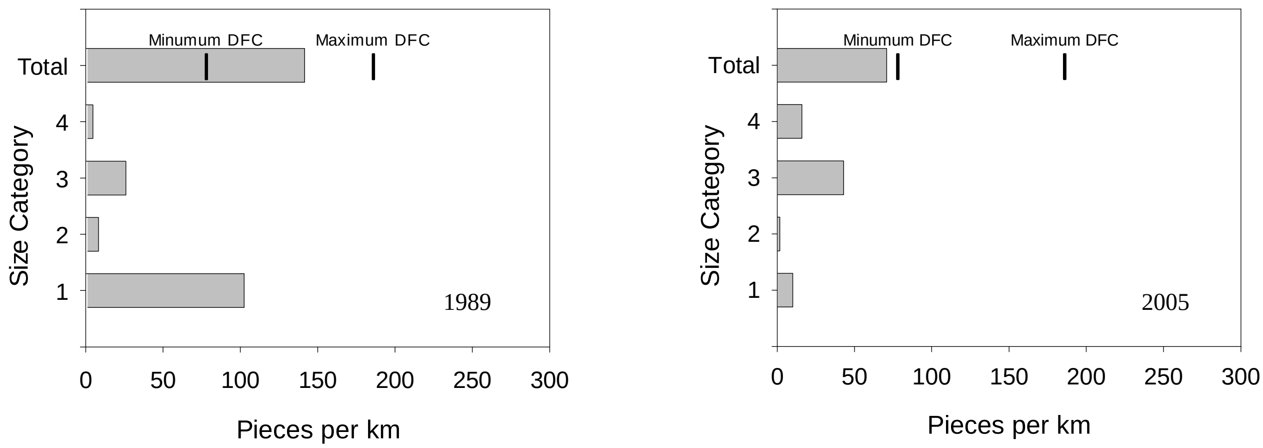
Other Stream Attributes	**1989**	**2005**
Mean Bankfull Channel Width (m):	NA	7
Mean Channel Gradient (%):	NA	14
Median Water Temperature (C):	NA	14



Estimated area of Little Cove Creek in pools and riffles as calculated using BVET techniques. The GWJNF DFC for pool area is 35%-65% of total stream area.



Maximum and average depths for pools and riffles and residual depths in Little Cove Creek. The top and bottom of the boxes represent the 25th and 75th percentiles, the bar in the center of the box represents the median, whiskers represent the 10th and 90th percentiles, and closed circles represent the entire range of the data.



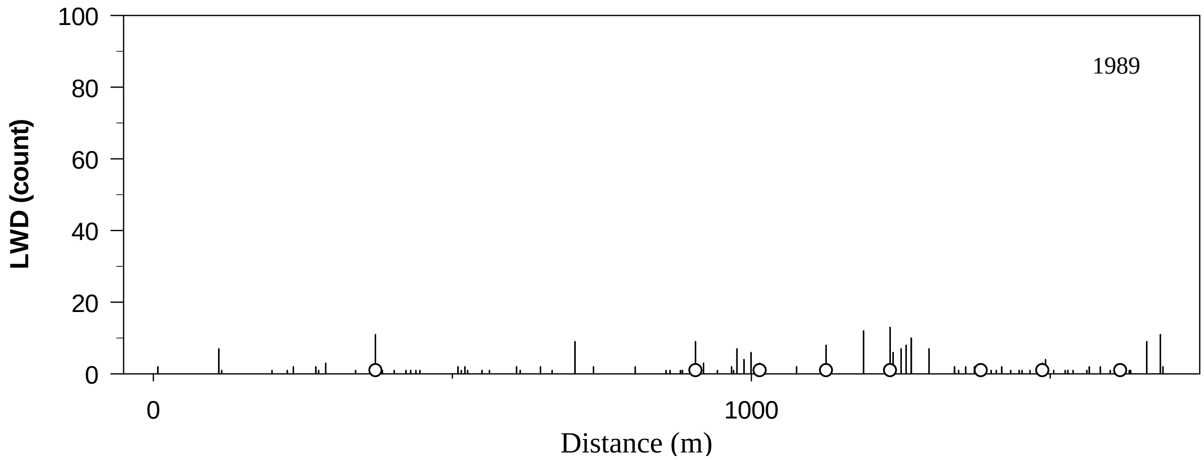
LWD per kilometer in Little Cove Creek in 1989 and 2005. LWD size classes: Size 1: < 5 m long, 10-55 cm diameter; Size 2: <5 m long, > 55 cm diameter; Size 3: > 5 m long, 10-55 cm diameter; Size 4: > 5 m long, > 55 cm diameter. The GWJNF DFC for LWD is 78-186 Total pieces per km.

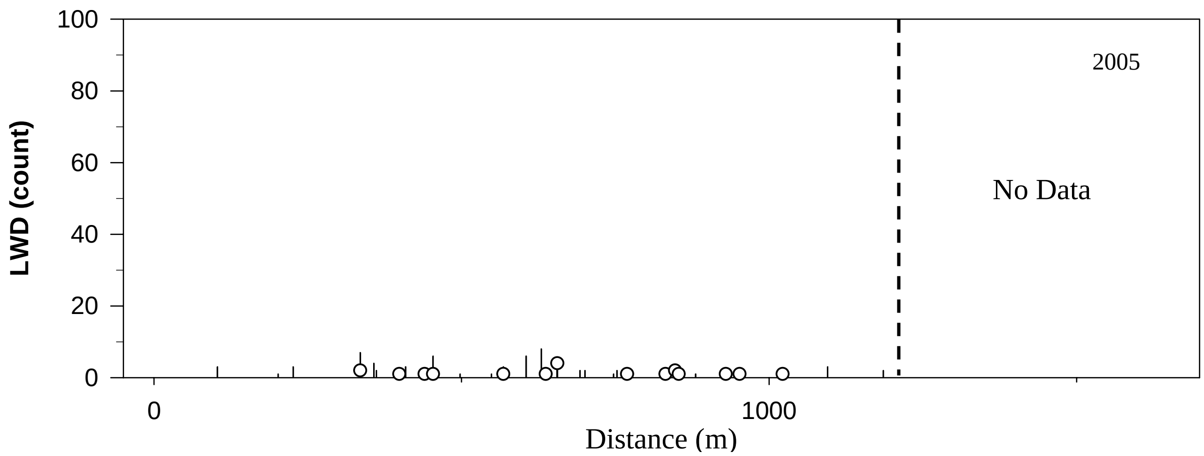
Stream features recorded for Little Cove Creek during BVET habitat survey, 1989. Distance is meters from start of survey.

Stream Feature	Distance (m)	Width (m)	Comments
TRIBUTARY	762.8		TRIBUTARY
TRIBUTARY	1161.2		TRIBUTARY

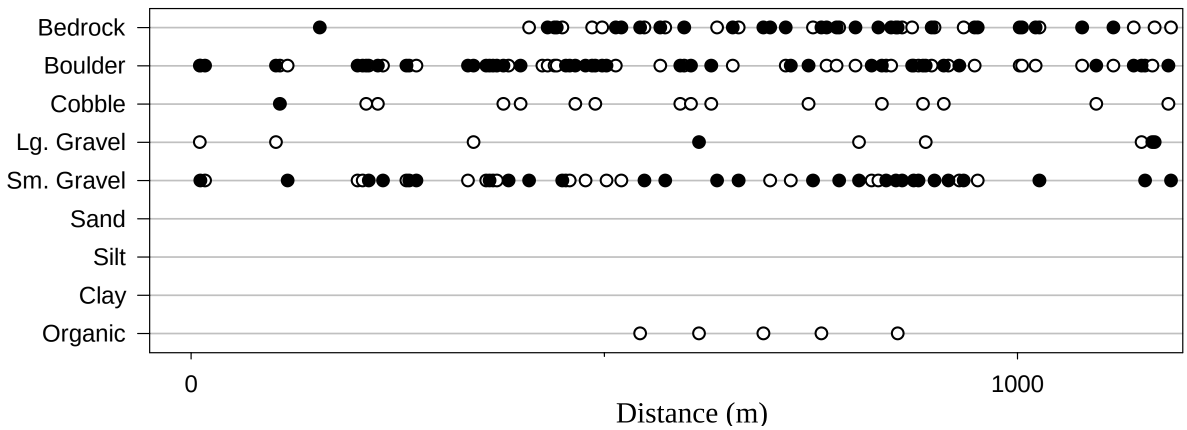
Stream features recorded for Little Cove Creek during BVET habitat survey, 2005. Distance is meters from start of survey. Similar data were not collected in 1989.

Stream Feature	Distance (m)	Width (m)	Comments
FALL	107.7		1 M
FALL	596.8		2 M
TRIBUTARY	685.0	2.0	CASCADES UP THE SIDE OF MOUNTAIN
FALL	841.1		2 M
FALL	874.4		2 M
FALL	1140.7		1.5 M





Distribution and abundance of LWD in Little Cove Creek in 1989 and 2005. LWD were recorded for each habitat unit in the stream. X-axis indicates distance upstream from National Forest boundary. Dashed line indicates end of shorter survey.



Distribution of substrates in Little Cove Creek in 2005. X-axis indicates distance upstream from National Forest boundary. Similar data are not available for the 1989 inventory.

Stream:	**Rocky Branch**	
District:	Pedlar	
USGS Quadrangle:	Forks of Buffalo	
	1989	**2005**
Survey Date:	7/21/1989	6/2/2005
Total Distance Surveyed (km):	1.0	1.0

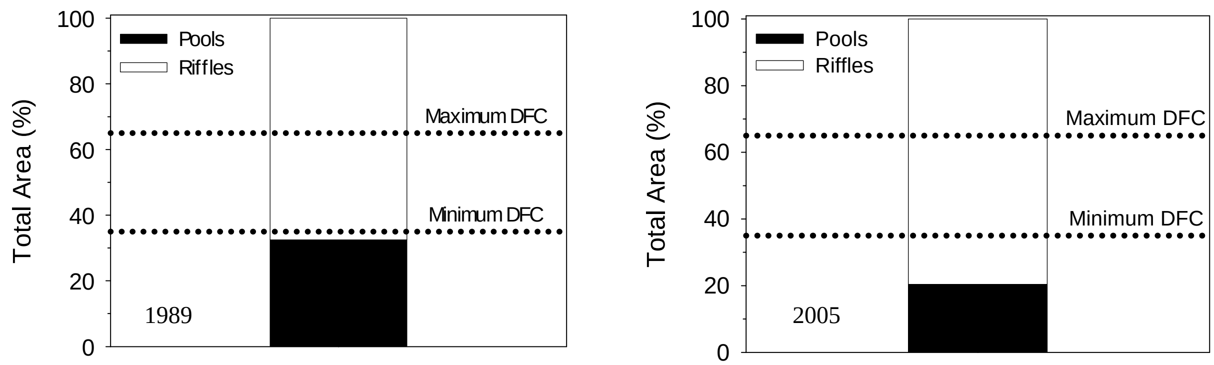
	Pools		**Riffles**	
	1989	**2005**	**1989**	**2005**
Percent of Total Stream Area:	33	21	67	79
Total Area (m^2):	1046 ± 85	539 ± 63	2161 ± 176	2090 ± 694
Correction Factor Applied:	0.93	0.99	0.99	0.90
Number of Paired Samples:	12	3	5	4
Total Count:	74	39	69	47
Number per km:	72	39	67	47
Mean Area (m^2):	14	14	31	44
Mean Maximum Depth (cm):	53	54	23	24
Mean Average Depth (cm):	36	31	15	11
Mean Residual Depth (cm):	NA	20	--	--
Percent Surveyed as Glides:	39	0	--	--
Percent Surveyed as Runs:	--	--	0	0
Percent Surveyed as Cascades:	--	--	49	38
Percent with > 35% Fines:	0	8	0	0

	Pieces per km	
Large Woody Debris Size Classes	**1989**	**2005**
1 - 5 m long, 10 cm – 55 cm diameter:	33	15
1 - 5 m long, > 55 cm diameter:	11	9
> 5 m long, 10 cm – 55 cm diameter:	20	49
> 5 m long, > 55 cm diameter:	14	9
Total:	78	82

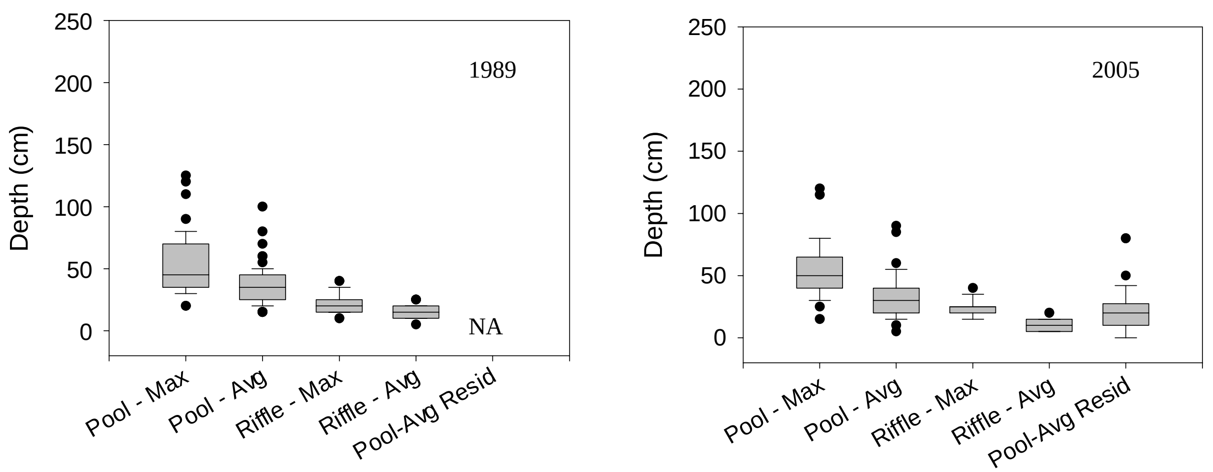
Rosgen's Channel Type*	**Frequency (%)**
A:	100
B:	0
C:	0
D:	0
E:	0
F:	0
G:	0

*recorded in 2005 only

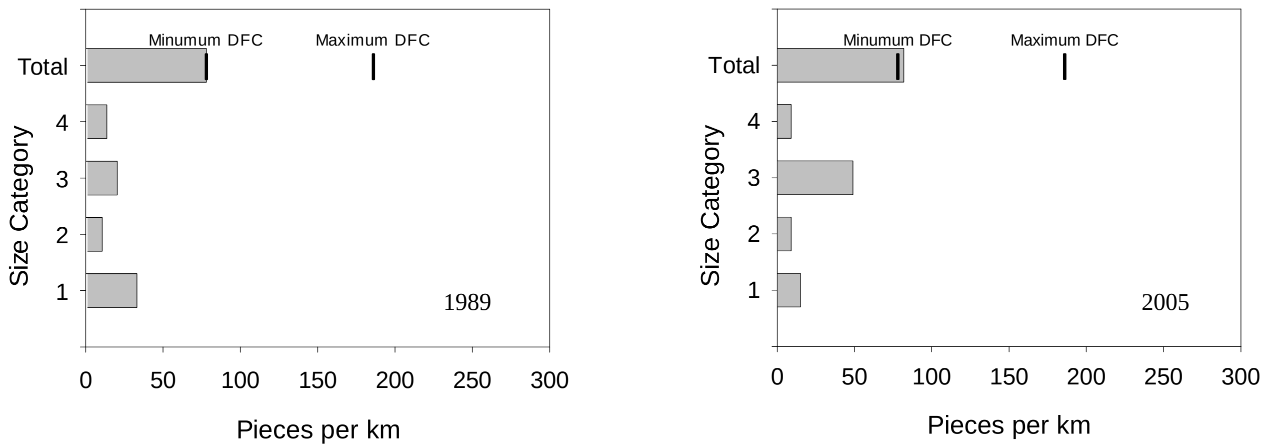
Other Stream Attributes	**1989**	**2005**
Mean Bankfull Channel Width (m):	NA	4
Mean Channel Gradient (%):	NA	10
Median Water Temperature (C):	NA	12



Estimated area of Rocky Branch in pools and riffles as calculated using BVET techniques. The GWJNF DFC for pool area is 35%-65% of total stream area.



Maximum and average depths for pools and riffles and residual depths in Rocky Branch. The top and bottom of the boxes represent the 25th and 75th percentiles, the bar in the center of the box represents the median, whiskers represent the 10th and 90th percentiles, and closed circles represent the entire range of the data.



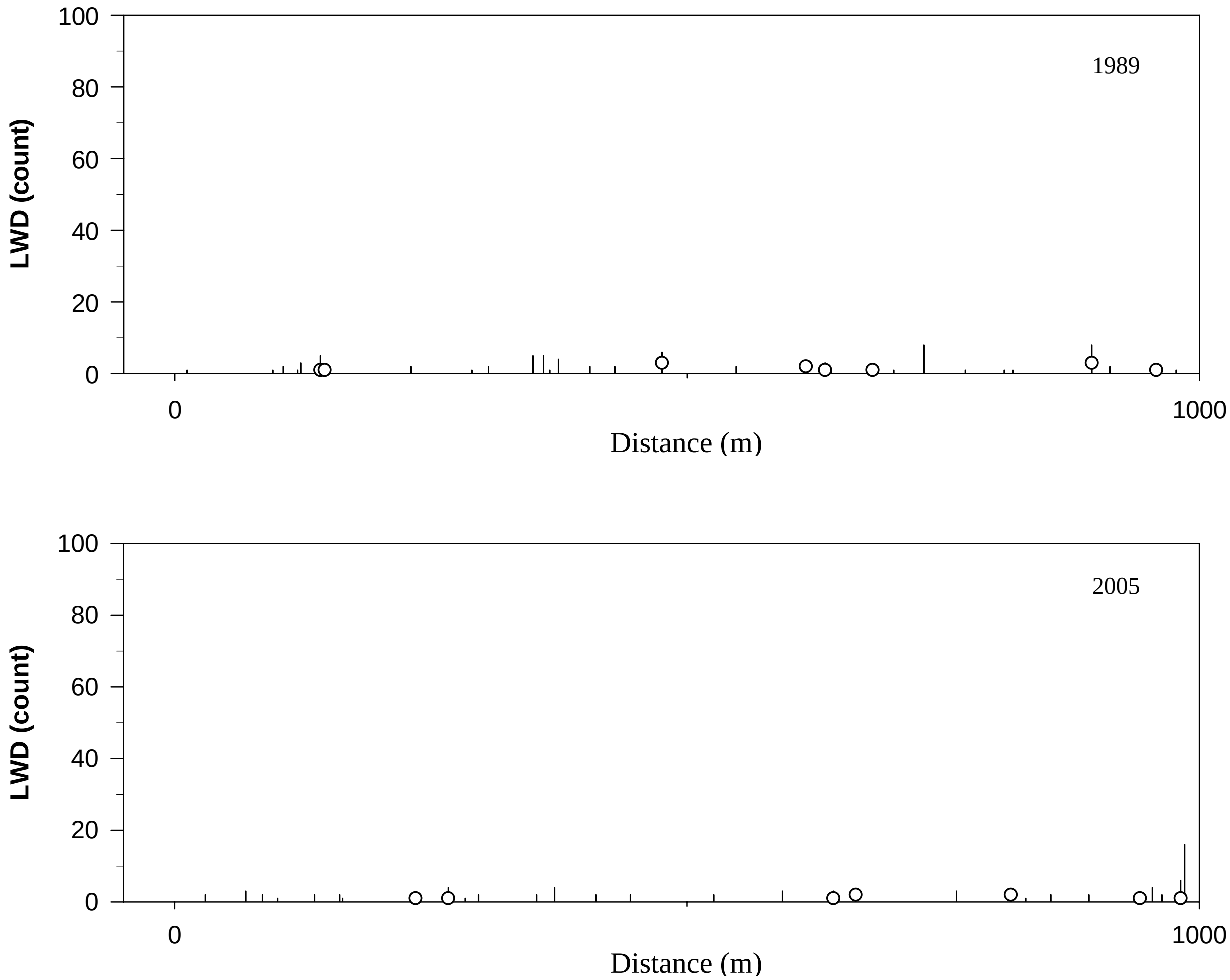
LWD per kilometer in Rocky Branch. LWD size classes: Size 1: < 5 m long, 10-55 cm diameter; Size 2: <5 m long, > 55 cm diameter; Size 3: > 5 m long, 10-55 cm diameter; Size 4: > 5 m long, > 55 cm diameter. The GWJNF DFC for LWD is 78-186 Total pieces per km.

Stream features recorded for Rocky Branch during BVET habitat survey, 1989. Distance is meters from start of survey.

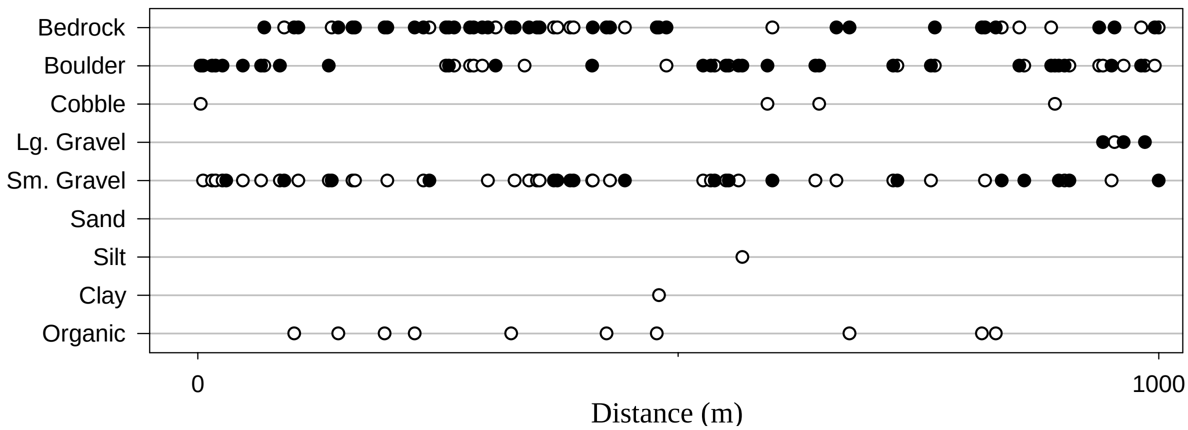
Stream Feature	Distance (m)	Width (m)	Comments
TRIBUTARY	645.9		

Stream features recorded for Rocky Branch during BVET habitat survey, 2005. Distance is meters from start of survey. Similar data were not collected in 1989.

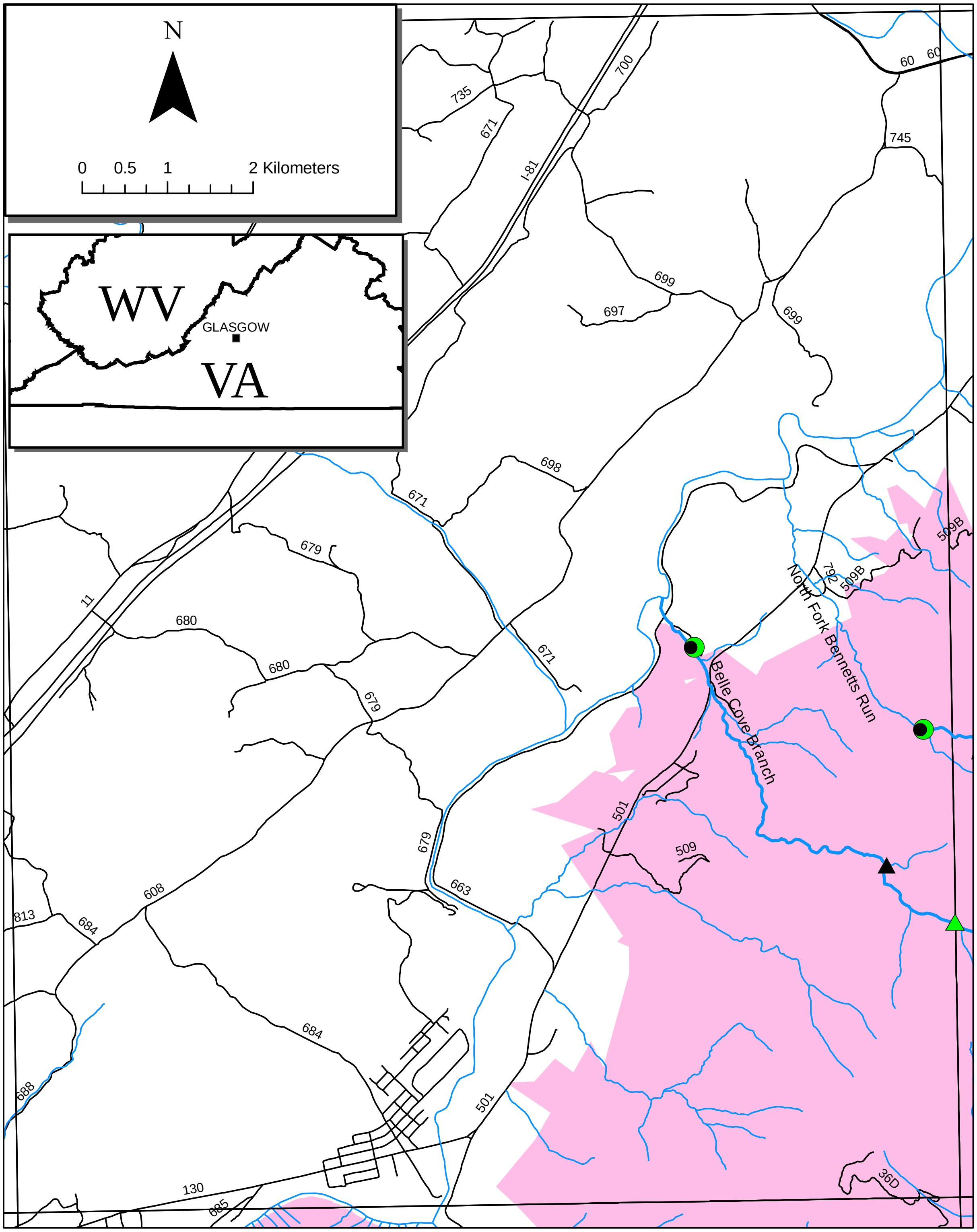
Stream Feature	Distance (m)	Width (m)	Comments
FALL	47.1	2.5	2 M HIGH
FALL	104.7		10 M HIGH
FALL	146.2		7.5 M FALL
FALL	197.4		4 M HIGH
FALL	429.0		10 M HIGH
FALL	480.1		1.5 M HIGH
FALL	556.7		2 M HIGH
FALL	598.0		2.5 M HIGH
FALL	664.6		2 FALLS ABOUT 3 M HIGH
SEEP	870.9		RIGHT SIDE
FALL	1051.2		3 M HIGH
TRIBUTARY	1097.4	1.0	ON RIGHT
END	1202.0		END SURVEY CONTINUOUS CASCADE FOR GREATER THAN 150 M TREACHEROUS



Distribution and abundance of LWD in Rocky Branch in 1989 and 2005. LWD were recorded for each habitat unit in the stream. X-axis indicates distance upstream from National Forest boundary.



Distribution of substrates in Rocky Branch in 2005. X-axis indicates distance upstream from National Forest boundary. Similar data are not available for the 1995 inventory.



Start (circle) and end (triangle) points for BVET stream habitat inventories performed on stream reaches on the Glasgow quadrangle in 1995 (green) and 2005 (black).

Stream:	**Belle Cove Creek**	
District:	Pedlar	
USGS Quadrangle:	Glasgow	
	1995	**2005**
Survey Date:	8/9/1995	6/1/2005
Total Distance Surveyed (km):	5.9	4.0

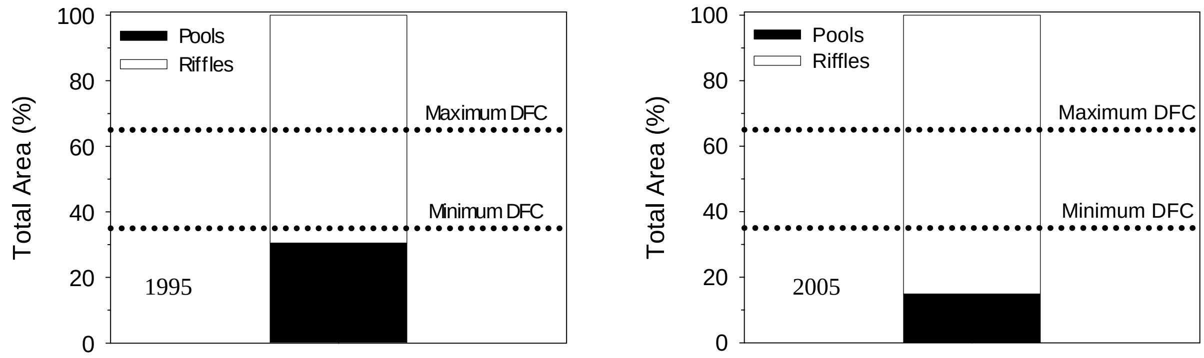
	Pools		**Riffles**	
	1995	**2005**	**1995**	**2005**
Percent of Total Stream Area:	31	15	69	85
Total Area (m^2):	4201 ± 180	1550 ± 220	9537 ± 792	8774 ± 1258
Correction Factor Applied:	1.06	0.79	1.02	0.74
Number of Paired Samples:	10	8	8	7
Total Count:	190	74	151	72
Number per km:	32	18	25	18
Mean Area (m^2):	22	21	63	122
Mean Maximum Depth (cm):	52	41	23	29
Mean Average Depth (cm):	35	28	12	14
Mean Residual Depth (cm):	NA	18	--	--
Percent Surveyed as Glides:	NA	24	--	--
Percent Surveyed as Runs:	--	--	NA	6
Percent Surveyed as Cascades:	--	--	NA	10
Percent with > 35% Fines:	0	0	0	0

	Pieces per km	
Large Woody Debris Size Classes	**1995**	**2005**
1 - 5 m long, 10 cm – 55 cm diameter:	70	16
1 - 5 m long, > 55 cm diameter:	15	0
> 5 m long, 10 cm – 55 cm diameter:	182	35
> 5 m long, > 55 cm diameter:	21	1
Total:	287	52

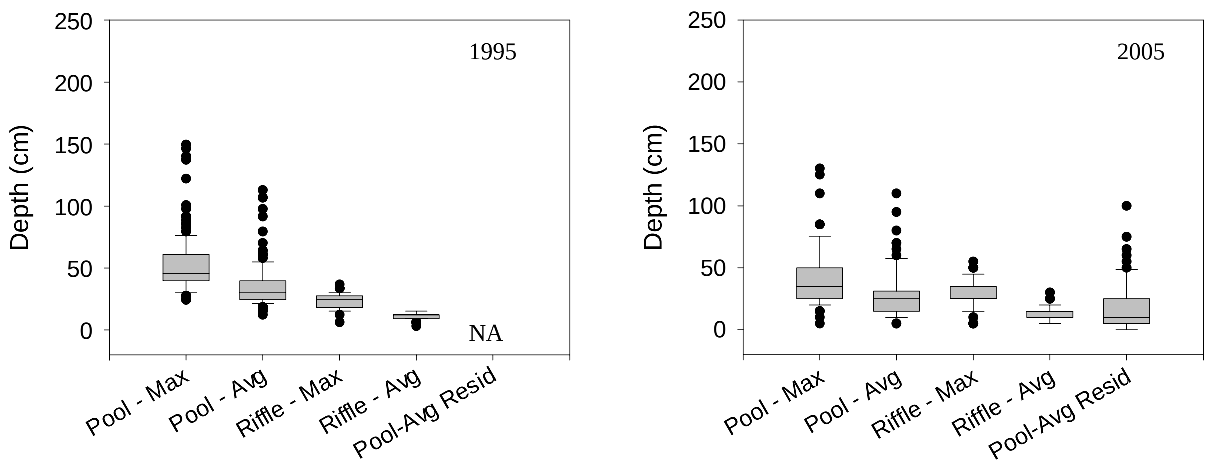
Rosgen's Channel Type*	**Frequency (%)**
A:	0
B:	100
C:	0
D:	0
E:	0
F:	0
G:	0

*recorded in 2005 only

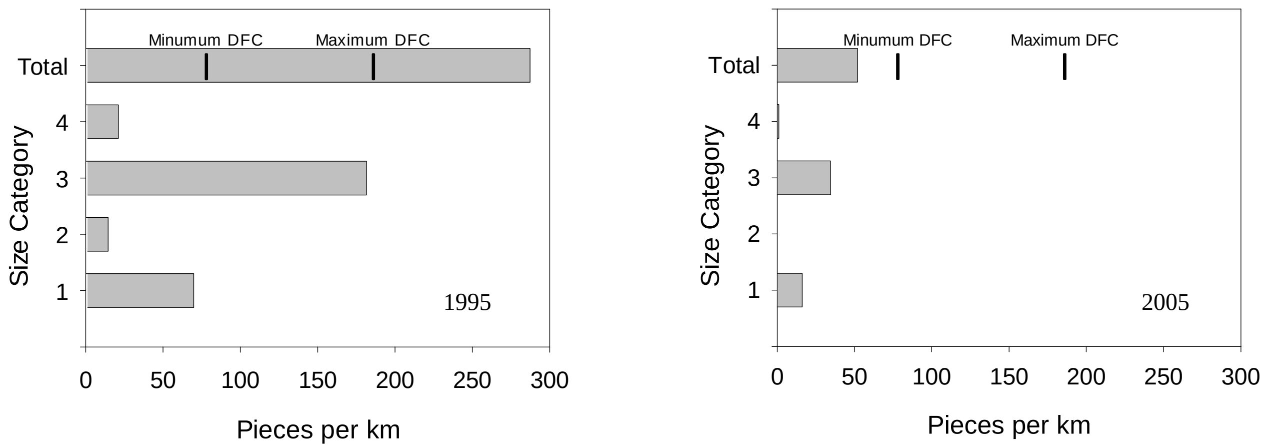
Other Stream Attributes	**1995**	**2005**
Mean Bankfull Channel Width (m):	9	5
Mean Channel Gradient (%):	NA	6
Median Water Temperature (C):	NA	19



Estimated area of Belle Cove Creek in pools and riffles as calculated using BVET techniques. The GWJNF DFC for pool area is 35%-65% of total stream area.



Maximum and average depths for pools and riffles and residual depths in Belle Cove Creek. The top and bottom of the boxes represent the 25th and 75th percentiles, the bar in the center of the box represents the median, whiskers represent the 10th and 90th percentiles, and closed circles represent the entire range of the data.



LWD per kilometer in Belle Cove Creek. LWD size classes: Size 1: < 5 m long, 10-55 cm diameter; Size 2: <5 m long, > 55 cm diameter; Size 3: > 5 m long, 10-55 cm diameter; Size 4: > 5 m long, > 55 cm diameter. The GWJNF DFC for LWD is 78-186 Total pieces per km.

Stream features recorded for Belle Cove Creek during BVET habitat survey, 1995. Distance is meters from start of survey.

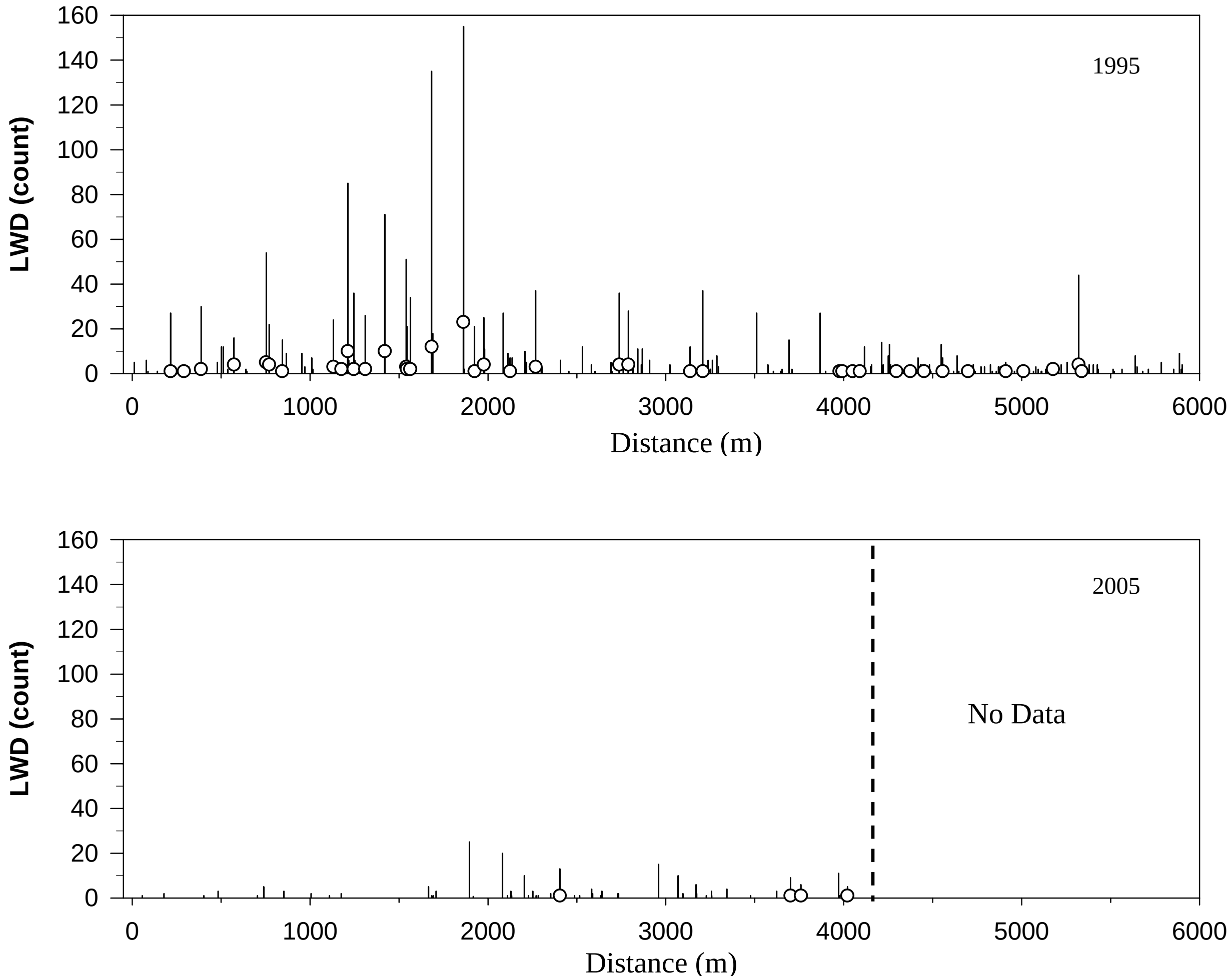
Stream Feature	**Distance (m)**	**Width (m)**	**Comments**
CULVERT	381.3		CONCRETE
OTHER	1113.4		EXPOSED PIPE
TRIBUTARY	1893.4		MUDSLIDE DEVASTATED
TRIBUTARY	2074.2		MUDSLIDE NOW BEDROCK
OTHER	2997.1		MUDSLIDE
TRIBUTARY	3244.0		RIGHT SIDE DRY
TRIBUTARY	3260.8		RIGHT SIDE DRY
TRIBUTARY	3381.1		LEFT SIDE DRY
TRIBUTARY	3579.9		RIGHT SIDE.INTERMITANT
TRIBUTARY	3882.2		1ST FORK LEFT SIDE
TRIBUTARY	4173.9		LEFT SIDE TRIBUTARY FORK?
TRIBUTARY	4269.3		FORK
TRIBUTARY	5025.8		RIGHT SIDE. 2ND FORK
OTHER	5324.9		LARGE MUD SLIDE
FORD	5638.5		TRAIL CROSSING
TRIBUTARY	5735.4		RIGHT SIDE. FORK
SEEP	5806.4		RIGHT SIDE.
TRIBUTARY	5897.3		RIGHT SIDE. SMALL
TRIBUTARY	5925.3		FORK LEFT SIDE SMALLER;RIGHT SIDE. NOT MUCH BIGGER
END	5925.3		END SURVEY

See next page for 2005 features

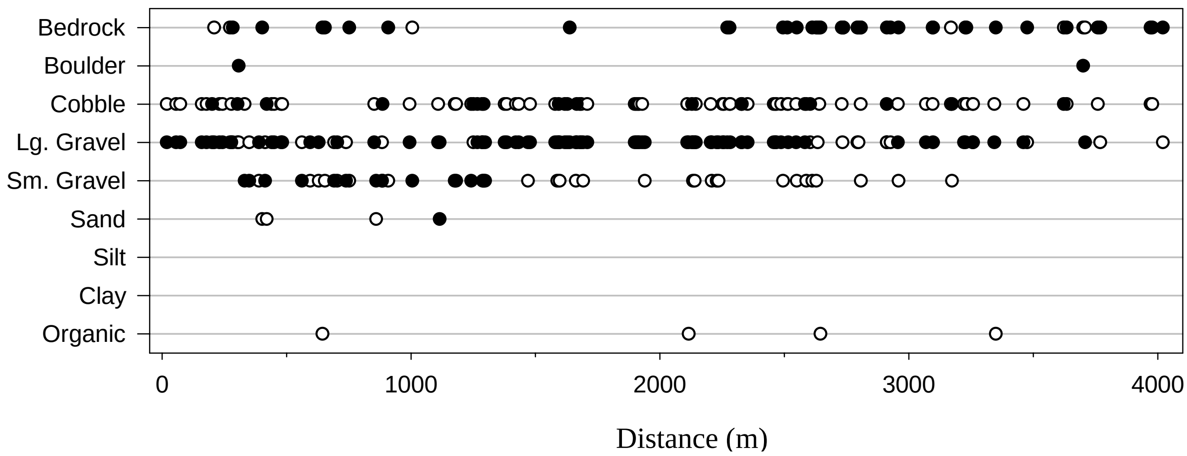
See previous page for 1995 features

Stream features recorded for Belle Cove Creek during BVET habitat survey, 2005. Distance is meters from start of survey.

Stream Feature	Distance (m)	Width (m)	Comments
SIDE CHANNEL	48.3	1.5	IN ON RIGHT
SIDE CHANNEL	204.0		OUT ON RIGHT
SIDE CHANNEL	288.0	1.0	IN ON LEFT
SIDE CHANNEL	384.0		OUT ON LEFT
TRIBUTARY	465.0	0.5	IN ON LEFT
SIDE CHANNEL	519.0	1.5	IN ON RIGHT
SIDE CHANNEL	567.0		OUT ON RIGHT
SIDE CHANNEL	596.0	1.5	IN ON RIGHT
SIDE CHANNEL	640.0		OUT ON RIGHT
SIDE CHANNEL	815.0	1.0	
CULVERT	860.0		BRIDGE, NATURAL SUBSTRATE' CEMENT, HEIGHT:3.5M, WIDTH:5.5, NO PERCH , RT 501, ENDS AT 879M
TRIBUTARY	1175.0	0.5	
TRIBUTARY	1670.0	1.0	
SIDE CHANNEL	1702.0		IN ON RIGHT
SIDE CHANNEL	1740.0		OUT ON RIGHT, DRY
TRIBUTARY	1761.4		IN ON LEFT, DRY
SIDE CHANNEL	1947.6		IN ON RIGHT
SLIDE	2203.8		
SLIDE	2453.0		
SLIDE	3244.0		
SIDE CHANNEL	3320.0		IN ON RIGHT
SIDE CHANNEL	3340.0		OUT ON RIGHT
OTHER	3652.0		CLIFF IN STREAM
FALL	4020.0		1.5M HEIGH
END	4021.0		CONFLUENCE OF TWO UNKNOWN STREAMS, 5:30



Distribution and abundance of LWD in Belle Cove Creek in 1995 and 2005. LWD were recorded for each habitat unit in the stream. X-axis indicates distance upstream from National Forest boundary. Dashed line indicates end of shorter survey.



Distribution of substrates in Belle Cove Creek in 2005. X-axis indicates distance upstream from National Forest boundary. Similar data are not available for the 1995 inventory.

Stream:	**North Fork Bennetts Run**	
District:	Pedlar	
USGS Quadrangle:	Glasgow, Buena Vista	
	1995	**2005**
Survey Date:	08/09/1995	6/02/2005
Total Distance Surveyed (km):	1.8	2.4

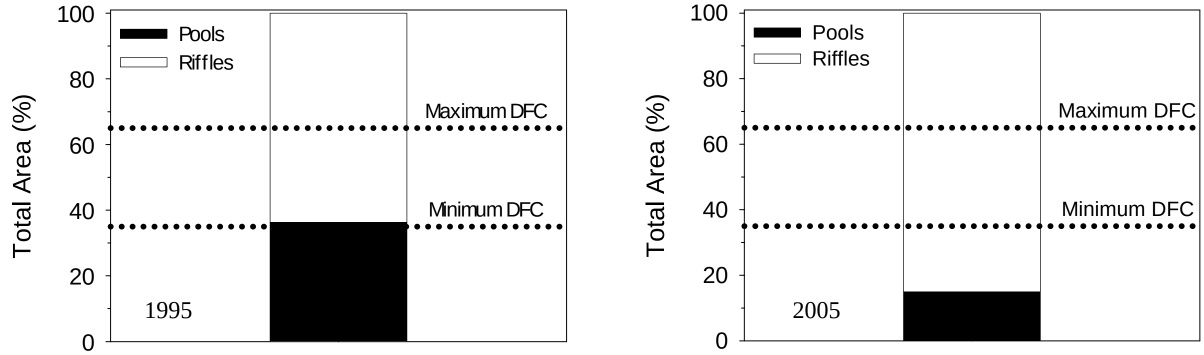
	Pools		**Riffles**	
	1995	**2005**	**1995**	**2005**
Percent of Total Stream Area:	36	17	64	83
Total Area (m^2):	1641 ± 186	1012 ± 433	2871 ± 226	4925 ± 929
Correction Factor Applied:	1.03	0.81	1.01	1.05
Number of Paired Samples:	6	4	5	5
Total Count:	117	49	103	56
Number per km:	64	21	56	24
Mean Area (m^2):	14	21	28	88
Mean Maximum Depth (cm):	46	52	21	30
Mean Average Depth (cm):	30	36	11	12
Mean Residual Depth (cm):	NA	25	--	--
Percent Surveyed as Glides:	NA	4	--	--
Percent Surveyed as Runs:	--	--	NA	0
Percent Surveyed as Cascades:	--	--	NA	36
Percent with > 35% Fines:	0	45	0	7

	Pieces per km	
Large Woody Debris Size Classes	**1995**	**2005**
1 - 5 m long, 10 cm – 55 cm diameter:	122	7
1 - 5 m long, > 55 cm diameter:	13	10
> 5 m long, 10 cm – 55 cm diameter:	144	36
> 5 m long, > 55 cm diameter:	42	5
Total:	320	58

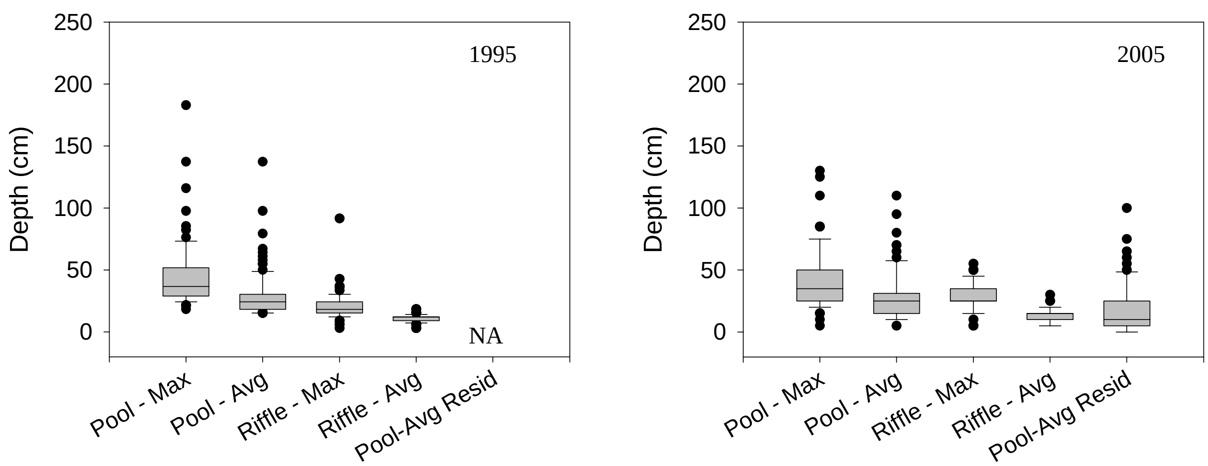
Rosgen's Channel Type*	**Frequency (%)**
A:	90
B:	10
C:	0
D:	0
E:	0
F:	0
G:	0

*recorded in 2005 only

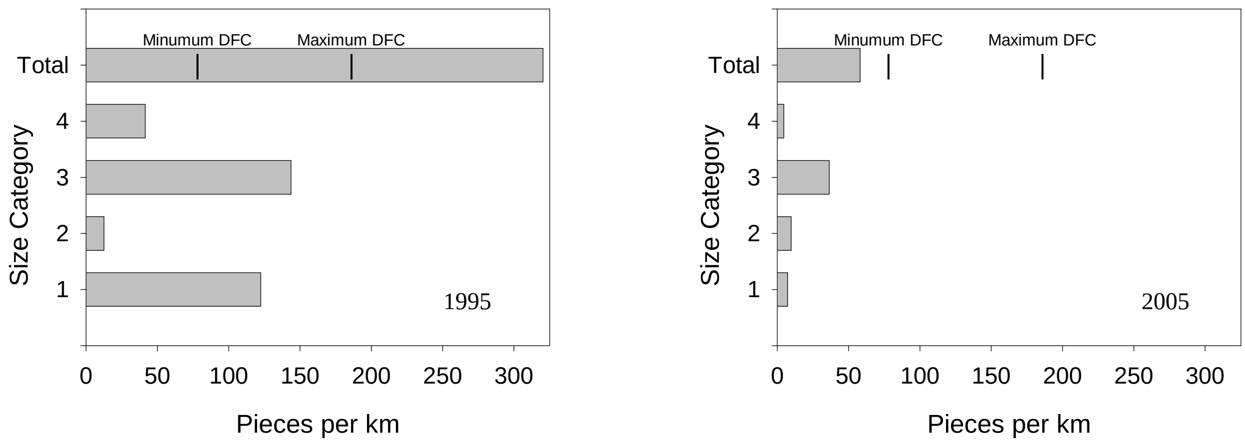
Other Stream Attributes	**1995**	**2005**
Mean Bankfull Channel Width (m):	7	10
Mean Channel Gradient (%):	NA	10
Median Water Temperature (C):	NA	14



Estimated area of North Fork Bennetts Run in pools and riffles as calculated using BVET techniques. The GWJNF DFC for pool area is 35%-65% of total stream area.



Maximum and average depths for pools and riffles and residual depths in North Fork Bennetts Run. The top and bottom of the boxes represent the 25th and 75th percentiles, the bar in the center of the box represents the median, whiskers represent the 10th and 90th percentiles, and closed circles represent the entire range of the data.



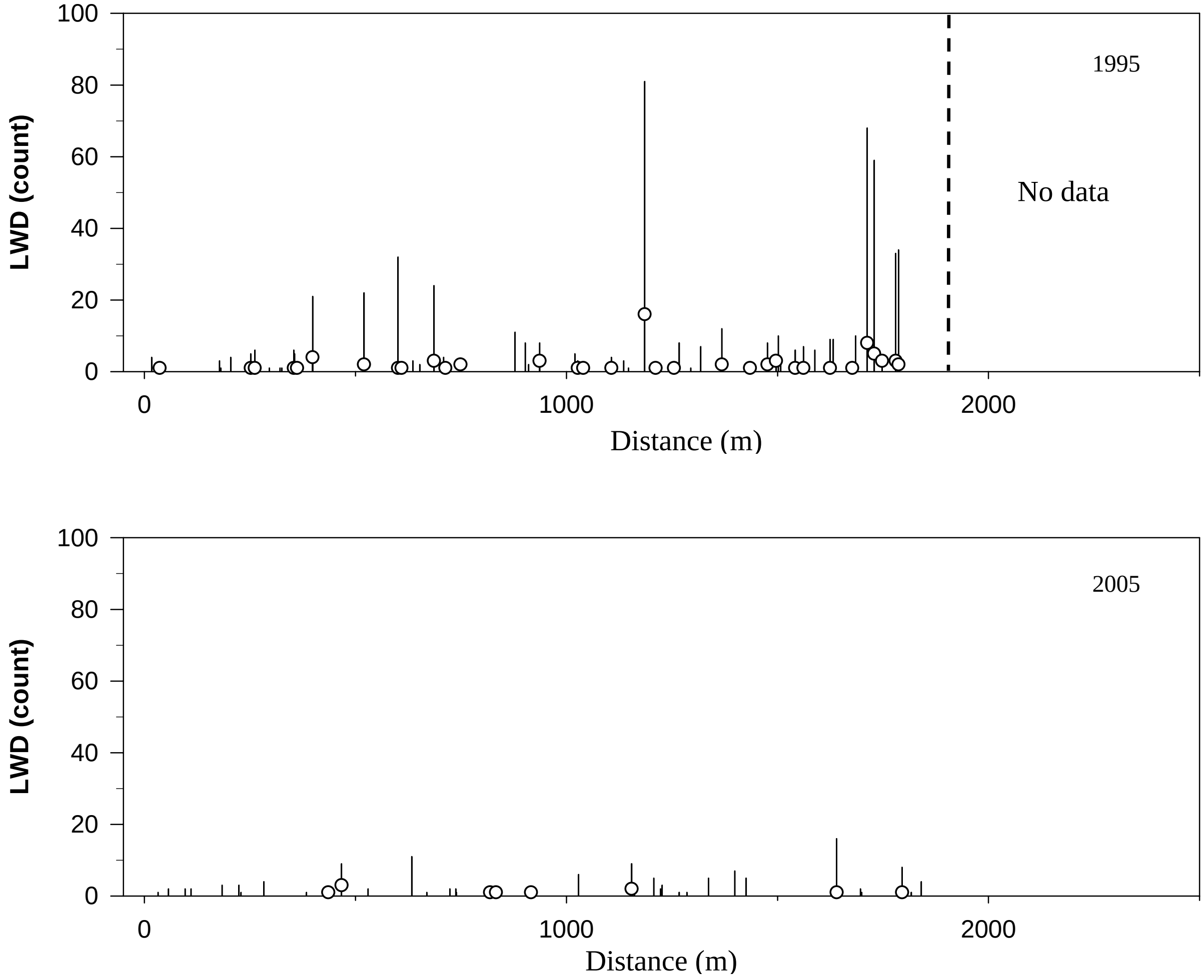
LWD per kilometer in North Fork Bennetts Run. LWD size classes: Size 1: < 5 m long, 10-55 cm diameter; Size 2: <5 m long, > 55 cm diameter; Size 3: > 5 m long, 10-55 cm diameter; Size 4: > 5 m long, > 55 cm diameter. The GWJNF DFC for LWD is 78-186 Total pieces per km.

Stream features recorded for North Fork Bennetts Run during BVET habitat survey, 1995. Distance is meters from start of survey.

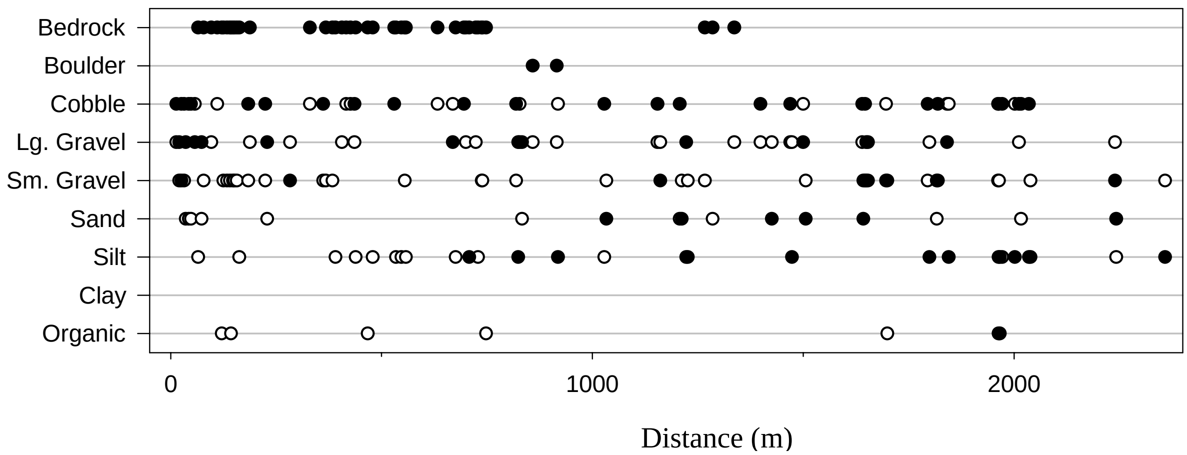
Stream Feature	Distance (m)	Width (m)	Comments
TRIBUTARY	412.4		LEFT-20' WIDE-STRIPPED TO BEDROCK
TRIBUTARY	1280.2		LEFT

Stream features recorded for North Fork Bennetts Run during BVET habitat survey, 2005. Distance is meters from start of survey.

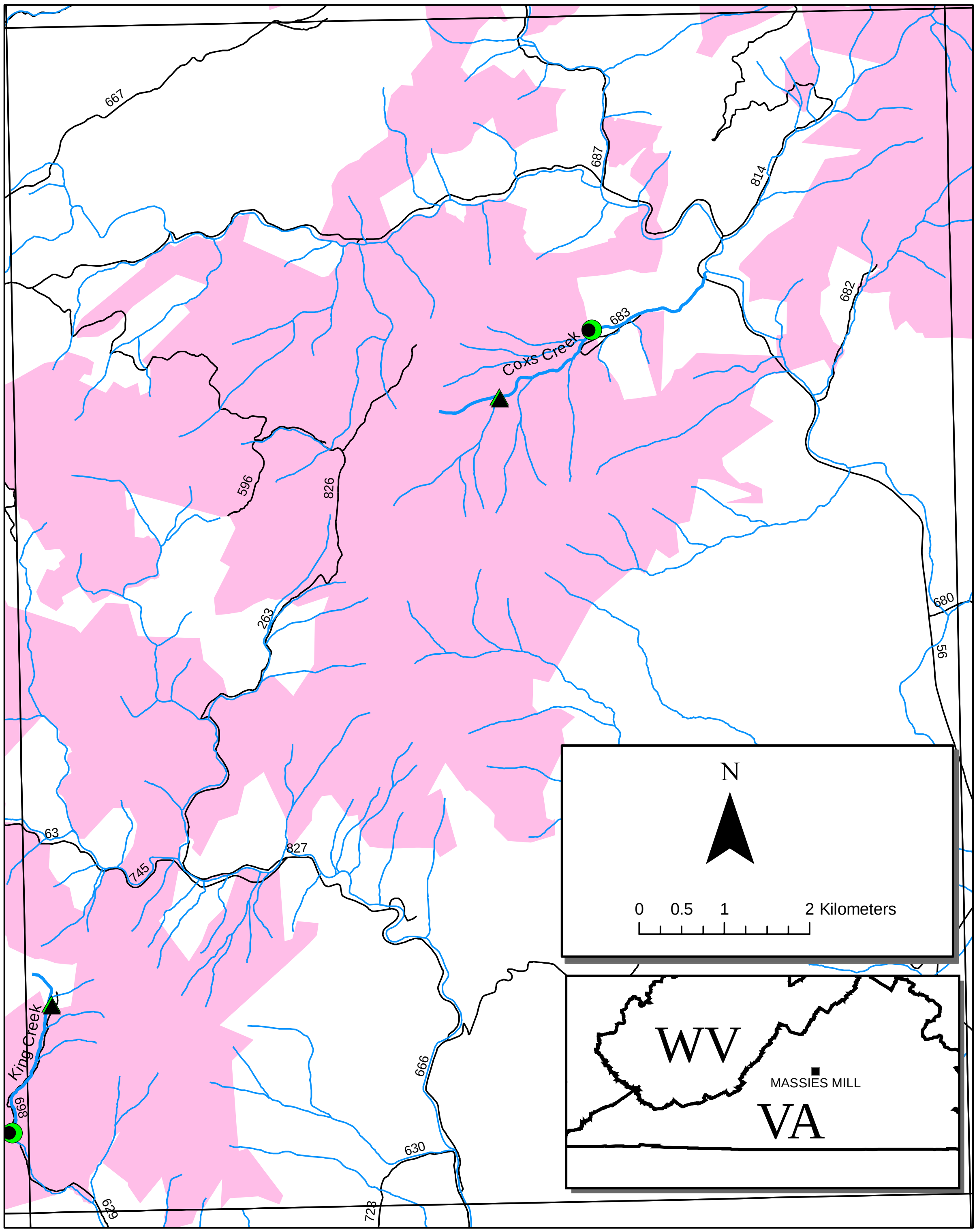
Stream Feature	Distance (m)	Width (m)	Comments
OTHER	13.1		PIPELINE
SIDE CHANNEL	214.0		IN ON LEFT
SIDE CHANNEL	224.0		OUT ON LEFT
TRIBUTARY	374.8		IN ON LEFT
OTHER	450.0		LOG JAM
SIDE CHANNEL	494.0		IN ON LEFT
SIDE CHANNEL	519.0		OUT ON LEFT
SIDE CHANNEL	780.0		IN ON RIGHT
SIDE CHANNEL	799.0		OUT ON RIGHT
SIDE CHANNEL	930.0		IN ON RIGHT
SIDE CHANNEL	939.0		OUT ON RIGHT
TRIBUTARY	1149.0	0.3	IN ON LEFT
TRIBUTARY	1625.0	0.5	
CULVERT	1653.4		ROAD 510, ROUND METAL, 2 PIPES, WIDTH 1.7M, NO NATURAL SUBSTRATE, CORRUGATED. 13M LONG.
SIDE CHANNEL	1699.4		IN ON RIGHT
SIDE CHANNEL	1717.0		OUT ON RIGHT
FORD	1805.6		
SIDE CHANNEL	1951.0		IN ON RIGHT
SIDE CHANNEL	1985.8		OUT ON RIGHT
TRIBUTARY	2026.0	1.0	IN ON RIGHT
END	23582.9		CHANNEL IMPASSIBLE NO EVIDENCE OF COMING BACK



Distribution and abundance of LWD in North Fork Bennetts Run in 1995 and 2005. LWD were recorded for each habitat unit in the stream. X-axis indicates distance upstream from National Forest boundary. Dashed line indicates end of shorter survey.



Distribution of substrates in North Fork Bennetts Run in 2005. X-axis indicates distance upstream from National Forest boundary. Similar data are not available for the 1995 inventory.



Start (circle) and end (triangle) points for BVET stream habitat inventories performed on stream reaches on the Massies Mill quadrangle in 1995 (green) and 2005 (black).

Stream:	**Coxs Creek**	
District:	Pedlar	
USGS Quadrangle:	Massies Mill	
	1995	**2005**
Survey Date:	7/17/1995	6/3/2005
Total Distance Surveyed (km):	1.6	1.2

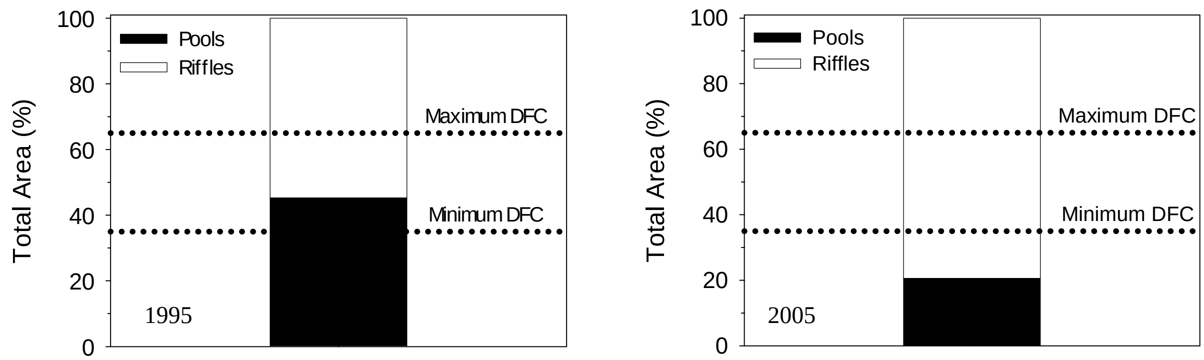
	Pools		**Riffles**	
	1995	**2005**	**1995**	**2005**
Percent of Total Stream Area:	45	21	55	79
Total Area (m^2):	2531 ± 121	1031 ± 658	3041 ± 606	3957 ± 825
Correction Factor Applied:	1.03	1.06	1.02	0.94
Number of Paired Samples:	7	4	5	4
Total Count:	137	43	94	42
Number per km:	85	35	58	34
Mean Area (m^2):	18	24	32	94
Mean Maximum Depth (cm):	58	53	29	43
Mean Average Depth (cm):	35	34	15	21
Mean Residual Depth (cm):	NA	16	--	--
Percent Surveyed as Glides:	NA	7	--	--
Percent Surveyed as Runs:	--	--	NA	5
Percent Surveyed as Cascades:	--	--	NA	0
Percent with > 35% Fines:	0	0	0	0

	Pieces per km	
Large Woody Debris Size Classes	**1995**	**2005**
1 - 5 m long, 10 cm – 55 cm diameter:	71	4
1 - 5 m long, > 55 cm diameter:	4	0
> 5 m long, 10 cm – 55 cm diameter:	13	41
> 5 m long, > 55 cm diameter:	2	0
Total:	91	45

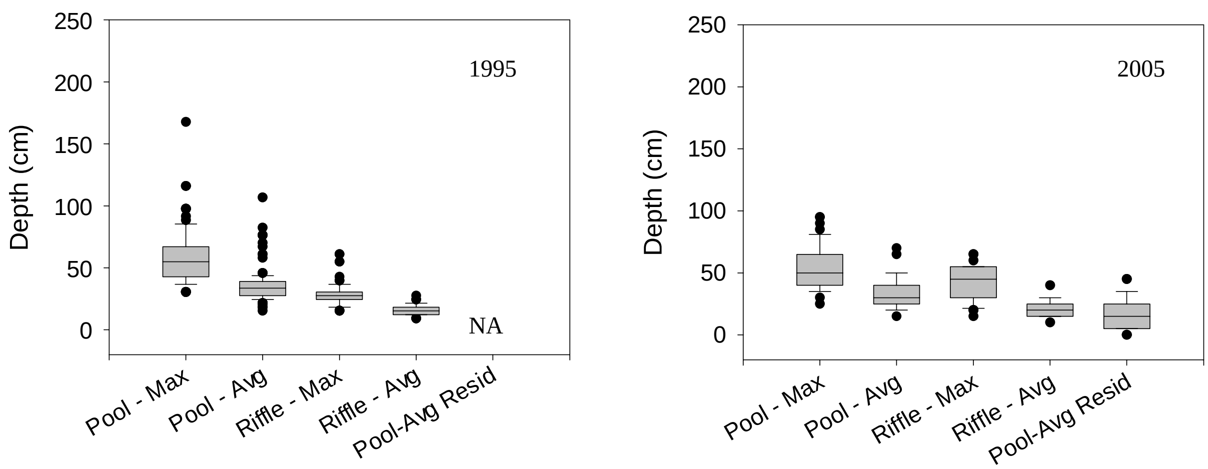
Rosgen's Channel Type*	**Frequency (%)**
A:	0
B:	100
C:	0
D:	0
E:	0
F:	0
G:	0

*recorded in 2005 only

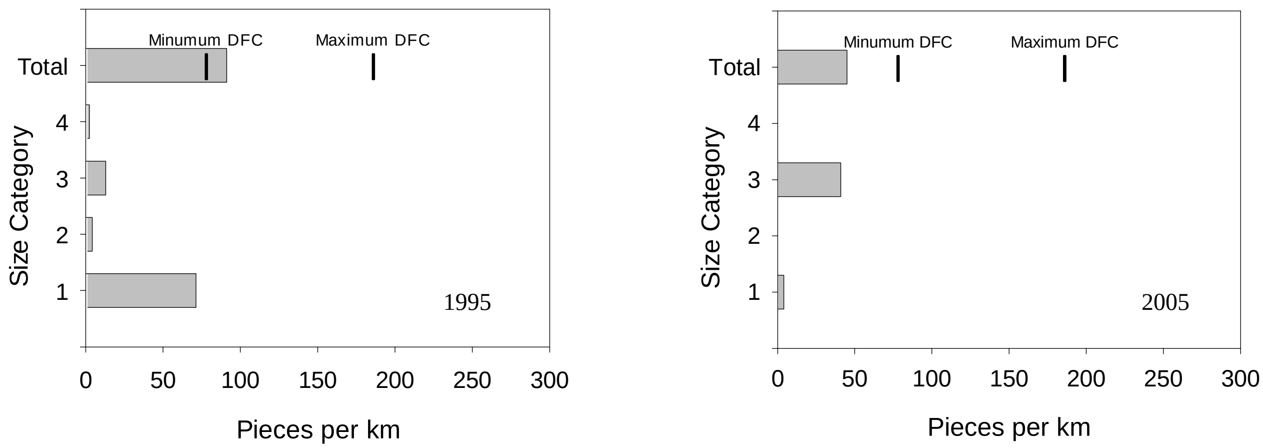
Other Stream Attributes	**1995**	**2005**
Mean Bankfull Channel Width (m):	10	8
Mean Channel Gradient (%):	NA	7
Median Water Temperature (C):	NA	13.5



Estimated area of Coxs Creek in pools and riffles as calculated using BVET techniques. The GWJNF DFC for pool area is 35%-65% of total stream area.



Maximum and average depths for pools and riffles and residual depths in Coxs Creek. The top and bottom of the boxes represent the 25th and 75th percentiles, the bar in the center of the box represents the median, whiskers represent the 10th and 90th percentiles, and closed circles represent the entire range of the data.



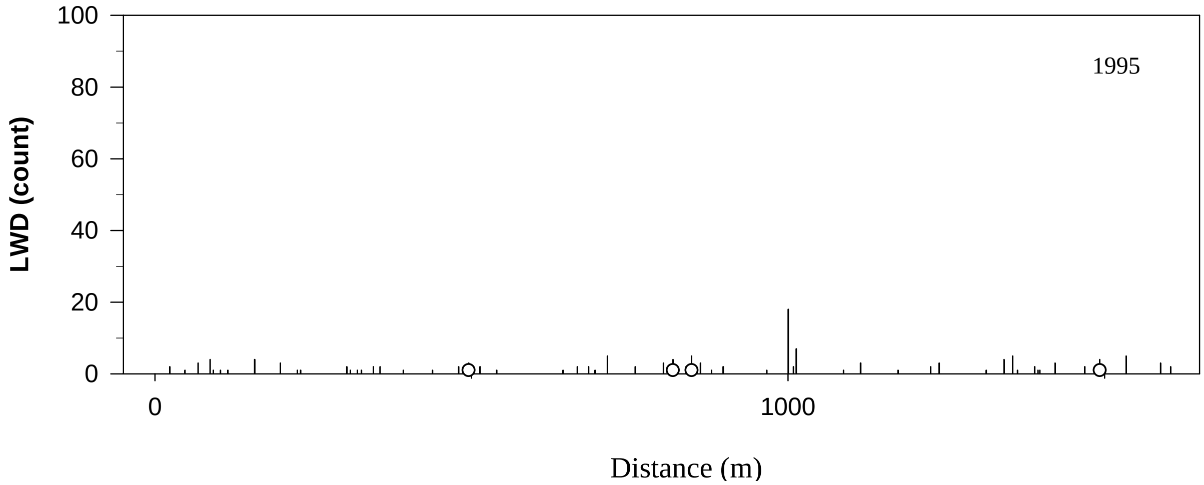
LWD per kilometer in Coxs Creek. LWD size classes: Size 1: < 5 m long, 10-55 cm diameter; Size 2: <5 m long, > 55 cm diameter; Size 3: > 5 m long, 10-55 cm diameter; Size 4: > 5 m long, > 55 cm diameter. The GWJNF DFC for LWD is 78-186 Total pieces per km.

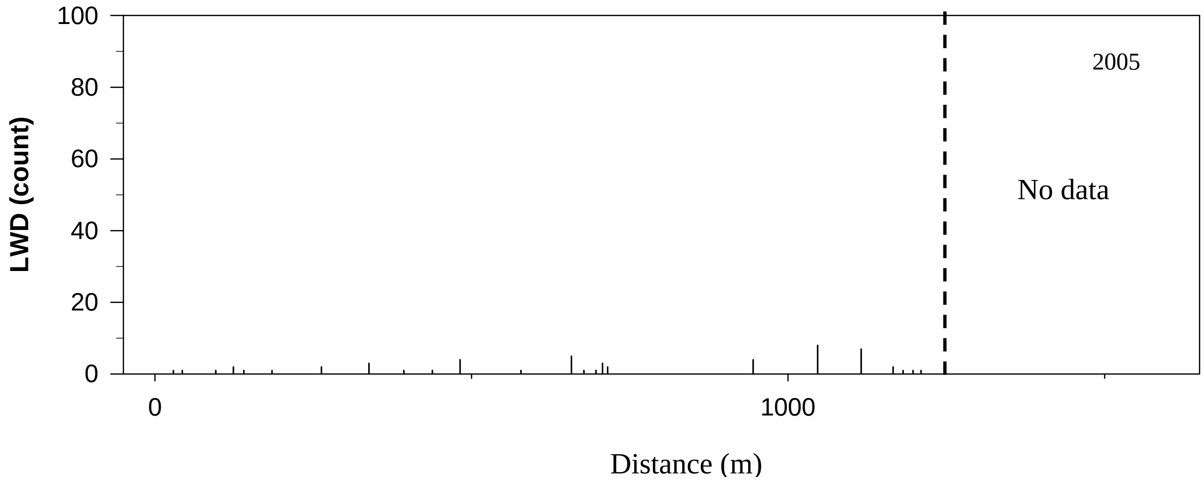
Stream features recorded for Coxs Creek during BVET habitat survey, 1995. Distance is meters from start of survey.

Stream Feature	Distance (m)	Width (m)	Comments
FALL	721.8	1.2	
FALL	941.2	1.2	
FALL	961.6	1.5	
FALL	967.7	1.0	
FALL	1308.8	2.1	
FALL	1342.6	1.5	

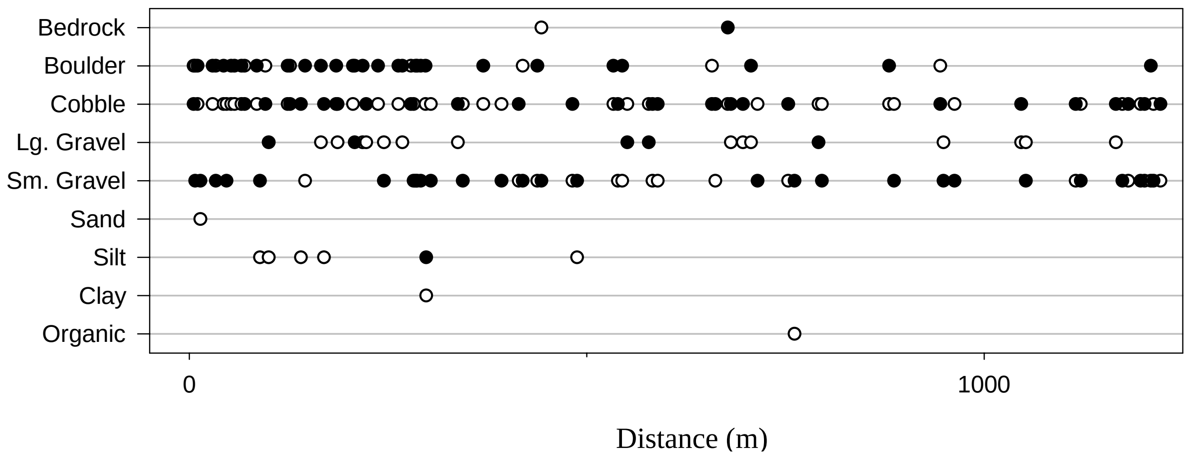
Stream features recorded for Coxs Creek during BVET habitat survey, 2005. Distance is meters from start of survey.

Stream Feature	Distance (m)	Width (m)	Comments
SIDE CHANNEL	317.2		IN ON RIGHT
SIDE CHANNEL	326.9		OUT ON RIGHT
SIDE CHANNEL	350.0		IN ON LEFT
SIDE CHANNEL	373.0		OUT ON LEFT
SIDE CHANNEL	510.5		IN ON RIGHT
SIDE CHANNEL	526.0		OUT ON RIGHT
TRIBUTARY	815.0		IN ON LEFT
SIDE CHANNEL	968.0		IN ON LEFT
SIDE CHANNEL	995.0		OUT ON LEFT
SIDE CHANNEL	1017.0		IN ON RIGHT
SIDE CHANNEL	1045.0		OUT ON RIGHT
END	1222.0		12:30 CONFLUENCE OF 2 TRIBUTARIES

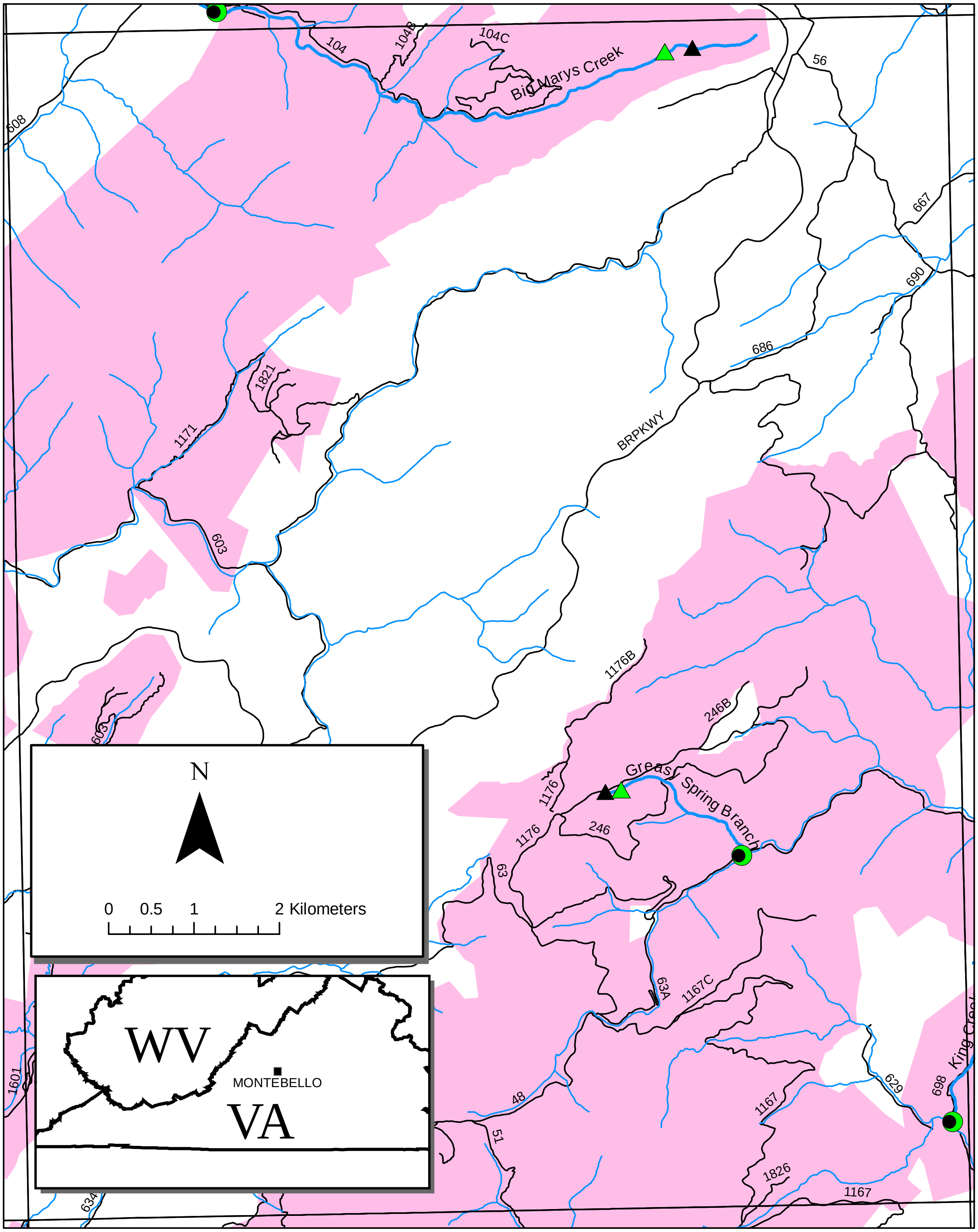




Distribution and abundance of LWD in Coxs Creek in 1995 and 2005. LWD were recorded for each habitat unit in the stream. X-axis indicates distance upstream from National Forest boundary. Dashed line indicates end of shorter survey.



Distribution of substrates in Coxs Creek in 2005. X-axis indicates distance upstream from National Forest boundary. Similar data are not available for the 1995 inventory.



Start (circle) and end (triangle) points for BVET stream habitat inventories performed on stream reaches on the Montebello quadrangle in 1995 (green) and 2005 (black).

Stream:	**Greasy Springs**	
District:	Pedlar	
USGS Quadrangle:	Montebello	
	1995	**2005**
Survey Date:	7/36/1995	5/31/2005
Total Distance Surveyed (km):	1.8	1.9

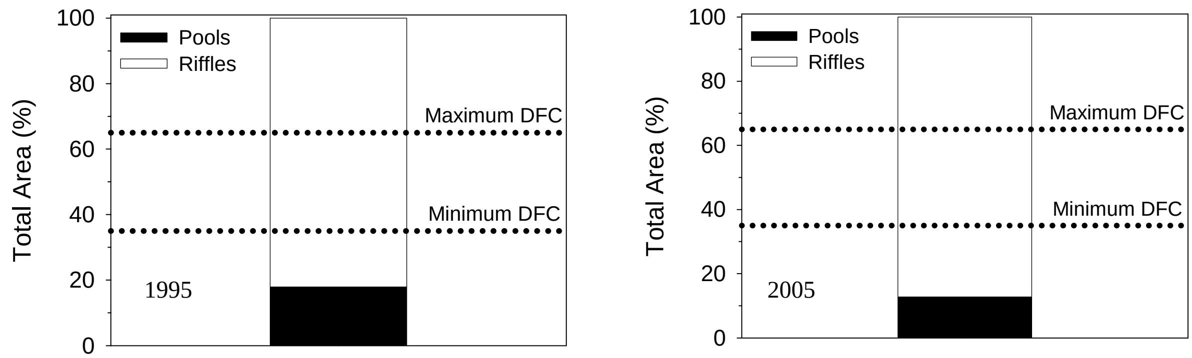
	Pools		**Riffles**	
	1995	**2005**	**1995**	**2005**
Percent of Total Stream Area:	18	13	82	87
Total Area (m^2):	824 ± 575	1008 ± 66	3753 ± 307	6757 +/ 1641
Correction Factor Applied:	0.85	1.00	0.91	1.19
Number of Paired Samples:	5	7	4	7
Total Count:	80	70	74	79
Number per km:	43	36	40	41
Mean Area (m^2):	10	14	51	86
Mean Maximum Depth (cm):	54	46	34	34
Mean Average Depth (cm):	38	31	18	19
Mean Residual Depth (cm):	NA	15	--	--
Percent Surveyed as Glides:	NA	9	--	--
Percent Surveyed as Runs:	--	--	NA	1
Percent Surveyed as Cascades:	--	--	NA	22
Percent with > 35% Fines:	0	60	0	1

	Pieces per km	
Large Woody Debris Size Classes	**1995**	**2005**
1 - 5 m long, 10 cm – 55 cm diameter:	41	25
1 - 5 m long, > 55 cm diameter:	14	20
> 5 m long, 10 cm – 55 cm diameter:	94	108
> 5 m long, > 55 cm diameter:	34	25
Total:	183	178

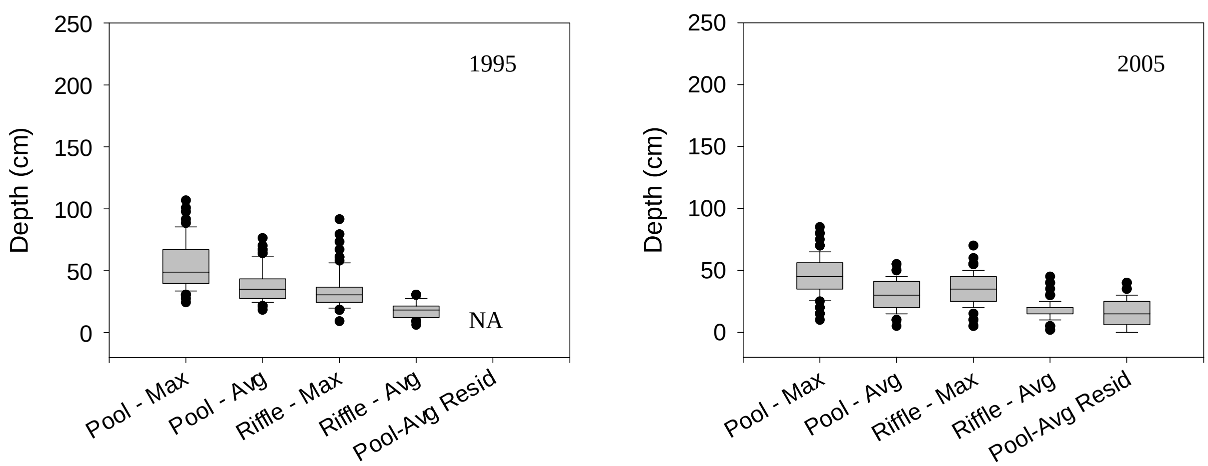
Rosgen's Channel Type*	**Frequency (%)**
A:	72
B:	28
C:	0
D:	0
E:	0
F:	0
G:	0

*recorded in 2005 only

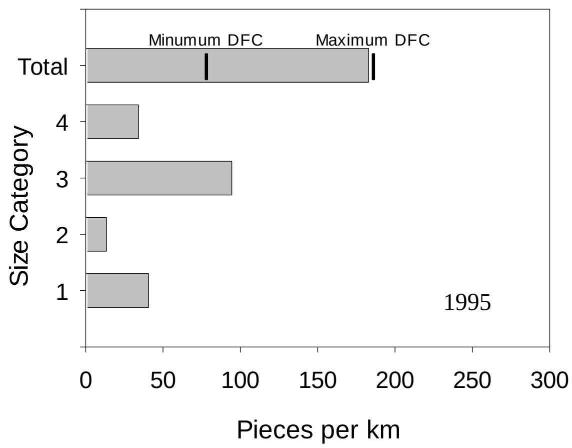
Other Stream Attributes	**1995**	**2005**
Mean Bankfull Channel Width (m):	6	6
Mean Channel Gradient (%):	NA	12
Median Water Temperature (C):	NA	12

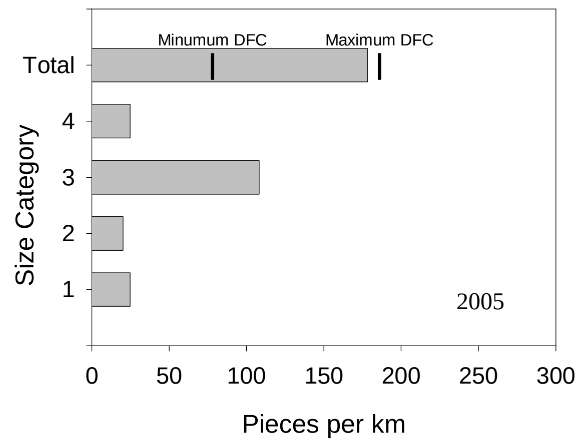


Estimated area of Greasy Springs in pools and riffles as calculated using BVET techniques. The GWJNF DFC for pool area is 35%-65% of total stream area.



Maximum and average depths for pools and riffles and residual depths in Greasy Springs. The top and bottom of the boxes represent the 25th and 75th percentiles, the bar in the center of the box represents the median, whiskers represent the 10th and 90th percentiles, and closed circles represent the entire range of the data.





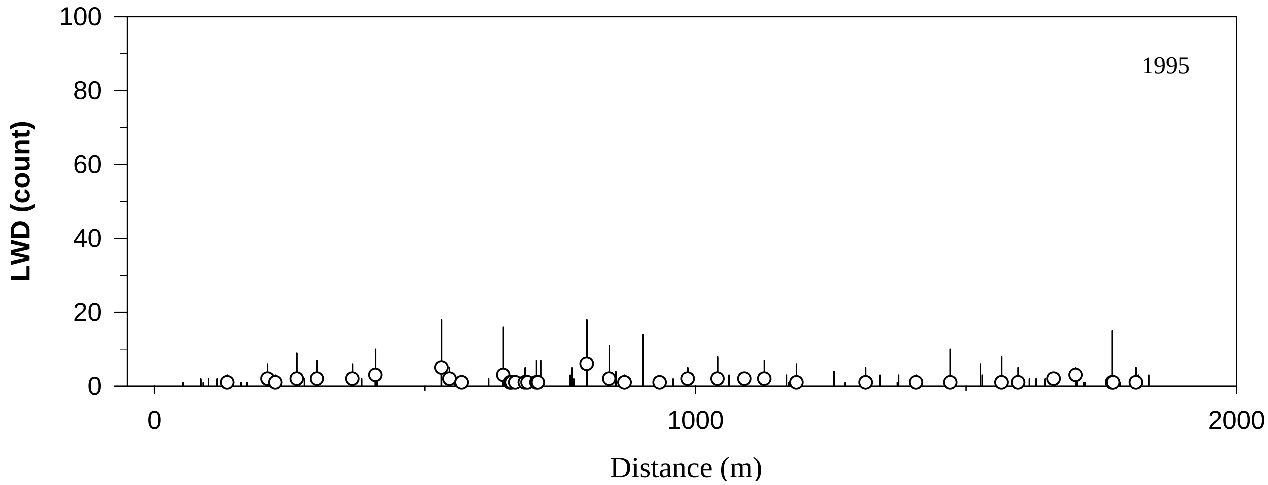
LWD per kilometer in Greasy Springs. LWD size classes: Size 1: < 5 m long, 10-55 cm diameter; Size 2: <5 m long, > 55 cm diameter; Size 3: > 5 m long, 10-55 cm diameter; Size 4: > 5 m long, > 55 cm diameter. The GWJNF DFC for LWD is 78-186 Total pieces per km.

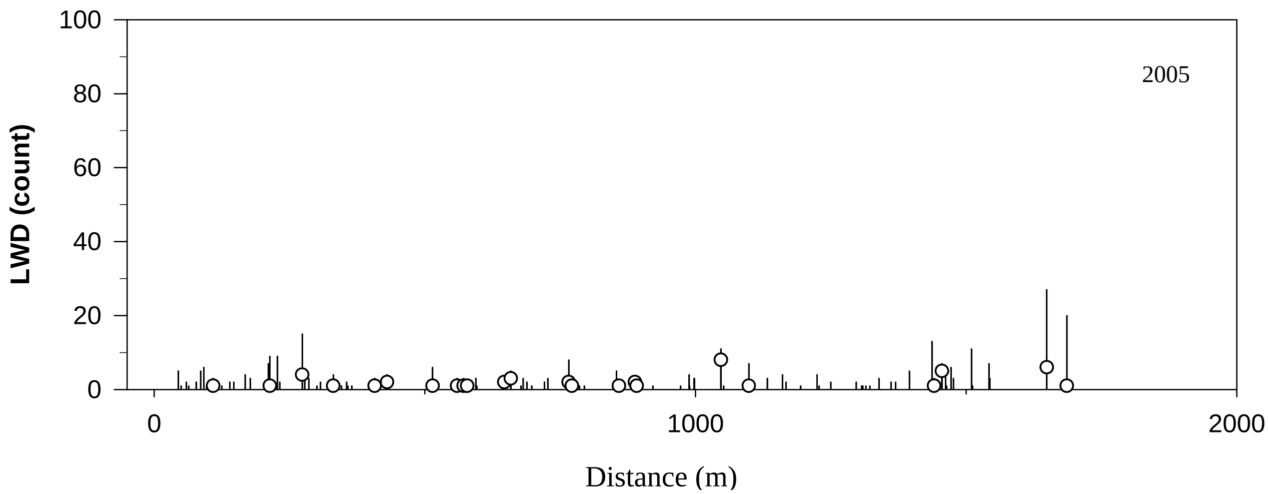
Stream features recorded for Greasy Springs during BVET habitat survey, 1995. Distance is meters from start of survey.

Stream Feature	Distance (m)	Width (m)	Comments
BRIDGE	13.1		
TRIBUTARY	907.7		LEFT
TRIBUTARY	1300.3		RIGHT
CULVERT	1481.9	1.4	
TRIBUTARY	1674.9		RIGHT

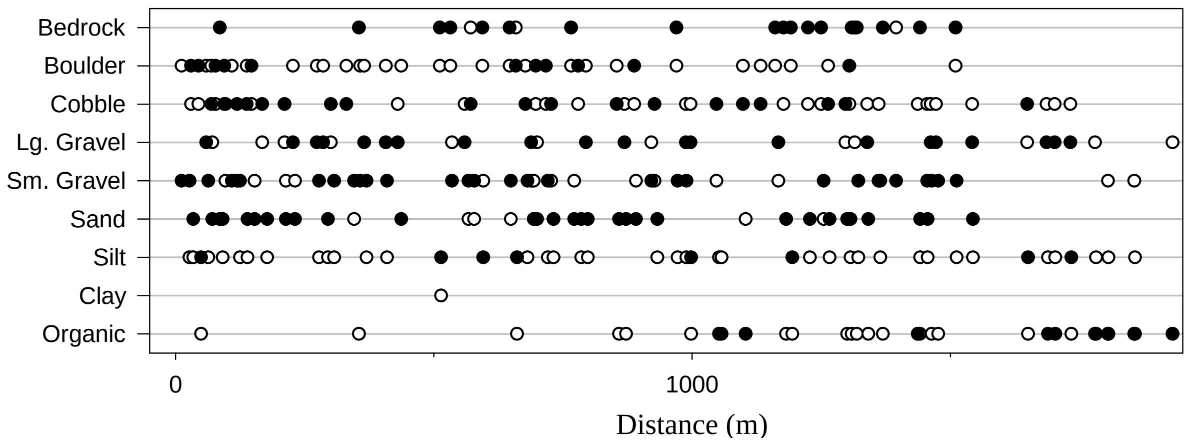
Stream features recorded for Greasy Springs during BVET habitat survey, 2005. Distance is meters from start of survey.

Stream Feature	Distance (m)	Width (m)	Comments
CULVERT	24.1	4.5	FOREST RT. 63, PERCH: 60CM TYPE: PIPE, MATERIAL: METAL
CULVERT	1409.0	3.0	PIPE/METAL





Distribution and abundance of LWD in Greasy Springs in 1995 and 2005. LWD were recorded for each habitat unit in the stream. X-axis indicates distance upstream from National Forest boundary.



Distribution of substrates in Greasy Springs in 2005. X-axis indicates distance upstream from National Forest boundary. Similar data are not available for the 1995 inventory.

Stream:	**King Creek**	
District:	Pedlar	
USGS Quadrangle:	Montebello, Massies Mill	
	1995	**2005**
Survey Date:	7/27/1995	6/30/2005
Total Distance Surveyed (km):	1.7	1.7

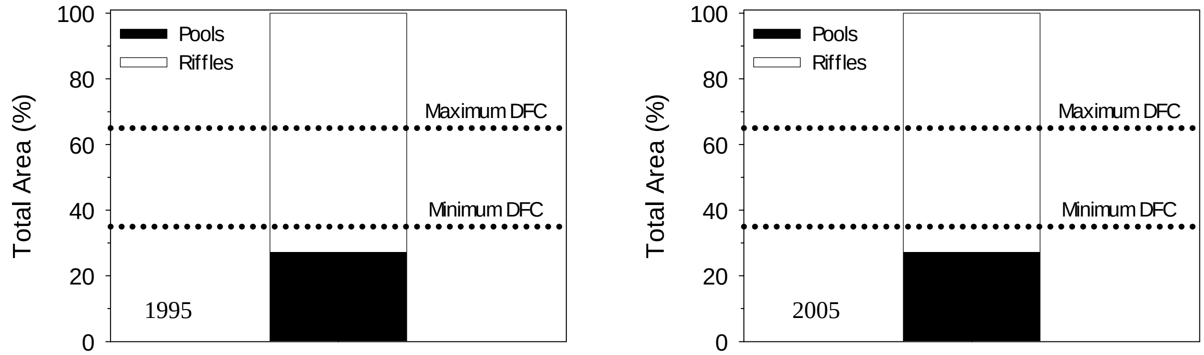
	Pools		**Riffles**	
	1995	**2005**	**1995**	**2005**
Percent of Total Stream Area:	27	21	73	79
Total Area (m^2):	1138 ± 276	1179 ± 317	3023 ± 584	4440 ± 1416
Correction Factor Applied:	0.96	0.99	1.05	1.00
Number of Paired Samples:	6	5	5	5
Total Count:	118	54	96	47
Number per km:	68	33	55	28
Mean Area (m^2):	10	22	31	94
Mean Maximum Depth (cm):	44	48	26	25
Mean Average Depth (cm):	33	32	15	15
Mean Residual Depth (cm):	NA	18	--	--
Percent Surveyed as Glides:	NA	0	--	--
Percent Surveyed as Runs:	--	--	NA	0
Percent Surveyed as Cascades:	--	--	NA	0
Percent with > 35% Fines:	0	37	0	0

	Pieces per km	
Large Woody Debris Size Classes	**1995**	**2005**
1 - 5 m long, 10 cm – 55 cm diameter:	26	14
1 - 5 m long, > 55 cm diameter:	2	0
> 5 m long, 10 cm – 55 cm diameter:	41	41
> 5 m long, > 55 cm diameter:	2	1
Total:	72	56

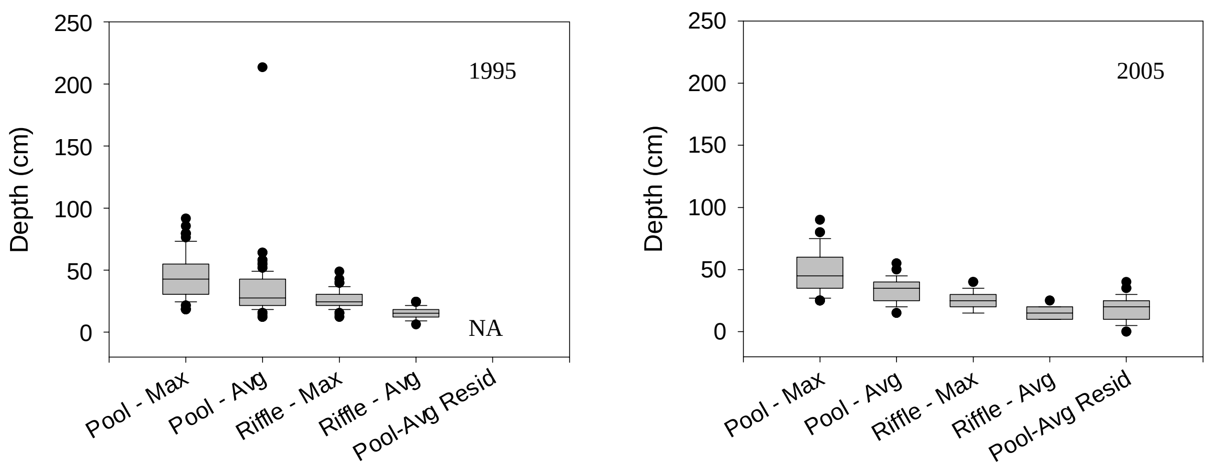
Rosgen's Channel Type*	**Frequency (%)**
A:	33
B:	67
C:	0
D:	0
E:	0
F:	0
G:	0

*recorded in 2005 only

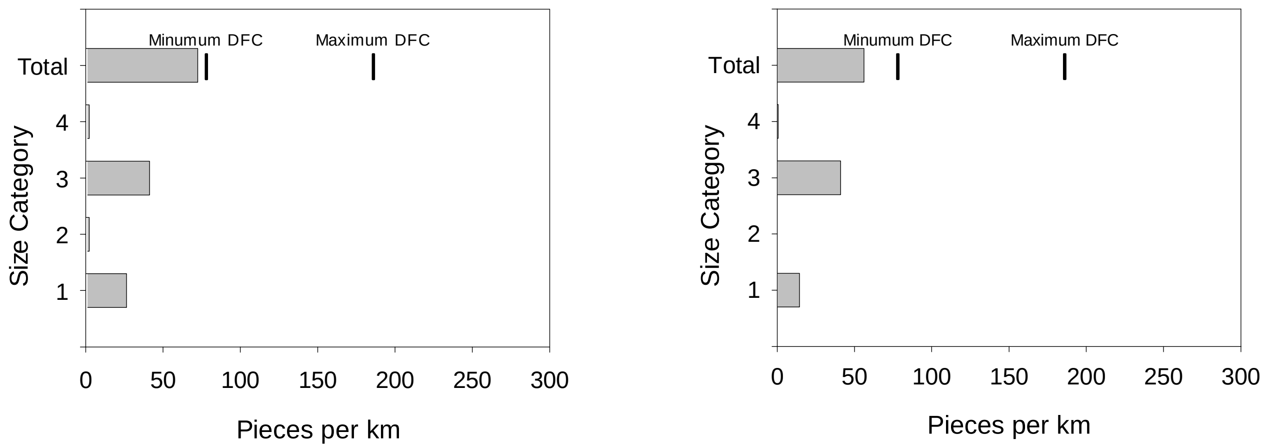
Other Stream Attributes	**1995**	**2005**
Mean Bankfull Channel Width (m):	5	13
Mean Channel Gradient (%):	NA	5
Median Water Temperature (C):	NA	16



Estimated area of King Creek in pools and riffles as calculated using BVET techniques. The GWJNF DFC for pool area is 35%-65% of total stream area.



Maximum and average depths for pools and riffles and residual depths in King Creek. The top and bottom of the boxes represent the 25th and 75th percentiles, the bar in the center of the box represents the median, whiskers represent the 10th and 90th percentiles, and closed circles represent the entire range of the data.



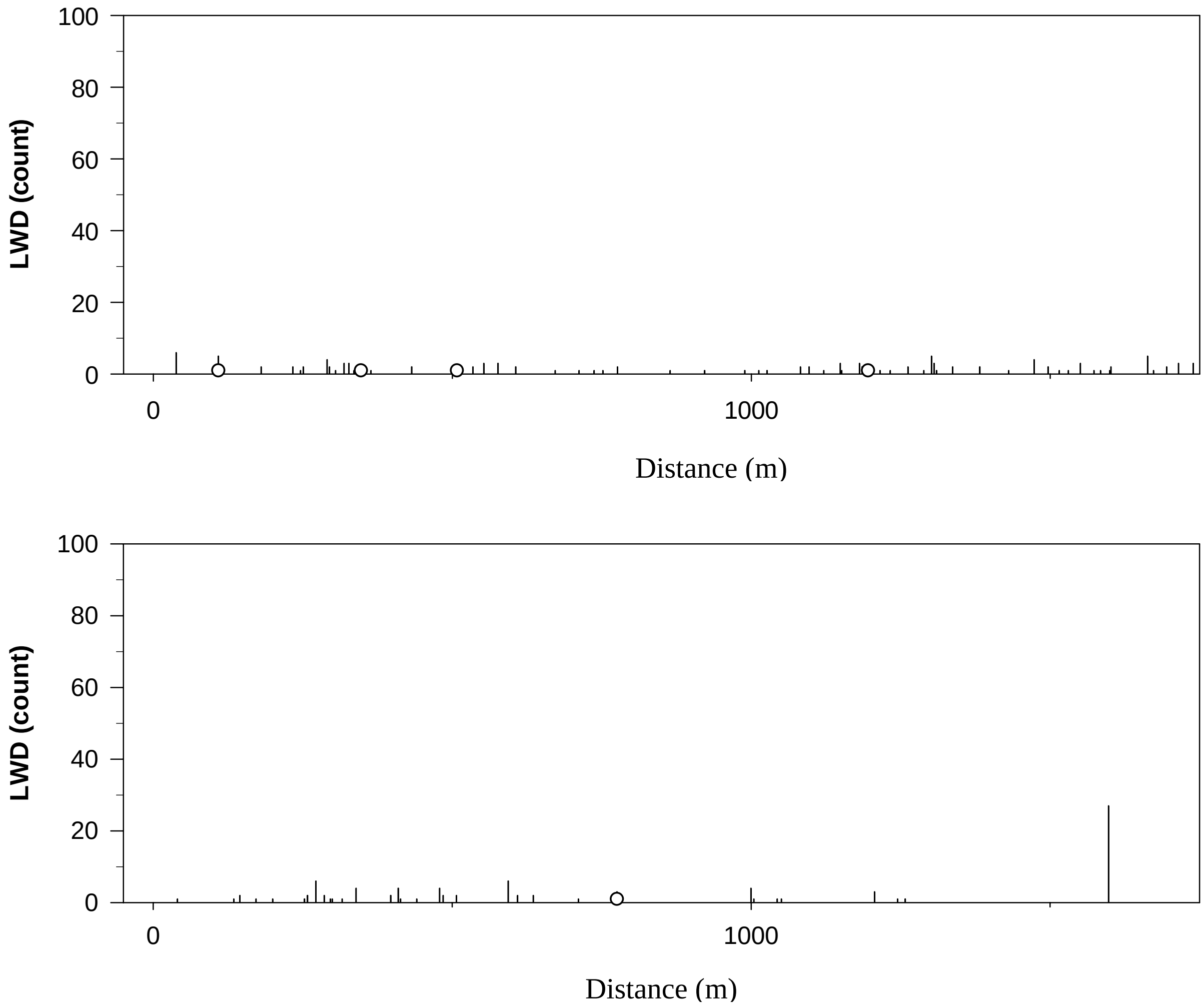
LWD per kilometer in King Creek. LWD size classes: Size 1: < 5 m long, 10-55 cm diameter; Size 2: <5 m long, > 55 cm diameter; Size 3: > 5 m long, 10-55 cm diameter; Size 4: > 5 m long, > 55 cm diameter. The GWJNF DFC for LWD is 78-186 Total pieces per km.

Stream features recorded for King Creek during BVET habitat survey, 1995. Distance is meters from start of survey.

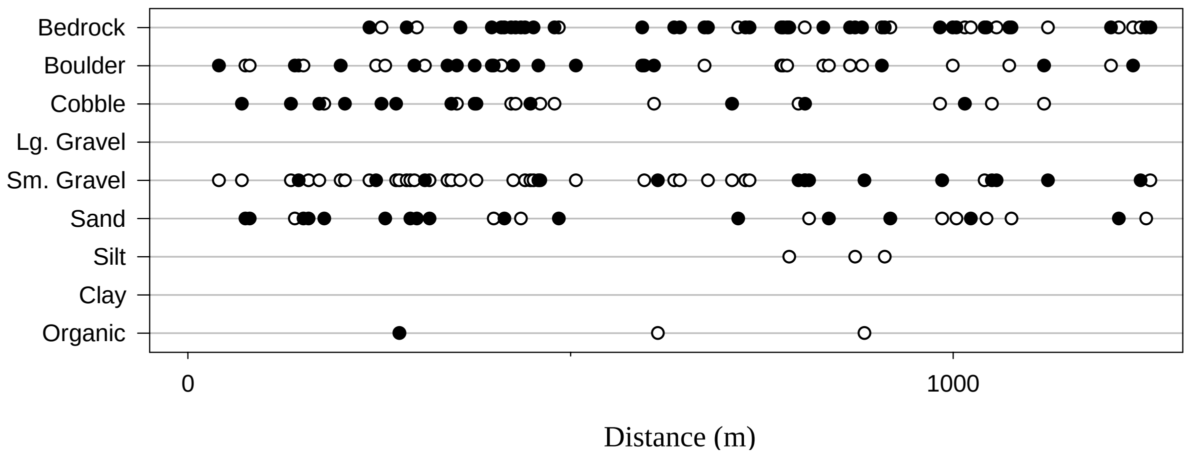
Stream Feature	Distance (m)	Width (m)	Comments
FORD	45.1		TRAIL CROSSING
TRIBUTARY	837.6		RIGHT
FORD	870.2		TRAIL CROSSING
TRIBUTARY	952.2		RIGHT
TRIBUTARY	1345.7		LEFT
TRIBUTARY	1457.9	1.4	
TRIBUTARY	1470.4		RIGHT

Stream features recorded for King Creek during BVET habitat survey, 2005. Distance is meters from start of survey.

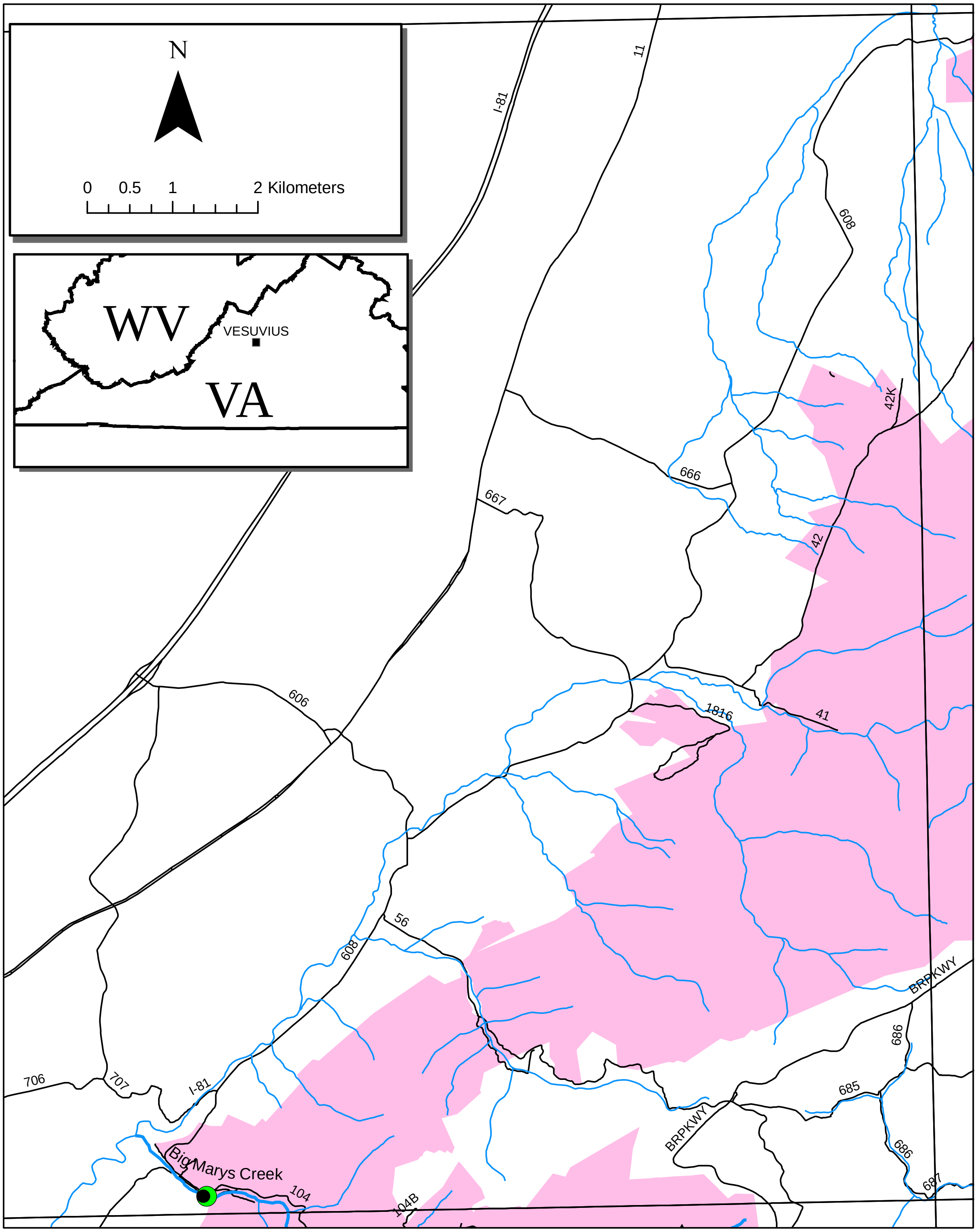
Stream Feature	Distance (m)	Width (m)	Comments
FORD	40.5		ROAD 698
SIDE CHANNEL	748.6		IN ON LEFT
FORD	830.4		ROAD 698
SIDE CHANNEL	1159.7		IN ON LEFT
SIDE CHANNEL	1194.8		OUT ON LEFT
TRIBUTARY	1297.4		IN ON LEFT
TRIBUTARY	1402.7		IN ON RIGHT
END	1656.0		END SURVEY AT RED BOUNDARY BLAZES 17:30.



Distribution and abundance of LWD in King Creek in 1995 and 2005. LWD were recorded for each habitat unit in the stream. X-axis indicates distance upstream from National Forest boundary.



Distribution of substrates in King Creek in 2005. X-axis indicates distance upstream from National Forest boundary. Similar data are not available for the 1995 inventory.



Start (circle) and end (triangle) points for BVET stream habitat inventories performed on stream reaches on the Vesuvius quadrangle in 1995 (green) and 2005 (black).

Stream:	**Big Marys Creek**	
District:	Pedlar	
USGS Quadrangle:	Vesuvius, Montebello	
	1995	**2005**
Survey Date:	7/19/1995	7/05/2005
Total Distance Surveyed (km):	7.2	7.9

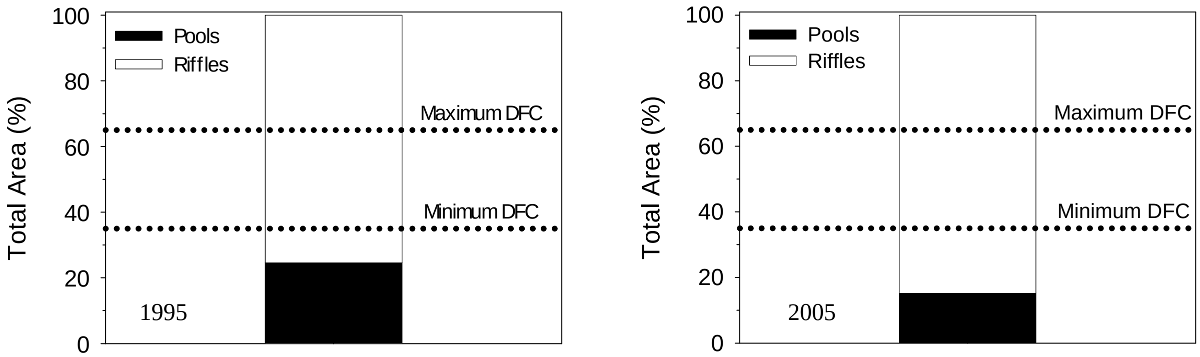
	Pools		**Riffles**	
	1995	**2005**	**1995**	**2005**
Percent of Total Stream Area:	25	15	75	85
Total Area (m^2):	6452 ± 1096	4403 ± 441	19673 ±2412	24420 ± 4516
Correction Factor Applied:	0.96	1.04	1.02	1.26
Number of Paired Samples:	14	11	12	11
Total Count:	265	114	236	114
Number per km:	37	14	33	14
Mean Area (m^2):	24	39	83	214
Mean Maximum Depth (cm):	53	48	25	29
Mean Average Depth (cm):	36	30	14	14
Mean Residual Depth (cm):	NA	22	--	--
Percent Surveyed as Glides:	NA	15	--	--
Percent Surveyed as Runs:	--	--	NA	3
Percent Surveyed as Cascades:	--	--	NA	12
Percent with > 35% Fines:	0	17	0	1

	Pieces per km	
Large Woody Debris Size Classes	**1995**	**2005**
1 - 5 m long, 10 cm – 55 cm diameter:	10	5
1 - 5 m long, > 55 cm diameter:	3	0
> 5 m long, 10 cm – 55 cm diameter:	4	35
> 5 m long, > 55 cm diameter:	2	2
Total:	20	43

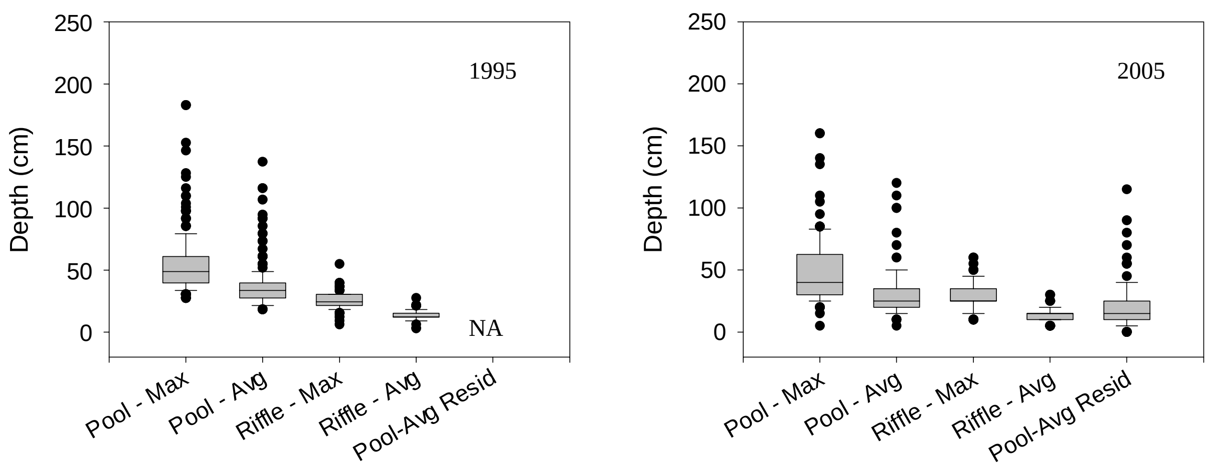
Rosgen's Channel Type*	**Frequency (%)**
A:	15
B:	85
C:	0
D:	0
E:	0
F:	0
G:	0

*recorded in 2005 only

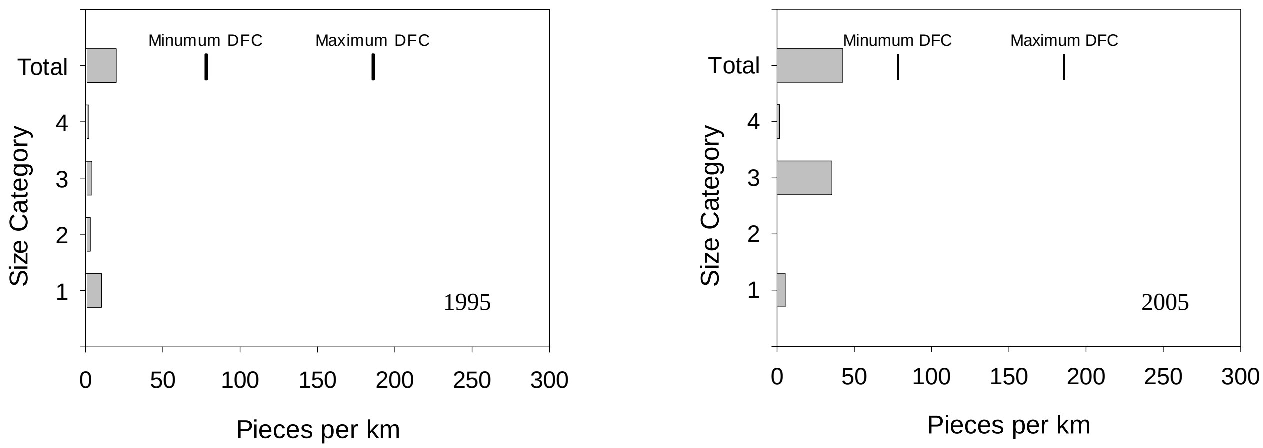
Other Stream Attributes	**1995**	**2005**
Mean Bankfull Channel Width (m):	8	7
Mean Channel Gradient (%):	NA	5
Median Water Temperature (C):	NA	21



Estimated area of Big Marys Creek in pools and riffles as calculated using BVET techniques. The GWJNF DFC for pool area is 35%-65% of total stream area.



Maximum and average depths for pools and riffles and residual depths in Big Marys Creek. The top and bottom of the boxes represent the 25th and 75th percentiles, the bar in the center of the box represents the median, whiskers represent the 10th and 90th percentiles, and closed circles represent the entire range of the data.



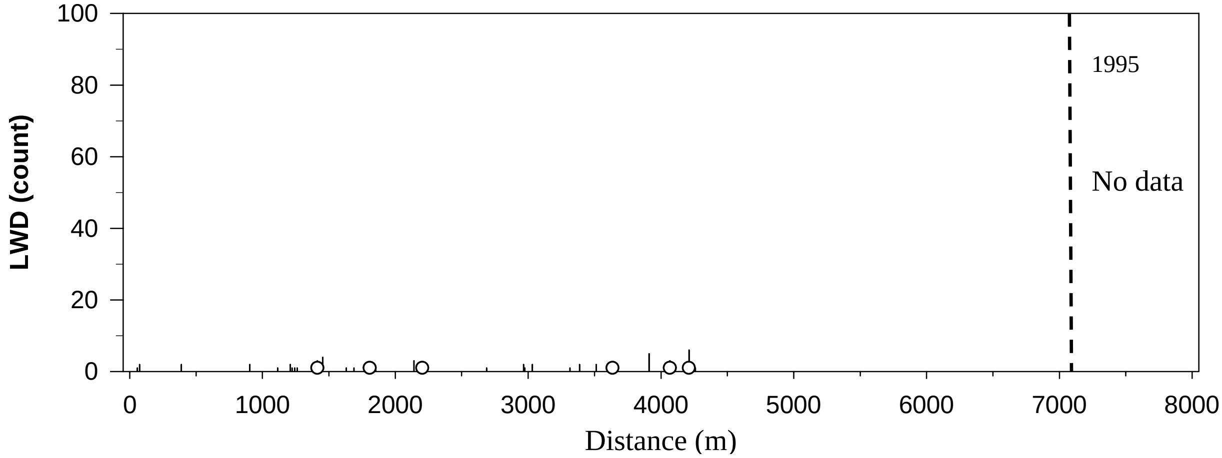
LWD per kilometer in Big Marys Creek. LWD size classes: Size 1: < 5 m long, 10-55 cm diameter; Size 2: <5 m long, > 55 cm diameter; Size 3: > 5 m long, 10-55 cm diameter; Size 4: > 5 m long, > 55 cm diameter. The GWJNF DFC for LWD is 78-186 Total pieces per km.

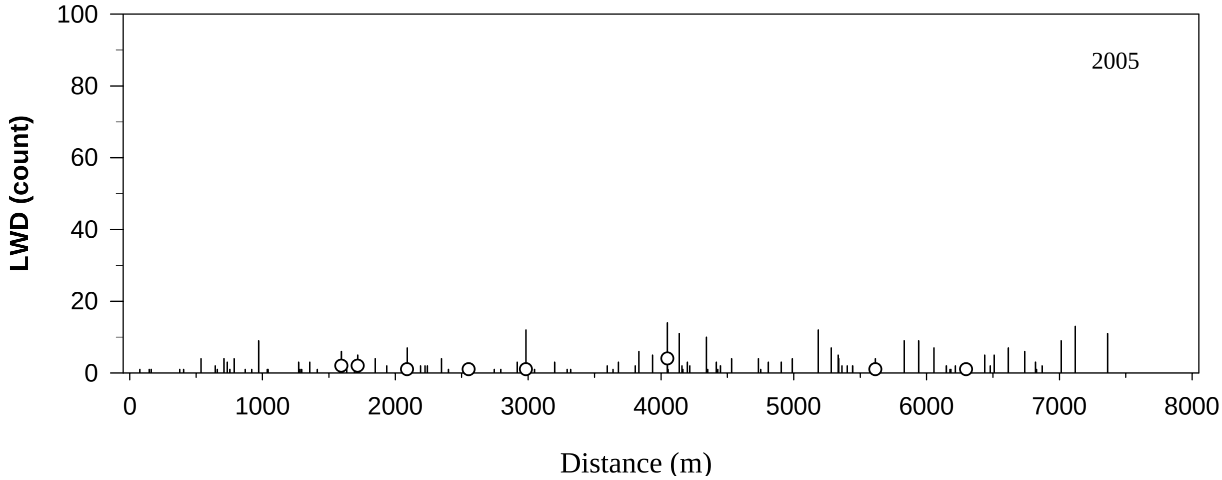
Stream features recorded for Big Marys Creek during BVET habitat survey, 1995. Distance is meters from start of survey.

Stream Feature	Distance (m)	Width (m)	Comments
TRIBUTARY	652.3		RIGHT, DRY
FORD	766.6		TRAIL CROSSING
TRIBUTARY	1037.5		LEFT
TRIBUTARY	2552.4		LEFT
TRIBUTARY	2764.2		RIGHT
FORD	3512.2		TRAIL CROSSING
TRIBUTARY	3517.4		RIGHT
TRIBUTARY	3838.7		LEFT
FORD	6938.5		TRAIL CROSSING

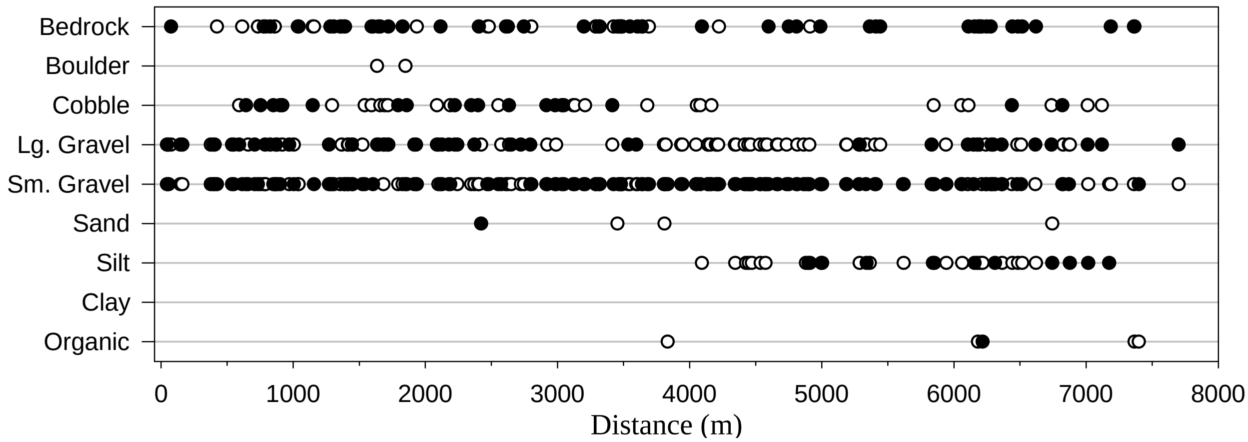
Stream features recorded for Big Marys Creek during BVET habitat survey, 2005. Distance is meters from start of survey.

Stream Feature	Distance (m)	Width (m)	Comments
TRIBUTARY	156.0	1.0	IN ON RIGHT
CULVERT	385.4		OPEN BOTTOM PIPE, HAS WING WALLS, 6M WIDE, HAS NATURAL SUBSTRATE
OTHER	462.0		CAMP ON RIGHT BANK
TRIBUTARY	1090.0	1.5	IN ON LEFT
SIDE CHANNEL	1400.0		IN ON RIGHT
SIDE CHANNEL	1444.0		OUT ON RIGHT
OTHER	1470.0		UNDERCUT BANK
FALL	1659.0	1.0	
TRIBUTARY	1935.3		DRY, IN ON RIGHT
TRIBUTARY	2654.2	1.0	IN ON LEFT
SIDE CHANNEL	2907.0		IN ON RIGHT
FORD	3393.4		
TRIBUTARY	3398.0		DRY IN ON RIGHT
SIDE CHANNEL	4077.7		IN ON RIGHT
SIDE CHANNEL	4117.0		OUT ON RIGHT
FORD	4290.0		TRAIL FORDS STREAM
FORD	4461.0		ROAD ENDS
TRIBUTARY	4461.0	0.5	IN ON LEFT
TRIBUTARY	4560.0		DRY IN ON RIGHT
FORD	5830.6		
SIDE CHANNEL	5860.0		IN ON LEFT
SIDE CHANNEL	5882.0		OUT ON LEFT
FORD	6170.0		TRAIL
SEEP	6478.8		IN ON RIGHT
FORD	6794.2		
OTHER	6888.0		LARGE BOULDER
SIDE CHANNEL	7025.0		IN ON LEFT
SIDE CHANNEL	7033.0		OUT ON LEFT
SIDE CHANNEL	7115.0		IN ON LEFT
SIDE CHANNEL	7167.1		OUT ON LEFT
END	7916.0		STREAM CHANNEL WAS LOST





Distribution and abundance of LWD in Big Marys Creek in 1995 and 2005. LWD were recorded for each habitat unit in the stream. X-axis indicates distance upstream from National Forest boundary. Dashed line indicates end of shorter survey.



Distribution of substrates in Big Marys Creek in 2005. X-axis indicates distance upstream from National Forest boundary. Similar data are not available for the 1995 inventory.

Appendix B: Habitat Inventory Categories

Table A1. Size classes used to categorize large woody debris during BVET habitat inventories on the Pedlar Ranger District, summer 1995 and 2005. Woody debris < 1.0 m in length or < 10 cm in diameter were omitted.

Size Class	Length (m)	Diameter (cm)
1	< 5	10-55
2	< 5	> 55
3	> 5	10-55
4	> 5	> 55

Table A2. Size classes used to categorize substrate particles during BVET habitat inventories on the Pedlar Ranger District, summer 2005. Size was visually estimated on the intermediate axis (b-axis).

Size Class	Name	Size (mm)	Description
1	Organic	--	Dead organic matter, leaves, detritus, etc.
2	Clay	< 0.00024	Sticky
3	Silt	0.00024-0.0039	Slippery
4	Sand	0.0039-2	Gritty
5	Small Gravel	3-16	Sand to thumbnail
6	Large Gravel	17-64	Thumbnail to fist
7	Cobble	65-256	Fist to head
8	Boulder	>256	Larger than head
9	Bedrock	--	Solid parent material

Table A3. Bankfull channel characteristics used to determine Rosgen channel types in the field during BVET habitat inventories on the Pedlar Ranger District, summer 2005.

Channel Type	A	B	C	D	E	F	G
Entrenchment	< 1.4	1.4 – 2.2	> 2.2	n/a	> 2.2	< 1.4	< 1.4
W/D Ratio	< 12	> 12	> 12	> 40	< 12	> 12	< 12
Slope (%)	4 – 9.9	2 – 3.9	< 2	< 4	< 2	< 2	2 – 3.9

American eel population density, growth and behavior in three Virginia mountain streams

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September 2005

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Abstract

American eels (*Anguilla rostrata*) historically occupied waters ranging from large coastal plain rivers to small mountain streams throughout the James River drainage (VA, USA). As their population numbers have declined overall, American eels have become increasingly rare in mountain streams. Little is known about the biology or behavior of American eels in mountain streams, or how to most effectively manage watersheds to protect or restore American eel habitat. In 1999, we used mark-recapture, passive integrated transponder (PIT) tag, and radio telemetry to examine population density, growth rates, and behavior of American eels within three mountain streams in the James River drainage. Our findings include population densities of 0.8 – 5.1 eels/100 m^2, average growth rates of 19 to 69 mm/yr, and limited movement of eels within study sections. In addition, we observed eels using interstitial spaces and undercut banks during periods of decreased activity associated with low water temperatures during winter. Eel population densities and growth rates within the studied streams are within the bounds of previously studied populations in eastern North America. The winter 'burrowing' behavior has implications for watershed management regarding stream bank stabilization and sediment inputs.

Introduction

American eels (*Anguilla rostrata*) historically occupied waters ranging from large coastal plain rivers to small mountain streams along the Atlantic slope, including tributarties to the Chesapeake Bay such as the James River (VA, USA). As population numbers have declined throughout their range (Haro et al. 2000), American eels have become increasingly rare in mountain streams (Jenkins and Burkhead 1993), yet little is known about the biology or behavior of American eels in mountain streams, or how to most effectively manage mountain watersheds to protect or restore American eel habitat.

In 1999, we used mark-recapture, passive integrated transponder (PIT) tag, and radio telemetry to examine population density, growth rates, and behavior (Table 1) of American eels in three mountain streams in the James River drainage (Figure 1). The objectives of our study were to:1) determine population density, 2) determine annual growth rate, 3) determine movement and activity patterns, and 4) compare results with previous American eel studies.

Methods

Population Density

We used mark-recapture to estimate the density of American eels in Shoe Creek, South Fork Piney River, and South Fork Tye River in summer 2000 and summer 2001. We captured eels by making a single pass through a 1000-m long reach with two 700 V AC backpack electrofishing units. All eels that we captured were given a pectoral fin clip and were released at their point of capture. We recaptured eels by making a second pass through the reach 1-2 days after marking was completed. We used Bailey's modification of the Petersen method (Ricker 1975) to estimate population size: $N = (M+1)(C+1)/(R+1)$; where 'N' is the population estimate, 'M' is the number marked and released, 'C' is the total number captured during the recapture event, and 'R' is the number of recaptures during the recapture event. Population estimates were divided by stream area (1000 m reach * average stream width) to calculate population densities.

Growth Rate

All captured eels greater than 200 mm total length (TL) were injected with a PIT tag (11.5 mm x 1.5 mm; 0.06 g). PIT tags contain a unique 10-digit alphanumeric code that identifies fish as individuals upon recapture. We sampled an additional 500 m upstream and downstream of the mark-recapture reach (2 km reach total) to capture additional eels for the growth rate study. We returned to the streams in summer 2002 - 2005 (except South Fork Piney, summer 2002 only) to recapture PIT tagged eels and mark additional fish. We calculated change in length and weight for eels that were marked with a PIT tag and then recaptured the following year as follows: $\Delta size = size_{t2} - size_{t1}$.

Behavior

We used radio telemetry to monitor movement and activity of 13 eels in Shoe Creek, 10 eels in South Fork Piney, and 10 eels in South Fork Tye River from summer 2000 to summer 2001. Radio transmitters (45 mm x 10 mm; 10 g) were surgically implanted into eels larger than 500 mm TL. The location of each eel was recorded at least once per week. In addition we monitored diel movement and activity of individual eels hourly for 24-hour periods. Diel tracking was performed for each eel at least once per season (winter, spring, summer, fall). Activity levels were determined during diel monitoring by listening for signal strength fluctuations during 3-minute periods. Fluctuations in signal strength represented an actively moving eel (Clapp et al. 1990). We used a combination of radio telemetry and direct observation by divers to document American eel behavior during periods of low activity in winter 2000.

Results

Population Density

Population density ranged from a low of 0.79±0.6 eels/100 m^2 in South Fork Piney River 2001 to a high of 5.1±1.5 eels/100 m^2 in the South Fork Tye River 2001. The Tye River had the highest and South Fork Piney River had the lowest population densities in both years (Figure 2).

Growth Rate

We PIT tagged a total of 1,312 eels between 1999 and 2005 and recaptured 2 - 35% the year after tagging (Table 2). On average, American eels captured the year after being marked and released grew 14 - 27 mm/yr (19 - 35 g/yr) in the South Fork Tye River and 22 - 51 mm/yr (29 - 46 g/yr) in Shoe Creek 1999-2001. The lowest growth rates for the South Fork Tye River were in

2005 (Figure 3). We did not recapture enough eels in Shoe Creek 2001-2005 or in South Fork Piney River in any year to estimate growth rates.

Behavior

Radio telemetered eels occupied a mean stream distance (distance between furthest upstream and furthest downstream locations) of 228±114 m, 375±358 m, 28±22 m, 276±267 m, and 36±24 m in summer 2000, fall 2000, winter 2000, spring 2001 and summer 2001, respectively. Only two eels moved among habitat units during diel monitoring; one moved 500 m downstream between 21:00 and 23:00 on 7/30/2000 and one moved 30 m downstream between 03:00 and 13:00 on 10/27/2000. Diel activity levels were lowest in winter 2000 (Figure 4). Telemetry locations suggested and diver observations confirmed that American eels occupied interstitial spaces between boulder and cobble substrates in the stream bed and beneath stream banks during periods of low activity in winter 2000.

Conclusions

The population densities and growth rates we observed were within the bounds of previous studies despite the fact that the majority of these studies focused on eels in larger warm-water rivers or estuaries. When compared with other non-coastal plain rivers in the James River drainage, the eel densities that we observed in the South Fork Tye River are atypically high (Smogor et al. 1995, Virginia Department of Game and Inland Fisheries (VDGIF), unpublished data). The average growth rates we observed were lower than those observed in coastal streams in GA (57-62 mm/yr; Helfman et al. 1984), but were similar to those observed in coastal RI (23-33 mm/yr; Oliveira 1999) and ME streams (18-32 mm/yr; Oliveira and McCleave 2002).

Our telemetry results suggest that eels in Virginia mountain streams occupy relatively small annual ranges (less than 300 m) and our mark-recapture results show that many eels occupy the same stream reach for several consecutive years. Half of the eels marked during the initial PIT tagging event (1999 in Shoe Creek, 2000 in South Fork Tye River) were recaptured at least once by 2004 (Table 2). In addition, telemetry results show that eels in VA mountain streams become less active and occupy interstitial spaces between large substrate particles in the stream bed and beneath stream banks during winter. Decreased activity is likely a physiological response to decreased water temperature in winter. American eels entered a torpid when held in a lab at less than 10 C (Walsh et al. 1983) and water temperature in VA mountain streams falls well below 10 C during winter (Figure 6).

Our results demonstrate that at least some Virginia mountain streams are capable of supporting large numbers of eels. Given that the vast majority of these eels are likely females (Jenkins 1993), and given the thousands of kilometers of mountain streams in the eastern U. S., these streams represent a potentially large source of reproductive power for a population in decline. This begs the question, ‘Why is the population density in South Fork Tye River much higher than other mountain streams?’. Possible explanations include access and habitat quality.

Access to many mountain streams may be limited by the presence of small dams. These dams may not present a complete barrier, but can have a cumulative filter effect (Verdon et al. 2003). A small lowhead dam located is located in the Piney River drainiage, but whether this can explain the differences in population density observed here is unknown. Where access is not limited eel density may be affected by habitat quality. Little is known about the habitat preferences of American eels in mountain streams and behavior when unfavorable conditions are encountered. For example, the effect of the absence or loss of interstitial spaces for overwintering habitat on eel density is unknown. Clearly, further investigation is needed to determine factors affecting use of mountain streams by American eels and the relative importance of these streams to the overall American eel population.

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Table 1. Activity on Shoe Creek, South Fork Piney River, and South Fork Tye River 1999 – 2005.

	1999	2000	2001	2002	2003	2004	2005
Shoe Creek							
population density		x	x				
growth rate	x	x	x	x	x	x	x
behavior		x	x				
South Fork Piney River							
population density		x	x				
growth rate		x	x	x			
behavior		x	x				
South Fork Tye River							
population density		x	x				
growth rate		x	x	x	x	x	x[1]
behavior		x	x				

[1]attempted recapture of previously tagged eels only; no new tags implanted

Table 2. Total American eels captured, number of PIT tags implanted, and percentage of recaptures in Shoe Creek, South Fork Piney River, and South Fork Tye River. Eels less than 200 mm were not tagged. Percentage of recaptures given as percent recaptured the following year (time t+1) and total percentage recaptured in all following years (all times). Multiple electrofishing passes were made through the reaches in 2000 and 2001. Single passes were used 2002 – 2005.

	Eels Captured	PIT implants	% recaps (time t+1)	% recaps (all times)
Shoe Creek				
1999	73	68	32	46
2000	132	93	20	37
2001	87	41	7	24
2002	42	22	9	27
2003	35	16	13	19
2004	67	43	2	2
2005	22	0	--	--
total:	458	283		
South Fork Piney River				
2000	49	40	5	23
2001	39	30	7	7
2002	57	41	--	
total:	145	111		
South Fork Tye River				
2000	334	279	35	56
2001	352	226	25	44
2002	290	149	17	33
2003	180	76	14	25
2004	232	116	18	18
2005	184	72	--	--
total:	1572	918		

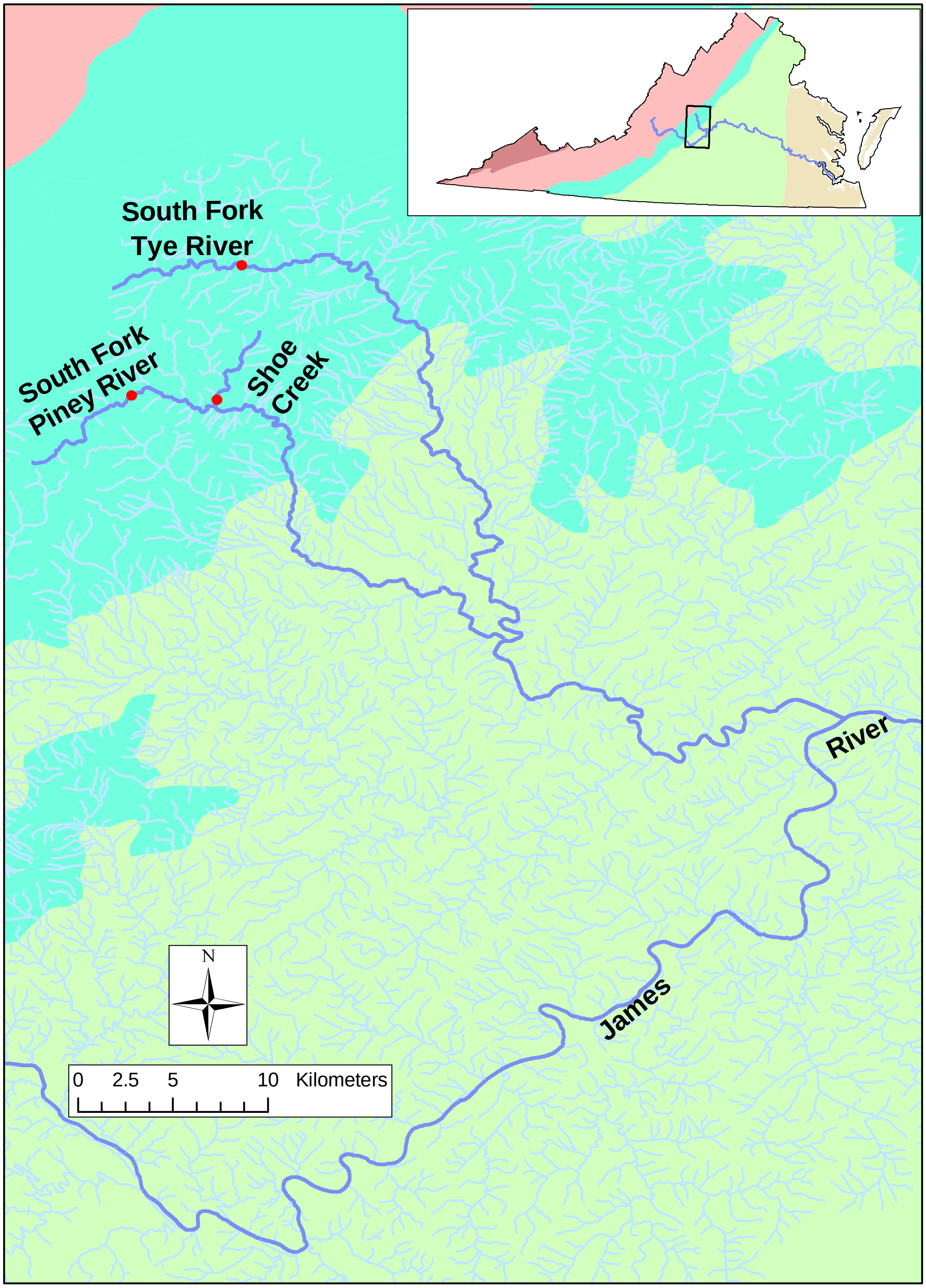

Figure 1. Study areas on Shoe Creek, South Fork Piney River, and South Fork Tye River. Shading indicates physiographic provinces; tan = Coastal Plain light green = Piedmont, dark green = Blue Ridge, pink = Valley and Ridge, red = Appalachian Plateau.

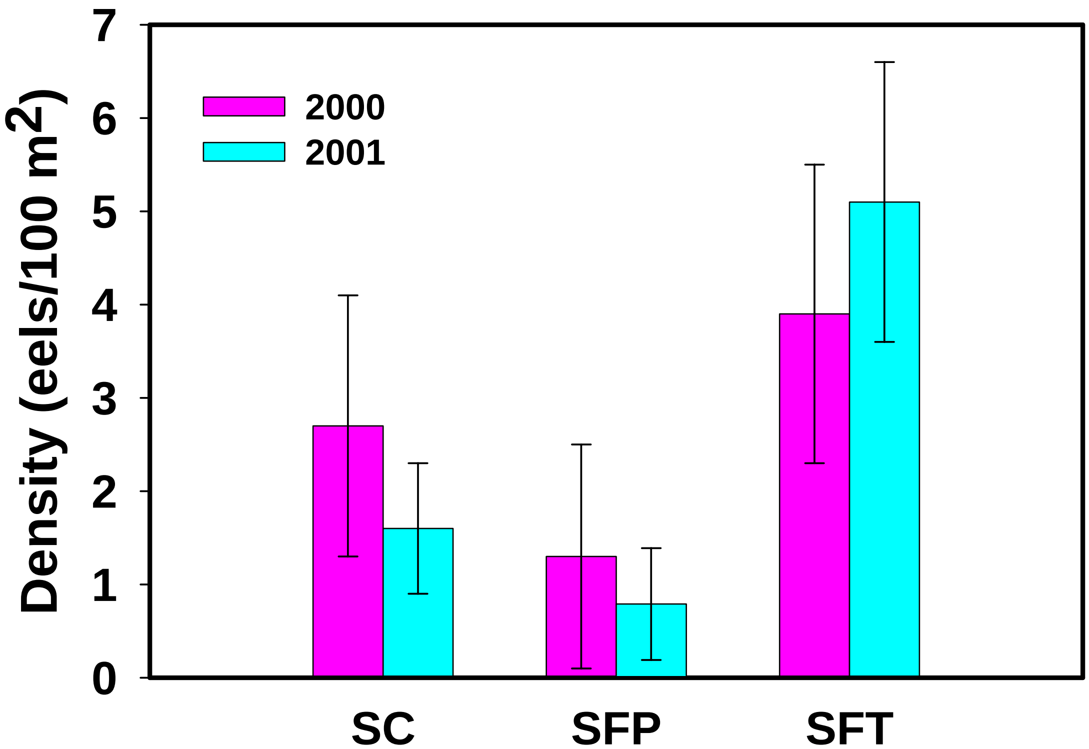

Figure 2. Population density of American eels in Shoe Creek (SC), South Fork Piney River (SFP), and South Fork Tye River (SFT) in 2000 and 2001 as determined by mark-recapture estimates. Error bars show 95% confidence intervals.

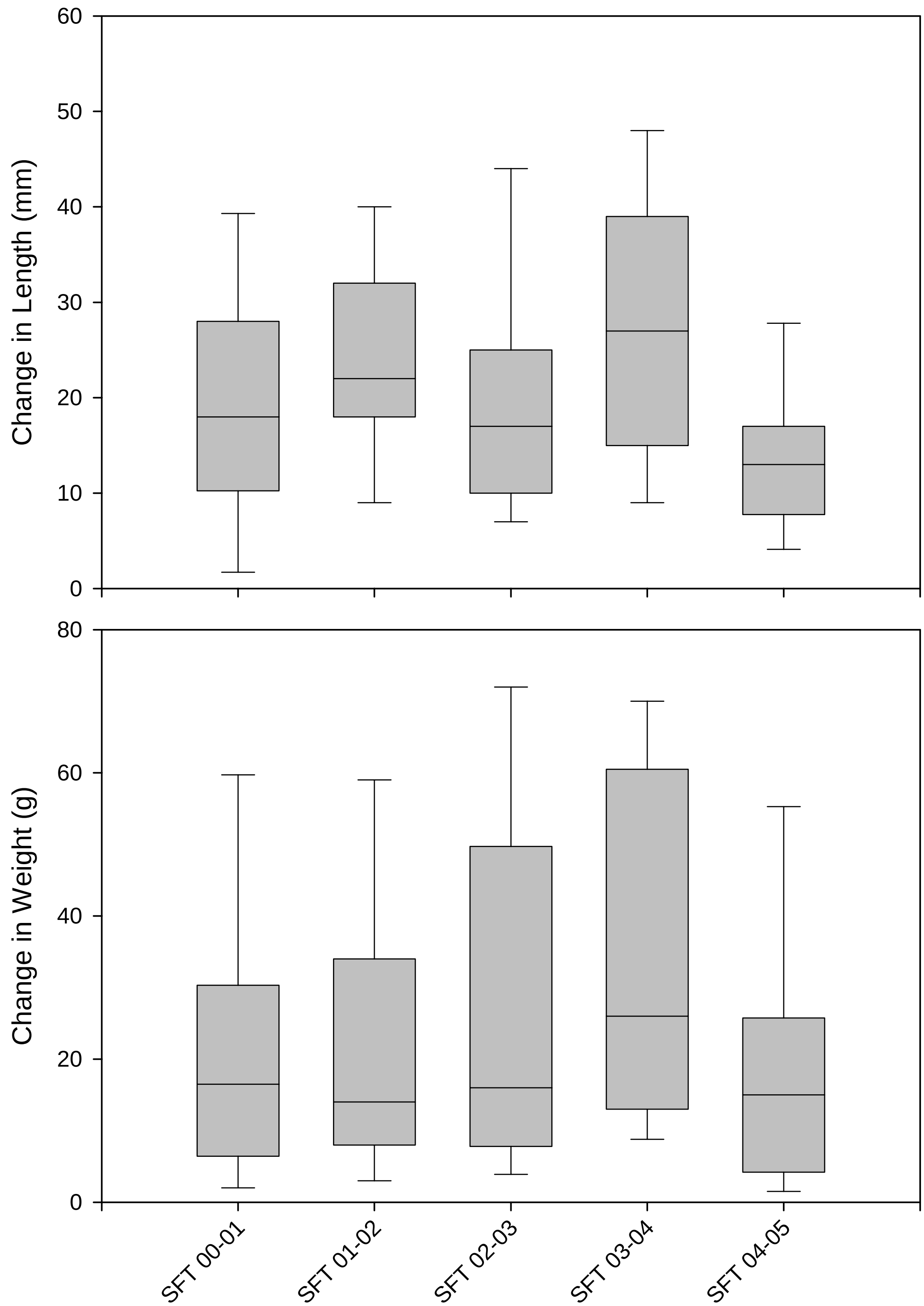

Figure 3. Growth of American eels marked with PIT tags, then recaptured the following year in South Fork Tye River (SFT). Middle line in box plot shows median, bottom and top of box show 25th and 75th percentiles, whiskers show 10th and 90th percentiles.

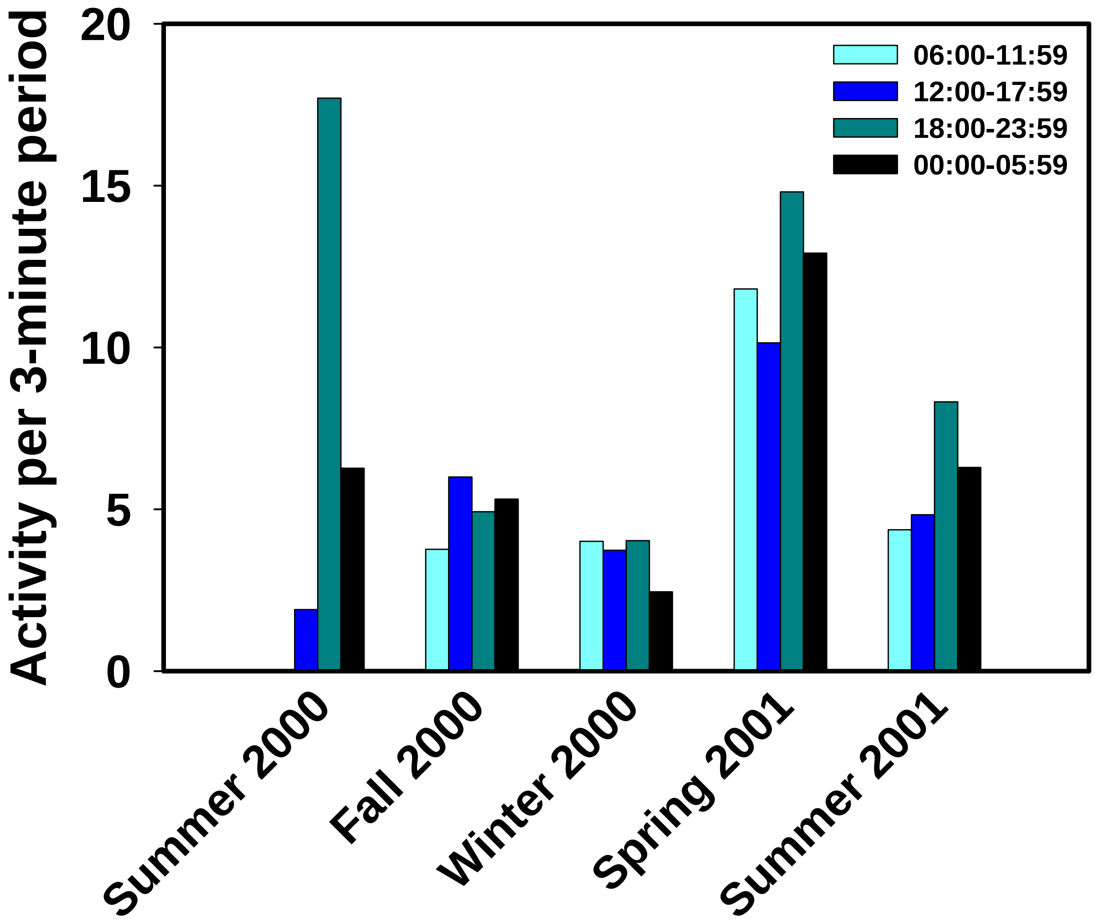

Figure 4. Average activity levels of telemetered American eels over 3-minute periods. Bars represent average of 2-6 eels for each time period.

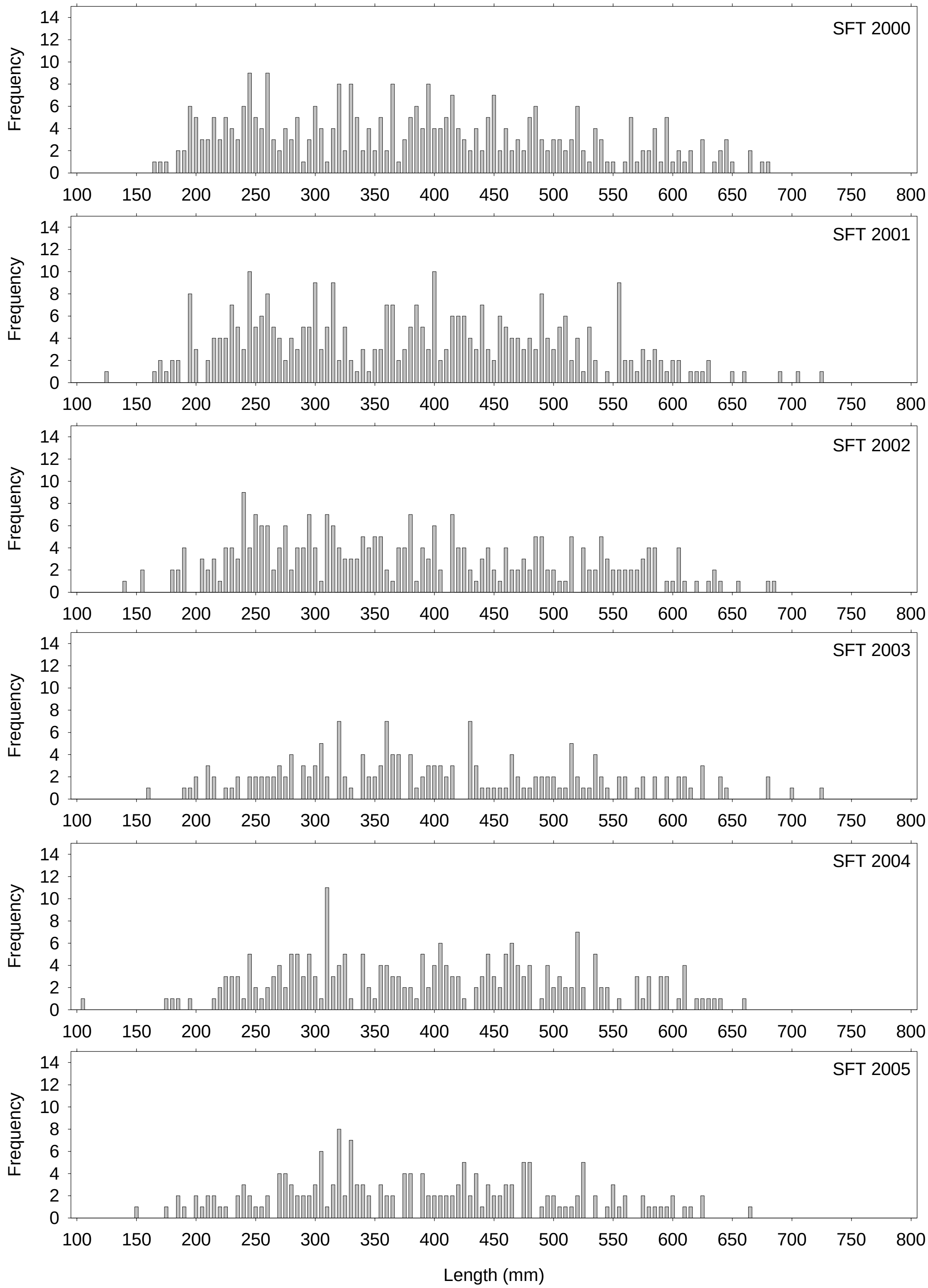

Figure 5. Length-frequency of American eels captured by backpack electrofishing in South Fork Tye River (SFT) 2000-2005. Eels less than 250 mm are sexually undifferentiated and eels greater than 400 mm are rarely males (Smogor et al. 1995). Decreased numbers 2002 - 2005 reflect decreased effort (single vs. multiple pass).

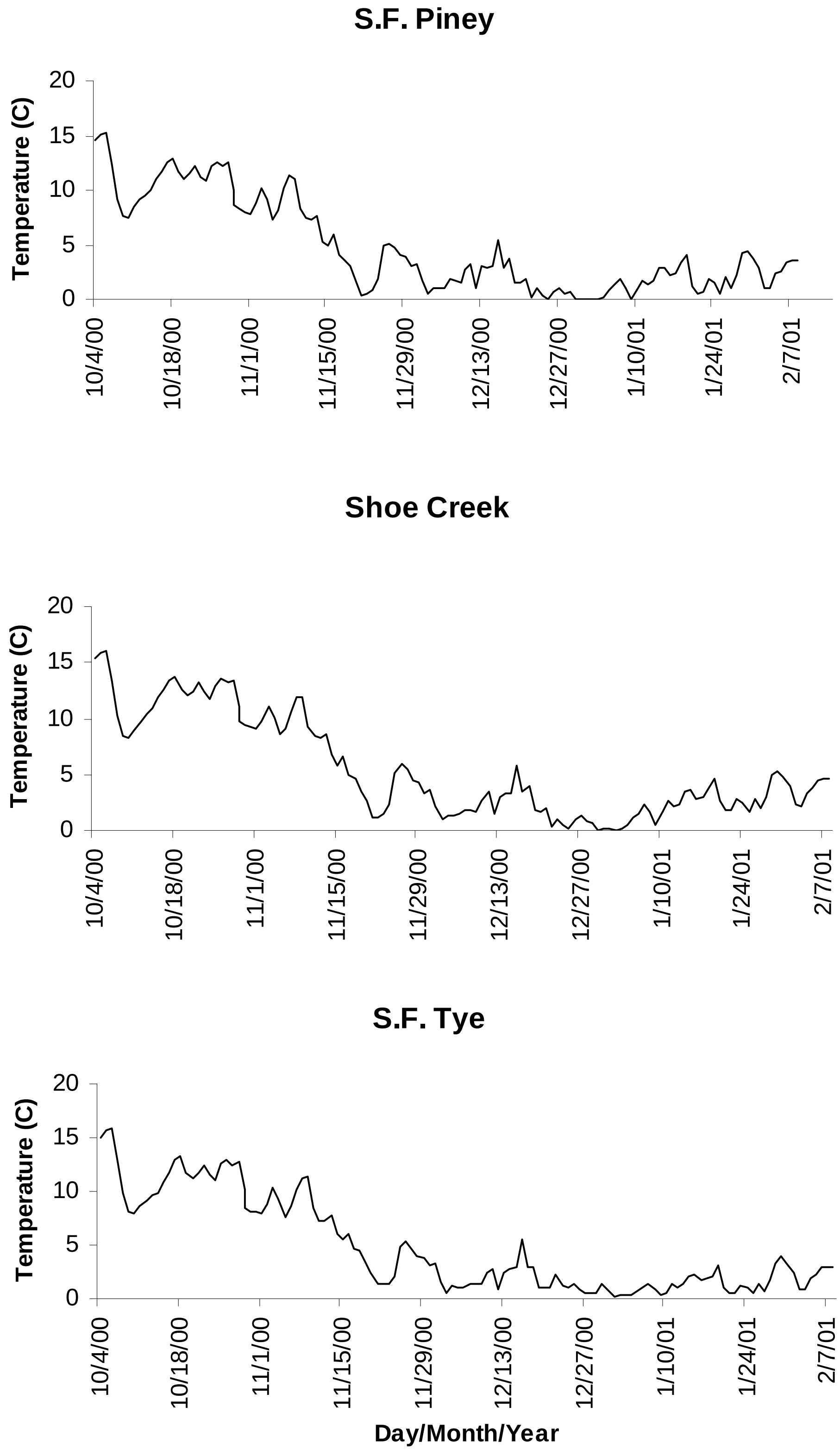

Figure 6. Average daily water temperatures recorded in South Fork Piney River, Shoe Creek and South Fork Tye River between October 2000 and February 2001.

Fish Passage Status of Road-Stream Crossings on Selected National Forests in the Southern Region, 2005

United States Department of Agriculture Forest Service
Southern Research Station
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Background

The United States has >6.2 million km of public roads (National Research Council 1997), that directly impact 20% of its land surface (Forman 2000). There are an estimated 1.4 million road-stream crossings in the United States and over 50,000 on National Forest managed lands in the eastern U.S. (M. Hudy, U.S. Forest Service, unpublished data), each of which represents a potential impediment or barrier to movement of fish and other aquatic organisms. The ability of animals to move freely through stream networks is an important aspect of a species' long-term viability (Fausch et al. 2002). In particular fish movement in streams prevents population fragmentation (Winston et al. 1991), allows for population recovery following disturbance (Detenbeck et al. 1992; Roghair and Dolloff 2005), and provides access to critical spawning habitats (Fausch and Young 1995). Early work examining effects of road-stream crossings on fish movement occurred primarily in the western U.S. and focused on anadromous Pacific salmon. Effects of road-stream crossings on stream-resident fishes in the eastern U.S. have received less attention, in part because resident fishes were regarded as sedentary (Gerking 1959). Recent research and re-examination of historic movement studies (Gowan et al. 1994) on a wide range of stream-resident fish species (Albanese et al. 2003; Schmetterling and Adams 2004; Warren and Pardew 1998) has shown that so called resident species exhibit greater frequency and magnitude of movement than previously was thought. For land managers, this new understanding of fishes ability and propensity to move has significant implications. Road-stream crossings must be managed to permit both downstream and upstream passage of aquatic animals.

In 2003 and 2004 the U.S. Forest Service Southern and Eastern Regions and the San Dimas Technology and Development Center (SDTDC) hosted several fish passage assessment and remediation workshops. The National Inventory and Assessment Procedure (NIAP) (Clarkin et al. 2003), developed by SDTDC, presented at these workshops provided a framework for collecting field data, but the assessment models, designed for fish species endemic to the western U.S., were not directly applicable to species in the eastern U.S. The southeastern U.S. has over 560 freshwater fish species in over 28 families encompassing a wide range of swimming and leaping abilities (Warren et al. 2000). Development of species-specific passage models was considered impractical and lack of data on leaping and swimming ability for most eastern fish species limited the usefulness of previously developed passage software such as FishXing (Love et al. 1999).

In 2003, graduate students and biologists of the U.S. Forest Service Aquatic Ecology Unit – East at James Madison University began to develop several simple models that would allow managers to quickly assess the passage status of a crossing for groups of fish with similar swimming abilities. Three 'coarse screening filters' were developed: Filter A for species with strong leaping and swimming abilities; Filter B for species with moderate leaping and swimming abilities; and Filter C for species with weak leaping and swimming abilities. Movement data on a broad cross section of eastern stream fishes showed that the coarse filters provided a reasonable estimate of the likelihood of a particular crossing presenting a barrier to upstream passage (Coffman 2005).

In 2005 the Southern Region elected to allocate 10% of its Roads and Trails (TRTR) funds to inventory road-stream crossings in the George Washington-Jefferson (GWJNF), Daniel Boone (DBNF), Ozark-St. Francis (OSFNF), Bankhead (BNF) and Talladega (TNF) National Forests (Figure 1). To insure a quality product with consistent data collection and analysis the Region partnered with the Southern Research Station, Center for Aquatic Technology Transfer (CATT) to design an inventory and assessment program for road-stream crossings. The CATT designed an inventory program based on the NIAP, deployed field crews to collect data, and then classified each crossing as passable, impassable or indeterminate for each of the three coarse filters described above. This report summarizes the results of road-stream crossing inventories and data analysis performed by the CATT in 2005.

Methods

Data Collection

Dimensions, shape (Figure 2), and condition of road-stream crossing structures and data pertaining to the adjacent stream channel were recorded for each site following the (NIAP) (Clarkin et al. 2003). A CST/berger SAL series automatic level with 32x magnification mounted on a tripod and a 25-foot stadia rod graduated in tenths of feet were used to measure the elevation of the crossing structure inlet and outlet, tailwater control, and the water surface (Figure 3). A measuring tape marked in hundredths of a foot was used to measure the distance between the crossings inlet and outlet. Bankfull channel width was measured at three locations upstream of the crossing and three downstream where natural channel geometry was intact (i.e. outside of the influence of the crossing structure). Photographs of the inlet and outlet were taken and each site was sketched on paper. Condition of the crossing structure was recorded and any natural barriers (e.g.. waterfalls) immediately upstream or downstream were documented. Natural stream substrate covering the bottom of the crossing structure was recorded as present continuous throughout the structure, present discontinuous, or not present. Substrate had to cover 100% of the structure bottom for a crossing to receive a present continuous throughout the structure designation. Crossing location was documented but the structure was not surveyed if there was inadequate habitat upstream of the crossing to support fish, or if the crossing structure was a bridge or natural ford. Bridges and natural fords were assumed to always provide adequate upstream fish passage. Crossing locations that could not be reached because of inaccessible or closed roads, private property issues, or locked gates were also documented.

Data Analysis

The elevation and distance measurements for the crossing inlet, crossing outlet, tailwater control, and water surface were used to calculate residual inlet depth, outlet drop, outlet perch, slope, and slope x length values for each crossing (Figure 3). Residual inlet depth was calculated as

$$P_3 – P_1,$$

where P_3 is the tailwater control elevation of the outlet pool and P_1 is the crossing inlet elevation. Residual inlet depth values greater than zero indicate the structure is completely backwatered, allowing fish passage. Outlet drop was calculated as

$$P_2 – P_3,$$

where P_2 is the crossing outlet elevation and P_3 is the tailwater control elevation of the outlet pool. Outlet perch was calculated as

$$P_2 – Ws,$$

where P_2 is the crossing outlet elevation and Ws is the water surface elevation immediately downstream of the outlet. Outlet perch is used in place of outlet drop when a tailwater control is not present and outlet drop cannot be calculated. Excessive outlet drop or outlet perch values indicate the presence of jump barriers. Slope was calculated as

$$(P_{1elev} – P_{2elev}) / (P_{1dist} – P_{2dist}) * 100,$$

where P_{1elev} is the crossing inlet elevation, P_{2elev} is the crossing outlet elevation, P_{1dist} is the crossing inlet distance, and P_{2dist} is the crossing outlet distance. Steep slope is an indicator of velocity barriers. Slope x length was calculated as

$$[(P_{1elev} – P_{2elev}) / (P_{1dist} – P_{2dist}) * 100] * (P_{1dist} – P_{2dist}),$$

where P_{1elev} is the crossing inlet elevation, P_{2elev} is the crossing outlet elevation, P_{1dist} is the crossing inlet distance, and P_{2dist} is the crossing outlet distance. High slope x length values indicate an exhaustion barrier.

Residual inlet depth, outlet drop, outlet perch, slope, and slope x length values for each crossing were applied to each of three regional coarse filters (Figures 4 – 6) to determine upstream passage status. Threshold values for each parameter differ by filter and were set according to published swimming and leaping abilities of representative species in each filter group, and relationships among crossing dimensions, species presence/absence data, and movement data (Coffman 2005). Filter A (Figure 4) classifies crossings for species with strong swimming and leaping abilities, such as the adult brook trout (*Savelinus fontinalis*). Filter B (Figure 5) classifies crossings for species with moderate swimming and leaping abilities such as juvenile trout or species in the minnow family (Cyprinidae). Filter C (Figure 6) classifies crossings for weak swimmers and leapers, such as species in the darter (Percidae) and sculpin (Cottidae) families. Crossings are classified as passable, impassable, or indeterminate for each of the three filters. Biological sampling or computer modeling is required to determine passage status for crossings classified as indeterminate.

Sites with more than one crossing structure (e.g. culverted site with multiple pipes) were occasionally encountered during the surveys. At these sites each individual structure was classified, which could result in a single site having multiple classifications for a given filter. Under those circumstances the location was classified based on the structure that received the best passage rating. For example, in a crossing location with two circular culverts where one was classified as impassable and one indeterminate by Filter B, the location would receive an overall classification of indeterminate rather than impassable.

The ratio of culvert width to bankfull channel width was also calculated for each site. The ratio was calculated as

$$CW / BCW,$$

where CW is the maximum width or diameter of the crossing structure and BCW is the average of all six (three upstream and three downstream) bankfull channel width measurements. A ratio of 1.0 or greater indicates that the crossing structure is equal to or greater than the width of the bankfull channel. Fords, vented fords, and sites with multiple crossing structures were eliminated from the analysis.

Results

We visited a total of 1337 road-stream crossings in 2005 and completed surveys at 297 sites (Table 1). Filter A (strong swimmers and leapers) classified 22% (n=64) of crossings as impassable, 30% (n=89) as passable, and 48% (n=144) as indeterminate (Figure 7, Table 2). Filter B (moderate swimmers and leapers) classified 63% (n=188) of crossings as impassable, 15% (n=45) as passable, and 22% (n=64) as indeterminate (Figure 8, Table 2). Filter C (weak swimmers and leapers) classified 81% (n=239), of crossings as impassable, 12% (n=36) as passable, and 7% (n=22) as indeterminate (Figure 9, Table 2). The GWJNF had the highest percentage of impassable sites for both Filter A and B, and the DBNF had the highest percentage of impassable sites for Filter C. All Forests had greater than 55% of sites for Filter B and greater than 75% of sites for Filter C classified as impassable (Figures 10-12, Table 2). Excessive outlet drops accounted for 61% of the impassable sites for Filter A, 74% for Filter B, and 85% for Filter C (Table 3).

The majority of crossings were either circular culverts (n=145) or pipe arches (n=88), while box culverts (n=18), vented fords (n=10), concrete slab fords (n=28), and open bottom arches (n=8) were less frequently encountered. Filter A classified 25% of circular culverts and 24% of pipe arch crossings as impassable (Figure 13, Table 4). The proportion of circular culverts and pipe arches classified impassable increased from Filter A to Filters B and C. Filter B classified 70% of circular culverts and 67% of pipe arch crossings as impassable (Figure 14, Table 4). Filter C classified 89% of circular culverts and 78% of pipe arches as impassable (Figure 15, Table 4). All three filters classified 100% of the open bottom arches as passable (Table 4).

Greater than 90% of all crossings (excluding fords, vented fords, and multiple structure crossings) had crossing to channel width ratios less than 1.0 (i.e. crossing width was less than the bankfull channel width). The mean crossing width to channel width ratio (n=177) was 0.54 (SD=0.23) (Figure 16). Only 11 crossings were greater than or equal to the mean bankfull channel width (i.e. crossing width to channel width ratio was greater than or equal to 1.0).

Discussion

Regional Analysis

Crossings that prevent upstream fish passage are a common feature of stream networks on all the Forests we surveyed. Considering all Forests, no more than 17% of crossings were passable for all three filters highlighting the potential severity of stream fragmentation. Outlet drop triggered passage failure at the majority of impassable sites for all three filters, but it was not the only factor that prevented movement at many sites. Over 40% of sites classified as impassable due to excessive outlet drop would also have failed due to either excessive slope or slope x length values. Even if fish had managed to find a way to leap into these crossing structures they likely would have faced water velocities that exceeded their swimming abilities or a combination of water velocity and pipe length that would have exhausted them before they could exit the upstream end of the structure. These conditions are created when crossing structures do not mimic natural channel characteristics such as bankfull channel width, slope, and substrate. The result is increased water velocity within the structure and scouring immediately downstream creating an outlet drop, or perch (Castro 2003). This effect is exaggerated in high gradient streams which may explain why the GWJNF, which had the highest gradient streams for Forests inventoried in 2005, also had the highest proportion of sites that failed for Filters A and B. Streams in the other Forests visited were primarily low gradient and failure for Filter A in these streams indicated an extreme passage problem.

The high proportion of impassable sites for Filters B and C is particularly troubling. Minnow and darter species, the majority of which fall within Filters B and C represent >70% of the freshwater fish diversity in the Southeast (Warren et al. 2000) and occur on every Forest in the Southern Region. These fishes also represent 65% of the imperiled fish taxa in the Southeast (Warren et al. 2000). Our results suggest that these species face barriers to movement at 60% - 80% of road-stream crossings on National Forest managed lands in the Southern Region. The fragmentation caused by these barriers likely contributes to species imperilment, and the high number of impassable sites adds to the challenge of restoring connectivity (Walsh et al. 1995).

All crossing types blocked upstream fish passage to some degree with the exception of open bottom arches. Open bottom arches typically had crossing to channel width ratios close to 1.0 and always had natural stream substrate throughout the crossing, providing favorable conditions for upstream fish passage. However, open bottom arches are expensive compared to other crossing types (Murphy and Pyles 1989), which may explain why we encountered relatively few of these structures. Other than open bottom arches, box culverts and vented fords had the smallest percentage of impassable sites, but sample size for these types was low in 2005. Pipe arches and circular culverts were the most frequently encountered crossing type. Pipe arches and circular culverts dominate the road-stream crossing landscape because they are the most readily available and cost effective to install, but as our results demonstrate, they can create passage problems when stream hydrology and biological factors are not carefully considered prior to installation (Baker and Votapka 1990).

Current Limitations and Future Improvements

The coarse filters presented here apply to several general categories of fish including strong swimmers and leapers (Filter A), moderate swimmers and leapers (Filter B), and weak swimmers and leapers (Filter C). We assigned adult trout to represent Filter A, minnows and young trout to represent Filter B, and darters and sculpins to represent Filter C, however there are a range of swimming and leaping abilities represented within each family. For example, passage of some minnow species may actually be best assessed by Filter A whereas others may fit better in Filter C. Still other families or species, such as those that are strong swimmers but weak to moderate leapers may require the creation of additional filters to correctly classify their passage status. Currently, few data are available regarding swimming and leaping ability of non-game fish species in the Southeast making it difficult to refine or expand the existing filters. Members of the sucker (Catostomidae), catfish (Ictuluridae) and sunfish (Centrarchidae) families may fit into such filters, but clearly more research is needed.

Results provided by the existing filters include a sometimes large area of indeterminate passage status. Crossings enter this “gray area” when they pass for outlet drop and slope but do not pass or fail for slope x length. The range of values that leads to an indeterminate classification for slope x length can be quite large, particularly for Filter A leaving a large portion of sites essentially unclassified. The slope x length value represents the relative level of exhaustion a fish would experience by trying to swim through a pipe of a certain slope for a given distance. Because few empirical data exist for species exhaustion rates the filters were designed to be conservative at this step. Biological sampling can provide important information for evaluating fish passage at sites classified indeterminate and generally with little expense relative to the cost of replacing a crossing structure. Mark-recapture sampling designs can vary in complexity and effort depending on project goals (Warren and Pardew 1998) and provide direct evidence of fish passage without the assumptions of fish passage models. The mark recapture design can be as simple as marking and releasing a sample of fish downstream of a crossing, and then sampling for marked fish about the crossing on subsequent sampling trips. Collection of marked fish above the crossing would indicate that crossing is passable for the species in question. More elaborate designs to detect if movement through the crossing is the same or similar to movement through the unobstructed natural stream channel can also be implemented (Coffman 2005). The use of mark-recapture studies at indeterminate sites would not only allow managers to classify these sites as passable or impassable, but would also provide data necessary to refine the filter thresholds and shrink the gray areas.

We could not perform surveys at nearly 4 out of every 5 sites we visited in summer 2005. Many sites were natural fords or bridges, which we do not survey or were on closed roads, behind private gates, etc. Our efficiency could be vastly improved with better pre-visit preparation. Early notification of the Forests selected for crossing assessments would give Forest personnel the time necessary to prepare for the assessment. This preparation should include watershed selection using existing databases, recent aerial photography, maps and local knowledge to eliminate crossings that do not require surveys (i.e. natural fords, bridges, and closed roads). Specific crossings scheduled to be surveyed that are behind locked gates or require passing through private property to access could be identified and the necessary steps taken to ensure efficient use of the field crews. Maps denoting crossings to be surveyed and sites to avoid can allow the field crews to coordinate an efficient strategy to complete the surveys. Because time and resources for assessment and remediation are limited, prioritization is crucial to the assessment program.

The Forests have opportunities to improve fish passage at road-stream crossings both during routine maintenance when crossing structures reach the end of their serviceable life, and when funding becomes available to replace crossings outside of the regular maintenance schedule. Managers should always consult with their biologists and hydrologists to determine whether routine replacements should include aquatic organism passage considerations. Selection of sites for replacement outside of the routine maintenance schedule can be more challenging. Currently, Forests can use the information from our surveys to locate impassable crossings that are candidates for replacement; however the number of impassable crossings per Forest makes selecting sites an overwhelming task. Survey results only provide passage status and exclude many other factors that should be considered when prioritizing crossings for replacement. Information such as miles of habitat upstream of a crossing, cost of replacement, species presence, and species status (i.e. threatened, endangered, exotic invasive) need to be included in the decision process. Given the large number of impassable sites, using criteria such as these to prioritize sites for remediation can be time consuming and overwhelming.

Decision support systems (DSS) can be designed to assist managers faced with complex prioritization problems such as these. For example, in the case of the crossing assessment project a DSS could be designed that would allow Forests to prioritize watersheds for assessment based on characteristics such as number of stream crossings, percent Forest ownership, or presence of endangered species within the watershed. Crossings within the prioritized watersheds that do not pose a threat to fish passage (i.e. bridges and natural fords) could be eliminated from the surveys prior to field crew visits saving valuable time. Once inventories are completed the DSS could be used to prioritize impassable sites for replacement based on factors such as the quantity and quality of habitat that could be opened upstream of a crossing. A DSS could be a powerful tool, helping Forests focus assessment efforts and make justifiable fish passage remediation decisions allowing them to more efficiently and effectively compete for funding.

The results of culvert inventories performed in the Southern Region in summer 2005 demonstrate the impact of road-stream crossings on aquatic organism passage in southern streams. Future inventories in the Region will expand the baseline data necessary to meet legislative provisions, prioritize crossings for replacements, and compete for remediation funds.

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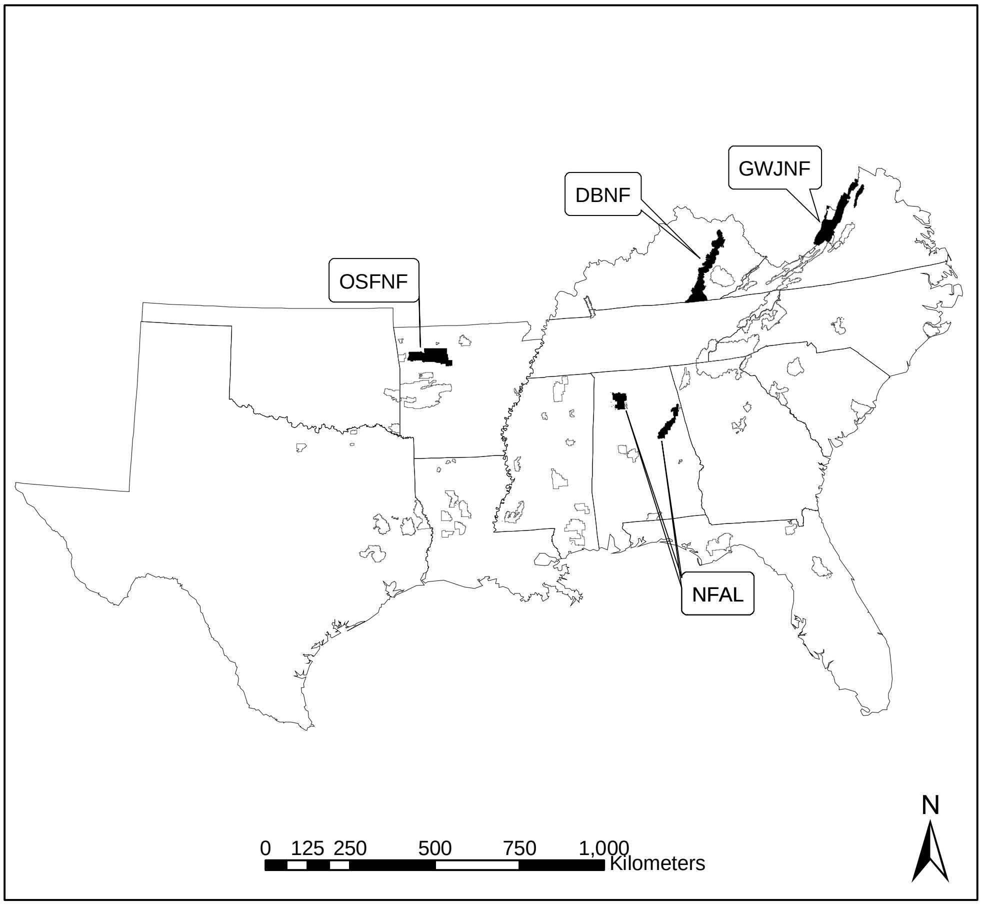

Figure 1. National Forests managed lands in the Southern Region. Crossing assessments were conducted during summer 2005 in areas shaded black. GWJNF= George Washington-Jefferson National Forest, DBNF= Daniel Boone National Forest, OSFNF= Ozark-St. Francis National Forest, NFAL= National Forests in Alabama (Bankhead NF, western; Talladega NF, eastern).

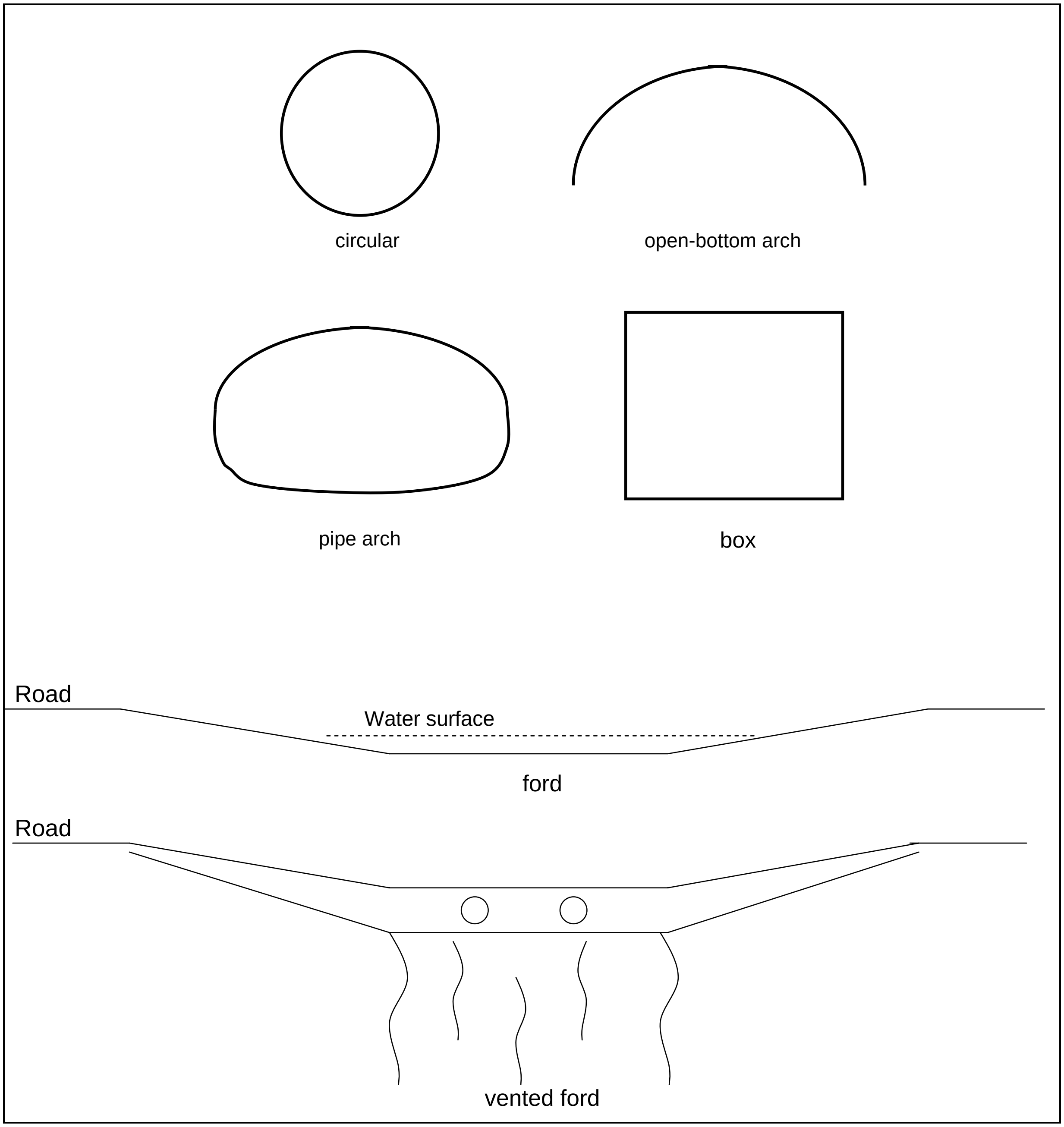

Figure 2. Common crossing shapes encountered during road-stream crossing inventories conducted in the Southern Region, summer 2005.

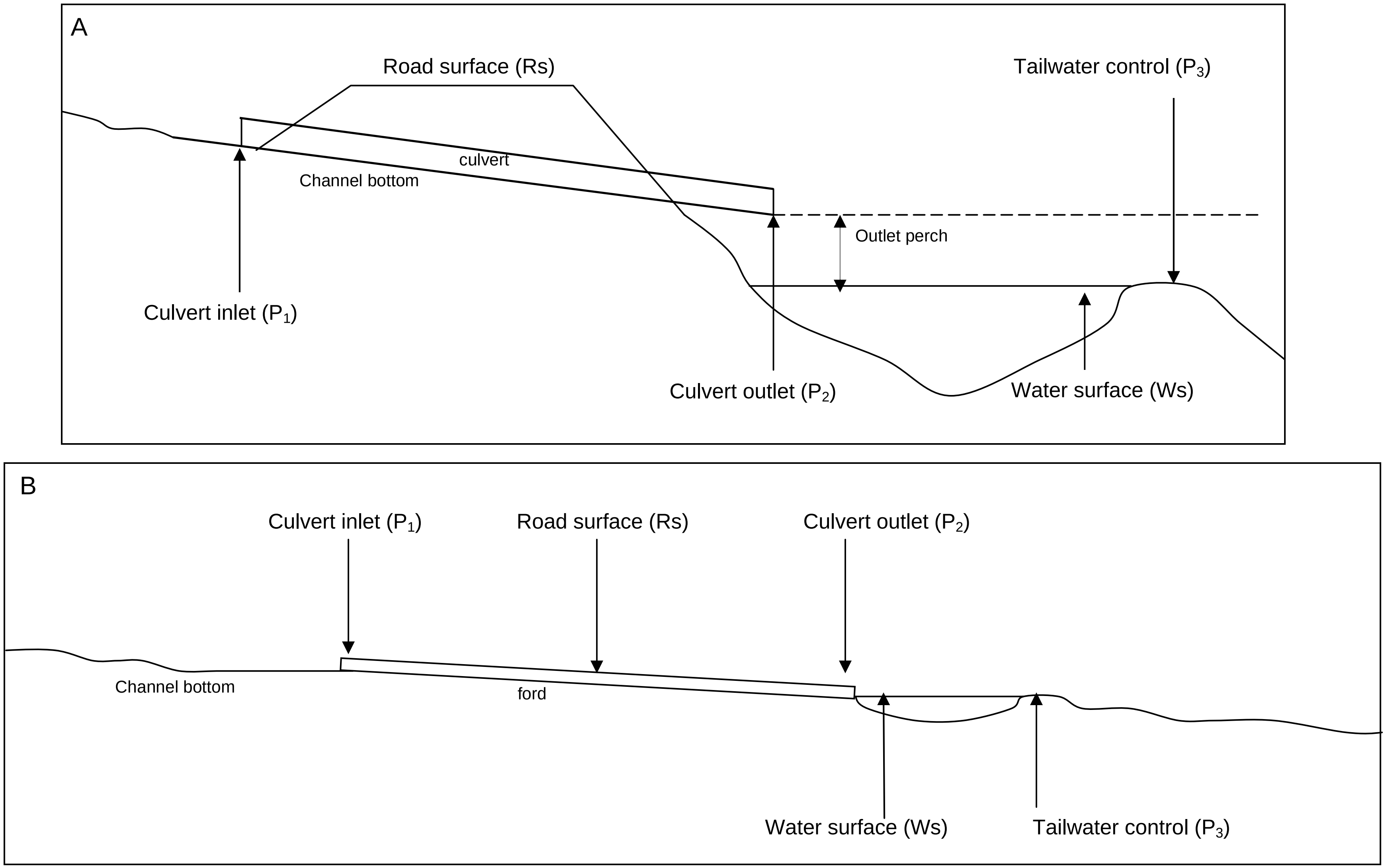

Figure 3. Survey points measured on culverts (A) and unvented fords (B) to calculate parameters used in coarse filters for upstream fish passage Adapted from Clarkin et al. 2003. Parameters are calculated as follows: Residual Inlet depth= $P_3 - P_1$, Outlet drop= $P_2 - P_3$, Outlet perch= P_2 – Ws, Slope= $(P_{1elev} - P_{2elev}) / (P_{1dist} - P_{2dist}) * 100$, Slope x Length= $[(P_{1elev} - P_{2elev}) / (P_{1dist} - P_{2dist}) * 100] * (P_{1dist} - P_{2dist})$.

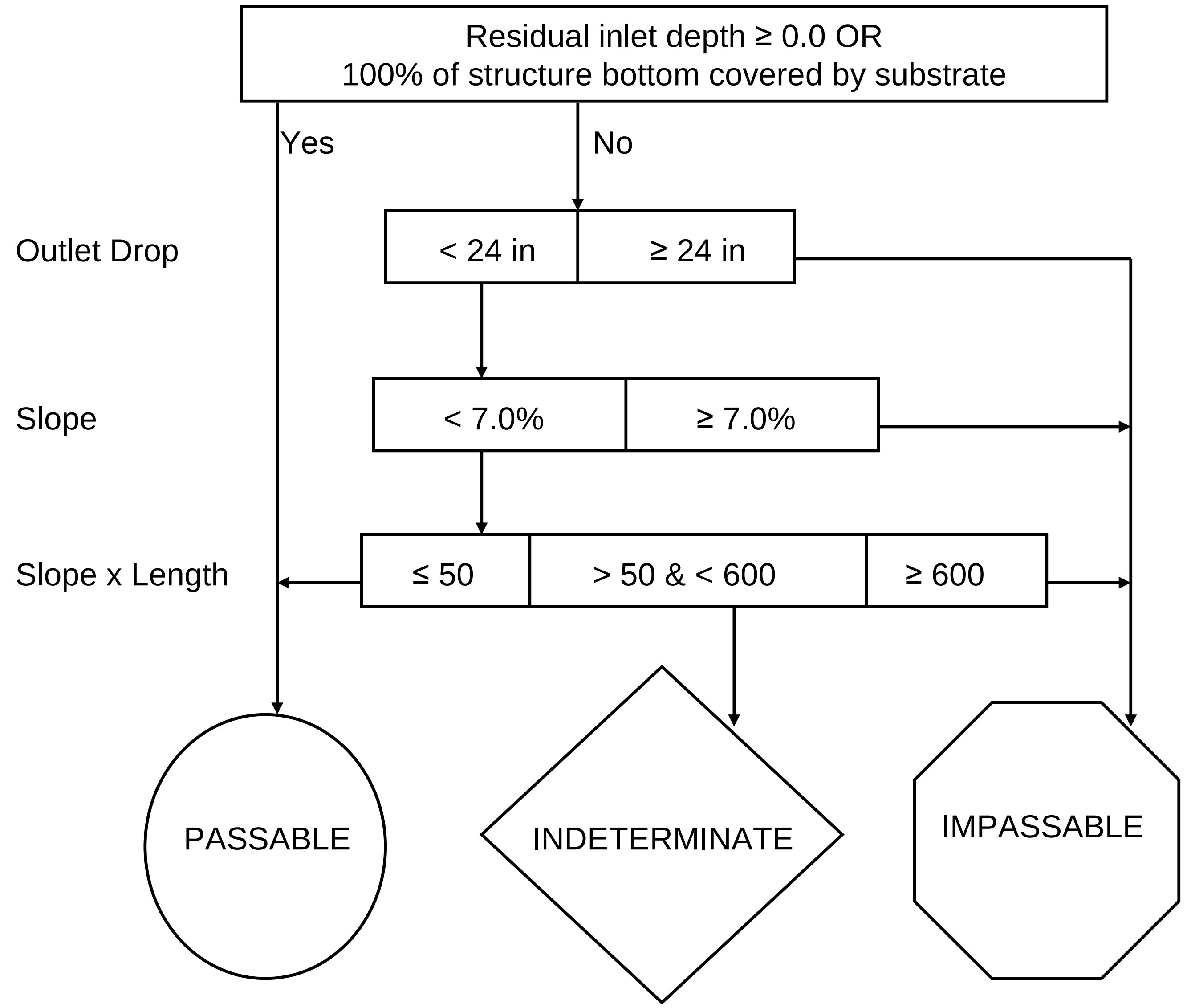

Figure 4. Coarse Filter A: Predictive model used to determine upstream passage for fish with swimming and leaping abilities similar to adult trout. A residual inlet depth ≥ 0.0 (Figure 2) indicates structure is fully backwatered. An outlet perch of 14 in. was used when outlet drop could not be calculated (Coffman 2005).

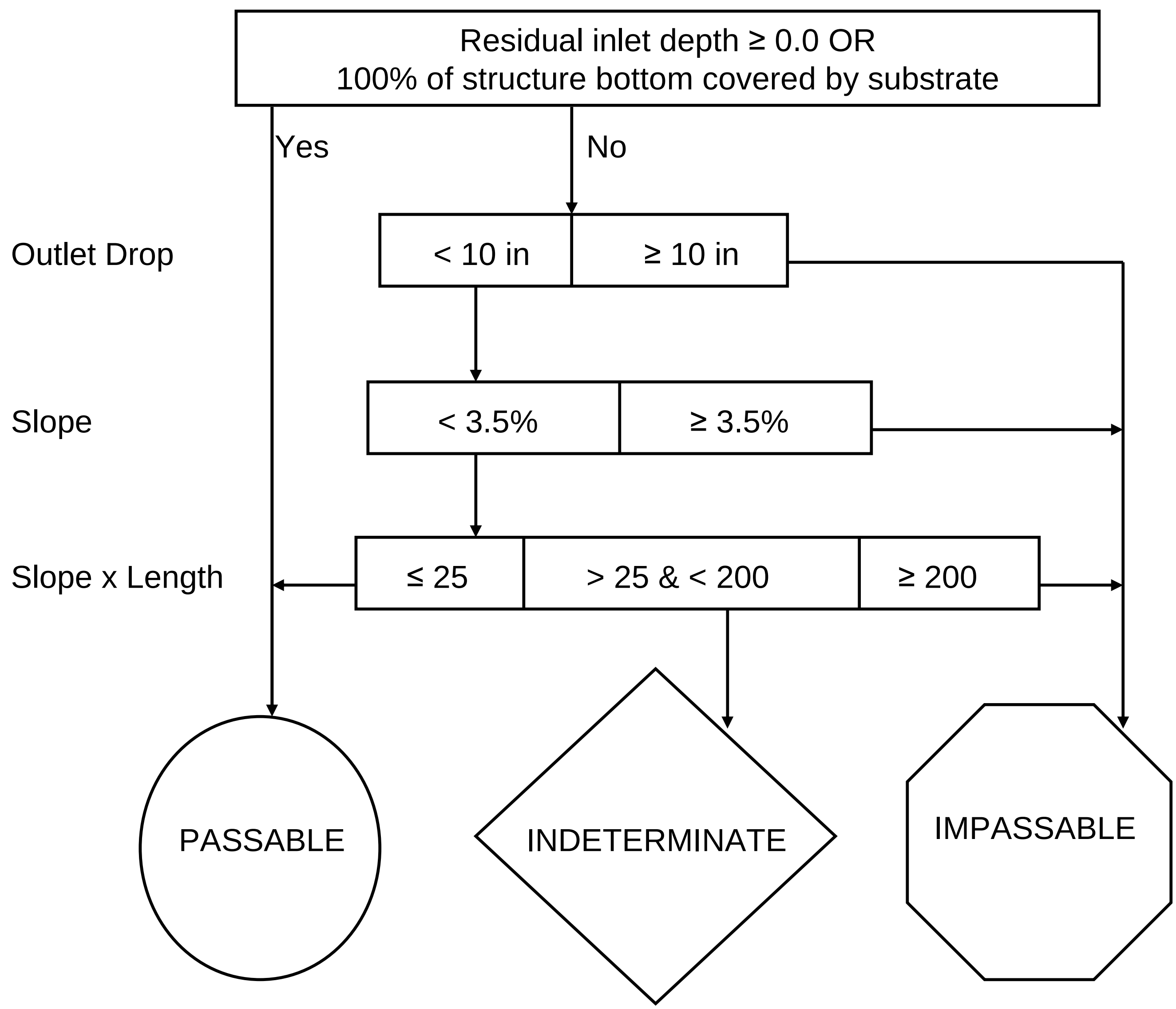

Figure 5. Coarse Filter B: Predictive model used to determine upstream passage for fish with swimming and leaping abilities similar to minnows and juvenile trout. A residual inlet depth ≥ 0.0 (Figure 2) indicates pipe is fully backwatered. An outlet perch of 5 in. was used when outlet drop could not be calculated (Coffman 2005).

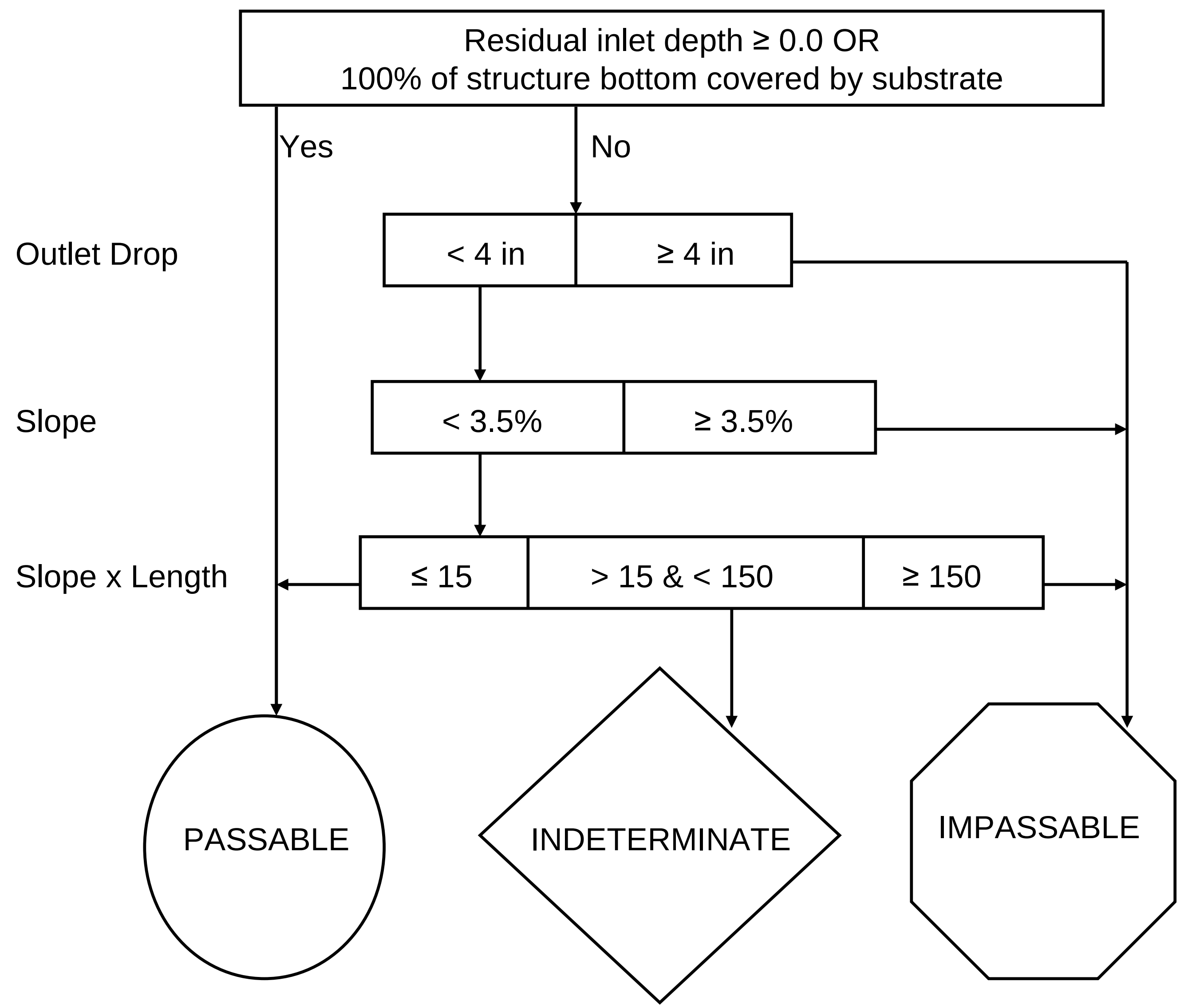

Figure 6. Coarse Filter C: Predictive model used to determine upstream passage for fish with swimming and leaping abilities similar to darters and sculpins. A residual inlet depth ≥ 0.0 (Figure 2) indicates pipe is fully backwatered. An outlet perch of 2 in. was used when outlet drop could not be calculated (Coffman 2005).

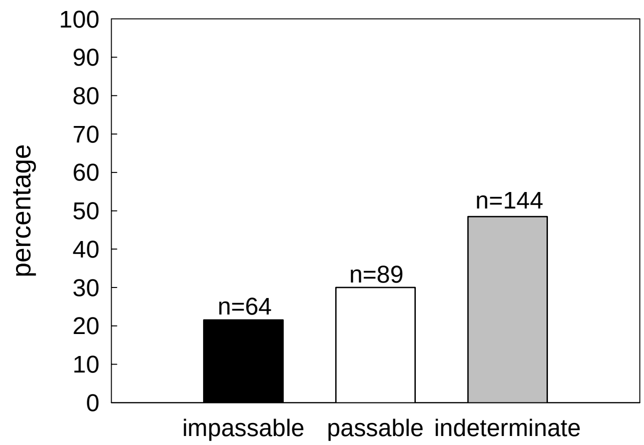

Figure 7. Percentage of crossings classified as impassable, passable, or indeterminate by Filter A; Southern Region (all Forests combined), summer 2005 (N=297).

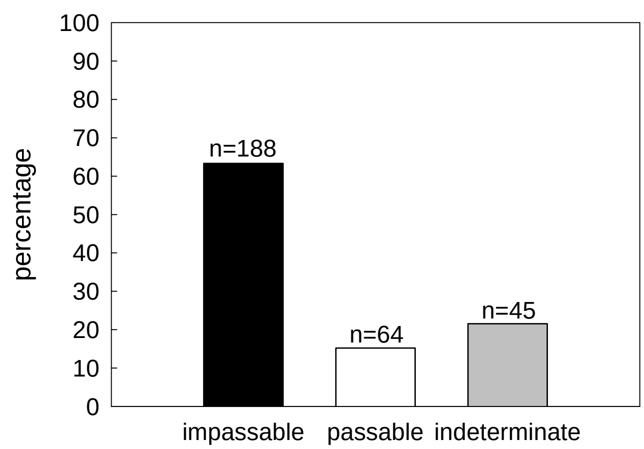

Figure 8. Percentage of crossings classified as impassable, passable, or indeterminate by Filter B; Southern Region (all Forests combined), summer 2005 (N=297).

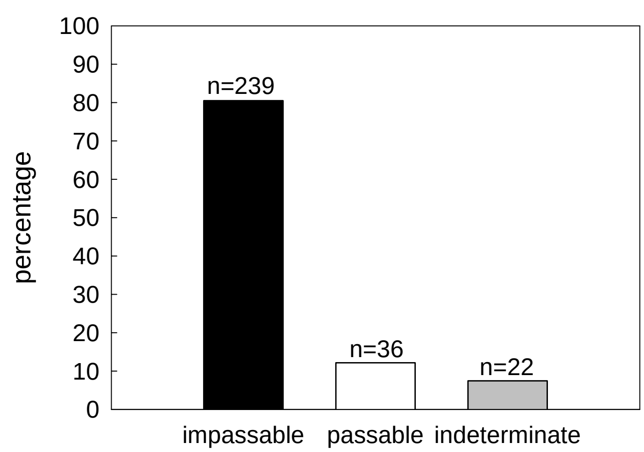

Figure 9. Percentage of crossings classified as impassable, passable, or indeterminate by Filter C; Southern Region (all Forests combined), summer 2005 (N=297).

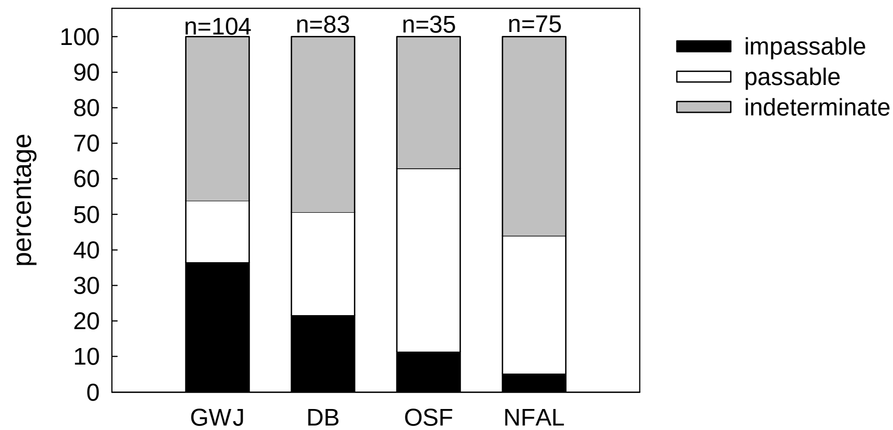

Figure 10. Percentage of crossings classified as impassable, passable, or indeterminate by Filter A; Southern Region (by Forest) summer 2005. GWJ=George Washington-Jefferson, DB=Daniel Boone, OSF=Ozark-St. Francis, and NFAL=National Forests in Alabama.

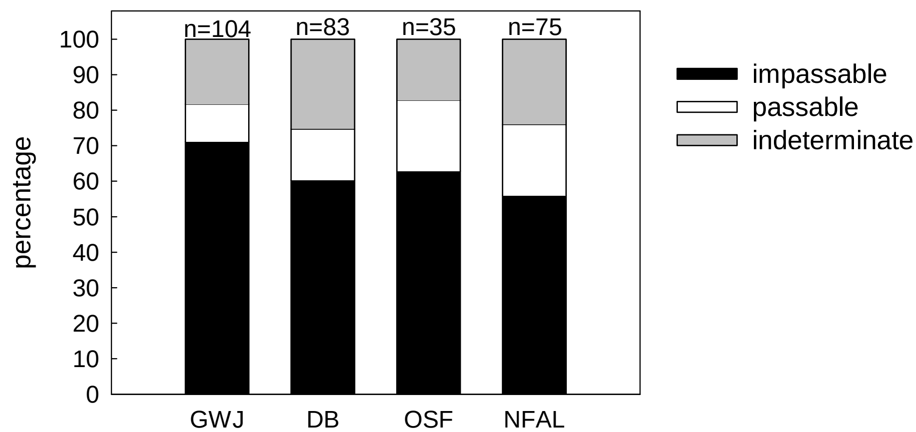

Figure 11. Percentage of crossings classified as impassable, passable, or indeterminate by Filter B; Southern Region (by Forest) summer 2005. GWJ=George Washington-Jefferson, DB=Daniel Boone, OSF=Ozark-St. Francis, and NFAL=National Forests in Alabama.

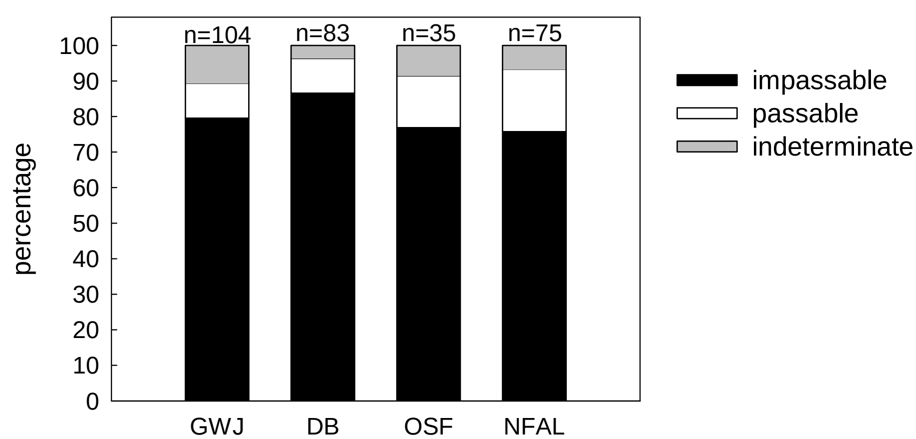

Figure 12. Percentage of crossings classified as impassable, passable, or indeterminate by Filter C; Southern Region (by Forest) summer 2005. GWJ=George Washington/ Jefferson, DB=Daniel Boone, OSF=Ozark/ St. Francis, and NFAL=National Forests in Alabama.

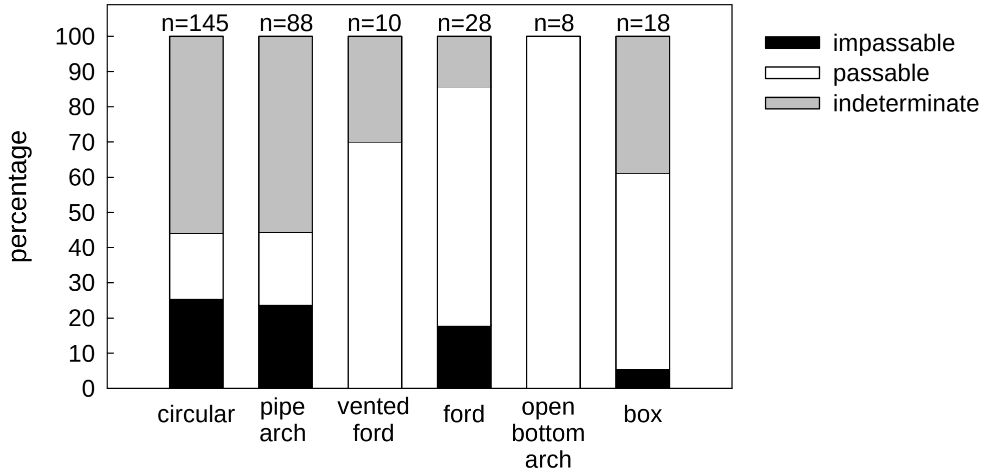

Figure 13. Percentage of each crossing type classified as impassable, passable, or indeterminate by Filter A; Southern Region (all Forests combined) summer 2005.

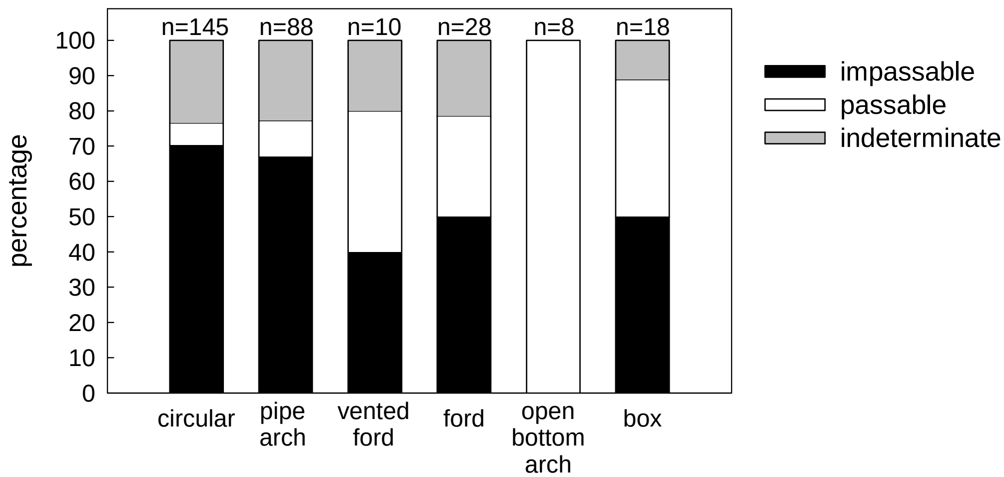

Figure 14. Percentage of each crossing type classified as impassable, passable, or indeterminate by Filter B; Southern Region (all Forests combined) summer 2005.

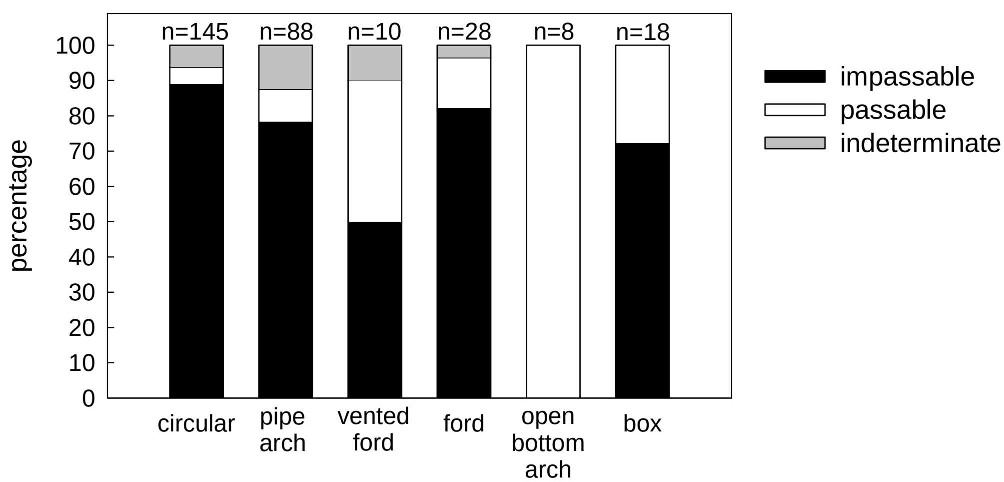

Figure 15. Percentage of each crossing type classified as impassable, passable, or indeterminate by Filter C; Southern Region (all Forests combined) summer 2005.

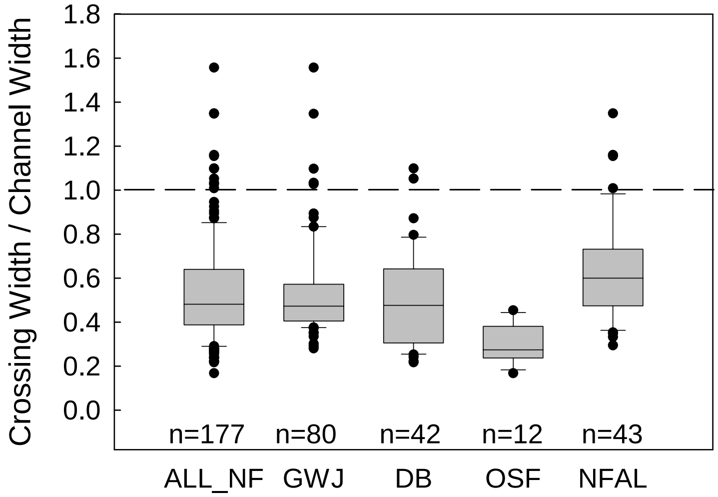

Figure 16. Crossing width to bankfull channel width ratio for crossings surveyed in summer 2005 (excluding fords, vented fords, and multiple structure crossings). A ratio of 1.0 (dashed line) or greater indicates the crossing structure opening is greater than or equal to the bankfull channel width. ALL_NF=Forests combined, GWJ=George Washington-Jefferson, DB=Daniel Boone, OSF=Ozark-St. Francis, and NFAL=National Forests in Alabama. The top and bottom of the boxes represent the 25th and 75th percentiles, the bar in the center of each box represents the median, whiskers represent the 10th and 90th percentiles, and closed circles represent the entire range of the data.

Table 1. Number of crossings documented (Total crossings documented) and number not surveyed (Crossings not surveyed) on Forests visited in summer 2005. Reasons for not surveying a documented site include: no suitable fish habitat upstream of crossing (NH); no access to site due to closed roads or private gates (NA); crossing was a natural ford (NF); crossing was a bridge (BR).

Forest	Total crossing documented	Crossing not surveyed (n, [%])				
		NH	NA	NF	BR	Total not surveyed
GWJNF	258	80 (52)	51 (33)	23 (15)	0 (0)	154 (60)
DBNF	206	28 (23)	61 (50)	21 (17)	13 (10)	123 (60)
OSFNF	724	85 (12)	396 (57)	191 (28)	17 (3)	689 (95)
NFAL	149	17 (23)	35 (47)	6 (8)	16 (22)	74 (50)
Total	1337	210 (20)	543 (52)	241 (23)	46 (4)	1040 (78)

Table 2. Number of crossings surveyed (Total surveyed) with coarse filter results for Forests visited in summer 2005. Coarse filter results are presented for Filter A, Filter B, and Filter C (see filter descriptions, Fig 3 – 5).

Forest	Total surveyed	Coarse filter results								
		Impassable (n, [%])			Passable (n, [%])			Indeterminate (n, [%])		
		A	B	C	A	B	C	A	B	C
GWJNF	104	38 (37)	74 (71)	83 (80)	18 (17)	11 (11)	10 (9)	48 (46)	19 (18)	11 (11)
DBNF	83	18 (22)	50 (60)	72 (87)	24 (29)	12 (14)	8 (10)	41 (49)	21 (25)	3 (4)
OSFNF	35	4 (11)	22 (63)	27 (77)	18 (51)	7 (20)	5 (14)	13 (37)	6 (17)	3 (9)
NFAL	75	4 (5)	42 (56)	57 (76)	29 (39)	15 (20)	13 (17)	42 (56)	18 (24)	5 (7)
Total	297	64 (22)	188 (63)	239 (81)	89 (30)	45 (15)	36 (12)	144 (49)	64 (22)	22 (7)

Table 3. Number of crossings (percentage in parentheses) classified as impassable due to excessive outlet drop, excessive slope, or excessive slope x length values for each coarse filter; Southern Region (all Forests combined), summer 2005.

	Filter A	Filter B	Filter C
Outlet drop	39 (61)	139 (74)	203 (85)
Slope	24 (37)	47 (25)	33 (14)
Slope*Length	1 (2)	2 (1)	3 (1)
Total	64 (22)	188 (63)	239 (81)

Table 4. Number of each crossing type (percentage in parentheses) classified as impassable, passable, or indeterminate for each coarse filter; Southern Region (all Forests combined) during summer 2005.

Classification	crossing type	Filter A	Filter B	Filter C
Impassable	circular	37 (25)	102 (70)	129 (89)
	pipe arch	21 (24)	59 (67)	69 (78)
	vented ford	0 (0)	4 (40)	5 (50)
	ford	5 (18)	14 (50)	23 (82)
	open bottom arch	0 (0)	0 (0)	0 (0)
	box	1 (6)	9 (50)	13 (72)
Passable	circular	27 (19)	9 (6)	7 (5)
	pipe arch	18 (20)	9 (10)	8 (9)
	vented ford	7 (70)	4 (40)	4 (40)
	ford	19 (68)	8 (29)	4 (14)
	open bottom arch	8 (100)	8 (100)	8 (100)
	box	10 (55)	7 (39)	5 (28)
Indeterminate	circular	81 (56)	34 (24)	9 (6)
	pipe arch	49 (56)	20 (23)	11 (13)
	vented ford	3 (30)	2 (20)	1 (10)
	ford	4 (14)	6 (21)	1 (4)
	open bottom arch	0 (0)	0 (0)	0 (0)
	box	7 (39)	2 (11)	0 (0)

Appendix A: Results for the George Washington-Jefferson National Forest

We visited 258 crossings on the Deerfield, Warm Springs, James River, and New River Valley Ranger Districts in 2005 (Figure A1, Table A1) and completed surveys on 40% (n=104) (Table A2). Filter A (strong swimmers and leapers) classified 37% (n=38) of crossings as impassable, 17% (n=18) as passable, and 46% (n=48) as indeterminate (Figure A2, Table A2). Filter B (moderate swimmers and leapers) classified 71% (n=74) of crossings as impassable, 11% (n=11) as passable, and 18% (n=19) as indeterminate (Figure A3, Table A2). Filter C (weak swimmers and leapers) classified 80% (n=83) of crossings as impassable, 9% (n=10) as passable, and 11% (n=11) as indeterminate (Figure A4, Table A2). Characteristics and filter classifications for each crossing are presented in Tables A3-A5.

The majority of the crossings surveyed were either circular culverts (n=46) or pipe arches (n=52), while open bottom arches (n=5), fords (n=1), vented fords (n=0), and box culverts (n=0) were less frequently encountered. Filter A classified 39% of circular culverts and 38% of pipe arch crossings as impassable (Figure A5). Filter B classified 80% of circular culverts and 71% of pipe arch crossings as impassable (Figure A6). Filter C classified 91% of circular culverts and 79% of pipe arch crossings as impassable (Figure A7). The 5 open bottom arches and 1 ford surveyed were passable for all 3 filters. The mean crossing width to channel width ratio for surveyed structures (excluding fords and multiple structure crossings) (n=80) was 0.54 (SD=0.22), and five crossings were greater than or equal to the mean bankfull channel width, three of which were open bottom arches (Figure A8).

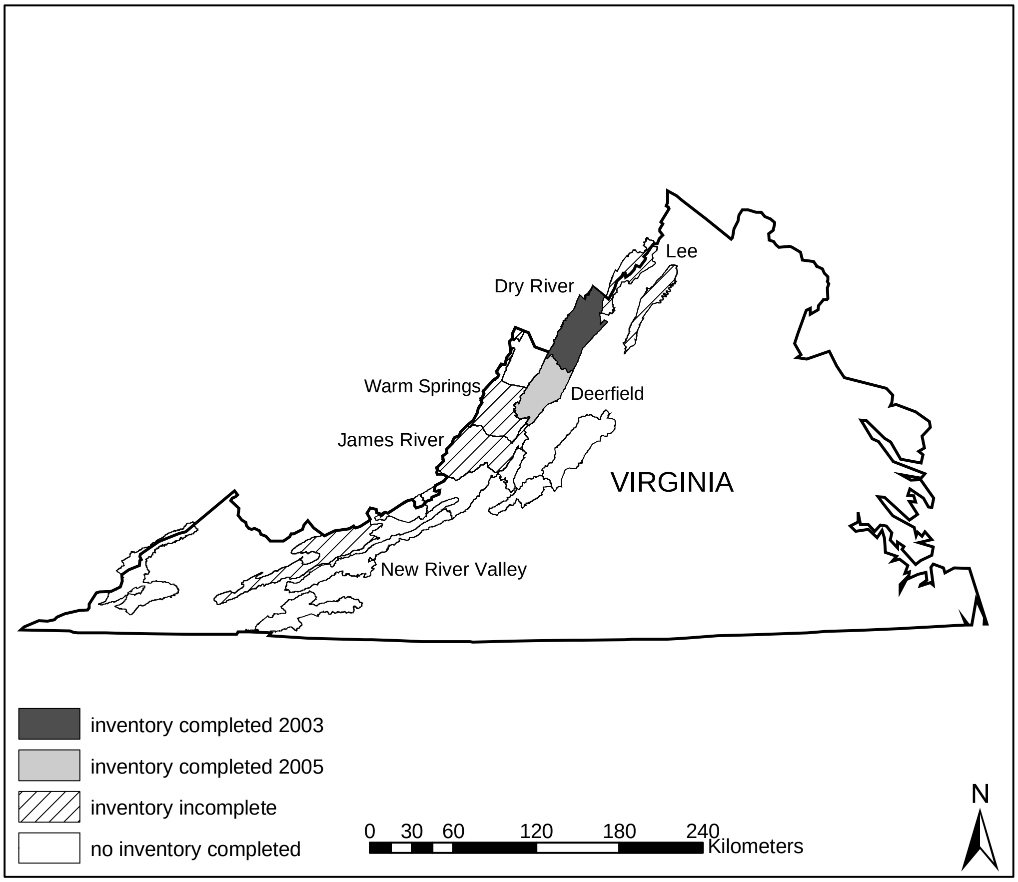

Figure A1. Ranger Districts on the George Washington-Jefferson National Forest road-stream crossing surveys were conducted. Results of inventories conducted by Fish and Aquatic Ecology Unit - East on Dry River and Lee Ranger Districts in 2003 presented in a separate report.

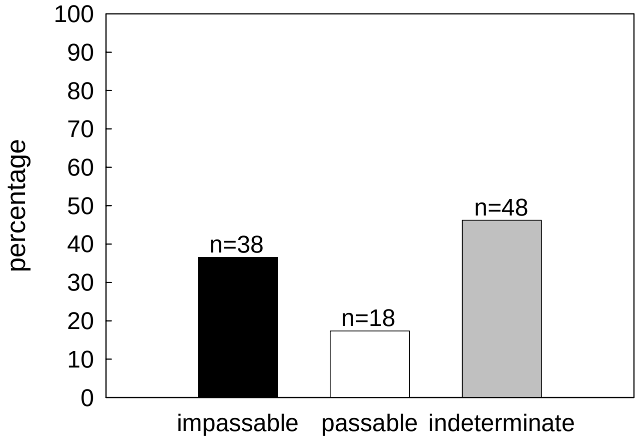

Figure A2. Percentage of crossings classified as impassable, passable, or indeterminate by Filter A; George Washington-Jefferson National Forest, summer 2005 (n=104).

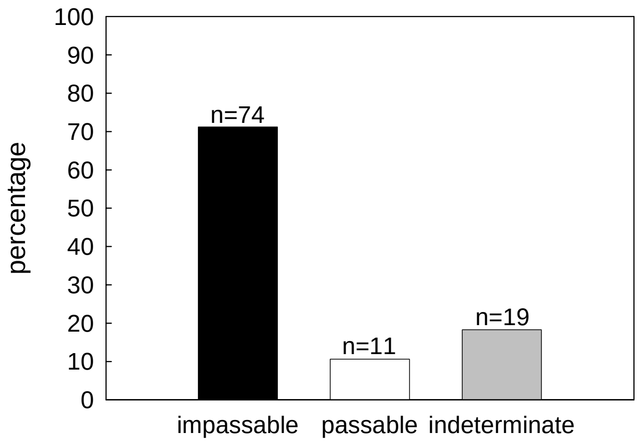

Figure A3. Percentage of crossings classified as impassable, passable, or indeterminate by Filter B; George Washington-Jefferson National Forest, summer 2005 (n=104).

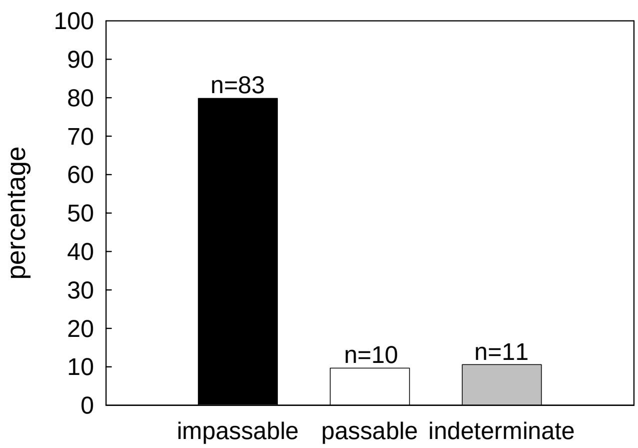

Figure A4. Percentage of crossings classified as impassable, passable, or indeterminate by Filter C; George Washington-Jefferson National Forest, summer 2005 (n=104).

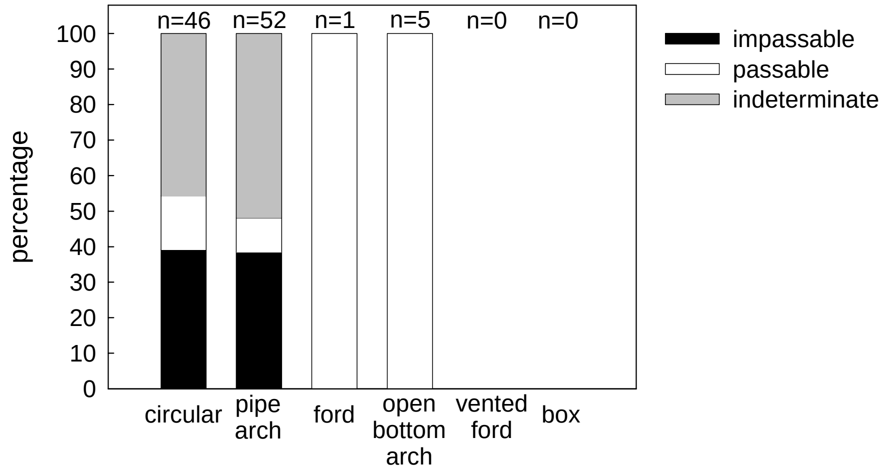

Figure A5. Percentage of each crossing type classified as impassable, passable, or indeterminate by Filter A; George Washington-Jefferson National Forest, summer 2005 (N=104).

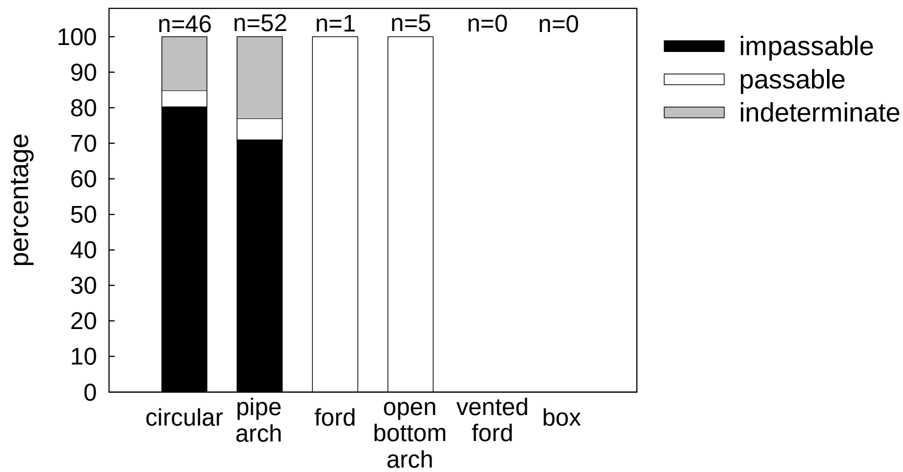

Figure A6. Percentage of each crossing type classified as impassable, passable, or indeterminate by Filter B; George Washington-Jefferson National Forest, summer 2005 (N=104).

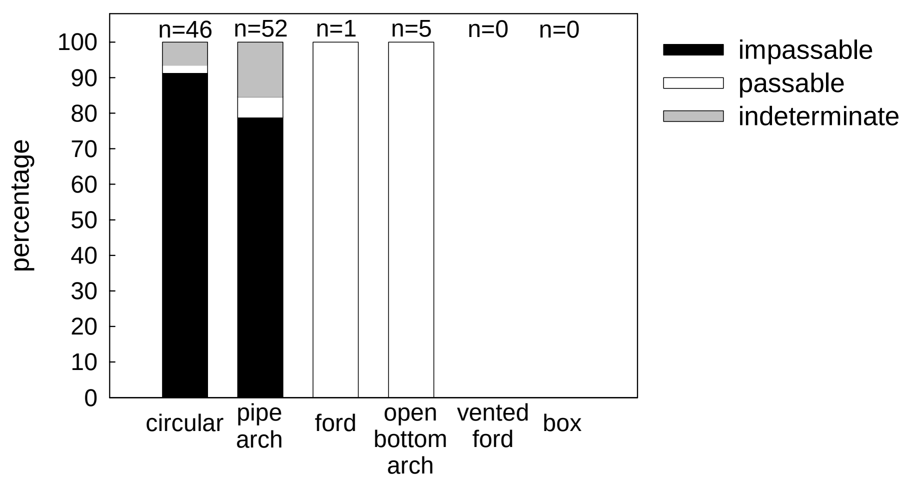

Figure A7. Percentage of each crossing type classified as impassable, passable, or indeterminate by Filter C; George Washington-Jefferson National Forest, summer 2005 (N=104).

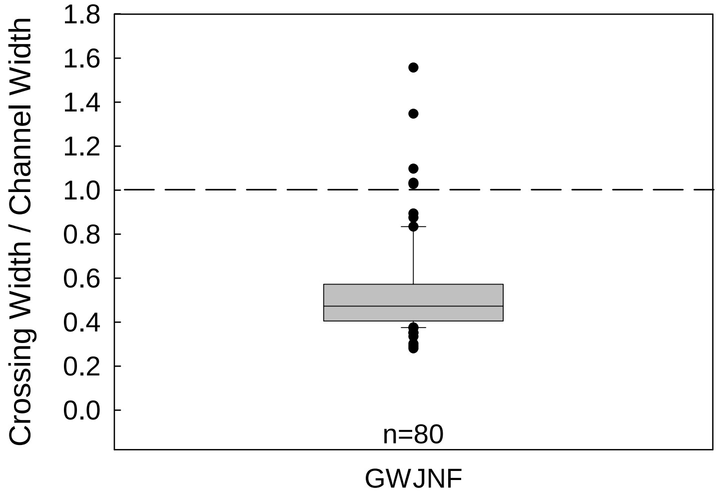

Figure A8. Crossing width to bankfull channel width ratio for crossings surveyed in summer 2005 on the George Washington-Jefferson National Forest (excluding fords, vented fords, and multiple structure crossings). A ratio of 1.0 (dashed line) or greater indicates the crossing structure opening is greater than or equal to the bankfull channel width. The top and bottom of the boxes represent the 25th and 75th percentiles, the bar in the center of each box represents the median, whiskers represent the 10th and 90th percentiles, and closed circles represent the entire range of the data.

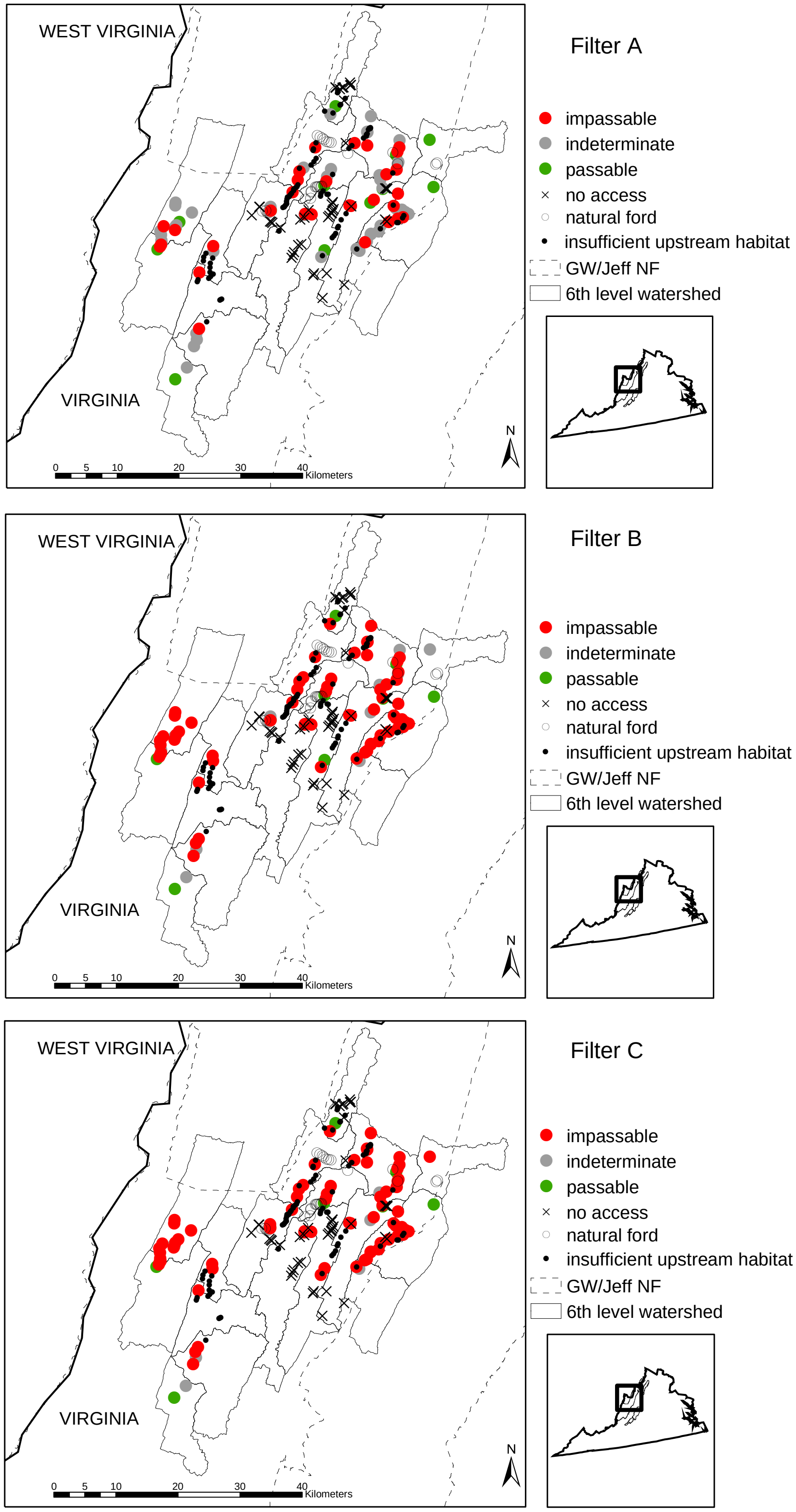

Figure A9. Location of crossings classified for fish passage by coarse filters A, B, and C within 6th level watersheds, and crossings not surveyed on the George Washington-Jefferson National Forest, summer 2005.

Table A1. Number of crossings documented (Total crossings documented) and not surveyed (crossings not surveyed) on the GWJNF in summer 2005. Reasons for not surveying a documented site include: no suitable fish habitat upstream of crossing (NH); no access to site due to closed roads or private gates (NA); crossing was a natural ford (NF); crossing was a bridge (BR).

Forest	Total crossing documented	Crossings not surveyed (n, [%])				
		NH	NA	NF	BR	Total not surveyed
GWJNF	258	80 (52)	51 (33)	23 (15)	0 (0)	154 (60)

Table A2. Number of crossings surveyed (Total surveyed) with coarse filter results for the GWJNF in summer 2005. Coarse filter results are presented for Filter A, Filter B, and Filter C (see filter descriptions, Fig 3 – 5).

Forest	Total surveyed	Coarse filter results								
		Impassable (n, [%])			Passable (n, [%])			Indeterminate (n, [%])		
		A	B	C	A	B	C	A	B	C
GWJNF	104	38 (37)	74 (71)	83 (80)	18 (17)	11 (11)	10 (10)	48 (46)	19 (18)	10 (11)

Table A3. Location of crossings surveyed on the George Washington-Jefferson National Forest during the summer of 2005. Site ID consists of the Forest abbreviation (GWJ), road the crossing is on (1576), and the distance (miles) from the junction road (0.4).

Site ID	Pipe #	District	Junction Road	Stream Name	Quad	6th Level Watershed
GWJ1576-0.4	1	Deerfield	61	Clayton Mill Spring Creek	Deerfield	020802020105
GWJ255-0.9	1	Deerfield	173	Holloway Draft	Deerfield	020802020103
GWJ255-0.9	2	Deerfield	173	Holloway Draft	Deerfield	020802020103
GWJ255-4.5	1	Deerfield	629	Rock lick	Deerfield	020802020103
GWJ255-4.6	1	Deerfield	629	Rock lick	Deerfield	020802020103
GWJ255-4.6	2	Deerfield	629	Rock lick	Deerfield	020802020103
GWJ381-0.1	1	Deerfield	82	Fridley Branch	Elliot Knob	020802020105
GWJ381-0.1	2	Deerfield	82	Fridley Branch	Elliot Knob	020802020105
GWJ381-3.6	1	Deerfield	82	Scott Hollow	Deerfield	020802020105
GWJ381-4.65	1	Deerfield	82	UT Kiser Hollow	Deerfield	020802020105
GWJ382-1.2	1	Deerfield	82	Archer Run	Augusta Springs	020802020201
GWJ382-2.3	1	Deerfield	82	Gum Lick Hollow	Augusta Springs	020802020201
GWJ382-4.3	1	Deerfield	82	Kennedy Draft	Augusta Springs	020802020201
GWJ382-5.5	1	Deerfield	82	Taylor Hollow	Craigsville	020802020201
GWJ382-6.5	1	Deerfield	82	Staples Hollow	Craigsville	020802020201
GWJ382-7.1	1	Deerfield	82	Stouples Hollow	Craigsville	020802020201
GWJ382-7.15	1	Deerfield	82	Stouples Hollow	Craigsville	020802020201
GWJ382-9.6	1	Deerfield	82	Wallace Draft	Craigsville	020802020201
GWJ382-9.9	1	Deerfield	82	Wallace Draft	Craigsville	020802020201
GWJ383h-.001	1	Deerfield	42	Fall Branch	Elliot Knob	020802020201
GWJ383h-.001	2	Deerfield	42	Fall Branch	Elliot Knob	020802020201
GWJ387-0.05	1	Deerfield	61	Little Mill Creek	Green Valley	020802020106
GWJ393-0.2	1	Deerfield	173	Left Fork Halloway Draft	Deerfield	020802020103
GWJ394-0.39	1	Deerfield	627	Rail Hollow	Williamsville	020802010701
GWJ394-0.4	1	Deerfield	627	Rail Hollow	Williamsville	020802010701

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Site ID	Pipe #	District	Junction Road	Stream Name	Quad	6th Level Watershed
GWJ394-0.8	1	Deerfield	627	Rail Hollow	Williamsville	020802010701
GWJ394-10.7	1	Deerfield	627	Wide Hollow	Williamsville	020802010603
GWJ394-10.71	1	Deerfield	627	Wide Hollow	Williamsville	020802010603
GWJ394-12.1	1	Deerfield	627	Brushy Fork	Williamsville	020802010603
GWJ394-6.9	1	Deerfield	627	Marshall Draft	Williamsville	020802010701
GWJ394-9.4	1	Deerfield	627	Hulit Draft	Williamsville	020802010603
GWJ394b-0.8	1	Deerfield	394	House Run	Deerfield	020802010603
GWJ394y-0.01	1	Deerfield	394	Rail Hollow	Williamsville	020802010701
GWJ394z-.01	1	Deerfield	394	Rail Hollow	Williamsville	020802010701
GWJ395-1.3	1	Deerfield	616	Clover Lick Hollow	McDowell	020802010602
GWJ395-3.5	1	Deerfield	616	Jerry's Hollow	McDowell	020802010602
GWJ399-1.0	1	Deerfield	600	Jerkemtite Branch	Deerfield	020802020104
GWJ399b-0.8	1	Deerfield	399	Tom Lee Draft	Deerfield	020802020104
GWJ399b-1.6	1	Deerfield	399	Frames Draft	Deerfield	020802020104
GWJ399b-3.9	1	Deerfield	399	Stoney Lick	Deerfield	020802020104
GWJ433-1.3	1	Deerfield	629	Buck Lick Run	Williamsville	020802010704
GWJ433-2.35	1	Deerfield	629	Buck Lick Run	Williamsville	020802010704
GWJ433-2.4	1	Deerfield	629	Rock Lick Run	Williamsville	020802010704
GWJ61-0.8	1	Deerfield	600	Clayton Mill Spring Creek	Deerfield	020802020105
GWJ61-6.3	1	Deerfield	600	Little Mill Creek	Green Valley	020802020106
GWJ61-6.3	2	Deerfield	600	Little Mill Creek	Green Valley	020802020106
GWJ627-4.4	1	Deerfield	629	Scotchtown Draft	Williamsville	020802010701
GWJ687-0.09	1	Deerfield	1133	Ramsey Draft	Craigsville	020802020202
GWJ687-0.5	1	Deerfield	382	Ramsey Draft	Craigsville	020802020202
GWJ688-2.2	1	Deerfield	42	East Dry Branch	Elliot Knob	020700050102
GWJ688-2.2	2	Deerfield	42	East Dry Branch	Elliot Knob	020700050102
GWJ688-2.2	3	Deerfield	42	East Dry Branch	Elliot Knob	020700050102
GWJ77-0.25	1	Deerfield	688	West Dry Branch	Elliot Knob	020802020103

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Site ID	Pipe #	District	Junction Road	Stream Name	Quad	6th Level Watershed
GWJ77-1.0	1	Deerfield	688	Laurel Branch	Elliot Knob	020802020103
GWJ77-1.65	1	Deerfield	688	White Rock Branch	Elliot Knob	020802020103
GWJ77-1.65	2	Deerfield	688	White Rock Branch	Elliot Knob	020802020103
GWJ77-1.9	1	Deerfield	688	S Fork White Rock Branch	Elliot Knob	020802020103
GWJ77-2.9	1	Deerfield	688	Steel Lick Draft	Elliot Knob	020802020103
GWJ77-2.9	2	Deerfield	688	Steel Lick Draft	Elliot Knob	020802020103
GWJ77-3.2	1	Deerfield	688	Charlie Lick Branch	Elliot Knob	020802020103
GWJ77-3.8	1	Deerfield	688	Still Run	Elliot Knob	020802020103
GWJ77-5.6	1	Deerfield	688	UT Daddy Run	Elliot Knob	020802020103
GWJ77-6.2	1	Deerfield	688	Staples Run	Deerfield	020802020103
GWJ77-6.8	1	Deerfield	688	Corbett Branch	Deerfield	020802020103
GWJ81-2.4	1	Deerfield	688	Hodges Draft	McDowell	020802020103
GWJ82-0.1	1	Deerfield	382	Hite Hollow	Augusta Springs	020802020201
GWJ82-0.5	1	Deerfield	382	Hite Hollow	Augusta Springs	020802020201
GWJ82-1.0	1	Deerfield	382	Hite Hollow	Augusta Springs	020802020201
GWJ82-1.6	1	Deerfield	382	Hite Hollow	Augusta Springs	020802020201
GWJ82-1.9	1	Deerfield	382	Hite Hollow	Augusta Springs	020802020201
GWJ82-5.39	1	Deerfield	382	Fridleys Branch	Elliot Knob	020802020105
GWJ82-7.5	1	Deerfield	382	Fridleys Branch	Deerfield	020802020105
GWJ125-6.95	1	Warm Springs	606	Smith Creek	Healing Springs	020802010506
GWJ125-9.1	1	Warm Springs	606	Left Prong Wilson Creek	Healing Springs	020802010506
GWJ1747-0.02	1	Warm Springs	220	Rocky Run	Burnsville	020802010102
GWJ194-4.8	1	Warm Springs	629	Stouts Creek	Healing Springs	020802010801
GWJ194-5.6	1	Warm Springs	629	Stouts Creek	Healing Springs	020802010801
GWJ194-6.7	1	Warm Springs	629	Wilson Creek	Healing Springs	020802010801
GWJ194-6.7	2	Warm Springs	629	Wilson Creek	Healing Springs	020802010801
GWJ194-7.6	1	Warm Springs	629	Porter's Mill Creek	Healing Springs	020802010801
GWJ241-10.0	1	Warm Springs	621	Ned Hollow	Sunrise	020802010102

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Site ID	Pipe #	District	Junction Road	Stream Name	Quad	6th Level Watershed
GWJ241-3.6	1	Warm Springs	621	Limeklin Run	Warm Springs	020802010103
GWJ241-3.9	1	Warm Springs	621	UT Limekiln Run	Sunrise	020802010103
GWJ241-4.0	1	Warm Springs	621	UT Limekiln Run	Sunrise	020802010103
GWJ241-4.0	2	Warm Springs	621	UT Limekiln Run	Sunrise	020802010103
GWJ241-4.3	1	Warm Springs	621	UT Limekiln Run	Sunrise	020802010103
GWJ241-4.5	1	Warm Springs	621	Limeklin Run	Sunrise	020802010103
GWJ241-4.9	1	Warm Springs	621	Kelley Run	Sunrise	020802010102
GWJ241-6.0	1	Warm Springs	621	Kelley Run	Sunrise	020802010102
GWJ241-6.7	1	Warm Springs	621	Kelley Run	Sunrise	020802010102
GWJ241-9.0	1	Warm Springs	621	UT Jackson River	Sunrise	020802010102
GWJ241-9.3	1	Warm Springs	621	Birch Run	Sunrise	020802010102
GWJ241-9.6	1	Warm Springs	621	UT Jackson River	Sunrise	020802010102
GWJ358-1.3	1	Warm Springs	gate	Jordan Run	Bath Alum	020802010703
GWJ401-1.4	1	Warm Springs	623	Cave Run	Sunrise	020802010102
GWJ401-1.7	1	Warm Springs	623	Cave Run	Sunrise	020802010102
GWJ465-1.3	1	Warm Springs	609	Dry Run	Bath Alum	020802010702
GWJ465-2.3	1	Warm Springs	609	Cub Run	Bath Alum	020802010702
GWJ603trail	1	Warm Springs	621	Ned Hollow	Sunrise	020802010102
GWJ10570-2.6	1	NewRiver	734	Laurel Creek	Interior	050500020304
GWJ613-0.4	1	NewRiver	635	White Rock Branch	Interior	050500020305
GWJ613-0.4	2	NewRiver	635	White Rock Branch	Interior	050500020305
GWJ125-1.3	1	James River	625	Pounding Mill Creek	Covington	020802010504
GWJ587-0.4	1	James River	606	Smith Creek	Clifton Forge	020802010507

Table A4. Coarse filter A, B, and C, classifications for crossings surveyed on the George Washington-Jefferson National Forest, summer 2005.

Site ID	Pipe #	Filter A	Filter B	Filter C
GWJ1576-0.4	1	impassable	impassable	impassable
GWJ255-0.9	1	impassable	impassable	impassable
GWJ255-0.9	2	impassable	impassable	impassable
GWJ255-4.5	1	indeterminate	impassable	impassable
GWJ255-4.6	1	indeterminate	impassable	impassable
GWJ255-4.6	2	impassable	impassable	impassable
GWJ381-0.1	1	passable	indeterminate	indeterminate
GWJ381-0.1	2	passable	passable	passable
GWJ381-3.6	1	impassable	impassable	impassable
GWJ381-4.65	1	passable	indeterminate	indeterminate
GWJ382-1.2	1	impassable	impassable	impassable
GWJ382-2.3	1	impassable	impassable	impassable
GWJ382-4.3	1	impassable	impassable	impassable
GWJ382-5.5	1	indeterminate	impassable	impassable
GWJ382-6.5	1	indeterminate	impassable	impassable
GWJ382-7.1	1	indeterminate	impassable	impassable
GWJ382-7.15	1	indeterminate	impassable	impassable
GWJ382-9.6	1	indeterminate	impassable	impassable
GWJ382-9.9	1	impassable	impassable	impassable
GWJ383h-.001	1	indeterminate	indeterminate	indeterminate
GWJ383h-.001	2	passable	passable	passable
GWJ387-0.05	1	indeterminate	impassable	impassable
GWJ393-0.2	1	impassable	impassable	impassable
GWJ394-0.39	1	indeterminate	impassable	impassable
GWJ394-0.4	1	indeterminate	indeterminate	impassable
GWJ394-0.8	1	indeterminate	indeterminate	impassable
GWJ394-10.7	1	impassable	impassable	impassable
GWJ394-10.71	1	impassable	impassable	impassable
GWJ394-12.1	1	indeterminate	impassable	impassable
GWJ394-6.9	1	impassable	impassable	impassable
GWJ394-9.4	1	impassable	impassable	impassable
GWJ394b-0.8	1	impassable	impassable	impassable
GWJ394y-0.01	1	impassable	impassable	impassable
GWJ394z-.01	1	passable	passable	passable
GWJ395-1.3	1	indeterminate	impassable	impassable
GWJ395-3.5	1	passable	passable	passable
GWJ399-1.0	1	passable	passable	passable
GWJ399b-0.8	1	impassable	impassable	impassable
GWJ399b-1.6	1	indeterminate	impassable	impassable

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Site ID	Pipe #	Filter A	Filter B	Filter C
GWJ399b-3.9	1	indeterminate	impassable	impassable
GWJ433-1.3	1	impassable	impassable	impassable
GWJ433-2.35	1	impassable	impassable	impassable
GWJ433-2.4	1	indeterminate	impassable	impassable
GWJ61-0.8	1	impassable	impassable	impassable
GWJ61-6.3	1	passable	passable	impassable
GWJ61-6.3	2	passable	indeterminate	impassable
GWJ627-4.4	1	indeterminate	indeterminate	indeterminate
GWJ687-0.09	1	indeterminate	impassable	impassable
GWJ687-0.5	1	indeterminate	indeterminate	indeterminate
GWJ688-2.2	1	passable	impassable	impassable
GWJ688-2.2	2	indeterminate	indeterminate	impassable
GWJ688-2.2	3	passable	indeterminate	impassable
GWJ77-0.25	1	indeterminate	indeterminate	impassable
GWJ77-1.0	1	impassable	impassable	impassable
GWJ77-1.65	1	impassable	impassable	impassable
GWJ77-1.65	2	impassable	impassable	impassable
GWJ77-1.9	1	passable	passable	passable
GWJ77-2.9	1	indeterminate	impassable	impassable
GWJ77-2.9	2	indeterminate	impassable	impassable
GWJ77-3.2	1	indeterminate	indeterminate	impassable
GWJ77-3.8	1	impassable	impassable	impassable
GWJ77-5.6	1	impassable	impassable	impassable
GWJ77-6.2	1	indeterminate	indeterminate	indeterminate
GWJ77-6.8	1	indeterminate	impassable	impassable
GWJ81-2.4	1	indeterminate	impassable	impassable
GWJ82-0.1	1	indeterminate	impassable	impassable
GWJ82-0.5	1	indeterminate	impassable	impassable
GWJ82-1.0	1	indeterminate	impassable	impassable
GWJ82-1.6	1	indeterminate	impassable	impassable
GWJ82-1.9	1	impassable	impassable	impassable
GWJ82-5.39	1	impassable	impassable	impassable
GWJ82-7.5	1	indeterminate	impassable	impassable
GWJ125-6.95	1	passable	passable	passable
GWJ125-9.1	1	indeterminate	indeterminate	indeterminate
GWJ1747-.02	1	indeterminate	impassable	impassable
GWJ194-4.8	1	impassable	impassable	impassable
GWJ194-5.6	1	indeterminate	impassable	impassable
GWJ194-6.7	1	indeterminate	indeterminate	indeterminate
GWJ194-6.7	2	indeterminate	indeterminate	indeterminate
GWJ194-7.6	1	indeterminate	impassable	impassable

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Site ID	Pipe #	Filter A	Filter B	Filter C
GWJ241-10	1	passable	impassable	impassable
GWJ241-3.6	1	passable	passable	passable
GWJ241-3.9	1	impassable	impassable	impassable
GWJ241-4.0	1	impassable	impassable	impassable
GWJ241-4.0	2	impassable	impassable	impassable
GWJ241-4.3	1	indeterminate	impassable	impassable
GWJ241-4.5	1	indeterminate	indeterminate	impassable
GWJ241-4.9	1	indeterminate	impassable	impassable
GWJ241-6.0	1	indeterminate	impassable	impassable
GWJ241-6.7	1	impassable	impassable	impassable
GWJ241-9.0	1	impassable	impassable	impassable
GWJ241-9.3	1	indeterminate	indeterminate	indeterminate
GWJ241-9.6	1	indeterminate	impassable	impassable
GWJ358-1.3	1	impassable	impassable	impassable
GWJ401-1.4	1	indeterminate	impassable	impassable
GWJ401-1.7	1	indeterminate	impassable	impassable
GWJ465-1.3	1	impassable	impassable	impassable
GWJ465-2.3	1	indeterminate	impassable	impassable
GWJ603trail	1	passable	indeterminate	indeterminate
GWJ10570-2.6	1	impassable	impassable	impassable
GWJ613-0.4	1	impassable	impassable	impassable
GWJ613-0.4	2	impassable	impassable	impassable
GWJ125-1.3	1	passable	passable	passable
GWJ587-0.4	1	passable	passable	passable

Table A5. Description of crossings surveyed on the George Washington-Jefferson National Forest, summer 2005. Shape abbreviations: C= circular, PA= pipe arch, OBA= open bottom arch, and F= ford. Channel width is the mean bankfull channel width. N= no natural substrate, N (discontin)= discontinuous substrate, Y= continuous natural substrate. An NA (not applicable) indicates outlet drop (no outlet pool or tailwater control) or outlet perch (stream dry) could not be calculated. Negative outlet drop or perch values indicate a submerged outlet (structure partially backwatered). Residual inlet depth values ≥ 0.0 indicate the structure is fully backwatered.

Site ID	Pipe #	Shape	Pipe Condition	Mean Channel Width (ft)	Continuous Substrate in Structure	Pipe slope (%)	Pipe Width: Channel Width ratio	Outlet Drop (in)	Outlet Perch (in)	Residual Inlet Depth (in)	Pipe Length (ft)	Slope (%) * Length (ft)
GWJ1576-0.4	1	C	fair	7.1	N	11.00	0.42	14.40	12.84	0.00	33.1	364.0
GWJ255-0.9	1	PA	poor	13.7	N (discontin)	2.17	0.48	32.46	16.86	0.00	48.1	104.5
GWJ255-0.9	2	PA	poor	13.7	N (discontin)	2.07	0.48	32.58	16.98	0.00	48.1	99.5
GWJ255-4.5	1	C	poor	8.5	N	4.22	0.53	12.60	9.96	0.00	36.0	152.0
GWJ255-4.6	1	PA	poor	11.3	N	4.14	0.46	23.58	8.34	0.00	34.4	142.5
GWJ255-4.6	2	PA	poor	11.3	N	6.60	0.46	24.12	8.88	0.00	34.4	227.0
GWJ381-0.1	1	PA	good	20.0	N (discontin)	1.21	0.33	-0.12	-3.36	0.00	36.5	44.0
GWJ381-0.1	2	PA	good	20.0	Y	0.56	0.33	2.64	-0.60	0.00	36.5	20.5
GWJ381-3.6	1	PA	poor	16.1	Y	7.72	0.28	-0.72	NA	0.00	23.0	177.5
GWJ381-4.65	1	PA	good	13.3	N	1.96	0.47	-1.02	-1.80	0.00	25.0	49.0
GWJ382-1.2	1	C	poor	9.7	N (discontin)	2.51	0.38	38.88	NA	0.00	78.2	196.0
GWJ382-2.3	1	PA	poor	11.1	N	2.78	0.51	32.64	NA	0.00	59.0	164.0
GWJ382-4.3	1	PA	good	19.3	N	3.27	0.50	24.24	30.90	0.00	52.8	172.5
GWJ382-5.5	1	PA	good	13.1	N	5.02	0.57	18.12	14.76	0.00	48.5	243.5
GWJ382-6.5	1	PA	good	11.8	N	5.01	0.57	13.32	NA	0.00	42.7	214.0
GWJ382-7.1	1	C	good	13.6	N	4.07	0.39	22.80	NA	0.00	48.7	198.0
GWJ382-7.15	1	C	good	10.5	N	3.45	0.48	11.28	12.36	0.00	69.5	240.0
GWJ382-9.6	1	C	good	14.3	N	4.34	0.35	7.32	NA	0.00	45.0	195.5
GWJ382-9.9	1	C	good	11.7	N	1.70	0.38	80.52	NA	0.00	45.0	76.5
GWJ383h-.001	1	PA	fair	16.0	N (discontin)	2.29	0.38	3.84	-0.06	0.00	33.0	75.5
GWJ383h-.001	2	PA	fair	16.0	Y	1.52	0.38	1.20	-2.70	0.00	33.0	50.0
GWJ387-0.05	1	PA	good	12.6	N	3.49	0.83	14.04	-0.72	0.00	35.0	122.0
GWJ393-0.2	1	C	good	11.4	N	7.59	0.39	16.86	NA	0.00	38.0	288.5

Table continued next page…

Site ID	Pipe #	Shape	Pipe Condition	Mean Channel Width (ft)	Continuous Substrate in Structure	Pipe slope (%)	Pipe Width: Channel Width ratio	Outlet Drop (in)	Outlet Perch (in)	Residual Inlet Depth (in)	Pipe Length (ft)	Slope (%) * Length (ft)
GWJ394-0.39	1	C	fair	7.4	N	4.86	0.40	5.34	NA	0.00	77.3	375.5
GWJ394-0.4	1	C	fair	10.1	N	1.45	0.40	9.12	NA	0.00	80.4	116.4
GWJ394-0.8	1	PA	poor	14.8	N	1.94	0.39	8.10	6.78	0.00	59.5	115.5
GWJ394-10.7	1	PA	fair	9.5	N	7.78	0.40	-14.88	NA	0.00	67.5	525.0
GWJ394-10.71	1	C	good	11.5	N	5.12	0.44	25.92	NA	0.00	64.3	329.0
GWJ394-12.1	1	C	good	10.8	N	5.68	0.43	23.88	25.44	0.00	76.0	432.0
GWJ394-6.9	1	C	good	12.2	N	7.77	0.41	13.14	13.14	0.00	101.0	785.0
GWJ394-9.4	1	C	good	10.3	N	6.44	0.44	37.80	42.72	0.00	64.8	417.0
GWJ394b-0.8	1	C	good	10.9	N	3.79	0.46	24.78	NA	0.00	49.0	185.5
GWJ394y-0.01	1	C	poor	8.5	N	8.05	0.35	6.24	NA	0.00	23.3	187.5
GWJ394z-0.01	1	C	poor	10.8	N (discontin)	0.67	0.37	-3.48	NA	5.28	22.5	15.0
GWJ395-1.3	1	C	good	12.6	N	3.80	0.40	7.92	6.60	0.00	44.0	167.0
GWJ395-3.5	1	OBA	good	18.7	Y	0.82	0.53	-4.20	-4.80	0.24	40.0	33.0
GWJ399-1.0	1	F	good	19.7	N	0.28	NA	3.36	1.08	0.00	21.6	6.0
GWJ399b-0.8	1	PA	good	11.3	N	4.99	0.42	27.12	12.18	0.00	35.7	178.0
GWJ399b-1.6	1	PA	good	14.2	N	3.78	0.48	-8.64	-8.64	0.00	44.9	169.5
GWJ399b-3.9	1	C	fair	14.6	N	2.82	0.55	18.84	15.12	0.00	55.7	157.0
GWJ433-1.3	1	PA	good	14.1	N	4.70	0.51	25.08	24.36	0.00	36.6	172.0
GWJ433-2.35	1	C	fair	8.6	N	7.10	0.49	50.52	NA	0.00	34.7	246.5
GWJ433-2.4	1	C	poor	10.4	N (discontin)	5.45	0.40	20.22	NA	0.00	38.5	210.0
GWJ61-0.8	1	C	good	7.1	N (discontin)	9.80	0.56	NA	1.00	0.00	24.5	241.0
GWJ61-6.3	1	C	poor	10.9	N (discontin)	0.46	0.37	9.42	5.94	0.00	24.9	11.5
GWJ61-6.3	2	C	poor	10.9	N (discontin)	1.04	0.37	8.52	5.04	0.00	24.9	26.0
GWJ627-4.4	1	PA	poor	13.5	N	3.05	0.33	-4.68	-30.12	0.00	40.3	123.0
GWJ687-0.09	1	C	good	13.3	N	5.72	0.30	-0.96	NA	0.00	30.0	171.5
GWJ687-0.5	1	C	fair	10.3	N	2.87	0.39	-2.76	NA	0.00	50.2	144.0
GWJ688-2.2	1	C	good	19.5	N	1.63	0.12	13.44	6.24	0.00	30.0	49.0
GWJ688-2.2	2	C	good	19.5	N	2.23	0.10	4.80	-2.40	0.00	30.0	67.0

Table continued next page…

Site ID	Pipe #	Shape	Pipe Condition	Mean Channel Width (ft)	Continuous Substrate in Structure	Pipe slope (%)	Pipe Width: Channel Width ratio	Outlet Drop (in)	Outlet Perch (in)	Residual Inlet Depth (in)	Pipe Length (ft)	Slope (%) * Length (ft)
GWJ688-2.2	3	C	good	19.5	N	1.00	0.10	9.00	1.80	0.00	30.0	30.0
GWJ77-0.25	1	PA	good	11.5	N	3.10	0.66	7.44	-3.60	0.00	49.0	152.0
GWJ77-1.0	1	PA	good	14.4	N (discontin)	2.20	0.55	54.54	47.82	0.00	49.8	109.5
GWJ77-1.65	1	PA	good	17.8	N	2.61	0.34	37.08	NA	0.00	36.0	94.0
GWJ77-1.65	2	PA	good	17.8	N	2.44	0.34	36.96	NA	0.00	36.0	88.0
GWJ77-1.9	1	OBA	good	17.0	Y	0.50	0.59	-2.04	-0.36	0.12	32.0	16.0
GWJ77-2.9	1	C	good	16.4	N	2.48	0.24	19.08	NA	0.00	43.5	108.0
GWJ77-2.9	2	C	good	16.4	N	3.01	0.24	12.72	NA	0.00	41.0	123.5
GWJ77-3.2	1	PA	good	13.2	N	3.40	0.72	9.84	3.60	0.00	35.0	119.0
GWJ77-3.8	1	PA	poor	11.9	N	8.02	0.63	53.88	52.44	0.00	39.8	319.0
GWJ77-5.6	1	PA	poor	8.3	Y	12.30	0.48	30.72	27.24	0.00	23.0	283.0
GWJ77-6.2	1	C	fair	8.9	N	2.13	0.45	2.40	NA	0.00	40.0	85.0
GWJ77-6.8	1	PA	good	13.5	N (discontin)	1.87	0.89	16.20	15.60	0.00	54.0	101.0
GWJ81-2.4	1	PA	good	11.5	N	5.33	0.44	16.80	15.84	0.00	40.0	213.0
GWJ82-0.1	1	PA	good	22.0	N	3.59	0.52	-6.66	-13.62	0.00	51.7	185.5
GWJ82-0.5	1	PA	poor	12.7	N (discontin)	3.82	0.38	7.20	2.16	0.00	20.4	78.0
GWJ82-1.0	1	PA	fair	18.7	N	3.72	0.38	2.40	-2.88	0.00	26.1	97.0
GWJ82-1.6	1	PA	good	15.3	N	3.36	0.58	10.44	6.72	0.00	32.0	107.5
GWJ82-1.9	1	C	good	10.2	N	7.73	0.44	19.68	17.04	0.00	44.5	344.0
GWJ82-5.39	1	PA	good	11.6	N	12.13	0.52	33.84	43.80	0.00	42.2	512.0
GWJ82-7.5	1	PA	good	14.9	N (discontin)	4.47	0.57	-6.06	-11.94	0.00	33.9	151.5
GWJ125-6.95	1	OBA	good	11.3	Y	1.83	1.56	3.72	-3.00	0.00	47.0	86.0
GWJ125-9.1	1	PA	good	23.5	N	2.63	0.66	-2.28	-10.92	0.00	30.0	79.0
GWJ1747-0.02	1	PA	fair	15.6	N	2.85	0.42	11.76	7.68	0.00	36.2	103.0
GWJ194-4.8	1	C	good	7.0	N	5.47	0.57	NA	22.32	0.00	45.0	246.0
GWJ194-5.6	1	PA	good	10.6	N	5.68	0.47	12.30	10.50	0.00	36.0	204.5
GWJ194-6.7	1	PA	good	13.0	N	2.30	0.54	NA	-4.44	0.00	33.0	76.0
GWJ194-6.7	2	PA	good	13.0	N (discontin)	1.70	0.54	NA	-0.24	0.00	33.0	56.0

Table continued next page…

Site ID	Pipe #	Shape	Pipe Condition	Mean Channel Width (ft)	Continuous Substrate in Structure	Pipe slope (%)	Pipe Width: Channel Width ratio	Outlet Drop (in)	Outlet Perch (in)	Residual Inlet Depth (in)	Pipe Length (ft)	Slope (%) * Length (ft)
GWJ194-7.6	1	PA	good	7.2	N	6.69	0.83	4.32	7.08	0.00	42.0	281.0
GWJ241-10.0	1	C	good	13.0	N	0.95	0.46	15.72	15.60	0.00	40.2	38.0
GWJ241-3.6	1	PA	poor	8.5	N (discontin)	0.25	0.41	0.12	-0.96	0.00	27.61	7.0
GWJ241-3.9	1	PA	fair	5.4	N	7.38	0.54	2.64	-0.12	0.00	26.0	192.0
GWJ241-4.0	1	PA	good	7.8	N	6.79	0.60	24.12	18.36	0.00	29.9	203.0
GWJ241-4.0	2	PA	good	7.8	N	6.86	0.60	25.32	19.56	0.00	29.9	205.0
GWJ241-4.3	1	PA	good	4.7	N	5.76	1.03	1.32	0.00	0.00	26.2	151.0
GWJ241-4.5	1	PA	good	6.1	N	3.00	0.87	4.92	3.00	0.00	30.0	90.0
GWJ241-4.9	1	C	good	6.6	N	6.19	0.70	5.76	3.72	0.00	38.1	236.0
GWJ241-6.0	1	C	fair	4.5	N	4.95	1.03	12.12	9.96	0.00	38.0	188.0
GWJ241-6.7	1	C	good	6.6	N	7.43	0.60	12.00	6.84	0.00	33.1	246.0
GWJ241-9.0	1	C	good	6.1	N	11.74	0.77	20.40	18.00	0.00	36.3	426.0
GWJ241-9.3	1	PA	good	12.8	N	1.90	0.45	NA	-6.12	0.00	35.8	68.0
GWJ241-9.6	1	C	good	6.1	N	4.97	0.41	14.88	15.24	0.00	31.6	157.0
GWJ358-1.3	1	C	good	7.7	N	11.83	0.39	24.72	22.68	0.00	37.2	440.0
GWJ401-1.4	1	C	good	10.6	N (discontin)	4.67	0.47	23.76	20.40	0.00	32.0	149.5
GWJ401-1.7	1	C	good	8.7	N	6.63	0.46	9.24	9.06	0.00	29.5	195.5
GWJ465-1.3	1	C	good	10.4	N	7.53	0.29	6.72	NA	0.00	36.0	271.0
GWJ465-2.3	1	PA	good	11.1	N	4.54	0.69	20.76	16.56	0.00	38.8	176.0
GWJ603trail	1	C	good	7.4	N	2.39	0.41	0.60	-0.18	0.00	19.9	47.5
GWJ10570-2.6	1	C	good	14.7	N	3.12	0.52	32.52	32.52	0.00	50.5	157.5
GWJ613-0.4	1	PA	good	8.3	N	5.34	0.78	27.36	21.84	0.00	58.0	310.0
GWJ613-0.4	2	PA	good	8.3	N	5.07	0.78	30.00	24.48	0.00	58.0	294.0
GWJ125-1.3	1	OBA	good	17.1	Y	7.36	1.35	-5.88	-8.04	30.60	28.0	206.0
GWJ587-0.4	1	OBA	good	25.5	Y	0.29	1.10	7.68	-2.28	0.00	42.0	12.0

Appendix B: Results for the Daniel Boone National Forest

We visited 206 crossings on the Stearns, Somerset, and London Ranger Districts in 2005 (Figure B1, Table B1) and completed surveys on 40% (n=83) (Table B2). Filter A (strong swimmers and leapers) classified 22% (n=18) of crossings as impassable, 29% (n=24) as passable, and 49% (n=41) as indeterminate (Figure B2, Table B2). Filter B (moderate swimmers and leapers) classified 60% (n=50) of crossings as impassable, 15% (n=12) as passable, and 25% (n=21) as indeterminate (Figure B3, Table B2). Filter C (weak swimmers and leapers) classified 87% of crossings (n=72) as impassable, 10% (n=8) as passable, and 3% (n=3) as indeterminate (Figure B4, Table B2). Characteristics and filter classifications for each crossing are presented in Tables B3-B5.

The majority of the crossings were circular culverts (n=52) while fords (n=18), pipe arches (n=12), open bottom arches (n=1), vented fords (n=0), and box culverts (n=0) were less frequently encountered. Filter A classified 29% of circular culverts, 17% of fords, and 0% of pipe arches as impassable (Figure B5). Filter B classified 65% of circular culverts, 58% of pipe arches, and 50% of fords as impassable (Figure B6). Filter C classified 91% of pipe arches , 90% of circular culverts, and 78% of fords as impassable (Figure B7). The mean crossings width to channel width ratio (excluding fords and multiple structure crossings) (n=42) was 0.49 (SD=0.21), and only two crossings were greater than or equal to the mean bankfull channel width (Figure B8).

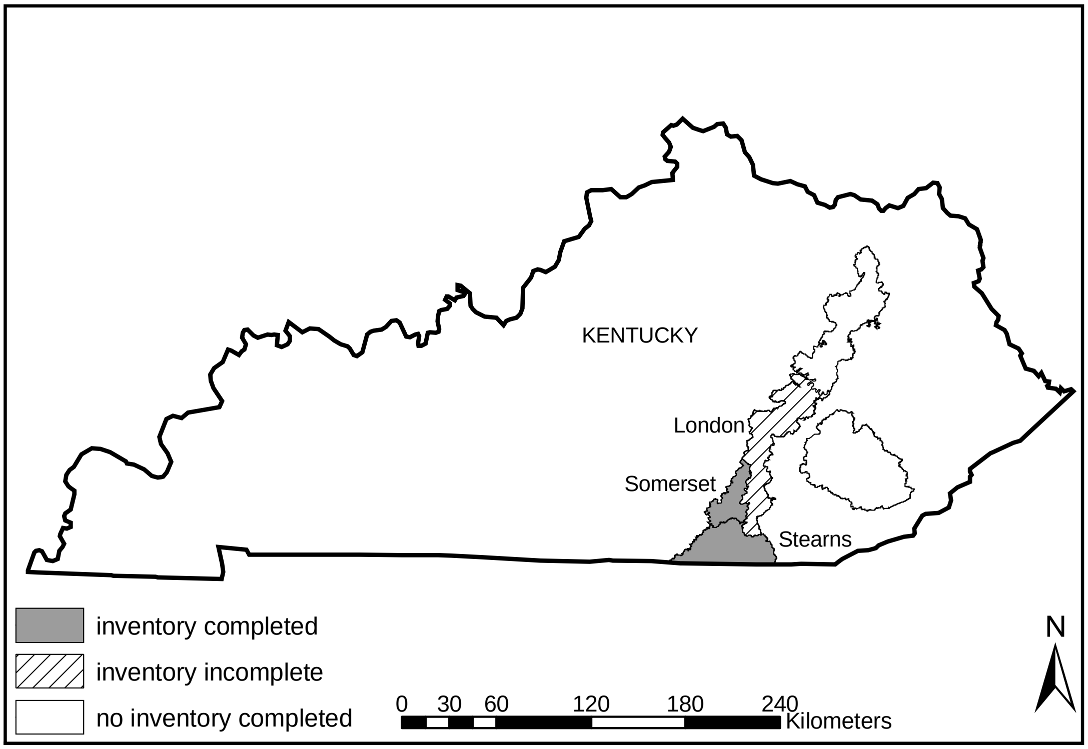

Figure B1. Ranger Districts on the Daniel Boone National Forest road-stream crossing surveys were conducted, summer 2005.

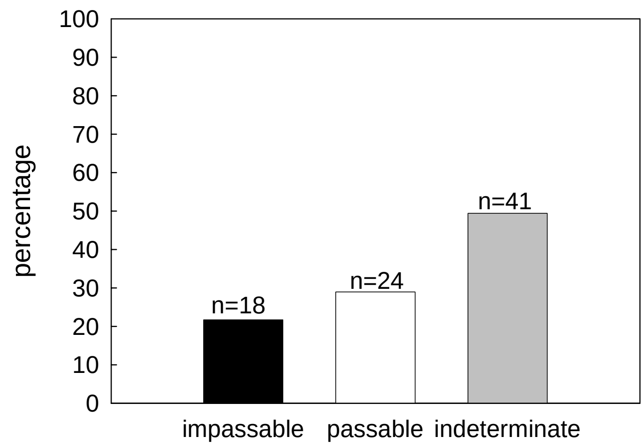

Figure B2. Percentage of crossings classified as impassable, passable, or indeterminate by Filter A; Daniel Boone National Forest, summer 2005 (N=83).

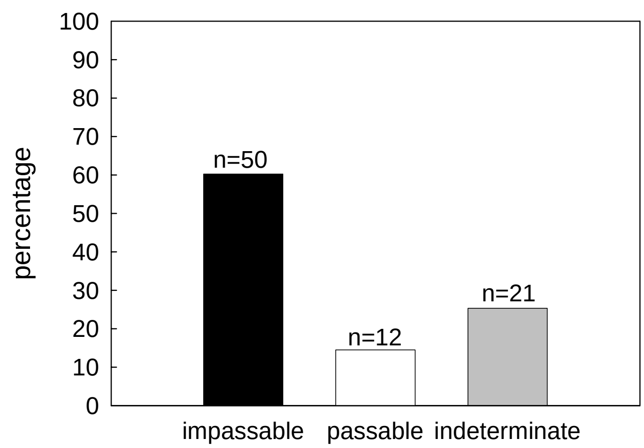

Figure B3. Percentage of crossings classified as impassable, passable, or indeterminate by Filter B; Daniel Boone National Forest, summer 2005 (N=83).

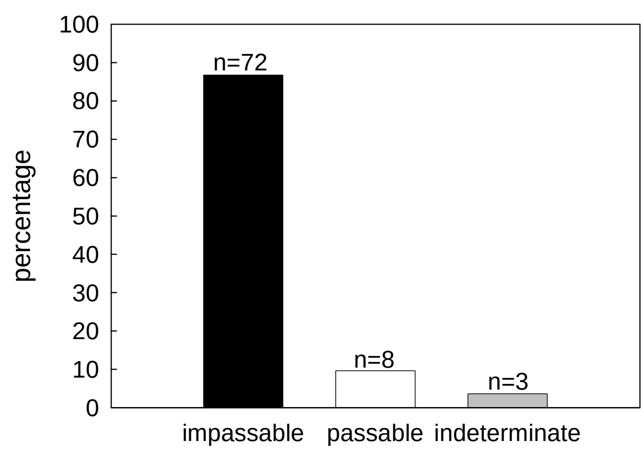

Figure B4. Percentage of crossings classified as impassable, passable, or indeterminate by Filter C; Daniel Boone National Forest, summer 2005 (N=83).

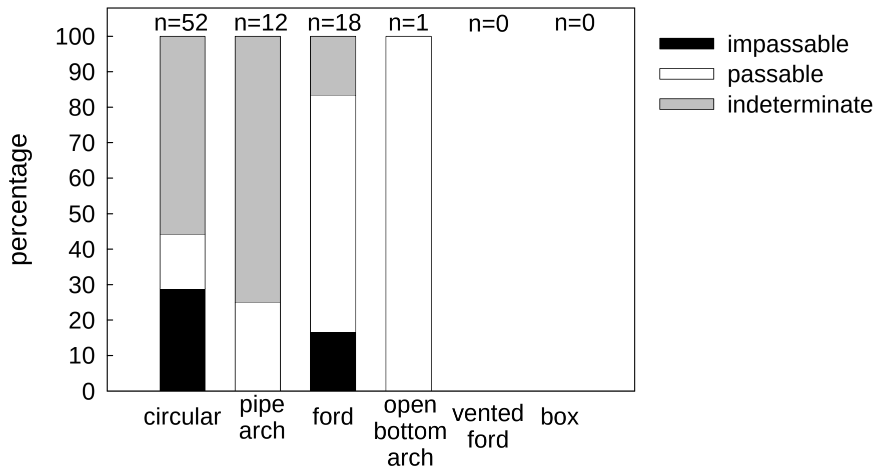

Figure B5. Percentage of each crossing type classified as impassable, passable, or indeterminate for Filter A; Daniel Boone National Forest, summer 2005 (N=83).

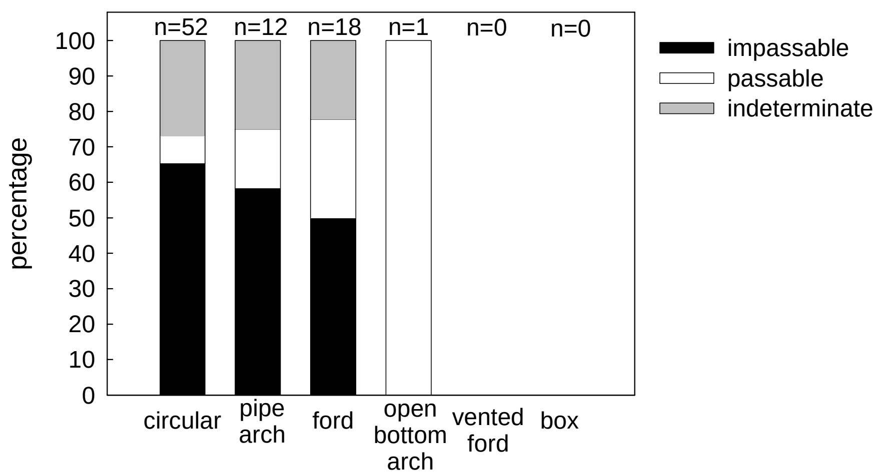

Figure B6. Percentage of each crossing type classified as impassable, passable, or indeterminate for Filter B; Daniel Boone National Forest, summer 2005 (N=83).

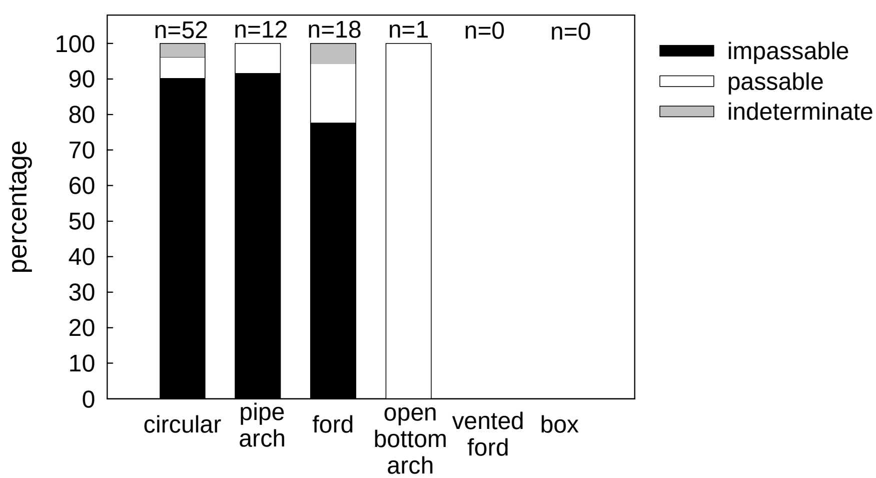

Figure B7. Percentage of each crossing type classified as impassable, passable, or indeterminate for Filter C; Daniel Boone National Forest, summer 2005 (N=83).

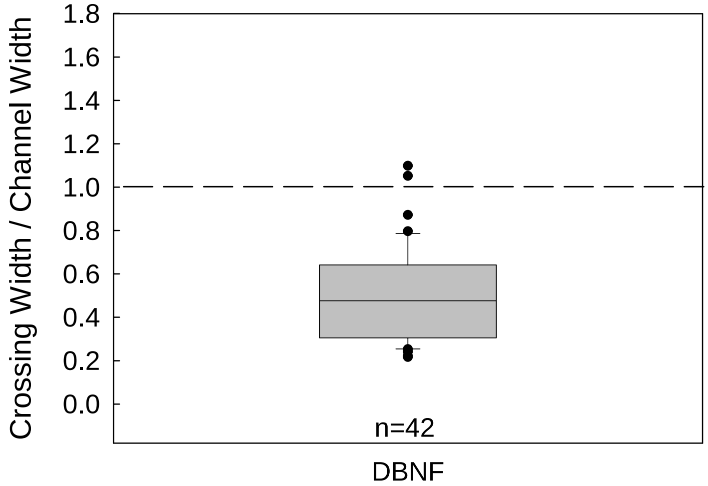

Figure B8. Crossing width to bankfull channel width ratio for crossings surveyed in summer 2005 on the Daniel Boone National Forest (excluding fords, vented fords and multiple structure crossings). A ratio of 1.0 (dashed line) or greater indicates the crossing structure opening is greater than or equal to the bankfull channel width. The top and bottom of the boxes represent the 25th and 75th percentiles, the bar in the center of each box represents the median, whiskers represent the 10th and 90th percentiles, and closed circles represent the entire range of the data.

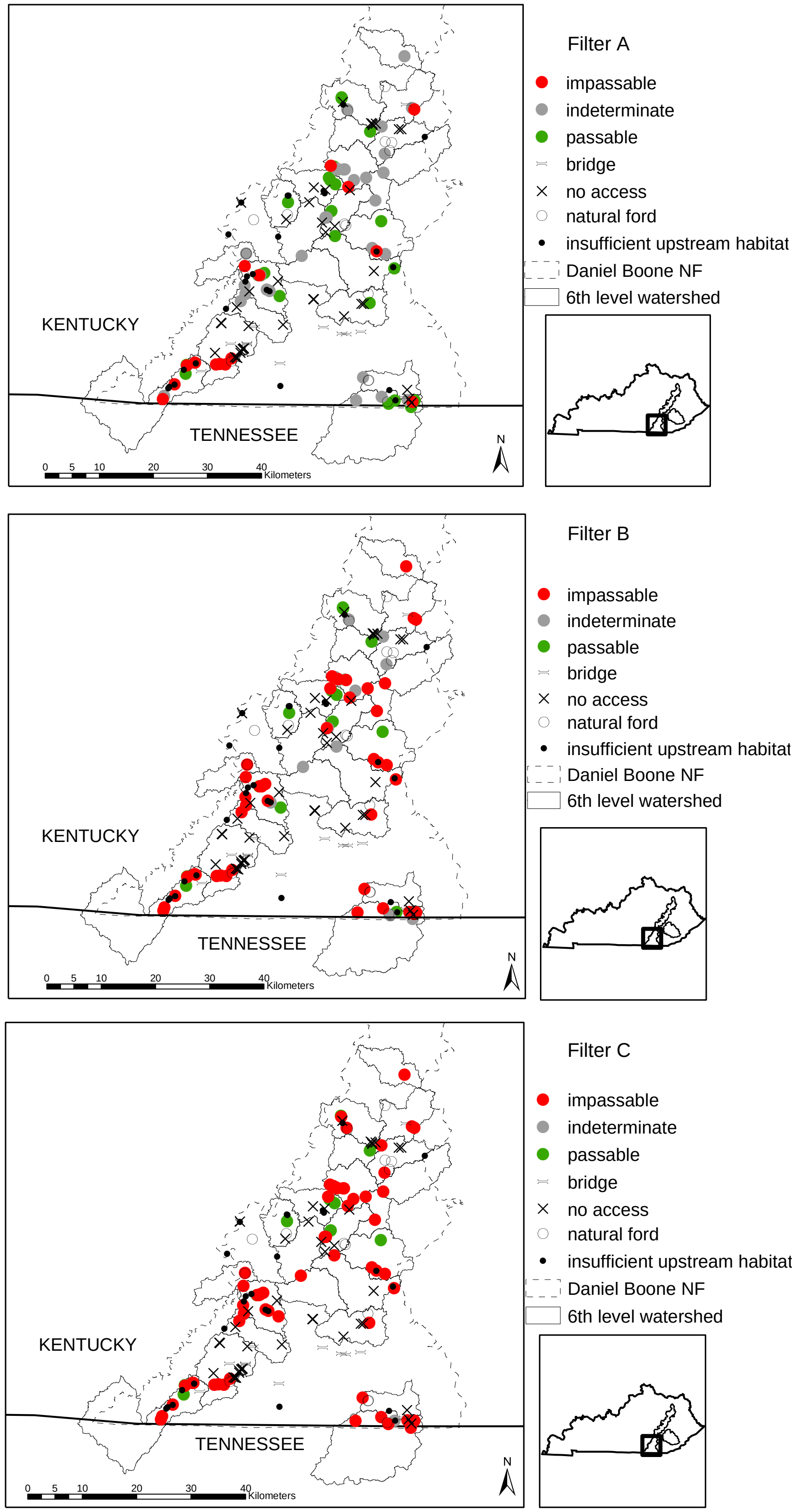

Figure B9. Location of crossings classified for fish passage by coarse filters A, B, and C within 6th level watersheds, and crossings not surveyed on the Daniel Boone National Forest, summer 2005.

Table B1. Number of crossings documented (Total crossings documented) and not surveyed (Crossings not surveyed) on the DBNF in summer 2005. Reasons for not surveying a documented site include: no suitable fish habitat upstream of crossing (NH); no access to site due to closed roads or private gates (NA); crossing was a natural ford (NF); crossing was a bridge (BR).

Forest	Total crossings documented	Crossings not surveyed (n, [%])				
		NH	NA	NF	BR	Total not surveyed
DBNF	206	28 (23)	61 (50)	21 (17)	13 (10)	123 (60)

Table B2. Number of crossings surveyed (Total surveyed) with coarse filter results for the DBNF in summer 2005. Coarse filter results are presented for Filter A, Filter B, and Filter C (see filter descriptions, Fig 3 – 5).

Forest	Total surveyed	Coarse filter results								
		Impassable (n, [%])			Passable (n, [%])			Indeterminate (n, [%])		
		A	B	C	A	B	C	A	B	C
DBNF	83	18 (22)	50 (60)	72 (87)	24 (29)	12 (14)	8 (10)	41 (49)	21 (25)	3 (4)

Table B3. Location of crossings surveyed on the Daniel Boone National Forest during the summer of 2005. Site ID consists of the Forest abbreviation (DB), road the crossing is on (119b), and the distance (miles) from the junction road (0.8).

Site ID	Pipe #	District	Junction Road	Stream Name	Quad	6th level watershed
DB100-1.5	1	London	1277	UT Cumberland River	Sawyer	051301011405
DB119b-0.8	1	London	119	Lick Branch	Ano	051301020507
DB119b-0.8	2	London	119	Lick Branch	Ano	051301020507
DB119b-0.8	3	London	119	Lick Branch	Ano	051301020507
DB131-0.3	1	London	3497	Rock Creek	Sawyer	051301020509
DB132-0.5	1	London	1193	UT Sam's Branch Laurel River Lk	Sawyer	051301011309
DB193-1.8	1	London	1277	Bark Camp Branch	Sawyer	051301011404
DB195-1.1	1	London	88	North Fork Gulf Branch	Cumberland Falls	051301011404
DB195-1.9	1	London	88	Hogbed Branch	Cumberland Falls	051301011404
DB195-3.3	1	London	88	South Fork	Cumberland Falls	051301011404
DB4094-0.6	1	London	4094 road sign	UT Hawk Creek	Bernstadt	051301020502
DB4133-0.49	1	London	766	UT Pound Branch	Ano	051301020508
DB4252-0.5	1	London	539	Amos Falls Branch	Cumberland Falls	051301011403
DB4252-0.5	2	London	539	Amos Falls Branch	Cumberland Falls	051301011403
DB534-xx	1	London	NA	Cane Creek	Cumberland Falls	051301011206
DB615-0.9	1	London	131	UT Ned Branch	Sawyer	051301020509
DB626-0.3	1	London	3497 (gate)	Dutch Brook	Sawyer	051301020509
DB741-0.3	1	London	781	UT Sinking Creek	London SW	051301020505
DB781-0.01	1	London	741	UT Sinking Creek	London SW	051301020505
DB119-3.7	1	Somerset	56	UT Storm Branch	Ano	051301020508
DB272-1.3	1	Somerset	122a	Big Lick	Hail	051301030202
DB272-1.7	1	Somerset	122a	Big Lick	Hail	051301030202
DB272-2.5	1	Somerset	122a	Big Lick	Sawyer	051301030202
DB46-0.6	1	Somerset	3257	Dry Branch	Hail	051301030201
DB5057-0.2	1	Somerset	750	UT Lick Creek	Ano	051301020506
DB5057-0.25	1	Somerset	750	UT Lick Creek	Ano	051301020506
DB5057-1.8	1	Somerset	750	Gwen's Branch	Ano	051301020506
DB5057-1.8	2	Somerset	750	Gwen's Branch	Ano	051301020506
DB5138-0.6	1	Somerset	122a	UT Bear Creek	Hail	051301020509
DB5138-1.0	1	Somerset	122a	Cub Creek	Hail	051301020509

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Site ID	Pipe #	District	Junction Road	Stream Name	Quad	6th level watershed
DB5138-1.5	1	Somerset	122a	Bear Creek	Hail	051301020509
DB5138-1.5	2	Somerset	122a	Bear Creek	Hail	051301020509
DB5138-1.6	1	Somerset	122a	UT Bear Creek	Hail	051301020509
DB5138-1.6	2	Somerset	122a	UT Bear Creek	Hail	051301020509
DB5138-1.61	1	Somerset	122a	Bear Creek	Hail	051301020509
DB5138-2.1	1	Somerset	122a	UT Bear Creek	Sawyer	051301020509
DB5138-2.1	2	Somerset	122a	UT Bear Creek	Sawyer	051301020509
DB5138-2.5	1	Somerset	122a	Bear Creek	Hail	051301020509
DB5165-0.3	1	Somerset	50	UT Cave Creek	Hail	051301030203
DB5183-0.2	1	Somerset	5181	Pink Branch	Hail	051301011406
DB5195-.09	1	Somerset	46	UT Dry Branch	Hail	051301030201
DB5234-0.4	1	Somerset	817	UT Eagle Creek	Hail	051301011403
DB5267-0.25	1	Somerset	927	UT Stanley Branch	Nevelsville	051301040703
DB5270-0.4	1	Somerset	927	Lick Branch	Nevelsville	051301040607
DB5279-0.8	1	Somerset	646a	Straight Creek	Nevelsville	051301040607
DB5279-1.2	1	Somerset	646a	Fox Den Hollow	Nevelsville	051301040607
DB5279-1.4	1	Somerset	646a	Straight Creek	Nevelsville	051301040607
DB5279-1.45	1	Somerset	646a	Straight Creek	Nevelsville	051301040607
DB5279-1.5	1	Somerset	646a	UT Straight Creek	Nevelsville	051301040607
DB5279-1.7	1	Somerset	646a	UT Straight Creek	Nevelsville	051301040607
DB5279-1.75	1	Somerset	646a	Straight Creek	Nevelsville	051301040607
DB137-0.05	1	Stearns	564	UT Rock Creek	Bell Farm	051301040408
DB137-0.8	1	Stearns	TN line on 137	Big Branch	Barthell SW	051301040408
DB137-1.2	1	Stearns	TN line on 137	Buffalo Branch	Barthell SW	051301040408
DB137-2.9	1	Stearns	TN line on 137	UT Rock Trace	Bell Farm	051301040408
DB137-2.9	2	Stearns	TN line on 137	UT Rock Trace	Bell Farm	051301040408
DB137x 0.01	1	Stearns	137	Rock Creek	Bell Farm	051301040408
DB492-2.3	1	Stearns	1470	Lot Hollow	Ketchen	051301011001
DB492-5.8	1	Stearns	1470	UT Rock Creek	Ketchen	051301011001
DB492-7.1	1	Stearns	1470	Rock Creek	Ketchen	051301011001
DB492-8.0	1	Stearns	1470	Shutin Branch	Ketchen	051301011001
DB498-0.9	1	Stearns	1470	Riggs Branch	Holly Hill	051301011002
DB502-0.6	1	Stearns	6274	UT Capuchin Creek	Jellico West	051301011001

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Site ID	Pipe #	District	Junction Road	Stream Name	Quad	6th level watershed
DB502-1.7	1	Stearns	492	UT Capuchin Creek	Jellico West	051301011001
DB564-0.1	1	Stearns	566	UT Rock Creek	Bell Farm	051301040408
DB564-1.3	1	Stearns	566	UT Rock Creek	Bell Farm	051301040408
DB564-1.3	2	Stearns	566	UT Rock Creek	Bell Farm	051301040408
DB566-0.05	1	Stearns	564	UT Rock Creek	Bell Farm	051301040408
DB566-2.4	1	Stearns	1363	UT Rock Creek	Barthell	051301040409
DB566-3.5	1	Stearns	1363	UT Rock Creek	Barthell	051301040409
DB566-4.6	1	Stearns	1363	UT Fidelity Locker	Barthell	051301040409
DB566-5.0	1	Stearns	1363	UT Rock Creek	Bell Farm	051301040409
DB6020-0.3	1	Stearns	90	Kilburn Fork	Wiborg	051301011402
DB6020-0.3	2	Stearns	90	Kilburn Fork	Wiborg	051301011402
DB6061-3.2	1	Stearns	1651	UT Big Creek	Wiborg	051301040607
DB6274-0.2	1	Stearns	502	UT Capuchin Creek	Jellico West	051301011001
DB6274-0.4	1	Stearns	6274	UT Capuchin Creek	Jellico West	051301011001
DB650-3.1	1	Stearns	69	Stallion Fork	Nevelsville	051301040606
DB663a-0.0	1	Stearns	663	Big North Fork	Nevelsville	051301040607
DB663a-0.5	1	Stearns	663	Big North Fork	Nevelsville	051301040607
DB663a-0.5	2	Stearns	663	Big North Fork	Nevelsville	051301040607
DB68-2.1	1	Stearns	651	Bridge Hollow	Nevelsville	051301040607
DB68-3.6	1	Stearns	651	Steven's Branch	Nevelsville	051301040607

Table B4. Coarse filter A, B, and C, classifications for crossings surveyed on the Daniel Boone National Forest, summer 2005.

Site ID	Pipe #	Filter A	Filter B	Filter C
DB100-1.5	1	indeterminate	impassable	impassable
DB119b-0.8	1	indeterminate	indeterminate	indeterminate
DB119b-0.8	2	indeterminate	indeterminate	indeterminate
DB119b-0.8	3	passable	passable	impassable
DB131-0.3	1	indeterminate	impassable	impassable
DB132-0.5	1	indeterminate	impassable	impassable
DB193-1.8	1	passable	passable	passable
DB195-1.1	1	indeterminate	impassable	impassable
DB195-1.9	1	impassable	impassable	impassable
DB195-3.3	1	indeterminate	impassable	impassable
DB4094-0.6	1	indeterminate	impassable	impassable
DB4133-0.49	1	indeterminate	indeterminate	impassable
DB4252-0.5	1	passable	impassable	impassable
DB4252-0.5	2	passable	impassable	impassable
DB534-xx	1	passable	impassable	impassable
DB615-0.9	1	indeterminate	indeterminate	impassable
DB626-0.3	1	impassable	impassable	impassable
DB741-0.3	1	indeterminate	impassable	impassable
DB781-0.01	1	impassable	impassable	impassable
DB119-3.7	1	indeterminate	indeterminate	impassable
DB272-1.3	1	passable	impassable	impassable
DB272-1.7	1	passable	passable	passable
DB272-2.5	1	indeterminate	indeterminate	impassable
DB46-0.6	1	indeterminate	indeterminate	impassable
DB5057-0.2	1	passable	passable	passable
DB5057-0.25	1	passable	passable	impassable
DB5057-1.8	1	indeterminate	indeterminate	impassable
DB5057-1.8	2	indeterminate	indeterminate	impassable
DB5138-0.6	1	impassable	impassable	impassable
DB5138-1.0	1	passable	indeterminate	impassable
DB5138-1.5	1	indeterminate	impassable	impassable
DB5138-1.5	2	indeterminate	impassable	impassable
DB5138-1.6	1	indeterminate	indeterminate	impassable
DB5138-1.6	2	indeterminate	indeterminate	impassable
DB5138-1.61	1	passable	passable	passable
DB5138-2.1	1	indeterminate	indeterminate	impassable
DB5138-2.1	2	indeterminate	indeterminate	impassable
DB5138-2.5	1	indeterminate	impassable	impassable
DB5165-0.3	1	passable	passable	passable
DB5183-0.2	1	passable	passable	passable
DB5195-.09	1	indeterminate	impassable	impassable
DB5234-0.4	1	passable	indeterminate	impassable
DB5267-0.25	1	indeterminate	impassable	impassable
DB5270-0.4	1	impassable	impassable	impassable
DB5279-0.8	1	passable	impassable	impassable

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Site ID	Pipe #	Filter A	Filter B	Filter C
DB5279-1.2	1	passable	indeterminate	impassable
DB5279-1.4	1	passable	impassable	impassable
DB5279-1.45	1	indeterminate	indeterminate	impassable
DB5279-1.5	1	impassable	impassable	impassable
DB5279-1.7	1	indeterminate	impassable	impassable
DB5279-1.75	1	passable	passable	passable
DB137-0.05	1	impassable	impassable	impassable
DB137-0.8	1	impassable	impassable	impassable
DB137-1.2	1	indeterminate	impassable	impassable
DB137-2.9	1	impassable	impassable	impassable
DB137-2.9	2	impassable	impassable	impassable
DB137x 0.01	1	passable	passable	passable
DB492-2.3	1	indeterminate	impassable	impassable
DB492-5.8	1	indeterminate	impassable	impassable
DB492-7.1	1	passable	indeterminate	impassable
DB492-8.0	1	passable	passable	indeterminate
DB498-0.9	1	indeterminate	impassable	impassable
DB502-0.6	1	indeterminate	impassable	impassable
DB502-1.7	1	passable	indeterminate	impassable
DB564-0.1	1	indeterminate	impassable	impassable
DB564-1.3	1	impassable	impassable	impassable
DB564-1.3	2	impassable	impassable	impassable
DB566-0.05	1	impassable	impassable	impassable
DB566-2.4	1	impassable	impassable	impassable
DB566-3.5	1	impassable	impassable	impassable
DB566-4.6	1	impassable	impassable	impassable
DB566-5.0	1	impassable	impassable	impassable
DB6020-0.3	1	indeterminate	impassable	impassable
DB6020-0.3	2	indeterminate	indeterminate	impassable
DB6061-3.2	1	passable	passable	impassable
DB6274-0.2	1	impassable	impassable	impassable
DB6274-0.4	1	passable	impassable	impassable
DB650-3.1	1	indeterminate	impassable	impassable
DB663a-0.0	1	indeterminate	impassable	impassable
DB663a-0.5	1	indeterminate	impassable	impassable
DB663a-0.5	2	indeterminate	indeterminate	impassable
DB68-2.1	1	indeterminate	impassable	impassable
DB68-3.6	1	indeterminate	impassable	impassable

Table B5. Description of crossings surveyed on the Daniel Boone National Forest, summer 2005. Shape abbreviations: C= circular, PA= pipe arch, OBA= open bottom arch, and F= ford. Channel width is the mean bankfull channel width. N= no natural substrate, N (discontin)= discontinuous substrate, Y= continuous natural substrate. An NA (not applicable) indicates outlet drop (no outlet pool or tailwater control) or outlet perch (stream dry) could not be calculated. Negative outlet drop or perch values indicate a submerged outlet (structure partially backwatered). Residual inlet depth values ≥ 0.0 indicate the structure is fully backwatered.

Site ID	Pipe #	Shape	Pipe Condition	Mean Channel Width (ft)	Continuous Substrate in Structure	Pipe slope (%)	Pipe Width: Channel Width ratio	Outlet Drop (in)	Outlet Perch (in)	Residual Inlet Depth (in)	Pipe Length (ft)	Slope (%) * Length (ft)
DB100-1.5	1	C	poor	5.2	N	2.96	0.87	13.62	NA	0.00	46.7	138.0
DB119b-0.8	1	C	poor	17.7	N (discontin)	1.93	0.25	2.64	2.28	0.00	34.2	66.0
DB119b-0.8	2	C	poor	17.7	N (discontin)	1.86	0.25	2.28	1.92	0.00	35.5	66.0
DB119b-0.8	3	C	fair	17.7	N (discontin)	0.60	0.25	5.34	4.98	0.00	34.3	20.5
DB131-0.3	1	C	good	7.4	N	3.15	0.48	11.52	NA	0.00	83.8	264.0
DB132-0.5	1	PA	poor	12.7	N	1.98	0.35	15.60	16.56	0.00	59.7	118.0
DB193-1.8	1	OBA	good	32.2	Y	3.51	0.65	-30.72	-41.76	0.24	72.3	254.0
DB195-1.1	1	PA	good	23.4	N	1.46	0.56	18.90	15.18	0.00	76.4	111.5
DB195-1.9	1	C	fair	14.0	N	3.72	0.36	32.40	29.16	0.00	93.0	346.0
DB195-3.3	1	PA	fair	17.2	N	1.31	0.70	11.40	3.60	0.00	66.6	87.0
DB4094-0.6	1	C	good	18.2	N	2.66	0.22	14.04	15.72	0.00	29.7	79.0
DB4133-0.49	1	PA	fair	7.3	N	1.70	0.59	9.24	7.50	0.00	35.2	60.0
DB4252-0.5	1	C	poor	10.6	N	0.67	0.47	12.84	10.44	0.00	46.0	31.0
DB4252-0.5	2	C	poor	10.6	N	0.60	0.47	13.20	10.80	0.00	44.4	26.5
DB534-xx	1	F	good	11.0	N (discontin)	1.60	0.00	NA	12.42	0.00	17.8	28.5
DB615-0.9	1	C	fair	6.4	N	2.98	0.39	6.96	8.88	0.00	24.8	74.0
DB626-0.3	1	C	good	13.2	N	9.68	0.30	17.40	NA	0.00	72.3	700.0
DB741-0.3	1	C	good	7.9	N	4.46	0.25	2.28	-2.16	0.00	24.9	111.0
DB781-0.01	1	C	fair	8.9	N	3.10	0.34	44.76	38.04	0.00	62.9	195.0
DB119-3.7	1	C	fair	10.2	N	1.39	0.54	9.60	13.14	0.00	80.1	111.0
DB272-1.3	1	PA	fair	16.8	N	0.56	0.68	11.64	21.00	0.00	47.9	27.0
DB272-1.7	1	PA	good	16.4	Y	0.18	0.76	-4.68	NA	3.84	39.4	7.0
DB272-2.5	1	PA	poor	21.5	N	1.34	0.58	-2.76	-1.32	0.00	116.6	156.0
DB46-0.6	1	PA	poor	5.5	N	2.28	1.10	6.96	NA	0.00	42.6	97.0
DB5057-0.2	1	C	good	9.7	Y	0.64	0.31	-2.52	-3.78	4.2	22.0	14.0
DB5057-0.25	1	PA	fair	12.6	N	1.06	0.35	8.58	NA	0.00	21.6	23.0

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Site ID	Pipe #	Shape	Pipe Condition	Mean Channel Width (ft)	Continuous Substrate in Structure	Pipe slope (%)	Pipe Width: Channel Width ratio	Outlet Drop (in)	Outlet Perch (in)	Residual Inlet Depth (in)	Pipe Length (ft)	Slope (%) * Length (ft)
DB5057-1.8	1	C	good	10.1	N	1.90	0.25	7.56	NA	0.00	31.0	59.0
DB5057-1.8	2	C	good	10.1	N	2.70	0.20	5.46	NA	0.00	31.5	85.0
DB5138-0.6	1	C	fair	9.6	N	8.05	0.26	53.52	52.56	0.00	39.9	321.0
DB5138-1.0	1	F	poor	17.3	N (discontin)	2.29	0.00	4.92	1.32	0.00	15.7	36.0
DB5138-1.5	1	C	good	19.9	N	2.10	0.20	11.28	8.28	0.00	41.4	87.0
DB5138-1.5	2	C	good	19.9	N	1.61	0.20	14.52	11.52	0.00	40.4	65.0
DB5138-1.6	1	C	fair	10.3	N	2.81	0.24	7.92	6.36	0.00	22.4	63.0
DB5138-1.6	2	C	fair	10.3	N	2.23	0.24	6.24	4.68	0.00	22.4	50.0
DB5138-1.61	1	F	poor	19.2	N (discontin)	0.79	0.00	NA	-3.24	0.00	15.2	12.0
DB5138-2.1	1	C	poor	9.7	N	3.23	0.31	5.64	4.08	0.00	30.0	97.0
DB5138-2.1	2	C	poor	9.7	N	3.47	0.31	4.68	3.12	0.00	30.0	104.0
DB5138-2.5	1	C	fair	11.1	N	4.00	0.27	2.52	2.40	0.00	39.5	158.0
DB5165-0.3	1	C	poor	9.6	N	0.10	0.42	3.72	NA	0.00	19.9	2.0
DB5183-0.2	1	C	bad	8.4	N	0.10	0.30	-2.28	-2.76	2.04	19.8	2.0
DB5195-.09	1	PA	poor	7.9	N	5.40	0.51	1.32	NA	0.00	21.3	115.0
DB5234-0.4	1	C	fair	4.3	N	2.55	1.05	7.86	7.56	0.00	11.4	29.0
DB5267-0.25	1	C	fair	6.3	N	4.51	0.48	-0.36	-1.44	0.00	27.3	123.0
DB5270-0.4	1	C	poor	12.5	N	0.46	0.24	34.68	32.76	0.00	18.5	8.5
DB5279-0.8	1	F	good	18.2	N (discontin)	0.65	0.00	15.96	14.52	0.00	15.5	10.0
DB5279-1.2	1	F	good	8.6	N (discontin)	1.43	0.00	9.72	8.40	0.00	22.3	32.0
DB5279-1.4	1	F	good	21.3	N (discontin)	2.87	0.00	15.66	10.68	0.00	17.0	48.0
DB5279-1.45	1	F	good	19.4	N	1.83	0.00	9.24	7.80	0.00	28.0	51.0
DB5279-1.5	1	F	good	8.8	N (discontin)	8.34	0.00	18.12	NA	0.00	15.7	233.0
DB5279-1.7	1	F	good	19.1	N (discontin)	4.19	0.00	14.04	12.00	0.00	15.5	65.0
DB5279-1.75	1	F	good	16.3	N (discontin)	0.09	0.00	1.74	NA	0.00	16.0	1.5
DB137-0.05	1	C	good	10.6	N	6.46	0.57	11.28	NA	0.00	115.9	749.0
DB137-0.8	1	F	good	13.2	N (discontin)	8.02	0.00	16.20	6.24	0.00	8.1	65.0
DB137-1.2	1	F	good	14.8	N	6.93	0.00	5.52	-1.56	0.00	14.0	97.0
DB137-2.9	1	C	poor	7.1	N	9.49	0.28	1.08	NA	0.00	25.4	241.0
DB137-2.9	2	C	poor	7.1	N	7.14	0.28	-1.20	NA	0.00	25.2	180.0

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Site ID	Pipe #	Shape	Pipe Condition	Mean Channel Width (ft)	Continuous Substrate in Structure	Pipe slope (%)	Pipe Width: Channel Width ratio	Outlet Drop (in)	Outlet Perch (in)	Residual Inlet Depth (in)	Pipe Length (ft)	Slope (%) * Length (ft)
DB137x 0.01	1	F	good	36.8	N (discontin)	0.50	0.00	0.96	0.24	0.00	14.0	7.0
DB492-2.3	1	C	good	8.2	N	4.47	0.31	7.26	4.14	0.00	-29.2	130.5
DB492-5.8	1	C	good	9.5	N	5.15	0.26	-0.06	-0.54	0.00	20.5	105.5
DB492-7.1	1	F	poor	25.5	N (discontin)	2.89	0.00	5.76	10.08	0.00	14.2	41.0
DB492-8.0	1	F	good	15.8	N (discontin)	1.63	0.00	0.48	2.28	0.00	14.1	23.0
DB498-0.9	1	PA	poor	6.1	N	4.00	0.49	10.92	9.84	0.00	41.8	167.0
DB502-0.6	1	C	poor	16.2	N	3.54	0.22	-2.28	-2.28	0.00	48.0	170.0
DB502-1.7	1	C	fair	14.8	N (discontin)	1.08	0.31	6.00	5.52	0.00	30.6	33.0
DB564-0.1	1	C	fair	9.0	N	6.11	0.44	7.14	6.84	0.00	40.0	244.5
DB564-1.3	1	C	poor	12.3	N	8.68	0.16	-0.12	NA	0.00	71.8	623.0
DB564-1.3	2	C	poor	12.3	N	8.68	0.16	-1.68	NA	0.00	71.8	623.0
DB566-0.05	1	C	good	6.3	N	1.87	0.80	36.30	29.88	0.00	41.5	77.5
DB566-2.4	1	C	poor	6.1	N	12.37	0.66	-2.40	NA	0.00	33.5	414.5
DB566-3.5	1	C	fair	9.0	N	7.48	0.28	12.66	NA	0.00	32.6	244.0
DB566-4.6	1	C	fair	10.5	N	8.42	0.38	69.24	67.86	0.00	26.0	219.0
DB566-5.0	1	C	good	12.3	N	4.12	0.36	49.92	13.44	0.00	21.0	86.5
DB6020-0.3	1	C	poor	13.4	N	3.75	0.30	4.92	1.02	0.00	60.0	225.0
DB6020-0.3	2	C	poor	13.4	N (discontin)	3.08	0.30	9.3	5.40	0.00	60.0	185.0
DB6061-3.2	1	F	good	7.0	N	1.19	0.00	9.36	9.12	0.00	13.4	16.0
DB6274-0.2	1	F	good	5.4	N	7.19	0.00	2.16	NA	0.00	18.8	135.0
DB6274-0.4	1	F	good	11.3	N	0.37	0.00	13.56	16.26	0.00	18.8	7.0
DB650-3.1	1	PA	good	11.9	N	3.48	0.59	7.80	18.36	0.00	83.6	291.0
DB663a-0.0	1	C	fair	9.5	N	5.29	0.53	18.96	NA	0.00	56.8	300.5
DB663a-0.5	1	C	poor	12.3	N	6.38	0.43	-3.96	-2.04	0.00	51.7	330.0
DB663a-0.5	2	C	poor	12.3	N	2.92	0.43	7.80	9.72	0.00	51.7	151.0
DB68-2.1	1	C	poor	9.1	N (discontin)	1.10	0.64	21.96	21.24	0.00	64.3	71.0
DB68-3.6	1	C	fair	8.9	N	5.95	0.68	10.92	11.04	0.00	54.8	326.0

Appendix C: Results for the Ozark-St. Francis National Forest

We visited 724 crossings on the Boston Mountain, Pleasant Hill, Buffalo, and Bayou Ranger Districts in 2005 (Figure C1, Table C1) and completed surveys on 5% (n=35) (Table C2). Filter A (strong swimmers and leapers) classified 12% (n=4) of crossings as impassable, 51% (n=18) as passable, and 37% (n=13) as indeterminate (Figure C2, Table C2). Filter B (moderate swimmers and leapers) classified 63% (n=22) of crossings as impassable, 20% (n=7) as passable, and 17% (n=6) as indeterminate (Figure C3, Table C2). Filter C (weak swimmers and leapers) classified 77% (n=27) of crossing as impassable, 14% (n=5) as passable, and 9% (n=3) as indeterminate (Figure C4, Table C2). Characteristics and filter classifications for each crossing are presented in Tables C3-C5.

The number of each crossing types surveyed was evenly distributed among circular culverts (n=8), fords (n=9), vented fords (n=7), and box culverts (n=8). In addition surveyed pipe arches (n=3) and open bottom arches (n=0) were less frequently encountered. Filter A classified 25% of circular culverts and 22% of fords as impassable (Figure C5). Filter B classified 100% of pipe arches, 63% of circular culverts and box culverts, 57% of vented fords, and 56% of fords as impassable (Figure C6). Filter C classified 100% of pipe arches and vented fords, 75% of circular culverts, 63% of box culverts, and 57% of vented fords as impassable (Figure C7). The mean crossing width to channel width ratio (excluding fords, vented fords, and multiple structure crossings) (n=12) was 0.30 (SD=0.08), and no crossings were greater than or equal to the bankfull channel width (i.e. crossing width to channel width ration was greater than or equal to 1.0) (Figure C8).

Figure C1. Ranger Districts on the Ozark St. Francis National Forest road-stream crossing surveys were conducted, summer 2005.

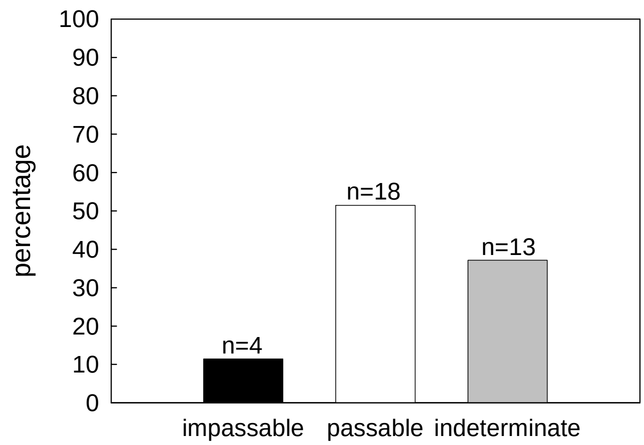

Figure C2. Percentage of crossings classified as impassable, passable, or indeterminate for Filter A; Ozark-St. Francis National Forest, summer 2005 (N=35).

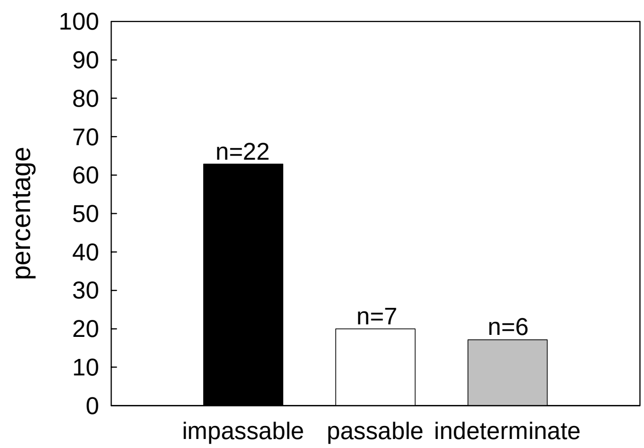

Figure C3. Percentage of crossings classified as impassable, passable, or indeterminate for Filter B; Ozark-St. Francis National Forest, summer 2005 (N=35).

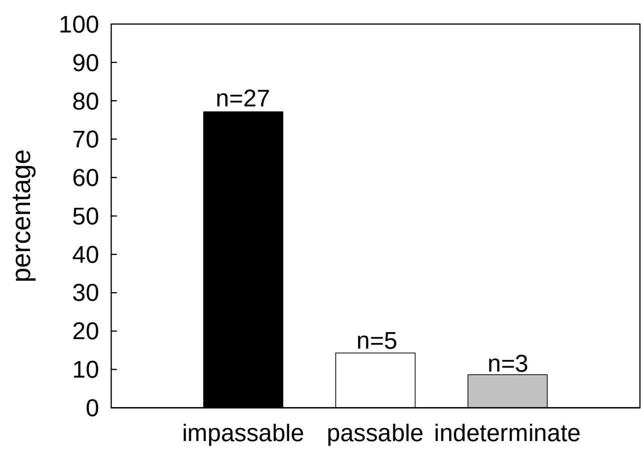

Figure C4. Percentage of crossings classified as impassable, passable, or indeterminate for Filter C; Ozark-St. Francis National Forest, summer 2005 (N=35).

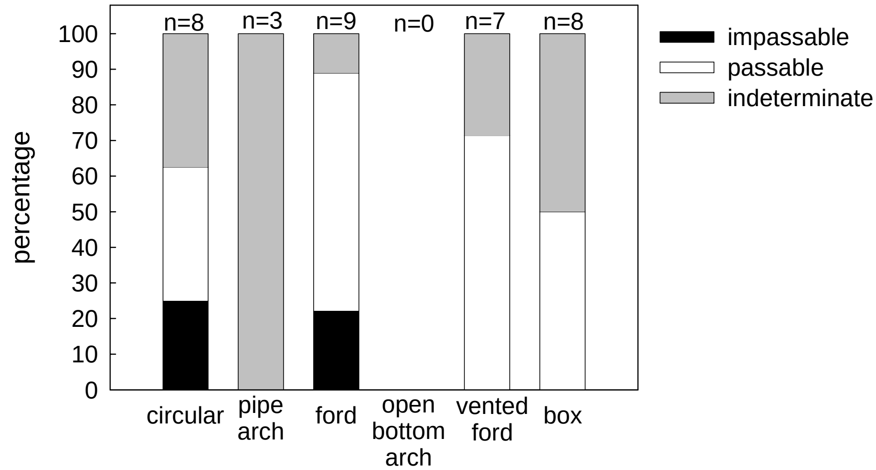

Figure C5. Percentage of each crossing type classified as impassable, passable, or indeterminate for Filter A; Ozark-St. Francis National Forest, summer 2005 (N=35).

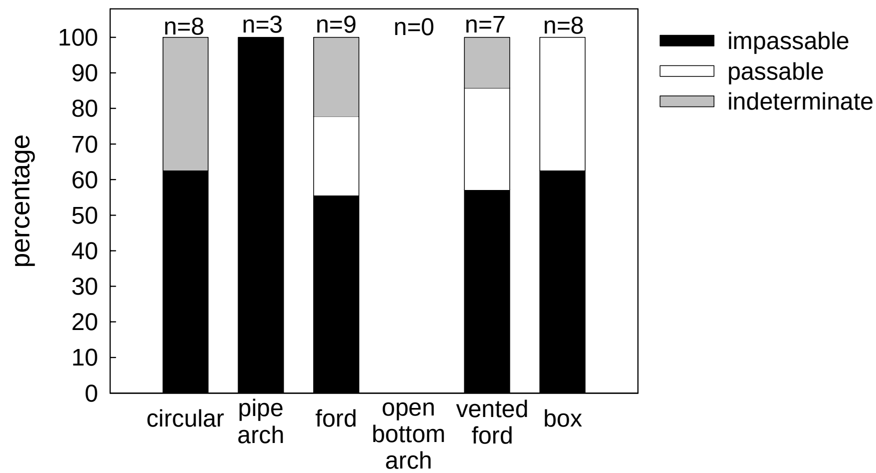

Figure C6. Percentage of each crossing type classified as impassable, passable, or indeterminate for Filter B; Ozark-St. Francis National Forest, summer 2005 (N=35).

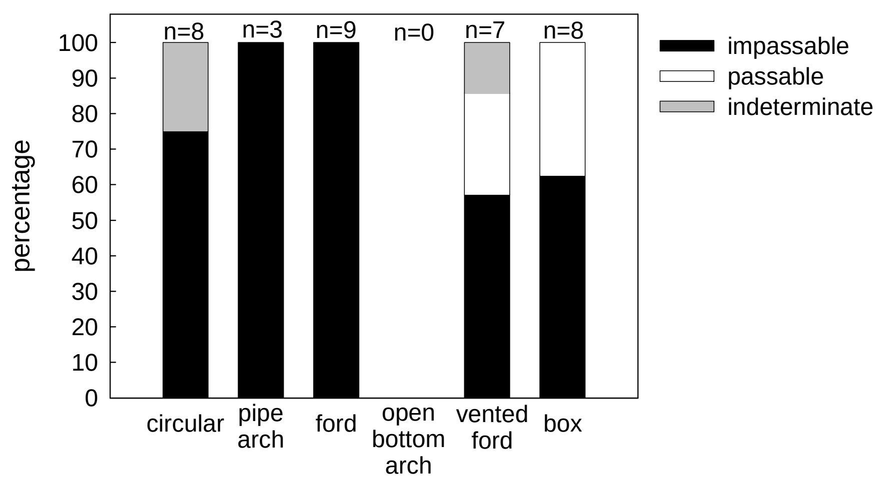

Figure C7. Percentage of each crossing type classified as impassable, passable, or indeterminate for Filter C; Ozark-St. Francis National Forest, summer 2005 (N=35).

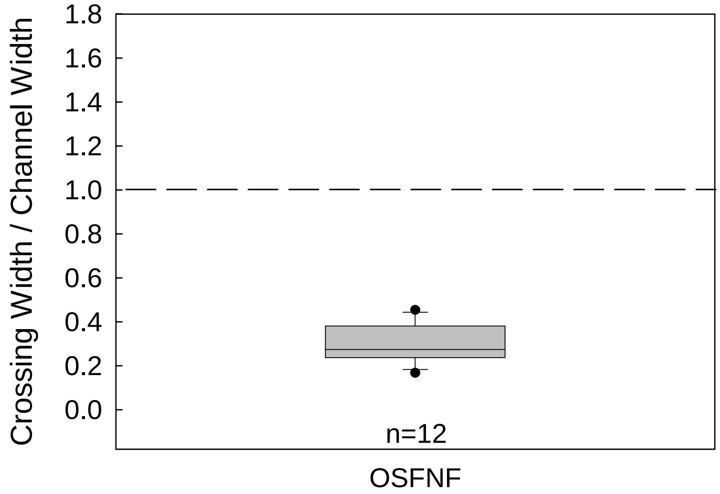

Figure C8. Crossing width to bankfull channel width ratio for crossings surveyed in summer 2005 on the Ozark-St. Francis National Forest (excluding fords, vented fords, and multiple structure crossings). A ratio of 1.0 (dashed line) or greater indicates the crossing structure opening is greater than or equal to the bankfull channel width. The top and bottom of the boxes represent the 25th and 75th percentiles, the bar in the center of each box represents the median, whiskers represent the 10th and 90th percentiles, and closed circles represent the entire range of the data.

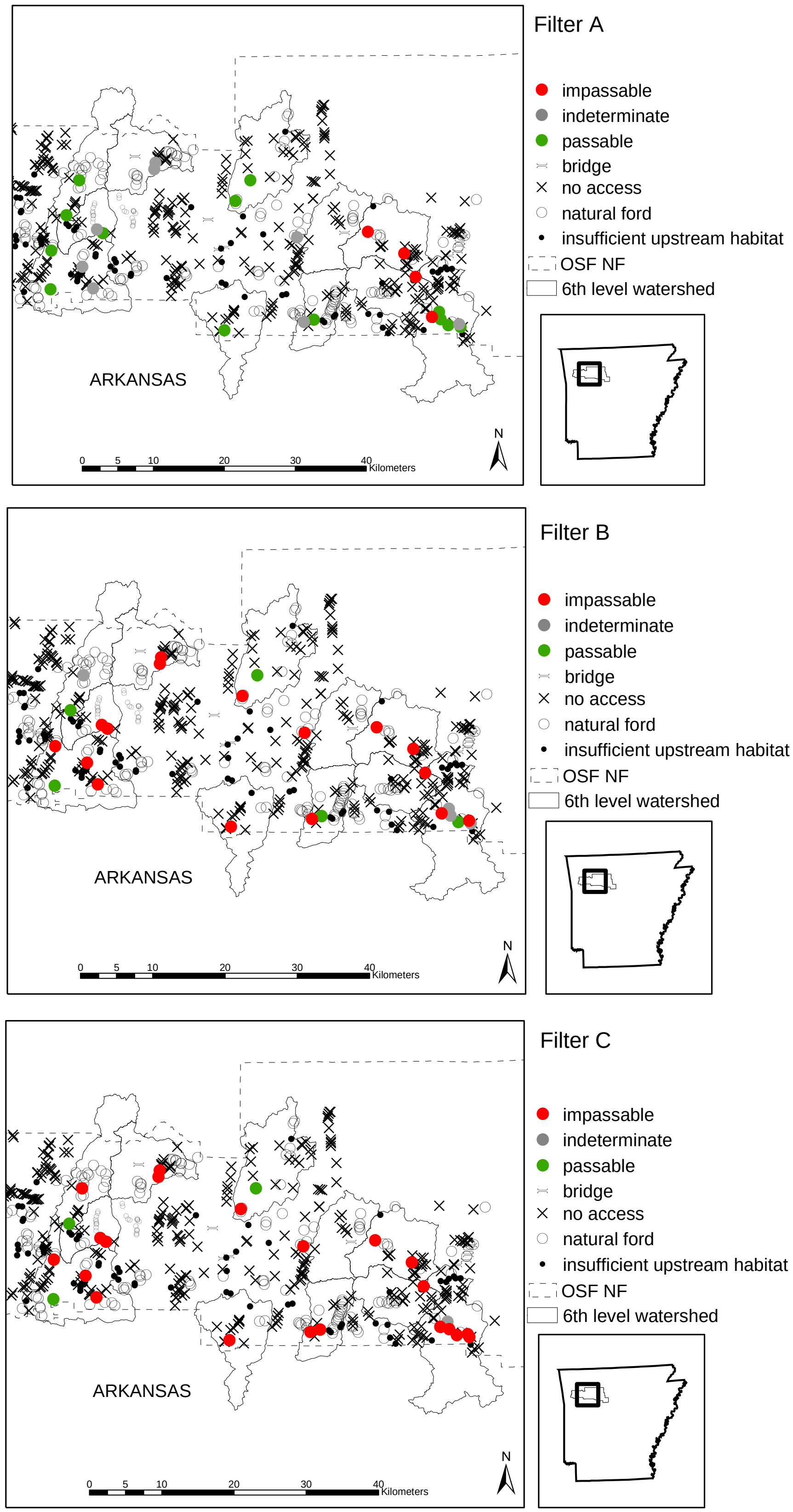

Figure C9. Location of crossings classified for fish passage by coarse filters A, B, and C within 6^{th} level watersheds, and crossings not surveyed on the Ozark St. Francis National Forest, summer 2005.

Table C1. Number of crossings documented (Total crossing documented) and not surveyed (Crossings not surveyed) on the OSFNF in summer 2005. Reasons for not surveying a documented site include: no suitable fish habitat upstream of crossing (NH); no access to site due to closed roads or private gates (NA); crossing was a natural ford (NF); crossing was a bridge (BR).

Forest	Total crossings documented	Crossings not surveyed (n, [%])				
		NH	NA	NF	BR	Total not surveyed
OSFNF	724	85 (12)	396 (57)	191 (28)	17 (3)	689 (95)

Table C2. Number of crossings surveyed (Total surveyed) with coarse filter results for the OSFNF in summer 2005. Coarse filter results are presented for Filter A, Filter B, and Filter C (see filter descriptions, Fig 3 – 5).

Forest	Total surveyed	Coarse filter results								
		Impassable (n, [%])			Passable (n, [%])			Indeterminate (n, [%])		
		A	B	C	A	B	C	A	B	C
OSFNF	35	4 (12)	22 (63)	27 (77)	18 (51)	7 (20)	5 (14)	13 (37)	6 (17)	3 (9)

Table C3. Location of crossings surveyed on the Ozark St. Francis National Forest during the summer of 2005. Site ID consists of the Forest abbreviation (OSF), road the crossing is on (1538), and the distance (miles) from the junction road (0.8).

Site ID	Pipe #	District	Junction Road	Stream Name	Quad	6th Level Watershed
OSF113-0.1	1	Bayou	123	UT Little Piney Creek	Hagarville	111102020804
OSF113-0.1	2	Bayou	123	UT Little Piney Creek	Hagarville	111102020804
OSF113-0.7	1	Bayou	123	UT Little Piney Creek	Hagarville	111102020804
OSF1813-0.05	1	Bayou	113	Little Sulphur Creek	Hagarville	111102020804
OSF1813-1.3	1	Bayou	113	UT Toms Branch	Hagarville	111102020804
OSF1813-1.6	1	Bayou	113	Toms Branch	Hagarville	111102020804
OSF1003-7.4	1	Boston Mtn	23	Spirits Creek	Bidville	111102010704
OSF1501-2.4	1	Boston Mtn	23	Big Eddy Hollow	Cass	111102010704
OSF1501-2.4	2	Boston Mtn	23	Big Eddy Hollow	Cass	111102010704
OSF1509-0.4	1	Boston Mtn	79	UT Mill Creek	St. Paul	110100010103
OSF1520-0.4	1	Boston Mtn	1520 road sign off 112	Fane Creek	Cass	111102010705
OSF1520-0.4	2	Boston Mtn	1520 road sign off 112	Fane Creek	Cass	111102010705
OSF1520-0.4	3	Boston Mtn	1520 road sign off 112	Fane Creek	Cass	111102010705
OSF1520-0.4	4	Boston Mtn	1520 road sign off 112	Fane Creek	Cass	111102010705
OSF1520-1.0	1	Boston Mtn	1520 road sign off 112	Cove Creek	Cass	111102010705
OSF1520-7.2	1	Boston Mtn	1520 road sign off 112	UT Mill Creek	Bidville	110100010103
OSF1520-7.2	2	Boston Mtn	1520 road sign off 112	UT Mill Creek	Bidville	110100010103
OSF1521-0.8	1	Boston Mtn	23	Cripple Branch	Cass	111102010704
OSF1405-0.8	1	Pleasant Hill	57	UT Piney Creek	Rosetta	111102020801
OSF1405-1.6	1	Pleasant Hill	21	Clifty Hollow	Ozone	111102020801
OSF1409-0.9	1	Pleasant Hill	57	UT Piney Creek	Rosetta	111102020802
OSF1422-1.3	1	Pleasant Hill	182	Dry Sprada Creek	Harmony	111102020501
OSF1422-2.7	1	Pleasant Hill	182	UT Sprada Creek	Harmony	111102020501
OSF1426-0.3	1	Pleasant Hill	123	UT Little Piney Creek	Hagarville	111102020804
OSF1538-0.5	1	Pleasant Hill	502	Lumpkin Creek	Pettigrew	110100010102

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Site ID	Pipe #	District	Junction Road	Stream Name	Quad	6th Level Watershed
OSF1538-1.0	1	Pleasant Hill	502	UT Lumpkin Creek	Pettigrew	110100010102
OSF1538-1.2	1	Pleasant Hill	502	Lumpkin Creek	Pettigrew	110100010102
OSF283-1.7	1	Pleasant Hill	164	Horsehead Creek	Hunt	111102020601
OSF353-0.2	1	Pleasant Hill	406	Little Mulberry Creek	Boston	111102010601
OSF36-0.3	1	Pleasant Hill	1425 A	UT Mulberry Creek	Oark	111102010604
OSF36-0.3	2	Pleasant Hill	1425 A	UT Mulberry Creek	Oark	111102010604
OSF407-0.1	1	Pleasant Hill	5151(409)	UT Mulberry Creek	Oark	111102010601
OSF5151-2.5	1	Pleasant Hill	407	Eldridge Hollow	Boston	111102010601
OSF5151-2.5	2	Pleasant Hill	407	Eldridge Hollow	Boston	111102010601
OSF5151-2.5	3	Pleasant Hill	407	Eldridge Hollow	Boston	111102010601

Table C4. Coarse filters A, B, and C, classifications for surveyed crossings on the Ozark-St. Francis National Forest, summer 2005.

Site ID	Pipe #	Filter A	Filter B	Filter C
OSF113-0.1	1	passable	indeterminate	indeterminate
OSF113-0.1	2	passable	indeterminate	indeterminate
OSF113-0.7	1	passable	indeterminate	impassable
OSF1813-0.05	1	passable	passable	impassable
OSF1813-1.3	1	indeterminate	impassable	impassable
OSF1813-1.6	1	passable	indeterminate	impassable
OSF1003-7.4	1	passable	impassable	impassable
OSF1501-2.4	1	indeterminate	impassable	impassable
OSF1501-2.4	2	indeterminate	impassable	impassable
OSF1509-0.4	1	passable	indeterminate	impassable
OSF1520-0.4	1	indeterminate	impassable	impassable
OSF1520-0.4	2	passable	impassable	impassable
OSF1520-0.4	3	passable	impassable	impassable
OSF1520-0.4	4	indeterminate	impassable	impassable
OSF1520-1.0	1	indeterminate	impassable	impassable
OSF1520-7.2	1	passable	passable	passable
OSF1520-7.2	2	passable	passable	passable
OSF1521-0.8	1	indeterminate	impassable	impassable
OSF1405-0.8	1	impassable	impassable	impassable
OSF1405-1.6	1	impassable	impassable	impassable
OSF1409-0.9	1	impassable	impassable	impassable
OSF1422-1.3	1	passable	passable	impassable
OSF1422-2.7	1	indeterminate	impassable	impassable
OSF1426-0.3	1	impassable	impassable	impassable
OSF1538-0.5	1	indeterminate	impassable	impassable
OSF1538-1.0	1	indeterminate	impassable	impassable
OSF1538-1.2	1	indeterminate	impassable	impassable
OSF283-1.7	1	passable	impassable	impassable
OSF353-0.2	1	passable	passable	passable
OSF36-0.3	1	indeterminate	impassable	impassable
OSF36-0.3	2	indeterminate	impassable	impassable
OSF407-0.1	1	passable	impassable	impassable
OSF5151-2.5	1	passable	passable	passable
OSF5151-2.5	2	passable	passable	Passable
OSF5151-2.5	3	passable	indeterminate	Indeterminate

Table C5. Description of crossings surveyed on the Ozark St. Francis National Forest, summer 2005. Shape abbreviations: C= circular, PA= pipe arch, OBA= open bottom arch, V= vented ford, B= box, and F= ford. Channel width is the mean bankfull channel width. N= no natural substrate, N (discontin)= discontinuous substrate, Y= continuous natural substrate. An NA (not applicable) indicates outlet drop (no outlet pool or tailwater control) or outlet perch (stream dry) could not be calculated. Negative outlet drop or perch values indicate a submerged outlet (structure partially backwatered). Residual inlet depth values ≥ 0.0 indicate the structure is fully backwatered.

Site ID	Pipe #	Shape	Pipe Condition	Mean Channel Width (ft)	Continuous Substrate in Structure	Pipe slope (%)	Pipe Width: Channel Width ratio	Outlet Drop (in)	Outlet Perch (in)	Residual Inlet Depth (in)	Pipe Length (ft)	Slope (%) * Length (ft)
OSF113-0.1	1	C	good	16.0	N	1.75	0.17	0.48	75.36	0.00	20.0	35.0
OSF113-0.1	2	C	good	16.0	N	1.80	0.17	1.20	76.08	0.00	20.0	36.0
OSF113-0.7	1	C	good	15.0	N	1.64	0.17	4.56	NA	0.00	24.4	40.0
OSF1813-.05	1	F	good	23.4	N	1.92	NA	NA	2.34	0.00	12.0	23.0
OSF1813-1.3	1	C	good	12.9	N	3.86	0.27	11.88	NA	0.00	36.8	142.0
OSF1813-1.6	1	F	good	19.2	N	1.97	NA	NA	2.40	0.00	15.0	29.5
OSF1003-7.4	1	B	good	28.8	N	0.88	0.26	22.32	17.76	0.00	13.0	11.5
OSF1501-2.4	1	B	good	29.7	N (discontin)	3.03	0.52	17.70	NA	0.00	63.3	192.0
OSF1501-2.4	2	B	good	29.7	N (discontin)	4.93	0.52	3.84	NA	0.00	63.3	312.0
OSF1509-0.4	1	F	good	13.8	N	3.00	NA	7.38	6.90	0.00	14.5	43.5
OSF1520-0.4	1	VF	fair	50.8	N	2.16	NA	18.24	11.70	0.00	24.1	52.0
OSF1520-0.4	2	VF	fair	50.8	N	1.49	NA	19.50	12.96	0.00	24.1	36.0
OSF1520-0.4	3	VF	fair	50.8	N	1.87	NA	19.68	13.14	0.00	24.1	45.0
OSF1520-0.4	4	VF	fair	50.8	N	2.72	NA	18.54	12.00	0.00	24.1	65.5
OSF1520-1.0	1	F	good	47.0	N	6.79	NA	-1.74	-2.16	0.00	16.8	114.0
OSF1520-7.2	1	B	poor	13.8	Y	5.52	0.29	-8.40	NA	0.00	20.0	110.5
OSF1520-7.2	2	B	poor	13.8	Y	0.65	0.29	3.30	NA	0.00	20.0	13.0
OSF1521-0.8	1	C	fair	19.0	N	1.65	0.42	11.88	8.88	0.00	42.3	70.0
OSF1405-0.8	1	C	fair	22.7	N	7.00	0.22	39.96	NA	0.00	40.0	280.0
OSF1405-1.6	1	F	fair	35.1	N	7.17	NA	12.00	NA	0.00	20.5	147.0
OSF1409-0.9	1	F	good	19.7	N	0.33	NA	40.56	27.42	0.00	12.2	4.0
OSF1422-1.3	1	F	good	26.1	N	0.32	NA	4.56	NA	0.00	20.0	6.5

Table continued next page…

Site ID	Pipe #	Shape	Pipe Condition	Mean Channel Width (ft)	Continuous Substrate in Structure	Pipe slope (%)	Pipe Width: Channel Width ratio	Outlet Drop (in)	Outlet Perch (in)	Residual Inlet Depth (in)	Pipe Length (ft)	Slope (%) * Length (ft)
OSF1422-2.7	1	C	poor	17.4	N	4.01	0.32	21.06	18.60	0.00	28.2	113.0
OSF1426-0.3	1	C	fair	8.8	N	5.12	0.45	27.18	NA	0.00	36.7	188.0
OSF1538-0.5	1	PA	fair	17.3	N	4.00	0.29	9.42	5.28	0.00	39.5	158.0
OSF1538-1.0	1	PA	fair	11.4	N	6.41	0.40	23.40	21.60	0.00	29.0	186.0
OSF1538-1.2	1	PA	fair	18.4	N	4.75	0.28	10.56	22.80	0.00	32.0	152.0
OSF283-1.7	1	F	good	45.6	N	0.55	NA	17.46	13.26	0.00	15.4	8.5
OSF353-0.2	1	B	fair	74.7	Y	7.64	NA	-3.48	-12.24	0.00	14.0	107.0
OSF36-0.3	1	B	fair	16.9	N	4.12	0.24	22.44	NA	0.00	45.4	187.0
OSF36-0.3	2	B	fair	16.9	N	4.26	0.24	21.96	NA	0.00	45.4	193.5
OSF407-0.1	1	F	fair	26.5	N	1.68	NA	12.90	18.48	0.00	14.0	23.5
OSF5151-2.5	1	VF	good	24.7	N	0.05	0.05	2.88	-2.28	0.00	40.4	2.0
OSF5151-2.5	2	VF	good	24.7	Y	0.52	0.05	4.20	-0.96	0.00	40.4	21.0
OSF5151-2.5	3	VF	good	24.7	N	0.69	0.05	1.68	-3.48	0.00	40.4	28.0

Appendix D: Results for the National Forests in Alabama

We visited a total of 149 culverts on the Bankhead, Shoals Creek, and Talladega Ranger Districts in 2005 (Figure D1, Table D1) and completed surveys on 50% (n=75) of the 149 crossings (Table D2). Filter A (strong swimmers and leapers) classified 5% (n=4) of crossings as impassable, 39% (n=29) as passable, and 56% (n=42) as indeterminate (Figure D2, Table D2). Filter B (moderate swimmers and leapers) classified 56% (n=42) of crossings as impassable, 20% (n=15) as passable, and 24% (n=18) as indeterminate (Figure D3, Table D2). Filter C (weak swimmers and leapers) classified 76% (n=57) of crossings as impassable, 17% (n=13) as passable, and 7% (n=5) as indeterminate (Figure D4, Table D2). Characteristics and filter classifications for each crossing are presented in Tables D3-D5.

The majority of the crossings were either circular culverts (n=39) or pipe arches (n=21), while box culverts (n=10), vented fords (n=3), and open bottom arches (n=2) were less frequently encountered. Filter A classified 10% of box culverts, 5% of circular culverts and 4% of pipe arches impassable (Figure D5). Filter B classified 67% of circular culverts, 57% of pipe arches, and 40% of box culverts impassable (Figure D6). Filter C classified 87% of circular culverts, 80% of box culverts, 67% of pipe arches, and 33% of vented fords impassable (Figure D7). The open bottom arches surveyed were passable for all 3 filters.

The mean crossings width to channel width ratio for surveyed structures (excluding fords and vented fords) (n=43) was 0.65 (SD=0.34), and four crossings were greater than or equal to the mean bankfull channel width (i.e. crossing width to channel width ration was greater than or equal to 1.0) (Figure D8).

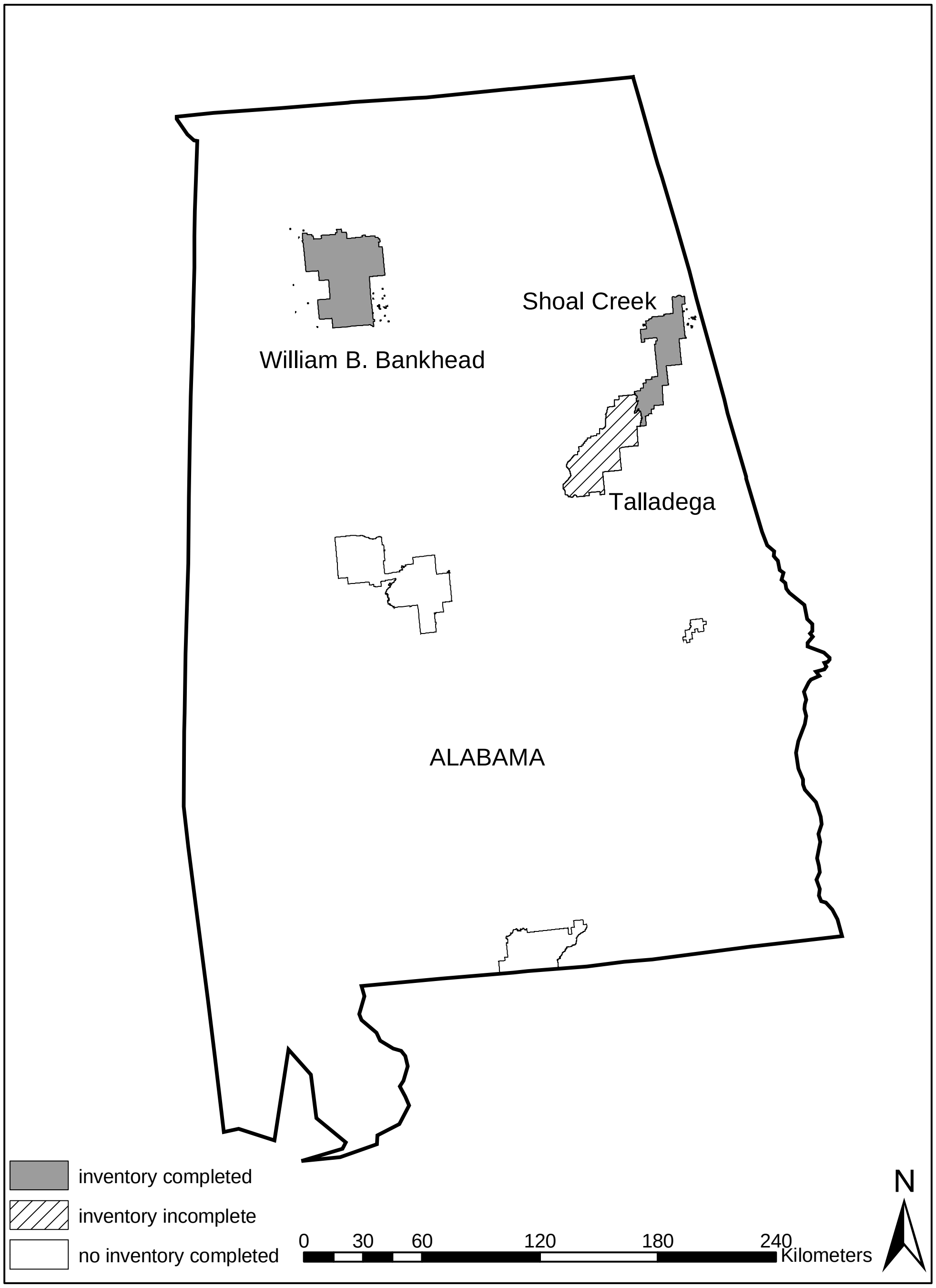

Figure D1. Ranger Districts on the National Forests in Alabama road-stream crossing surveys were conducted, summer 2005.

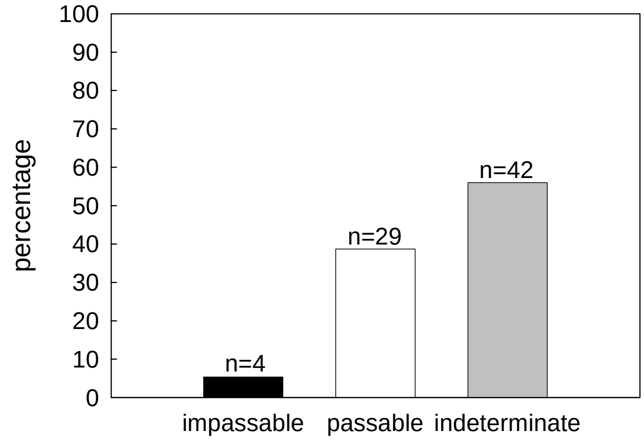

Figure D2. Percentage of crossings classified as impassable, passable, or indeterminate for Filter A; National Forests in Alabama (Bankhead and Talladega NFs), summer 2005 (N=75).

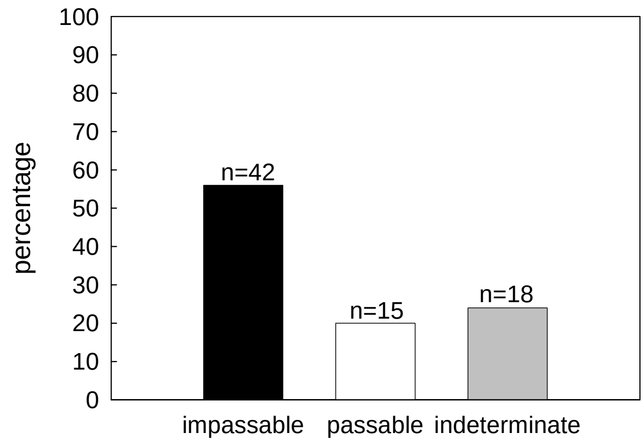

Figure D3. Percentage of crossings classified as impassable, passable, or indeterminate for Filter B; National Forests in Alabama (Bankhead and Talladega NFs), summer 2005 (N=75).

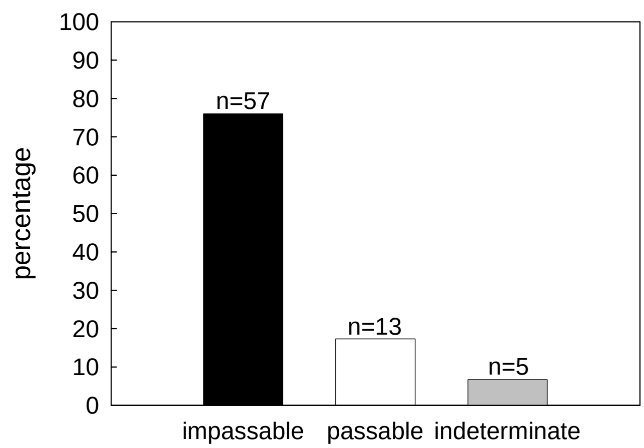

Figure D4. Percentage of crossings classified as impassable, passable, or indeterminate for Filter C; National Forests in Alabama (Bankhead and Talladega NFs), summer 2005 (N=75).

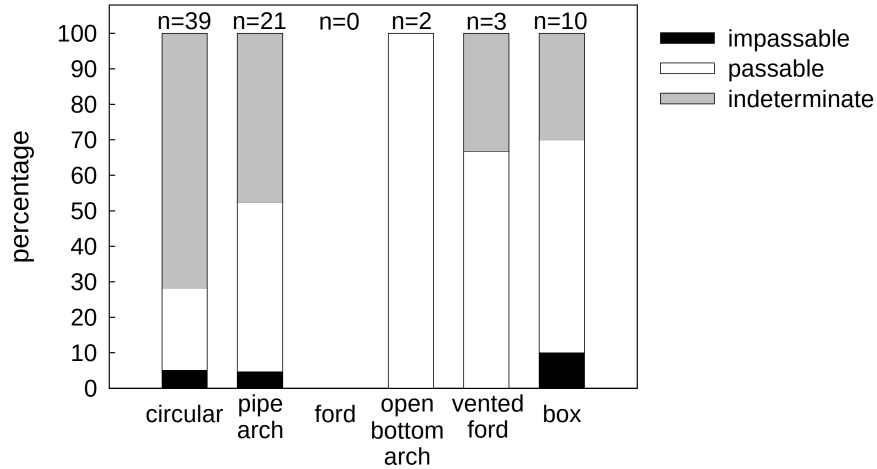

Figure D5. Percentage of each crossing type classified as impassable, passable, or indeterminate for Filter A; National Forests in Alabama (Bankhead and Talladega NFs), summer 2005 (N=75).

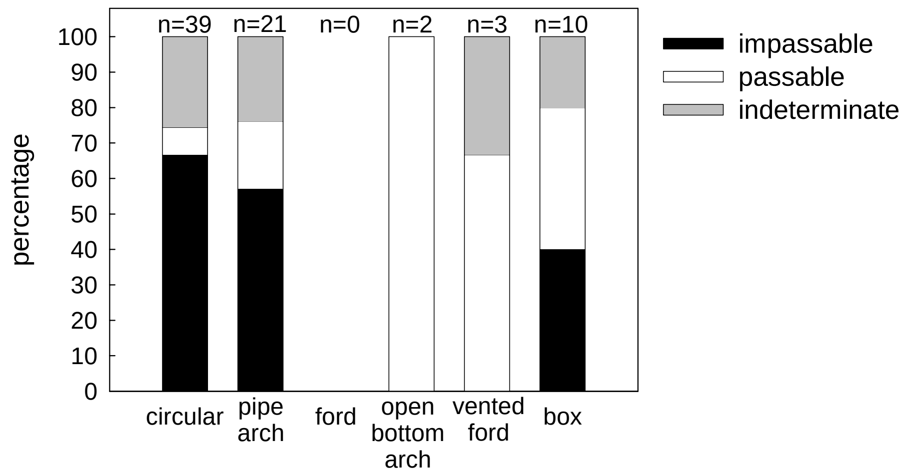

Figure D6. Percentage of each crossing type classified as impassable, passable, or indeterminate for Filter B; National Forests in Alabama (Bankhead and Talladega NFs), summer 2005 (N=75).

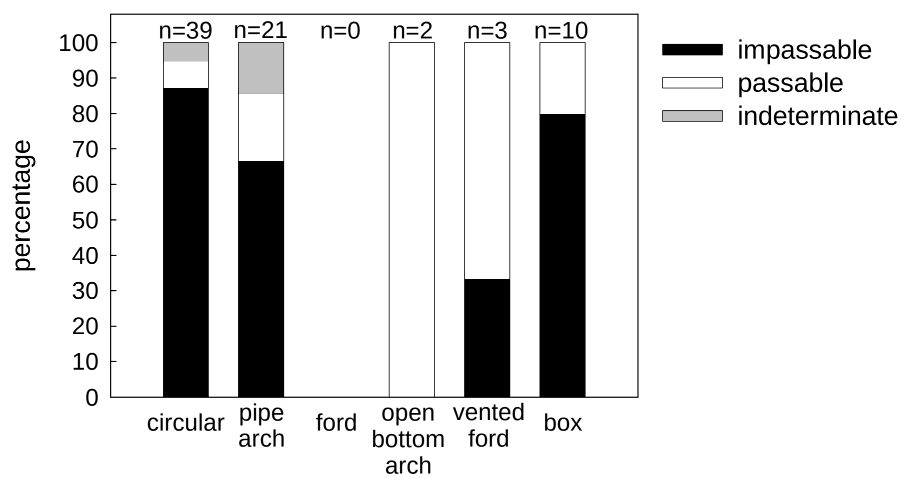

Figure D7. Percentage of each crossing type classified as impassable, passable, or indeterminate for Filter C; National Forests in Alabama (Bankhead and Talladega NFs), summer 2005 (N=75).

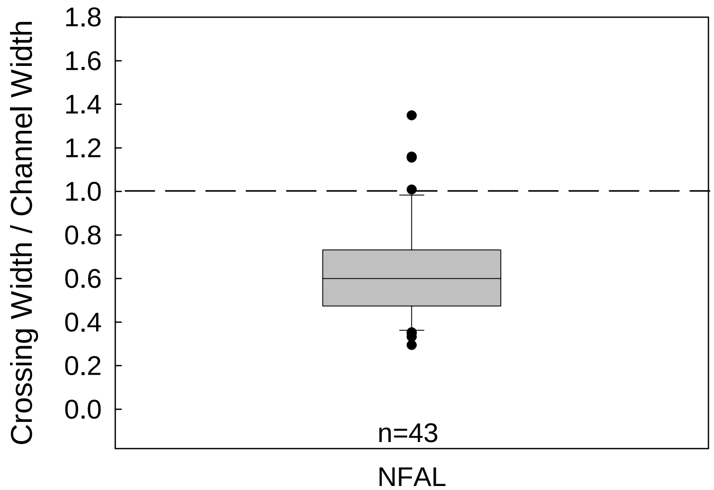

Figure D8. Crossing width to bankfull channel width ratio for crossings surveyed in summer 2005 on the National Forests in Alabama (Bankhead and Talladega NFs) (excluding fords, vented fords, and multiple structure crossings). A ratio of 1.0 (dashed line) or greater indicates the crossing structure opening is greater than or equal to the bankfull channel width. The top and bottom of the boxes represent the 25th and 75th percentiles, the bar in the center of each box represents the median, whiskers represent the 10th and 90th percentiles, and closed circles represent the entire range of the data.

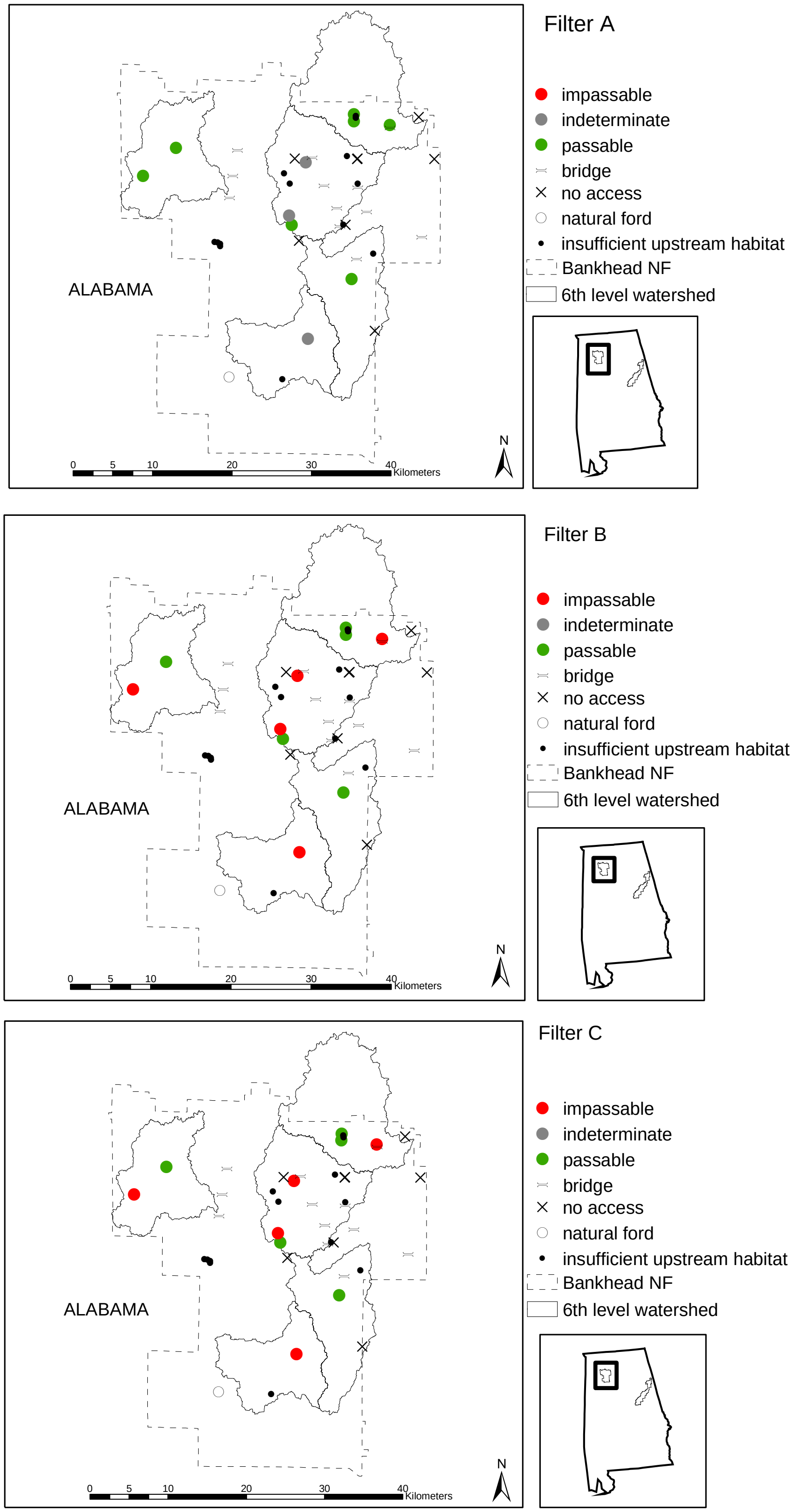

Figure D9. Location of crossings classified for fish passage by coarse filters A, B, and C within 6th level watersheds, and crossings not surveyed on the Bankhead National Forest in Alabama, summer 2005.

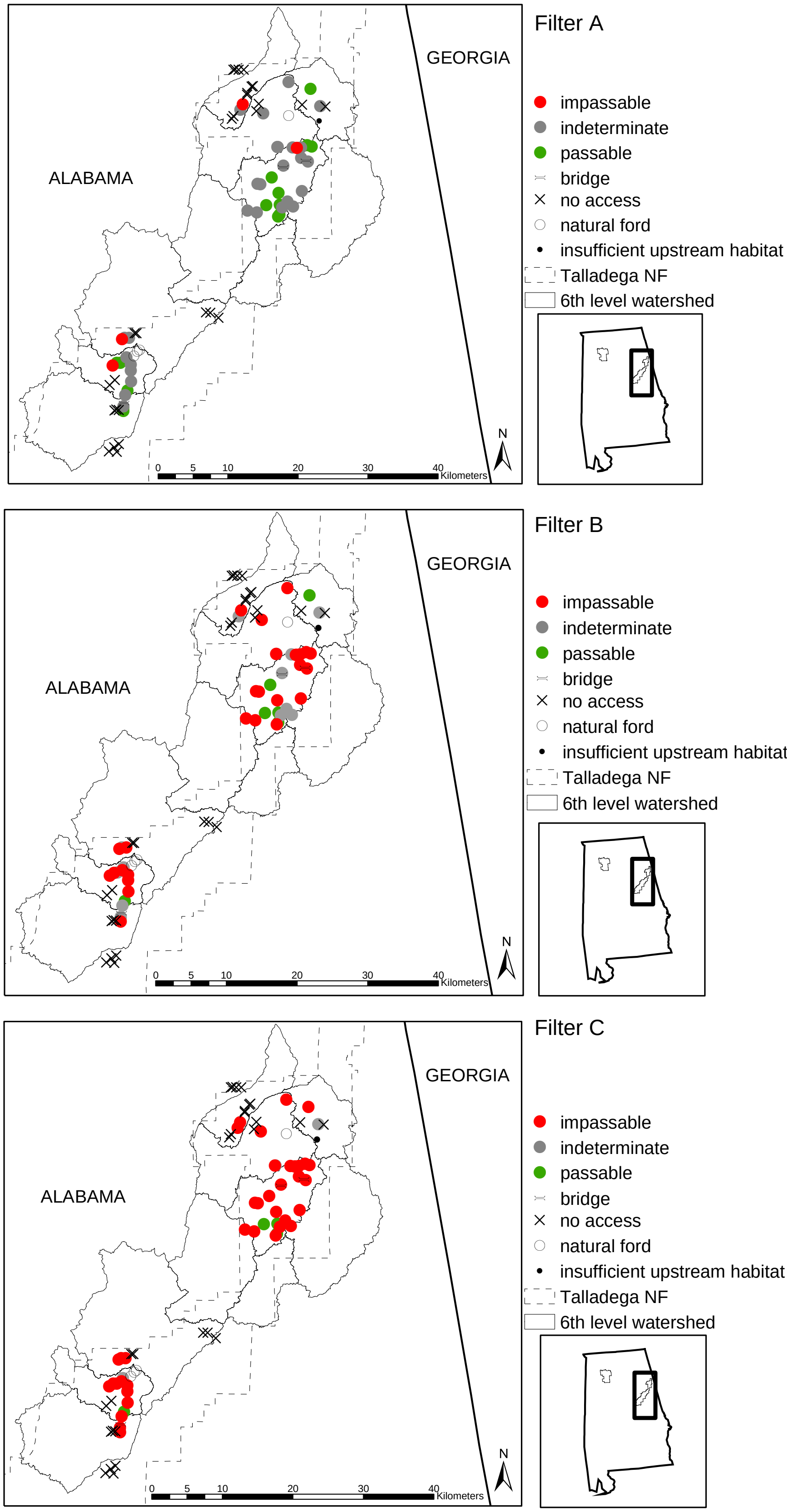

Figure D10. Location of crossings classified for fish passage by coarse filters A, B, and C within 6th level watersheds, and crossings not surveyed on the Talladega National Forest in Alabama, summer 2005.

Table D1. Number of crossings documented (Total crossings documented) and not surveyed (Crossings not surveyed) on the National Forests in Alabama (Bankhead and Talladega NFs) summer 2005. Reasons for not surveying a documented site include: no suitable fish habitat upstream of crossing (NH); no access to site due to closed roads or private gates (NA); crossing was a natural ford (NF); crossing was a bridge (BR).

Forest	Total crossings documented	Crossings not surveyed (n, [%])				
		NH	NA	NF	BR	Total not surveyed
NFAL	149	17 (23)	35 (47)	6 (8)	16 (22)	74 (50)

Table D2. Number of crossings surveyed (Total surveyed) with coarse filter results for the National Forests in Alabama (Bankhead and Talladega NFs) summer 2005. Coarse filter results are presented for Filter A, Filter B, and Filter C (see filter descriptions, Fig 3 – 5).

Forest	Total surveyed	Coarse filter results								
		Impassable (n, [%])			Passable (n, [%])			Indeterminate (n, [%])		
		A	B	C	A	B	C	A	B	C
NFAL	75	4 (5)	42 (56)	57 (76)	29 (39)	15 (20)	13 (17)	42 (56)	18 (24)	5 (7)

Table D3. Location of crossings surveyed on the National Forests in Alabama (Bankhead and Talladega NFs), summer of 2005. Site ID consists of the Forest abbreviation (BH), road the crossing is on (118A), and the distance (miles) from the junction road (0.3).

Site ID	Pipe #	District	Junction Road	Stream Name	Quad	6th Level Watershed
BH118A-0.3	1	Bankhead	118	Alford Spring	Houston	031601100105
BH160-0.9	1	Bankhead	160	Glover Creek	Addison	031601100203
BH160-0.9	2	Bankhead	160	Glover Creek	Addison	031601100203
BH204A-1.0	1	Bankhead	210	Basin Creek	Kinlock Spring	031601100101
BH204A-1.0	2	Bankhead	210	Basin Creek	Kinlock Spring	031601100101
BH204A-1.0	3	Bankhead	210	Basin Creek	Kinlock Spring	031601100101
BH208-4.0	1	Bankhead	203	Trib. Thompson Creek	Bee Branch	031601100101
BH248-0.35	1	Bankhead	63	Collier Creek Trib.	Grayson	031601100201
BH250-0.3	1	Bankhead	63	Collier Creek Trib.	Grayson	031601100201
BH254-0.45	1	Bankhead	246	Brushy Creek Trib.	Grayson	031601100201
BH254-0.45	2	Bankhead	246	Brushy Creek Trib.	Grayson	031601100201
BH264-1.5	1	Bankhead	49	Lee Creek	Upshaw	060300021005
BH264-1.5	2	Bankhead	49	Lee Creek	Upshaw	060300021005
BH264-2.15	1	Bankhead	249	Gillespie Creek	Oakville	060300021005
BH268-2.0	1	Bankhead	49	Trib. West Flint Creek	Upshaw	060300021005
BH268-2.0	2	Bankhead	49	Trib. West Flint Creek	Upshaw	060300021005
TNF500-0.7	1	Shoals Creek	553	Trib. Shoal Creek	Piedmont SE	031501060602
TNF500-1.2	1	Shoals Creek	55	Trib.Mary's Creek	Piedmont SE	031501050901
TNF500-1.3	1	Shoals Creek	500	Trib. Coleman Lake	Piedmont SE	031501060602
TNF500-1.4	1	Shoals Creek	553	Trib. Shoal Creek	Piedmont SE	031501060602
TNF500-1.7	1	Shoals Creek	553	Trib. Shoal Creek	Piedmont SE	031501060602
TNF500-11.2	1	Shoals Creek	281	Trib. Sweetwater Lake	Piedmont SE	031501060602
TNF500-2.2	1	Shoals Creek	change pavement to gravel	S. Fork Terrapin Creek	Piedmont SE	031501050901
TNF500-2.3	1	Shoals Creek	532	Trib. Shoal Creek	Piedmont SE	031501060602
TNF500-5.6	1	Shoals Creek	281	Trib. Highrock Lake	Heflin	031501060602
TNF500-5.8	1	Shoals Creek	281	Trib. Highrock Lake	Heflin	031501060602
TNF500-6.5	1	Shoals Creek	281	Trib. Highrock Lake	Heflin	031501060602
TNF500-6.5	2	Shoals Creek	281	Trib. Highrock Lake	Heflin	031501060602
TNF500-6.5	3	Shoals Creek	281	Trib. Highrock Lake	Heflin	031501060602
TNF500-6.8	1	Shoals Creek	281	Trib. Highrock Lake	Heflin	031501060602
TNF500-6.8	2	Shoals Creek	281	Trib. Highrock Lake	Heflin	031501060602

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Site ID	Pipe #	District	Junction Road	Stream Name	Quad	6th Level Watershed
TNF500-6.8	3	Shoals Creek	281	Trib. Highrock Lake	Heflin	031501060602
TNF500-8.2	1	Shoals Creek	281	Trib. Shoal Creek	Heflin	031501060602
TNF500-8.2	2	Shoals Creek	281	Trib. Shoal Creek	Heflin	031501060602
TNF500k-3.1	1	Shoals Creek	500	Dry Creek	Piedmont SE	031501060601
TNF522-0.5	1	Shoals Creek	522	Trib. Shoal Creek	Choccolocco	031501060602
TNF522-1.5	1	Shoals Creek	531	Trib. Choccolocco Creek	Choccolocco	031501060603
TNF529-1.2	1	Shoals Creek	500	Trib. Whitesides Mills Lake	Heflin	031501060602
TNF529-2.6	1	Shoals Creek	500	Trib. Whitesides Mills Lake	Choccolocco	031501060602
TNF529-2.6	2	Shoals Creek	500	Trib. Whitesides Mills Lake	Choccolocco	031501060602
TNF529-2.9	1	Shoals Creek	500	Trib. Whitesides Mills Lake	Choccolocco	031501060602
TNF531-0.2	1	Shoals Creek	548	Trib. Henry Creek	Heflin	031501080404
TNF531-1.1	1	Shoals Creek	500	Trib. Highrock Lake	Heflin	031501060602
TNF531-1.5	1	Shoals Creek	500	Trib. Highrock Lake	Heflin	031501060602
TNF531-1.5	2	Shoals Creek	500	Trib. Highrock Lake	Heflin	031501060602
TNF531-1.5	3	Shoals Creek	500	Trib. Highrock Lake	Heflin	031501060602
TNF532-0.9	1	Shoals Creek	500	Trib. Choccolocco Creek	Piedmont SE	031501060601
TNF532-1.0	1	Shoals Creek	500	Trib. Choccolocco Creek	Piedmont SE	031501060601
TNF548-0.2	1	Shoals Creek	500	Shoal Creek	Piedmont SE	031501060602
TNF548-0.2	2	Shoals Creek	500	Shoal Creek	Piedmont SE	031501060602
TNF548-2.7	1	Shoals Creek	531	Trib. Shoal Creek	Heflin	031501060602
TNF548-2.7	2	Shoals Creek	531	Trib. Shoal Creek	Heflin	031501060602
TNF553-1.9	1	Shoals Creek	500	Trib. Shoal Creek	Piedmont SE	031501060602
TNF553c-0.3	1	Shoals Creek	500	Trib. Shoal Creek	Piedmont SE	031501060602
TNF558a-0.9	1	Shoals Creek	570	Trib. Nances Creek	Jacksonville E	031501050905
TNF534r-0.1	1	Shoals Creek	55	Trib. Choccolocco Creek	Piedmont SE	031501060601
TNF600-0.9	1	Shoals Creek	385	Trib. Cheaha Creek	Cheaha Mt.	031501060608
TNF600-1.1	1	Shoals Creek	385	Trib. Cheaha Creek	Cheaha Mt.	031501060608
TNF570-0.1	1	Shoals Creek	change pavement to gravel	Trib. Nances Creek	Jacksonville E	031501050905
TNF486-0.7	1	Talladega	651	Trib. Salt Creek	Oxford	031501060606
TNF486-1.1	1	Talladega	651	Trib. Salt Creek	Oxford	031501060606
TNF486-1.1	2	Talladega	651	Trib. Salt Creek	Oxford	031501060606
TNF486-1.5	1	Talladega	651	Trib. Salt Creek	Oxford	031501060606
TNF486-1.9	1	Talladega	651	Trib. Salt Creek	Oxford	031501060606

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Site ID	Pipe #	District	Junction Road	Stream Name	Quad	6th Level Watershed
TNF486-1.9	2	Talladega	651	Trib. Salt Creek	Oxford	031501060606
TNF486-2.4	1	Talladega	651	Trib. Salt Creek	Oxford	031501060606
TNF600-1.5	1	Talladega	385	Cheaha Creek Trib.	Cheaha Mt.	031501060608
TNF643-0.7	1	Talladega	651	Trib. Dry Branch	Oxford	031501060604
TNF643-1.1	1	Talladega	651	Trib. Dry Branch	Oxford	031501060604
TNF643-1.3	1	Talladega	651	Trib. Dry Branch	Oxford	031501060604
TNF651-0.9	1	Talladega	CR 42	Trib. Salt Creek	Oxford	031501060606
TNF651-1.4	1	Talladega	CR 42	Salt Creek Trib.	Oxford	031501060606
TNF651-2.5	1	Talladega	CR 42	Dry Creek Trib.	Cheaha Mt.	031501060606
TNF651-3.2	1	Talladega	CR 42	Trib. Cheaha Creek	Cheaha Mt.	031501060606
TNF651-3.9	1	Talladega	CR 42	Dry Creek Trib.	Cheaha Mt.	031501060606

Table D4. Coarse filters A, B, and C, classifications for surveyed crossings on the National Forest in Alabama (Bankhead and Talladega NFs), summer 2005.

Site ID	Pipe #	Filter A	Filter B	Filter C
BH118A-0.3	1	indeterminate	impassable	impassable
BH160-0.9	1	indeterminate	indeterminate	indeterminate
BH160-0.9	2	passable	passable	passable
BH204A-1.0	1	passable	impassable	impassable
BH204A-1.0	2	passable	impassable	impassable
BH204A-1.0	3	passable	impassable	impassable
BH208-4.0	1	passable	passable	passable
BH248-0.35	1	indeterminate	impassable	impassable
BH250-0.3	1	passable	passable	passable
BH254-0.45	1	indeterminate	impassable	impassable
BH254-0.45	2	indeterminate	impassable	impassable
BH264-1.5	1	passable	passable	passable
BH264-1.5	2	passable	passable	passable
BH264-2.15	1	passable	passable	passable
BH268-2.0	1	passable	impassable	impassable
BH268-2.0	2	indeterminate	impassable	impassable
TNF500-0.7	1	indeterminate	indeterminate	impassable
TNF500-1.2	1	indeterminate	indeterminate	indeterminate
TNF500-1.3	1	impassable	impassable	impassable
TNF500-1.4	1	indeterminate	impassable	impassable
TNF500-1.7	1	indeterminate	impassable	impassable
TNF500-11.2	1	indeterminate	indeterminate	impassable
TNF500-2.2	1	passable	passable	impassable
TNF500-2.3	1	passable	impassable	impassable
TNF500-5.6	1	passable	impassable	impassable
TNF500-5.8	1	passable	passable	passable
TNF500-6.5	1	indeterminate	indeterminate	impassable
TNF500-6.5	2	indeterminate	indeterminate	impassable
TNF500-6.5	3	indeterminate	indeterminate	impassable
TNF500-6.8	1	passable	passable	passable
TNF500-6.8	2	passable	indeterminate	indeterminate
TNF500-6.8	3	passable	passable	passable
TNF500-8.2	1	passable	impassable	impassable
TNF500-8.2	2	indeterminate	impassable	impassable
TNF500k-3.1	1	indeterminate	impassable	impassable
TNF522-0.5	1	indeterminate	impassable	impassable
TNF522-1.5	1	indeterminate	impassable	impassable
TNF529-1.2	1	passable	passable	impassable
TNF529-2.6	1	indeterminate	impassable	impassable
TNF529-2.6	2	indeterminate	impassable	impassable
TNF529-2.9	1	indeterminate	impassable	impassable
TNF531-0.2	1	indeterminate	indeterminate	impassable
TNF531-1.1	1	indeterminate	indeterminate	impassable
TNF531-1.5	1	indeterminate	indeterminate	impassable
TNF531-1.5	2	passable	passable	passable

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Site ID	Pipe #	Filter A	Filter B	Filter C
TNF531-1.5	2	passable	passable	passable
TNF531-1.5	3	passable	passable	passable
TNF532-0.9	1	indeterminate	indeterminate	indeterminate
TNF532-1.0	1	indeterminate	impassable	impassable
TNF548-0.2	1	indeterminate	impassable	impassable
TNF548-0.2	2	passable	impassable	impassable
TNF548-2.7	1	indeterminate	impassable	impassable
TNF548-2.7	2	indeterminate	impassable	impassable
TNF553-1.9	1	indeterminate	impassable	impassable
TNF553c-0.3	1	indeterminate	impassable	impassable
TNF558a-0.9	1	indeterminate	indeterminate	impassable
TNF534r-0.1	1	indeterminate	impassable	impassable
TNF600-0.9	1	indeterminate	indeterminate	impassable
TNF600-1.1	1	passable	passable	passable
TNF570-0.1	1	impassable	impassable	impassable
TNF486-0.7	1	indeterminate	indeterminate	indeterminate
TNF486-1.1	1	passable	impassable	impassable
TNF486-1.1	2	passable	impassable	impassable
TNF486-1.5	1	passable	indeterminate	impassable
TNF486-1.9	1	passable	impassable	impassable
TNF486-1.9	2	indeterminate	impassable	impassable
TNF486-2.4	1	impassable	impassable	impassable
TNF600-1.5	1	passable	impassable	impassable
TNF643-0.7	1	indeterminate	impassable	impassable
TNF643-1.1	1	indeterminate	indeterminate	impassable
TNF643-1.3	1	impassable	impassable	impassable
TNF651-0.9	1	indeterminate	impassable	impassable
TNF651-1.4	1	indeterminate	impassable	impassable
TNF651-2.5	1	indeterminate	impassable	impassable
TNF651-3.2	1	passable	passable	passable
TNF651-3.9	1	indeterminate	indeterminate	impassable

Table D5. Description of crossings surveyed on the National Forests in Alabama (Bankhead and Talladega NFs) summer 2005. Shape abbreviations: C= circular, PA= pipe arch, OBA= open bottom arch, and F= ford. Channel width is the mean bankfull channel width. N= no natural substrate, N (discontin)= discontinuous substrate, Y= continuous natural substrate. An NA (not applicable) indicates outlet drop (no outlet pool or tailwater control) or outlet perch (stream dry) could not be calculated. Negative outlet drop or perch values indicate a submerged outlet (structure partially backwatered). Residual inlet depth values ≥ 0.0 indicate the structure is fully backwatered.

Site ID	Pipe #	Shape	Pipe Condition	Mean Channel Width (ft)	Continuous Substrate in Structure	Pipe slope (%)	Pipe Width: Channel Width ratio	Outlet Drop (in)	Outlet Perch (in)	Residual Inlet Depth (in)	Pipe Length (ft)	Slope (%) * Length (ft)
BH118A-0.3	1	C	fair	6.0	N	0.93	0.92	17.76	12.96	0.00	80.0	74.0
BH160-0.9	1	PA	fair	23.7	N	3.02	0.30	-9.36	6.36	0.00	28.5	86.0
BH160-0.9	2	PA	fair	23.7	N	0.72	0.27	-2.52	13.20	5.16	30.4	22.0
BH204A-1.0	1	PA	good	15.6	N	1.00	0.45	16.08	7.08	0.00	33.0	33.0
BH204A-1.0	2	PA	good	15.6	N	0.79	0.45	16.32	7.32	0.00	33.0	26.0
BH204A-1.0	3	PA	good	15.6	N	0.73	0.45	16.44	7.44	0.00	33.0	24.0
BH208-4.0	1	OBA	good	5.9	Y	0.00	1.35	4.20	-1.20	0.00	21.0	0.0
BH248-0.35	1	C	fair	4.2	N	2.93	0.94	14.40	13.80	0.00	41.0	120.0
BH250-0.3	1	C	good	3.5	Y	5.20	1.16	3.60	-6.60	0.00	63.5	330.0
BH254-0.45	1	C	poor	8.8	N	1.88	0.51	18.00	12.60	0.00	32.0	60.0
BH254-0.45	2	C	poor	8.8	N	2.50	0.51	16.80	11.40	0.00	32.0	80.0
BH264-1.5	1	C	good	17.1	N	1.33	0.20	-14.28	-22.20	19.08	30.0	40.0
BH264-1.5	2	C	good	17.1	N	0.47	0.20	-8.40	-16.32	10.08	30.0	14.0
BH264-2.15	1	PA	poor	16.7	N	3.00	0.35	NA	-24.00	0.96	21.0	63.0
BH268-2.0	1	PA	fair	4.6	N	1.13	1.17	16.68	8.88	0.00	32.0	36.0
BH268-2.0	2	PA	fair	4.6	N	1.91	1.17	17.76	9.96	0.00	27.0	51.5
TNF500-0.7	1	C	fair	6.2	N	1.88	0.73	4.20	2.88	0.00	66.5	125.0
TNF500-1.2	1	C	good	7.8	N	1.94	0.38	2.16	0.60	0.00	35.0	68.0
TNF500-1.3	1	C	fair	4.5	N	0.88	1.01	25.44	21.84	0.00	81.4	72.0
TNF500-1.4	1	C	fair	5.3	N	1.24	0.79	13.92	6.12	0.00	80.9	100.0
TNF500-1.7	1	C	fair	4.3	N	2.12	1.15	3.00	4.08	0.00	112.8	239.0
TNF500-11.2	1	C	fair	4.5	N	1.94	0.55	4.68	1.68	0.00	33.0	64.0

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Site ID	Pipe #	Shape	Pipe Condition	Mean Channel Width (ft)	Continuous Substrate in Structure	Pipe slope (%)	Pipe Width: Channel Width ratio	Outlet Drop (in)	Outlet Perch (in)	Residual Inlet Depth (in)	Pipe Length (ft)	Slope (%) * Length (ft)
TNF500-2.2	1	B	excellent	14.2	N	0.02	0.35	6.66	-0.54	0.00	24.0	0.5
TNF500-2.3	1	C	good	5.7	N	0.64	0.71	15.36	26.04	0.00	73.0	47.0
TNF500-5.6	1	B	good	11.1	N	0.19	0.90	12.48	9.12	0.00	31.7	6.0
TNF500-5.8	1	B	good	11.8	N	1.45	0.68	-13.20	-16.44	9.72	20.0	29.0
TNF500-6.5	1	C	good	6.3	N	2.03	0.40	5.04	1.68	0.00	39.0	79.0
TNF500-6.5	2	C	good	6.3	N	3.31	0.40	5.88	2.52	0.00	39.0	129.0
TNF500-6.5	3	C	good	6.3	N	2.85	0.40	5.04	1.68	0.00	39.0	111.0
TNF500-6.8	1	PA	fair	13.7	Y	0.08	0.40	NA	-2.64	0.00	26.4	2.0
TNF500-6.8	2	PA	fair	13.7	N (discontin)	1.33	0.40	NA	-4.44	0.00	26.4	35.0
TNF500-6.8	3	PA	fair	13.7	Y	0.30	0.40	NA	2.64	0.00	26.4	8.0
TNF500-8.2	1	C	poor	7.4	N	0.81	0.34	17.28	15.36	0.00	37.0	30.0
TNF500-8.2	2	C	poor	7.4	N	1.82	0.34	14.40	12.48	0.00	37.0	67.5.
TNF500k-3.1	1	C	good	9.6	N	5.59	0.73	13.20	11.52	0.00	34.0	190.0
TNF522-0.5	1	C	poor	6.1	N (discontin)	3.59	0.41	-3.12	-4.38	0.00	57.0	204.5
TNF522-1.5	1	C	good	5.5	N	3.74	0.73	13.20	10.32	0.00	49.6	185.5
TNF529-1.2	1	B	good	12.5	N	0.40	0.80	5.64	0.48	0.00	16.3	6.5
TNF529-2.6	1	C	good	14.4	N (discontin)	1.45	0.38	18.48	13.08	0.00	48.2	70.0
TNF529-2.6	2	C	good	14.4	N	1.36	0.38	18.66	13.26	0.00	48.2	65.5
TNF529-2.9	1	C	good	8.0	N	2.05	0.63	12.84	10.08	0.00	48.3	99.0
TNF531-0.2	1	PA	good	8.3	N	1.63	0.67	7.68	-1.20	0.00	41.0	67.0
TNF531-1.1	1	PA	fair	11.7	N	0.92	0.47	9.96	7.08	0.00	147.5	136.0
TNF531-1.5	1	VF	good	28.3	N	2.81	0.18	-2.88	-23.52	0.00	60.1	169.0
TNF531-1.5	2	VF	good	28.3	Y	0.35	0.18	-6.84	-27.48	4.32	60.1	21.0
TNF531-1.5	3	VF	good	28.3	N	0.62	0.18	-5.52	-26.16	9.96	60.1	37.0
TNF532-0.9	1	PA	good	8.5	N	2.74	0.59	3.24	0.72	0.00	31.7	87.0

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Site ID	Pipe #	Shape	Pipe Condition	Mean Channel Width (ft)	Continuous Substrate in Structure	Pipe slope (%)	Pipe Width: Channel Width ratio	Outlet Drop (in)	Outlet Perch (in)	Residual Inlet Depth (in)	Pipe Length (ft)	Slope (%) * Length (ft)
TNF532-1.0	1	C	good	5.6	N	3.92	0.53	3.72	0.96	0.00	31.1	122.0
TNF548-0.2	1	PA	fair	10.8	N	2.17	0.56	11.16	3.36	0.00	35.0	76.0
TNF548-0.2	2	PA	fair	10.8	N	0.60	0.56	17.16	9.36	0.00	35.0	21.0
TNF548-2.7	1	PA	good	10.3	N	3.60	0.53	0.36	-3.72	0.00	53.0	191.0
TNF548-2.7	2	PA	good	10.3	N	1.19	0.53	19.08	15.00	0.00	53.0	63.0
TNF553-1.9	1	B	fair	16.7	N	2.67	0.60	14.88	10.68	0.00	30.7	82.0
TNF553c-0.3	1	C	fair	6.6	N	4.81	0.38	-3.60	-5.94	0.00	32.2	155.0
TNF558a-0.9	1	C	poor	7.1	N	2.85	0.56	6.60	4.56	0.00	65.0	185.0
TNF534r-0.1	1	C	poor	7.8	N	6.06	0.64	-2.76	-6.24	0.00	39.8	241.0
TNF600-0.9	1	B	good	10.7	N	2.62	0.56	7.08	15.00	0.00	24.0	63.0
TNF600-1.1	1	B	good	7.1	Y	1.00	0.85	-0.60	-0.72	0.00	8.0	8.0
TNF570-0.1	1	PA	good	7.9	N	1.49	0.38	27.66	25.02	0.00	30.5	45.5
TNF486-0.7	1	C	good	6.0	N	3.16	0.33	3.60	0.12	0.00	25.0	79.0
TNF486-1.1	1	C	poor	4.5	N	1.71	0.44	21.60	6.24	0.00	24.5	42.0
TNF486-1.1	2	C	poor	4.5	N	2.02	0.44	19.68	4.32	0.00	24.5	49.5
TNF486-1.5	1	C	fair	6.8	N (discontin)	1.63	0.29	9.24	NA	0.00	24.5	40.0
TNF486-1.9	1	C	good	7.4	N	0.40	0.34	18.72	17.52	0.00	24.7	10.0
TNF486-1.9	2	C	good	7.4	N	3.28	0.34	14.76	13.56	0.00	24.7	81.0
TNF486-2.4	1	C	fair	4.3	N	7.14	0.59	-4.32	-4.92	0.00	21.0	150.0
TNF600-1.5	1	B	good	7.1	N	1.88	0.56	14.40	11.76	0.00	24.0	45.0
TNF643-0.7	1	PA	poor	9.1	N	3.39	0.64	15.18	14.28	0.00	60.5	205.0
TNF643-1.1	1	B	good	13.9	N	0.88	0.43	8.28	4.92	0.00	56.8	50.0
TNF643-1.3	1	B	good	14.7	N	7.17	0.54	-9.96	-10.92	0.00	29.0	208.0
TNF651-0.9	1	C	good	5.5	N	3.64	0.73	3.12	0.00	0.00	42.0	153.0
TNF651-1.4	1	PA	poor	14.0	N	2.75	0.64	10.32	5.04	0.00	48.3	133.0

Table continued next page…

Site ID	Pipe #	Shape	Pipe Condition	Mean Channel Width (ft)	Continuous Substrate in Structure	Pipe slope (%)	Pipe Width: Channel Width ratio	Outlet Drop (in)	Outlet Perch (in)	Residual Inlet Depth (in)	Pipe Length (ft)	Slope (%) * Length (ft)
TNF651-2.5	1	C	good	7.2	N	5.68	0.56	15.24	12.6	0.00	37.0	210.0
TNF651-3.2	1	OBA	good	22.8	Y	4.15	0.47	-3.24	-8.76	0.00	108.7	451.0
TNF651-3.9	1	C	good	3.9	N (discontin)	2.62	0.52	8.40	6.36	0.00	24.0	63.0

Fish Passage Status of Road-Stream Crossings on Selected National Forests in the Southern Region, 2006

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Southern Research Station
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Background

The ability to move freely through stream networks is an important aspect of a fish species' long-term viability (Fausch et al. 2002). Fish movement in streams prevents population fragmentation (Winston et al. 1991), allows for population recovery following disturbance (Detenbeck et al. 1992; Adams and Warren 2005; Roghair and Dolloff 2005), and provides access to critical habitats (Fausch and Young 1995). Early work examining effects of road-stream crossings on fish movement occurred primarily in the western U.S. and focused on anadromous Pacific salmon stocks. Effects of road-stream crossings on stream-resident fishes in the eastern U.S. received less attention, in part because such fishes were regarded as sedentary (Gerking 1959). Recent re-examination of historic movement studies (Gowan et al. 1994) and new research on a wide range of stream-resident fish species (Warren and Pardew 1998; Albanese et al. 2003; Schmetterling and Adams 2004) has shown a frequency and magnitude of movement that must be considered when making stream management decisions.

There are estimated to be over 50,000 road-stream crossings on National Forest managed lands in the eastern U.S. (M. Hudy, Forest Service U.S. Department of Agriculture, unpublished data). Each of these crossings represents a potential impediment or barrier to fish movement among stream reaches and watersheds. The Forest Service recognizes the importance of modifying or removing those crossings identified as barriers to meet its objective of restoring and maintaining native species diversity (Forest Service, U.S. Department of Agriculture 2004). In alignment with the Forest Service National Strategic Plan, the Southern Region has also listed the removal of barriers to fish and other aquatic organisms as a key strategy for meeting its critical objective of improving watershed condition (Southern Region Forest Service, U.S. Department of Agriculture *Draft*).

In 2003 and 2004 the U.S. Forest Service Southern and Eastern Regions and the San Dimas Technology and Development Center (SDTDC) hosted several fish passage assessment and remediation workshops. The National Inventory and Assessment Procedure (NIAP) (Clarkin et al. 2003) presented at these workshops provided a framework for collecting field data, but the assessment models, designed for western U.S. fish species, were not directly applicable to most species in the eastern U.S. The southeastern U.S. has over 660 freshwater fish species in 27 families encompassing a wide range of swimming and leaping abilities (Warren et al. 2000). Development of species-specific passage models was considered impractical and lack of data on leaping and swimming ability for most eastern fish species limited the usefulness of previously developed passage assessment software such as FishXing (Love et al. 1999).

In 2003, graduate students and biologists of the U.S. Forest Service Aquatic Ecology Unit – East at James Madison University began to develop models that would allow managers to quickly assess the passage status of a crossing. Three 'coarse screening filters' were developed based on leaping and swimming abilities: Filter A strong abilities; Filter B moderate abilities; and Filter C weak abilities. Model validation showed that when using data collected with the NAIP the coarse filters were reliable tools for predicting fish passage (Coffman 2005).

In 2005 the USFS Southern Region, pursuing its critical priority of improving watershed condition, elected to allocate 10% of its Roads and Trails (TRTR) funds annually for four years to inventory road-stream crossings and identify fish passage barriers in the Southern Region. To insure a quality product with consistent data collection and analysis the Region partnered with the Southern Research Station, Center for Aquatic Technology Transfer (CATT) to design and execute an inventory and assessment program for road-stream crossings. The CATT developed an inventory protocol based on the NIAP, deployed field crews to collect data, and then classified each crossing as passable, impassable or indeterminate for each of the three coarse filters described above. The CATT completed inventories on several Forests in summer 2005 (Coffman et al. 2005) and on the Apalachicola National Forest in January 2006 (Coffman et al. 2007). Between April and October 2006, surveys were conducted on the George Washington-Jefferson National Forest, Cherokee National Forest, National Forests in Alabama, Francis Marion-Sumter National Forest, National Forests in Mississippi, and National Forests in Texas (Figure 1). This report summarizes the results of road-stream crossing inventories performed by the CATT between April and October 2006.

Methods

Site Selection

In early March 2006, the Regional office reviewed work requests, selected Forests for site visits, and forwarded their selections to the CATT. The CATT contacted selected Forests in mid-March to request lists of road-stream crossings for survey. Forests selected crossings for survey non-randomly based on Forest-specific priorities.

Data Collection

Dimensions, characteristics, shape (Figure 2), and condition of road-stream crossing structures and data pertaining to the adjacent stream channel were recorded for each site following the National Inventory and Assessment Procedure (NIAP) for road-stream crossings (Clarkin et al. 2003). A CST/berger SAL series automatic level with 32x magnification mounted on a tripod and a 25-foot stadia rod graduated in tenths of feet were used to measure the elevation of the crossing structure inlet and outlet, tailwater control, and the water surface (Figure 3). A measuring tape marked in hundredths of a foot was used to measure the distance between the crossing inlet and outlet. Bankfull channel width was measured at three locations upstream of the crossing and three downstream where natural channel geometry was intact (i.e. outside of the influence of the crossing structure). Photographs of the inlet and outlet were taken and each site was sketched on paper. Condition of the crossing structure was recorded and any natural barriers (e.g. waterfalls) immediately upstream or downstream were documented. Natural stream substrate covering the bottom of the crossing structure was recorded as continuous throughout the structure, discontinuous, or not present. Substrate had to cover 100% of the structure bottom for a crossing to receive a continuous throughout the structure designation.

Data Analysis

The elevation and distance measurements for the crossing inlet, crossing outlet, tailwater control, and water surface were used to calculate residual inlet depth, outlet drop, outlet perch, slope, and slope x length values for each crossing (Figure 3).

Residual inlet depth is calculated as

$$P_3 - P_1,$$

where P_3 is the tailwater control elevation of the outlet pool and P_1 is the crossing inlet elevation. Residual inlet depth values greater than zero indicate the structure is completely backwatered, allowing fish passage.

Outlet drop is calculated as

$$P_2 - P_3,$$

where P_2 is the crossing outlet elevation and P_3 is the tailwater control elevation of the outlet pool.

Outlet perch is calculated as

$$P_2 - Ws,$$

where P_2 is the crossing outlet elevation and Ws is the water surface elevation immediately downstream of the outlet. Outlet perch is used in place of outlet drop when a tailwater control is not present and outlet drop cannot be calculated. Excessive outlet drop or outlet perch values indicate the presence of jump barriers.

Slope is calculated as

$$(P_{1elev} - P_{2elev}) / (P_{1dist} - P_{2dist}) * 100,$$

where P_{1elev} is the crossing inlet elevation, P_{2elev} is the crossing outlet elevation, P_{1dist} is the crossing inlet distance, and P_{2dist} is the crossing outlet distance. Steep slope is an indicator of velocity barriers.

Slope x length is calculated as

$$[(P_{1elev} - P_{2elev}) / (P_{1dist} - P_{2dist}) * 100] * (P_{1dist} - P_{2dist}),$$

where P_{1elev} is the crossing inlet elevation, P_{2elev} is the crossing outlet elevation, P_{1dist} is the crossing inlet distance, and P_{2dist} is the crossing outlet distance. High slope x length values indicate an exhaustion barrier.

Percent of crossing structure bottom with natural substrate, residual inlet depth, outlet drop, outlet perch, slope, and slope x length values for each crossing were applied to each of three regional coarse filters (Figures 4 – 6) to determine upstream passage status. Threshold values for each parameter differ by filter and were set according to published swimming and leaping abilities of representative species in each filter group, and relationships among crossing dimensions, species presence/absence data, and movement data (Coffman 2005). Filter A (Figure 4) classifies crossings for species with strong swimming and leaping abilities, such as the adult brook trout (*Salvelinus fontinalis*). Filter B (Figure 5) classifies crossings for species with moderate swimming and leaping abilities such as juvenile trout or species in the minnow family (Cyprinidae). Filter C (Figure 6) classifies crossings for weak swimmers and leapers, such as species in the darter (Percidae) and sculpin (Cottidae) families. Crossings are classified as passable, impassable, or indeterminate for each of the three filters. Biological sampling or computer modeling is required to determine passage status for crossings classified as indeterminate.

The ratio of culvert width to bankfull channel width was also calculated for each site. The ratio is calculated as

$$CW / BCW,$$

where CW is the maximum width or diameter of the crossing structure and BCW is the average of all six (three upstream and three downstream) bankfull channel width measurements. A ratio of 1.0 or greater indicates that the crossing structure is equal to or greater than the width of the bankfull channel. Fords, vented fords, and sites with multiple crossing structures were eliminated from this analysis.

Special Cases

Sites with more than one crossing structure (e.g. culverted site with multiple pipes) were occasionally encountered during the surveys. At these sites each individual structure was numbered sequentially from left to right when facing downstream. Each individual structure was then surveyed and classified, which could result in a single site having multiple classifications for a given filter. Under those circumstances the location was classified based on the structure that received the best passage rating. For example, in a crossing location with two circular culverts where one was classified as impassable and one indeterminate by Filter B, the location would receive an overall classification of indeterminate rather than impassable.

By definition open bottom arches receive a natural substrate continuous throughout structure designation, thus these structures receive a passable classification by default for each coarse filter. Full surveys were still completed at open bottom arches to capture channel conditions and crossing structure dimensions.

Crossing location was documented but the structure was not surveyed if there was inadequate habitat upstream of the crossing to support fish, or if the crossing structure was a bridge or natural ford. Bridges and natural fords were assumed to always provide adequate upstream fish passage. Crossing locations that could not be reached because of inaccessible or closed roads, private property issues, or locked gates were also documented, but not surveyed.

Results

We completed surveys at 431 of 633 documented road-stream crossings in 2006 (Table 1). The majority of all crossings were either impassable or indeterminate for all filters. Only 47%, 30%, and 24% of these crossings were rated passable by Filters A, B, and C respectively (Figures 7-9, Table 2). The percentage of crossings rated impassable, passable, and indeterminate by each Filter varied among Forests surveyed in 2006 (Figures 10-12). Excessive outlet drops accounted for 69%, 82%, and 91% of the impassable sites for Filters A, B, and C respectively (Table 3).

The majority of crossings surveyed were either circular culvert (61%, n=265) or pipe arches (20%, n=87). Box culverts (11%, n=49), vented fords (4%, n=16), concrete slab fords (1%, n=4), and bottomless arches (3%, n=10) were less frequently encountered. Filter A classified 11% of circular culverts and 13% of pipe arch crossings as impassable (Figure 13, Table 4). The proportion of circular culverts and pipe arches classified impassable increased from Filter A to Filters B and C. Filter B classified 40% of circular culverts and 57% of pipe arch crossings as impassable (Figure 14, Table 4). Filter C classified 53% of circular culverts and 67% of pipe arches as impassable (Figure 15, Table 4).

Crossing width was less than the bankfull channel width at more than 80% of all surveyed crossings (excluding fords, vented fords, and multiple structure crossings). The crossing width to channel width ratio was 0.73 ± 0.35 (mean ± SD) (n=267) (Figure 16). Only 51 crossings were greater than or equal to the mean bankfull channel width (i.e. crossing width to channel width ratio was greater than or equal to 1.0). The mean crossing width to channel width ratio for crossings classified impassable was significantly less than the mean ratio for crossings classified passable for all three filters (Table 5).

Discussion

Regional Analysis

Crossings that prevent upstream fish passage are a common feature of stream networks on southern Forests: less than 39% of the crossings surveyed on each Forest were rated as passable for all three filters. Outlet drop triggered passage failure at the majority of impassable sites, but it was not the only factor that would have prevented movement. Over 57% of sites classified as impassable due to excessive outlet drop by Filter C would also have failed due to either excessive slope or slope x length values. Even if fish had managed to find a way to leap into these crossing structures they likely would have faced water velocities that exceeded their swimming abilities or a combination of water velocity and pipe length that would have exhausted them before they could exit the upstream end of the structure. These conditions are created when crossing structures do not mimic natural channel characteristics such as bankfull channel width, slope, and substrate. Impassable crossing structures typically concentrate water into a steeper, narrower channel profile with less resistance to flow. The result is increased water velocity within the structure and scouring immediately downstream creating an outlet drop, or perch (Castro 2003). This effect is exaggerated in high gradient streams which may explain why the George Washington-Jefferson NF and Cherokee NF, which had the highest gradient streams for Forests inventoried in 2006, also had the highest proportion of sites that failed for all three filters. Streams in the other Forests were primarily low gradient where failure for Filter A suggests extreme passage problems.

The vast majority of crossings structures surveyed were narrower than the natural bankfull channel. Undersized crossing structures disrupt natural stream processes such as transport of sediment and large woody debris, leading to blocked inlets or blowouts during storm events. Changes in stream flow and water velocities caused by undersized structures can lead to the development of passage barriers as discussed previously. The average width ratio of impassable sites was much less than the average width ratio of passable sites, however some sites with low width ratios were still classified as passable, which precludes this metric from being a reliable indicator of passage status. One possible explanation for this could be varying ages of crossing structures. Initial installation of undersized culverts may not immediately result in passage barriers, but over time the combined effect of varying flows and the unnatural characteristics/dimensions of the crossings can lead to the creation of barriers. The width ratio is unlikely to change dramatically over time, but the filter classification could due to events such as downstream scour and uneven settling of culverts.

The high proportion of impassable crossings for Filters B and C is particularly troubling. Minnow and darter species, many of which are represented by Filters B and C, constitute roughly 66% of the freshwater fish diversity in the Southeast and the majority of the 28% that are threatened, endangered, or vulnerable to extinction (Warren et al. 2000). Our results suggest that these moderate and weak swimming species face barriers to movement at 50-65% of the crossings we surveyed. The habitat fragmentation associated with these crossings likely contributes to continued species imperilment, and adds to the challenge of restoring connectivity.

All crossing types blocked upstream fish passage to some degree with the exception of open bottom arches, which are classified passable by default as discussed in the ‘Special Cases’ section of this report. Our survey results revealed that most open bottom arches had high crossing to channel width ratios (70% were greater than 1.0) creating residual inlet depth, outlet drop, and slope conditions similar to the natural stream channel and thus favorable to fish passage. However, open bottom arches can be expensive and installation complicated compared to other crossing types (Murphy and Pyles 1989), which may explain why we encountered relatively few of these structures. Other than open bottom arches, box culverts and vented fords had the smallest percentage of impassable sites, but sample size for these types was low in 2006. Pipe arches and circular culverts were the most frequently encountered crossing type. Pipe arches and circular culverts dominate the road-stream crossing landscape because they are the most readily available and cost effective to install, but as our results demonstrate, they can create passage problems when stream hydrology and biological factors are not carefully considered prior to installation (Baker and Votapka 1990).

Current Limitations and Future Improvements

The coarse filters presented here apply to several general categories of fish including strong swimmers and leapers (Filter A), moderate swimmers and leapers (Filter B), and weak swimmers and leapers (Filter C). We assigned adult trout to represent Filter A, minnows and young trout to represent Filter B, and darters and sculpins to represent Filter C, however there are a range of swimming and leaping abilities represented within each family. For example some minnow species are strong swimmers and therefore may be most appropriately assessed by Filter A, whereas other weak swimming minnows may be candidates for Filter C. Still other families or species, such as those that are strong swimmers but weak to moderate leapers may require the creation of additional filters. Currently, few data are available regarding swimming and leaping abilities of non-game fish species in the Southeast making it difficult to refine or expand the existing set of filters. Members of the sucker (Catostomidae), catfish (Ictuluridae) and sunfish (Centrarchidae) families may fit into such filters, but clearly more research is needed.

Results provided by the existing filters include a sometimes large area of indeterminate passage status. Crossings enter this “gray area” when they pass for outlet drop and slope but do not pass or fail for slope x length. The range of values that leads to an indeterminate classification for slope x length can be quite large, particularly for Filter A leaving a large portion of sites essentially unclassified. The slope x length value represents the relative level of exhaustion a fish would experience by trying to swim through a pipe of a certain slope for a given distance. Because few empirical data exist for species exhaustion rates the filters were designed to be conservative. Biological sampling can provide important information for evaluating fish passage at sites classified indeterminate and generally with little expense relative to the cost of replacing a crossing structure. Mark-recapture sampling designs can vary in complexity and effort depending on project goals (Warren and Pardew 1998) and provide direct evidence of fish passage without the assumptions of fish passage models. The mark recapture design can be as simple as marking and releasing a sample of fish downstream of a crossing, and then sampling for marked fish above the crossing on subsequent sampling trips. Collection of marked fish above the crossing would indicate that crossing is passable for the species in question. More elaborate designs to detect if movement through the crossing is the same or similar to movement through the unobstructed natural stream channel can also be implemented (Coffman 2005). The use of mark-recapture studies at indeterminate sites would not only allow Forests to classify these sites as passable or impassable, but would also provide data necessary to refine the filter thresholds and shrink the gray areas.

The Forests have opportunities to improve fish passage at road-stream crossings both during routine maintenance, when crossing structures reach the end of their serviceable life, and when funding becomes available to replace crossings outside of the regular maintenance schedule. Managers should always consult with their biologists and hydrologists to determine whether routine replacements should include aquatic organism passage considerations. Selection of sites for replacement outside of the routine maintenance schedule can be more challenging. Currently, Forests can use the information from our surveys to locate impassable crossings that are candidates for replacement; however the number of impassable crossings per Forest makes selecting sites an overwhelming task. Survey results only provide passage status and exclude many other factors that should be considered when prioritizing crossings for replacement. Information such as miles of habitat upstream of a crossing, proximity to other barriers, cost of replacement, species presence, and species status (i.e. threatened, endangered, exotic invasive) need to be included in the decision process. Given the large number of impassable sites, using criteria such as these to prioritize sites for remediation can be time consuming and overwhelming.

Last year CATT proposed the development of a decision support system (DSS) to assist managers in prioritization of crossing remediation projects (Coffman et al. 2005). The DSS would allow managers to (1) prioritize watersheds for assessment based on selected watershed characteristics; and (2) after assessments are complete prioritize impassable crossings for replacement based on factors such as quantity and quality of habitat (Coffman et al. 2005). The CATT estimates that a working prototype DSS could be developed for one-tenth the expense of replacing a single culverted crossing (based on the installation of a 12 foot open bottom arch, 80 feet long with a 20 foot high road embankment that allows fish passage costs roughly $108,000 (USDA Forest Service 2006)). The DSS would help to ensure replacement crossing installations result in the most cost-effective benefit for the resource. A fully operational DSS would be a powerful tool for selecting from the large number of impassable crossings within each Forest.

In summer 2005, field crew efficiency was a major issue. Crews often arrived at Forests on short notice with little pre-visit reconnaissance or prioritization available for their use. As a result we surveyed only 22% of the sites we documented in 2005 (Coffman et al. 2005). Crew efficiency was greatly improved in 2006 (68% of sites documented were surveyed) due to increased coordination between the Region, Forests, and the CATT. The Region selected Forests early in the year allowing Forest staffs sufficient time to prioritize crossings and focus the survey efforts. Crew efficiency is critical given the limited amount of time available to survey each Forest. Further improvements in efficiency can be made as Forest Service staffs continue to prioritize watersheds and identify critical aquatic habitats containing road-stream crossings.

The results of culvert inventories performed in the Southern Region in summer 2006 demonstrate the effects of road-stream crossings on aquatic organism passage in southern streams. Future inventories in the Region will expand the baseline data necessary to meet national and regional strategic goals, prioritize crossings for replacements, and compete for remediation funds.

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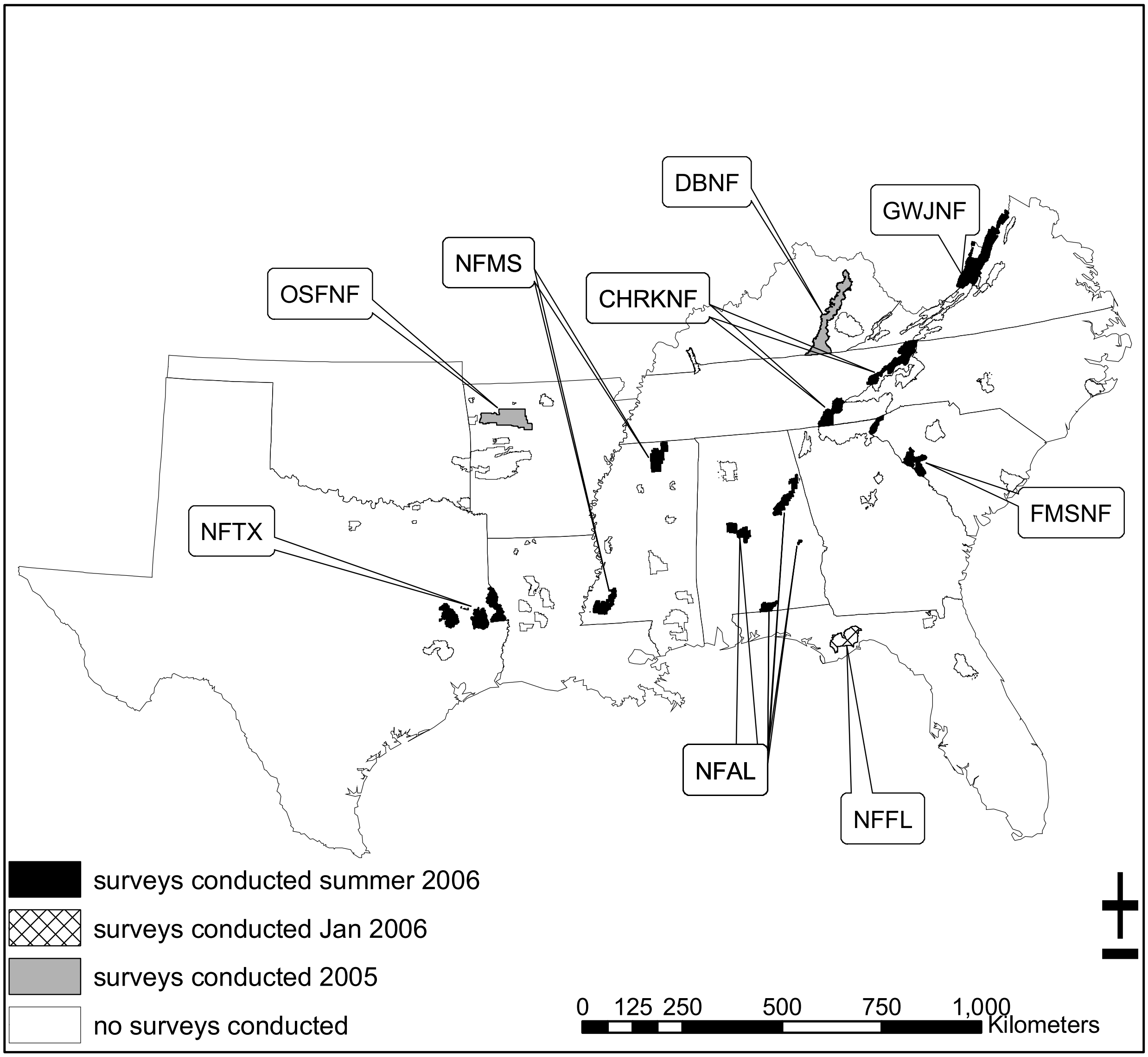

Figure 1. National Forests managed lands in the Southern Region. Crossing assessments were conducted between May and October 2006 in areas shaded black. GWJNF= George Washington-Jefferson National Forest, CHRKNF= Cherokee National Forest, NFMS= National Forests in Mississippi, NFAL= National Forests in Alabama, NFTX= National Forests in Texas, FMSNF= Francis Marion-Sumter National Forest. Crossing assessments were conducted in 2005 for National Forests shaded in gray (Coffman et al. 2005). The GWJNF and NFAL were surveyed in 2005 and 2006.

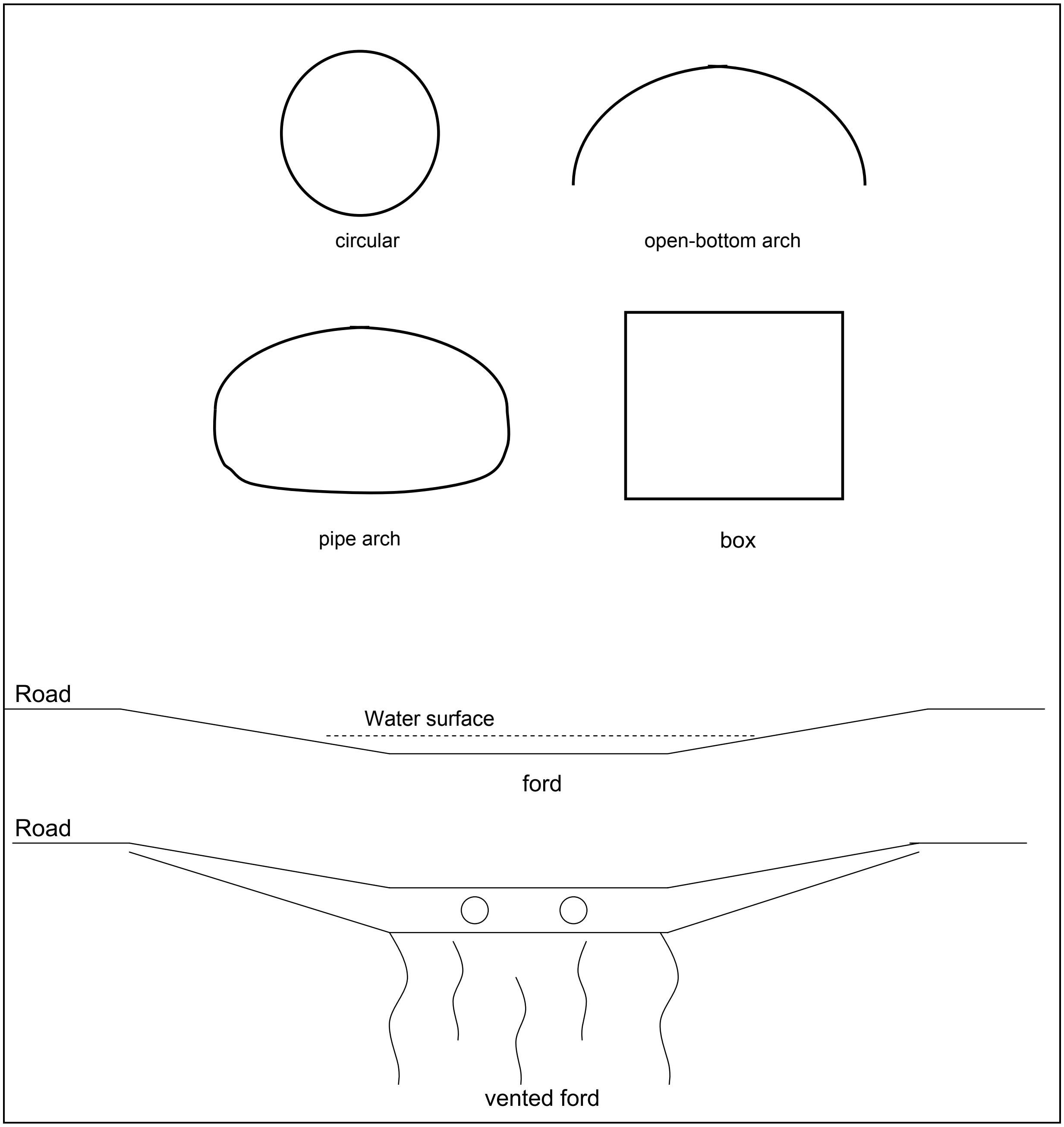

Figure 2. Common crossing shapes encountered during road-stream crossing inventories conducted in the Southern Region, summer 2006.

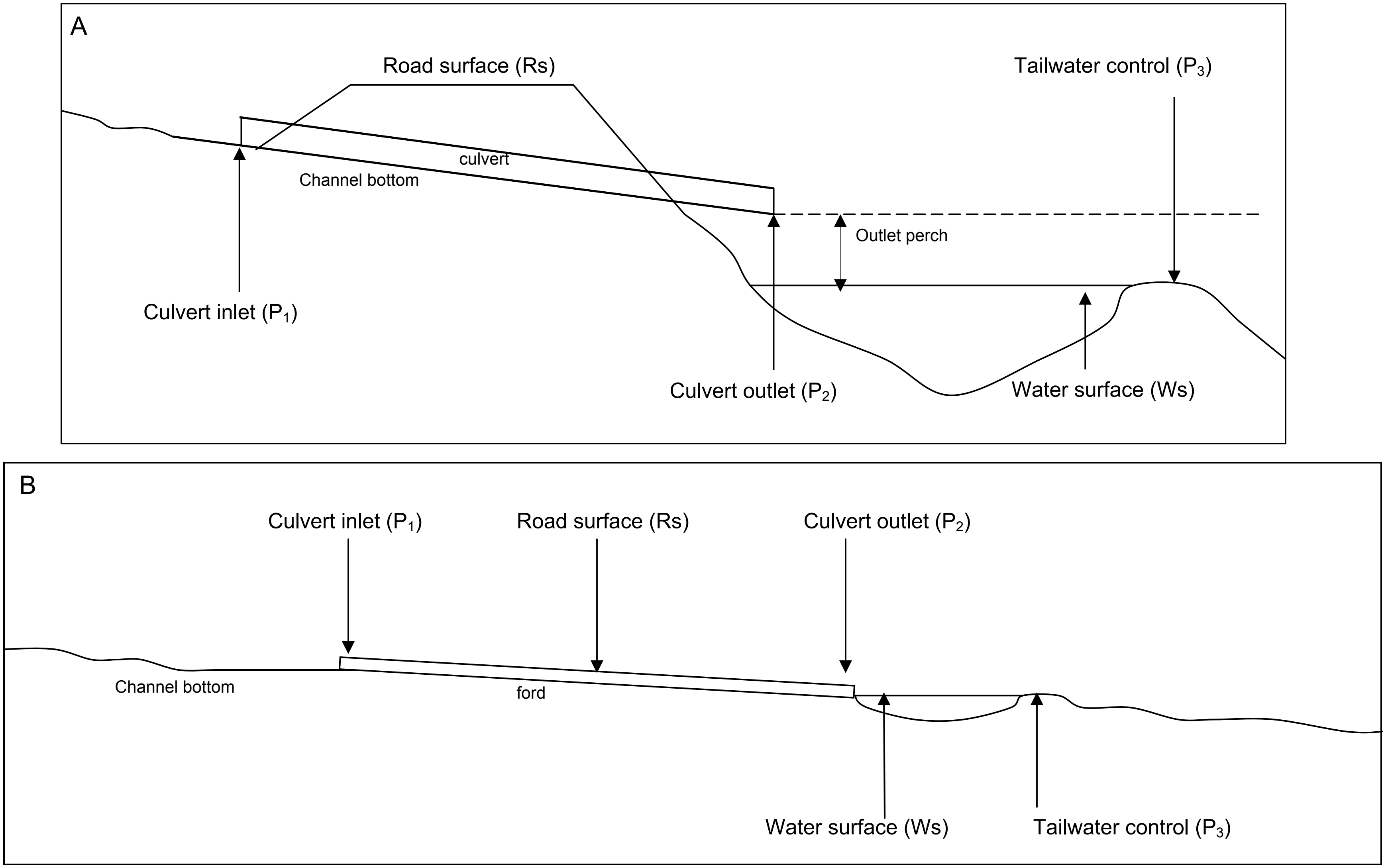

Figure 3. Survey points measured on culverts (A) and unvented fords (B) to calculate parameters used in coarse filters for upstream fish passage Adapted from Clarkin et al. 2003. Parameters are calculated as follows: Residual inlet depth= $P_3 - P_1$; Outlet drop= $P_2 - P_3$; Outlet perch= $P_2 - Ws$; Slope= $(P_{1elev} - P_{2elev}) / (P_{1dist} - P_{2dist}) * 100$; Slope x Length= $[(P_{1elev} - P_{2elev}) / (P_{1dist} - P_{2dist}) * 100] * (P_{1dist} - P_{2dist})$.

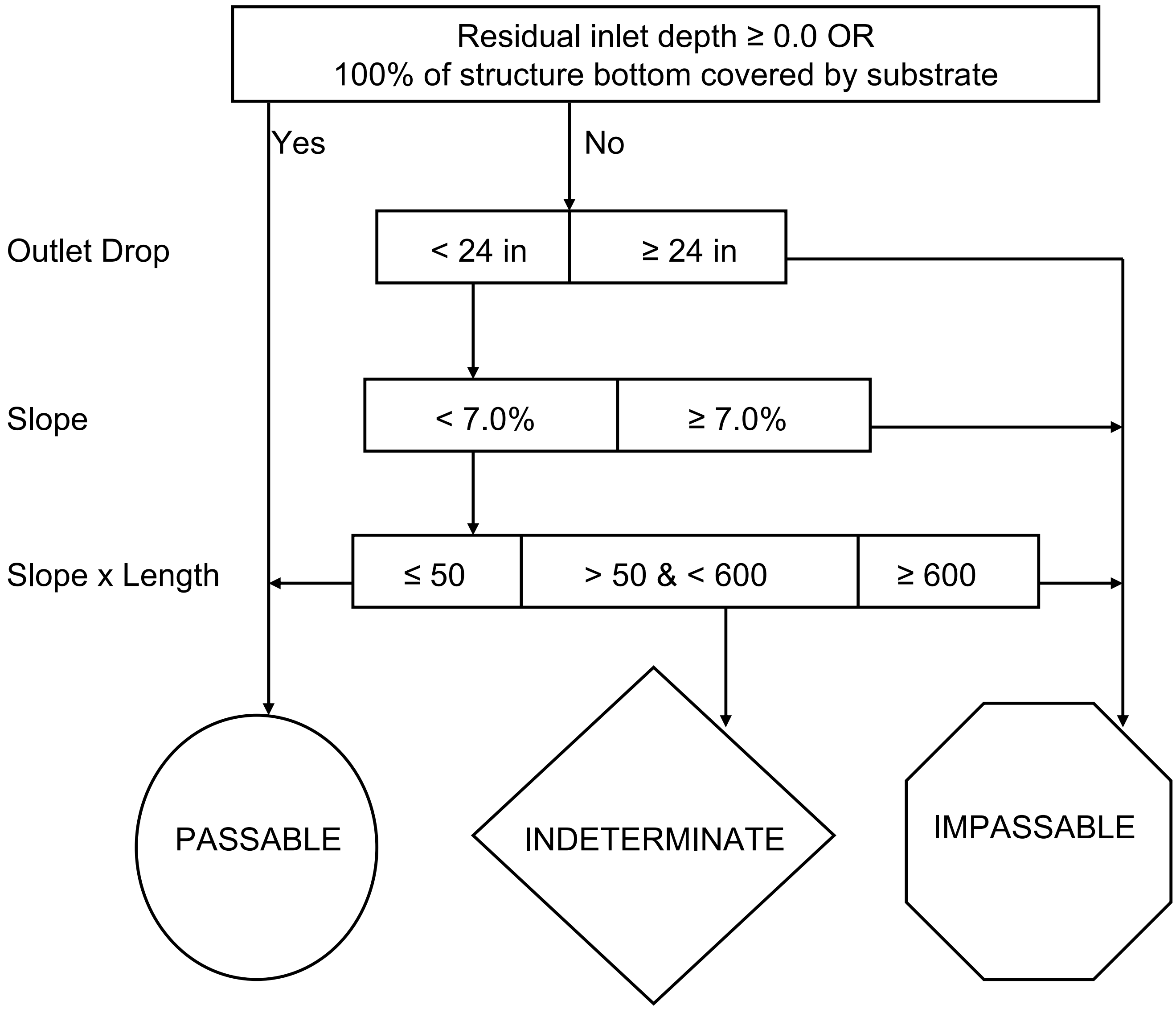

Figure 4. Coarse Filter A: Predictive model used to determine upstream passage for fish with swimming and leaping abilities similar to adult trout. A residual inlet depth ≥ 0.0 (Figure 2) indicates structure is fully backwatered. An outlet perch of 14 in is used when outlet drop could not be calculated (Coffman 2005).

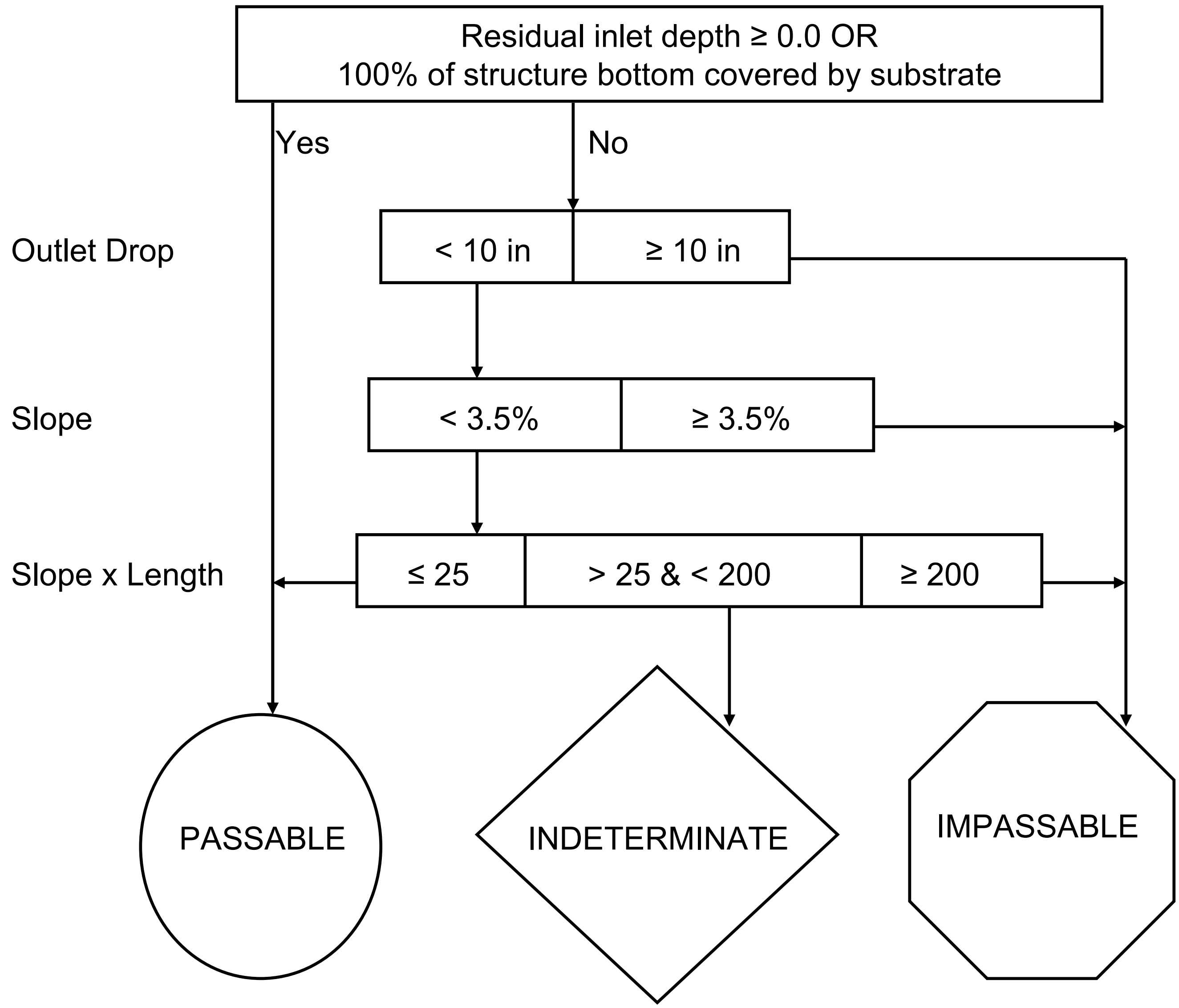

Figure 5. Coarse Filter B: Predictive model used to determine upstream passage for fish with swimming and leaping abilities similar to minnows and juvenile trout. A residual inlet depth ≥ 0.0 (Figure 2) indicates pipe is fully backwatered. An outlet perch of 5 in is used when outlet drop could not be calculated (Coffman 2005).

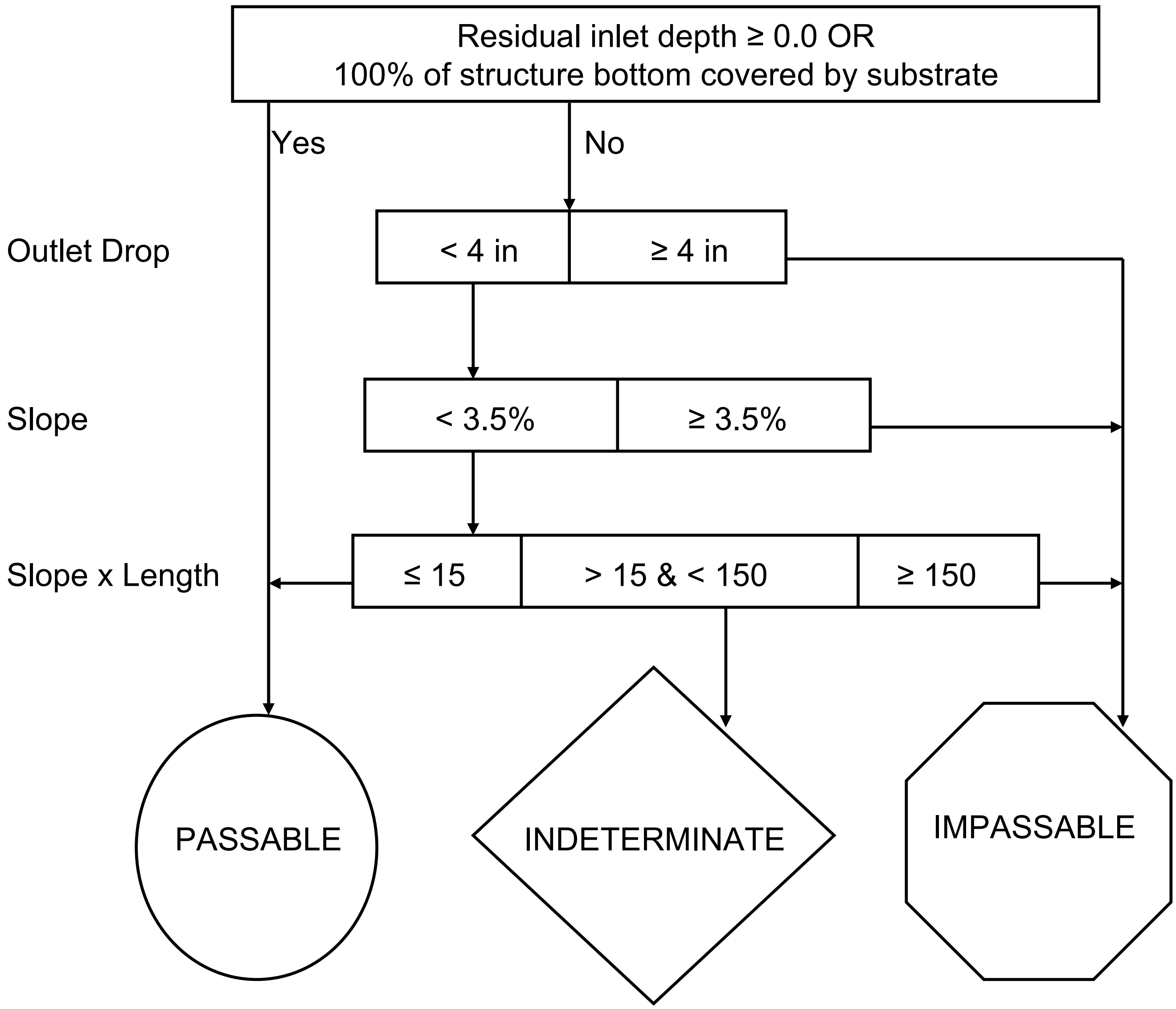

Figure 6. Coarse Filter C: Predictive model used to determine upstream passage for fish with swimming and leaping abilities similar to darters and sculpins. A residual inlet depth ≥ 0.0 (Figure 2) indicates pipe is fully backwatered. An outlet perch of 2 in is used when outlet drop could not be calculated (Coffman 2005).

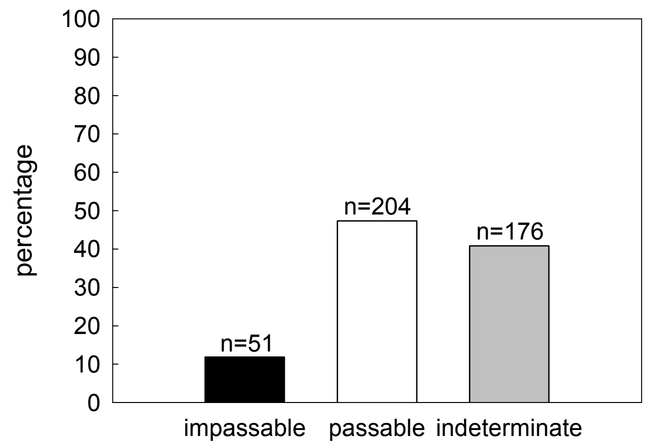

Figure 7. Percentage of crossings classified as impassable, passable, or indeterminate by Filter A; Southern Region (all Forests combined), summer 2006 (N=431).

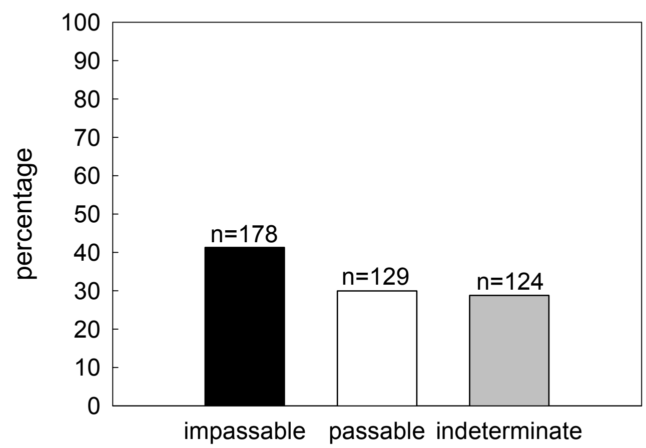

Figure 8. Percentage of crossings classified as impassable, passable, or indeterminate by Filter B; Southern Region (all Forests combined), summer 2006 (N=431).

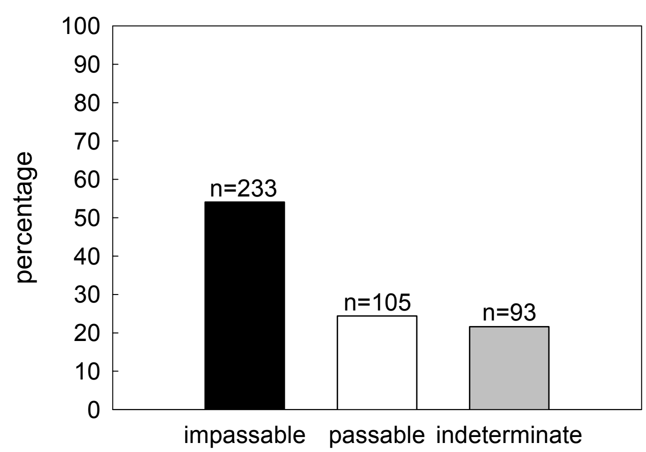

Figure 9. Percentage of crossings classified as impassable, passable, or indeterminate by Filter C; Southern Region (all Forests combined), summer 2006 (N=431).

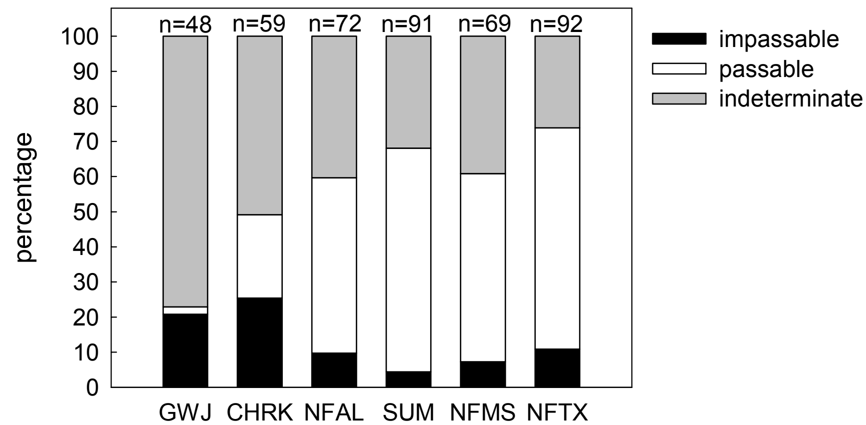

Figure 10. Percentage of crossings classified as impassable, passable, or indeterminate by Filter A; Southern Region (by Forest) summer 2006. GWJ=George Washington-Jefferson, CHRK=Cherokee, NFAL=National Forests in Alabama, SUM=Sumter, NFMS=National Forests in Mississippi, and NFTX=National Forests in Texas.

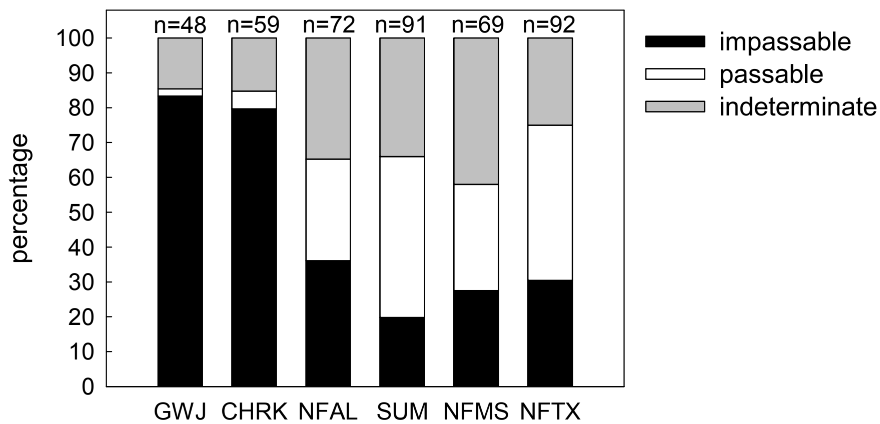

Figure 11. Percentage of crossings classified as impassable, passable, or indeterminate by Filter B; Southern Region (by Forest) summer 2006. GWJ=George Washington-Jefferson, CHRK=Cherokee, NFAL=National Forests in Alabama, SUM=Sumter, NFMS=National Forests in Mississippi, and NFTX=National Forests in Texas.

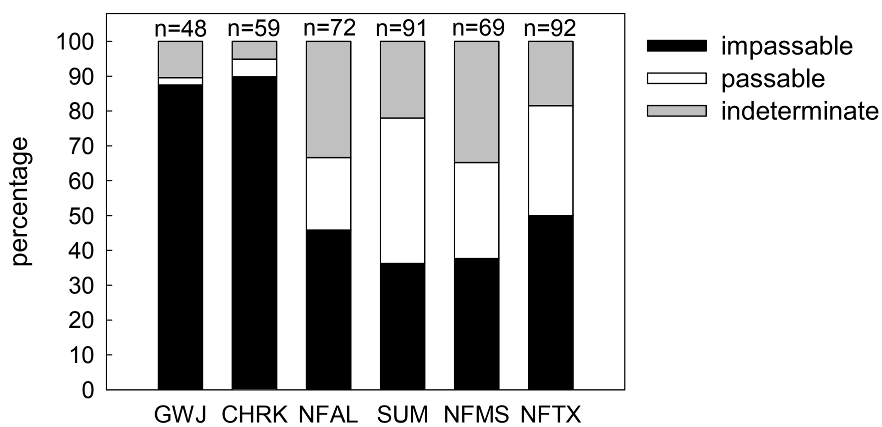

Figure 12. Percentage of crossings classified as impassable, passable, or indeterminate by Filter C; Southern Region (by Forest) summer 2006. GWJ=George Washington-Jefferson, CHRK=Cherokee, NFAL=National Forests in Alabama, SUM=Sumter, NFMS=National Forests in Mississippi, and NFTX=National Forests in Texas.

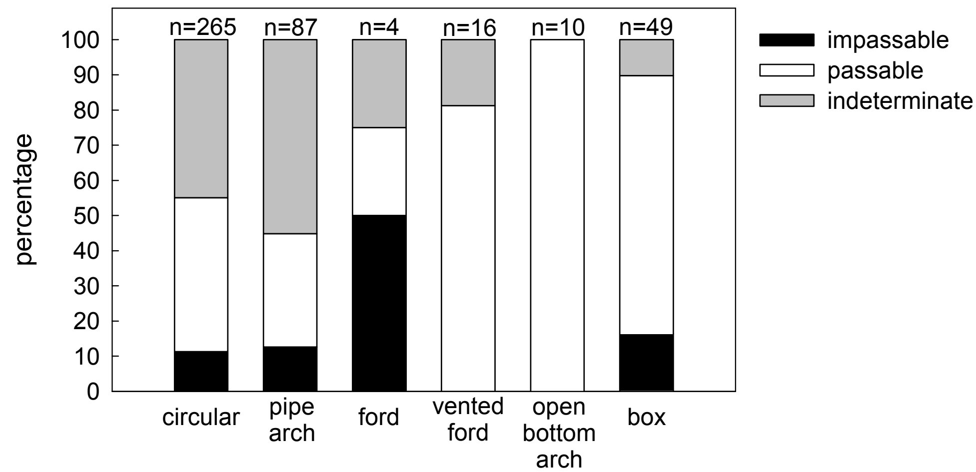

Figure 13. Percentage of each crossing type classified as impassable, passable, or indeterminate by Filter A; Southern Region (all Forests combined) summer 2006.

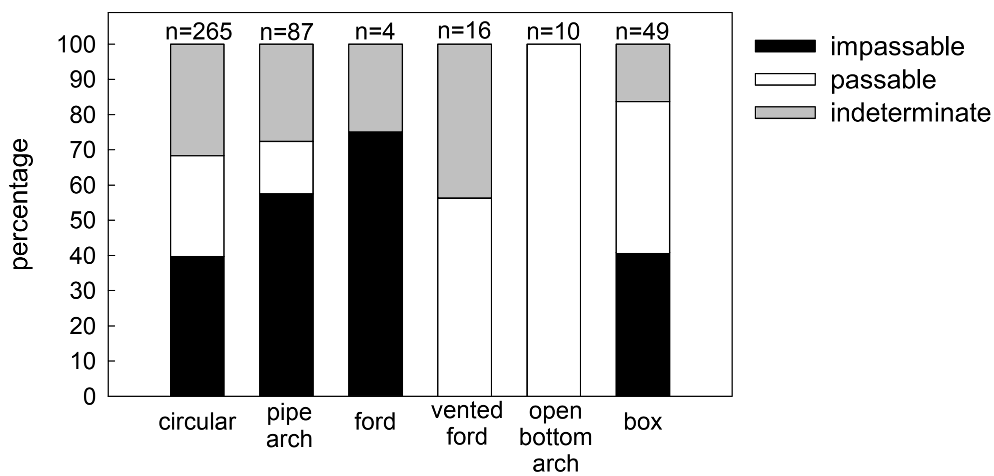

Figure 14. Percentage of each crossing type classified as impassable, passable, or indeterminate by Filter B; Southern Region (all Forests combined) summer 2006.

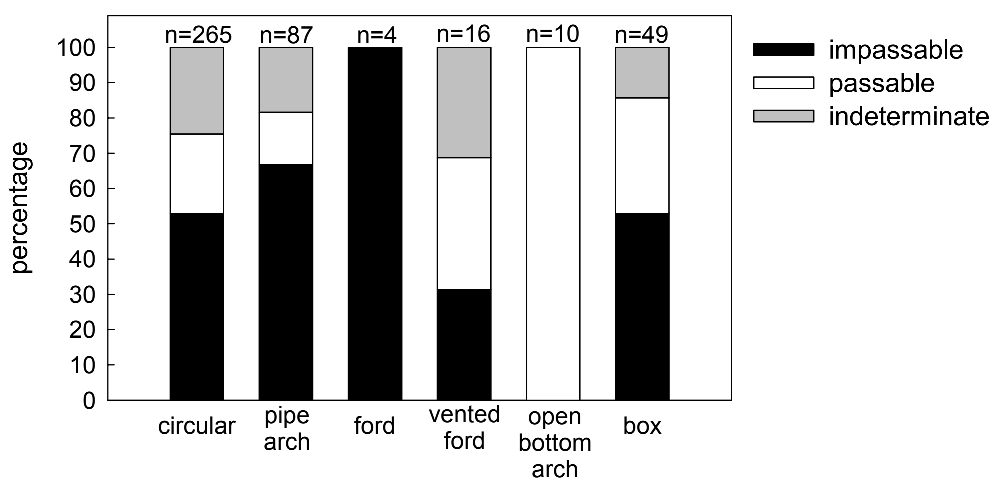

Figure 15. Percentage of each crossing type classified as impassable, passable, or indeterminate by Filter C; Southern Region (all Forests combined) summer 2006.

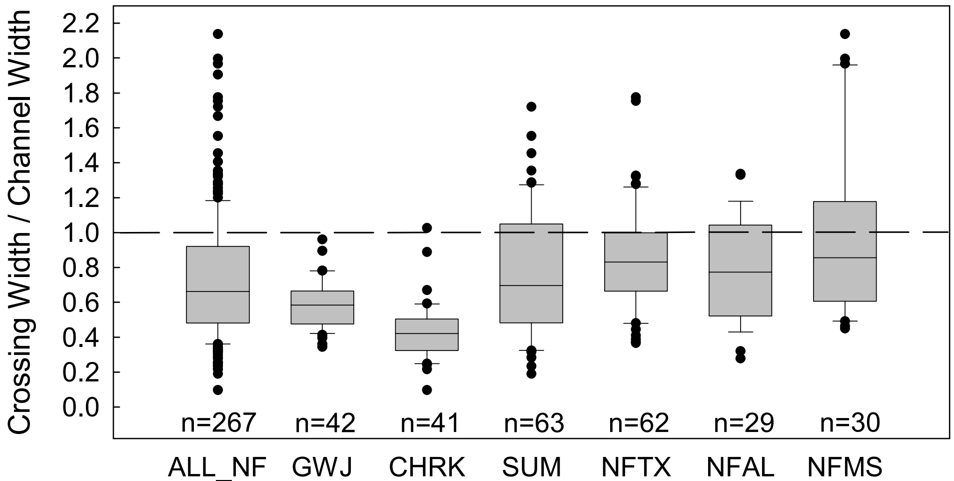

Figure 16. Crossing width to bankfull channel width ratio for crossings surveyed in summer 2006 (excluding fords, vented fords, and multiple structure crossings). A ratio of 1.0 (dashed line) or greater indicates the crossing structure opening is greater than or equal to the bankfull channel width. ALL_NF=Forests combined, GWJ=George Washington-Jefferson, CHRK=Cherokee, NFAL=National Forests in Alabama, SUM=Francis Marion-Sumter, NFMS=National Forests in Mississippi, and NFTX=National Forests in Texas. The top and bottom of the boxes represent the 25th and 75th percentiles, the bar in the center of each box represents the median, whiskers represent the 10th and 90th percentiles, and closed circles represent the entire range of the data.

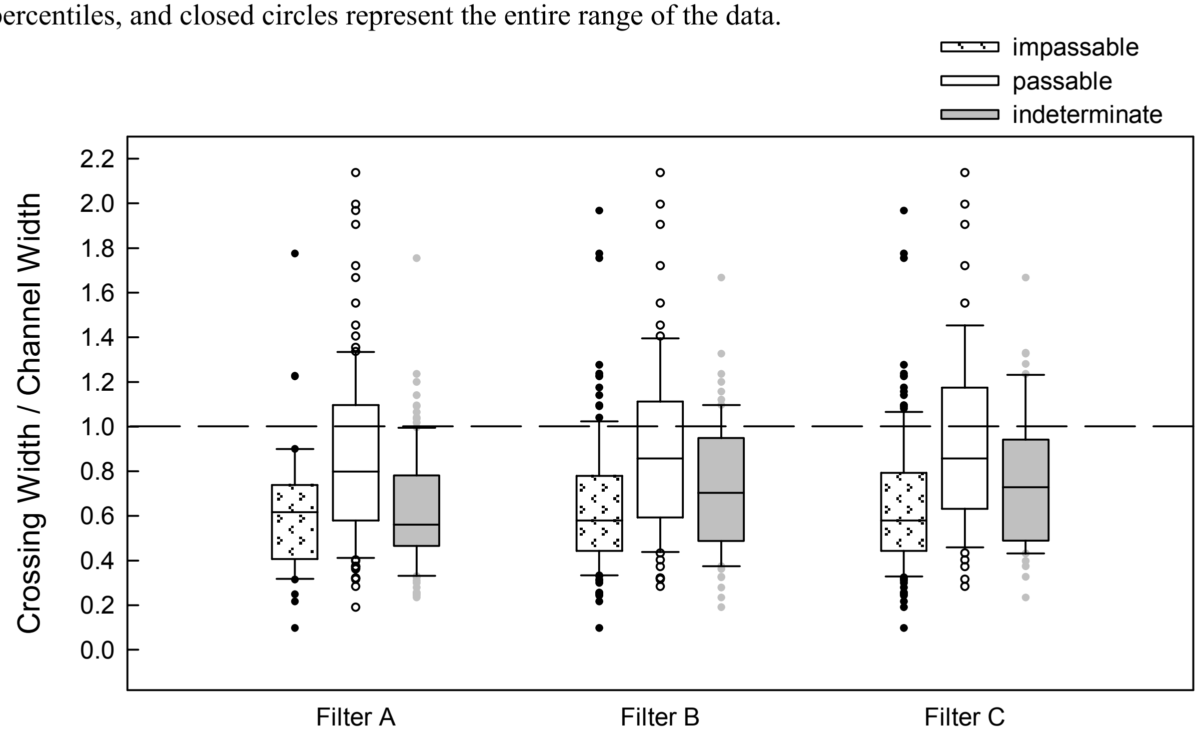

Figure 17. Crossing width to bankfull channel width ratio for crossings classified as impassable, passable, or indeterminate (all Forests combined) in summer 2006 (excluding fords, vented fords, and multiple structure crossings) A ratio of 1.0 (dashed line) or greater indicates the crossing structure opening is greater than or equal to the bankfull channel width. The top and bottom of the boxes represent the 25th and 75th percentiles, the bar in the center of each box represents the median, whiskers represent the 10th and 90th percentiles, and closed circles represent the entire range of the data.

Table 1. Number of crossings documented (Total crossings documented) and number not surveyed (Crossings not surveyed) on Forests visited in summer 2006. Reasons for not surveying a documented site include: no suitable fish habitat upstream of crossing (NH); no access to site due to closed roads or private gates (NA); crossing was a natural ford (NF); crossing was a bridge (BR).

Forest	Total crossings documented	Crossings not surveyed (n, [%])				
		NH	NA	NF	BR	Total not surveyed
GWJNF	66	14 (78)	0 (0)	4 (22)	0 (0)	18 (27)
CHRKNF	122	42 (67)	0 (0)	16 (25)	5 (8)	63 (52)
NFAL	103	14 (45)	0 (0)	0 (0)	17 (55)	31 (30)
FMSNF	120	18 (62)	7 (24)	4 (14)	0 (0)	29 (24)
NFMS	96	14 (52)	1 (4)	11 (40)	1 (4)	27 (28)
NFTX	126	31 (91)	1 (3)	1 (3)	1 (3)	34 (27)
Total	633	133 (66)	9 (4)	36 (18)	24 (12)	202 (32)

Table 2. Number of crossings surveyed (Total surveyed) with coarse filter results for Forests visited in summer 2006. Coarse filter results are presented for Filter A, Filter B, and Filter C (see filter descriptions, Fig 3 – 5).

Forest	Total surveyed	Coarse filter results								
		Impassable (n, [%])			Passable (n, [%])			Indeterminate (n, [%])		
		A	B	C	A	B	C	A	B	C
GWJNF	48	10 (21)	40 (83)	42 (88)	1 (2)	1 (2)	1 (2)	37 (77)	7 (15)	5 (10)
CHRKNF	59	15 (25)	47 (80)	53 (90)	14 (24)	3 (5)	3 (5)	30 (51)	9 (15)	3 (5)
NFAL	72	7 (10)	26 (36)	33 (46)	36 (50)	21 (29)	15 (21)	29 (40)	25 (35)	24 (33)
FMSNF	91	4 (4)	18 (20)	33 (36)	58 (64)	42 (46)	38 (42)	29 (32)	31 (34)	20 (22)
NFMS	69	5 (7)	19 (28)	26 (38)	37 (54)	21 (30)	19 (27)	27 (39)	29 (42)	24 (35)
NFTX	92	10 (11)	28 (30)	46 (50)	58 (63)	41 (45)	29 (32)	24 (26)	23 (25)	17 (18)
Total	431	51 (12)	178 (41)	233 (54)	204 (47)	129 (30)	105 (24)	176 (41)	124 (29)	93 (22)

Table 3. Number of crossings (percentage in parentheses) classified as impassable due to excessive outlet drop, excessive slope, or excessive slope x length values for each coarse filter; Southern Region (all Forests combined), summer 2006. Note: a crossing must pass for outlet drop to be considered for slope and it must pass for outlet drop and slope to be considered for slope*length.

	Filter A	Filter B	Filter C
Outlet drop	36 (69)	147 (82)	215 (91)
Slope	15 (31)	31 (18)	17 (8)
Slope*Length	0 (0)	0 (0)	1 (1)
Total	51 (12)	178 (41)	233 (54)

Table 4. Number of each crossing type (percentage in parentheses) classified as impassable, passable, or indeterminate for each coarse filter; Southern Region (all Forests combined) during summer 2006.

Classification	crossing type	Filter A	Filter B	Filter C
Impassable	circular	30 (11)	105 (39)	140 (53)
	pipe arch	11 (13)	50 (57)	58 (67)
	vented ford	0 (0)	0 (0)	5 (31)
	ford	2 (50)	3 (75)	4 (100)
	open bottom arch	0 (0)	0 (0)	0 (0)
	box	8 (16)	20 (41)	26 (53)
Passable	circular	116 (43)	76 (29)	60 (23)
	pipe arch	28 (32)	13 (15)	13 (15)
	vented ford	13 (81)	9 (56)	6 (38)
	ford	1 (25)	0 (0)	0 (0)
	open bottom arch	10 (100)	10 (100)	10 (100)
	box	36 (74)	21 (43)	16 (33)
Indeterminate	circular	119 (45)	84 (32)	65 (24)
	pipe arch	48 (55)	24 (28)	16 (18)
	vented ford	3 (19)	7 (44)	5 (31)
	ford	1 (25)	1 (25)	0 (0)
	open bottom arch	0 (0)	0 (0)	0 (0)
	box	5 (10)	8 (16)	7 (14)

Table 5. Mean Crossing width to channel width ratios (excluding fords, vented fords, and multiple structure crossings) for impassable, passable, and indeterminate classifications by each filter (Figures 4-6). Letters denote significant differences (ANOVA; P<0.05)

Filter A	$\overline{x}$	SD	n
Impassable	0.62 z	0.30	41
Passable	0.87 zy	0.40	112
Indeterminate	0.63 y	0.25	114
Filter B			
Impassable	0.64 x	0.30	126
Passable	0.90 x	0.41	71
Indeterminate	0.73 x	0.29	70
Filter C			
Impassable	0.65 wv	0.30	158
Passable	0.93 w	0.41	59
Indeterminate	0.77 v	0.30	50

Appendix A: Results for the George Washington-Jefferson National Forest

We completed surveys at 48 (73%) of 66 documented crossing structures on the Warm Springs and James River Ranger Districts in 2006 (Figure A1, Tables A1 and A2). Filter A (strong swimmers and leapers) classified 21% (n=10) of crossings as impassable, 2% (n=1) as passable, and 77% (n=37) as indeterminate (Figure A2, Table A2). Filter B (moderate swimmers and leapers) classified 83% (n=40) of crossings as impassable, 2% (n=1) as passable, and 15% (n=7) as indeterminate (Figure A3, Table A2). Filter C (weak swimmers and leapers) classified 88% (n=42) of crossings as impassable, 2% (n=1) as passable, and 10% (n=5) as indeterminate (Figure A4, Table A2). Characteristics and filter classifications for each crossing are presented in Tables A3-A5.

All of the crossings surveyed were either circular culverts (29%, n=14) or pipe arches (71%, n=34), while no open-bottom arches, fords, vented fords, or box culverts were surveyed. Filter A classified 36% of circular culverts and 15% of pipe arch crossings as impassable (Figure A5). Filter B classified 86% of circular culverts and 82% of pipe arch crossings as impassable (Figure A6). Filter C classified 93% of circular culverts and 85% of pipe arch crossings as impassable (Figure A7). The mean crossing width to channel width ratio for surveyed crossings (excluding fords and multiple structure crossings) was 0.59 ± 0.14 (mean ±SD) (n=42), and no crossings were greater than or equal to the mean bankfull channel width (Figure A8). The mean crossing width to channel width ratio for surveyed crossings classified impassable by Filter A was 0.58 ± 0.17 (n=10). The mean ratio for crossings classified impassable by Filter B was 0.58 ± 0.14 (n=37), and was 0.59 ± 0.15 (n=39) for Filter C (Figure A9). There were no crossings classified passable that met the requirements to calculate crossing to channel width ratios.

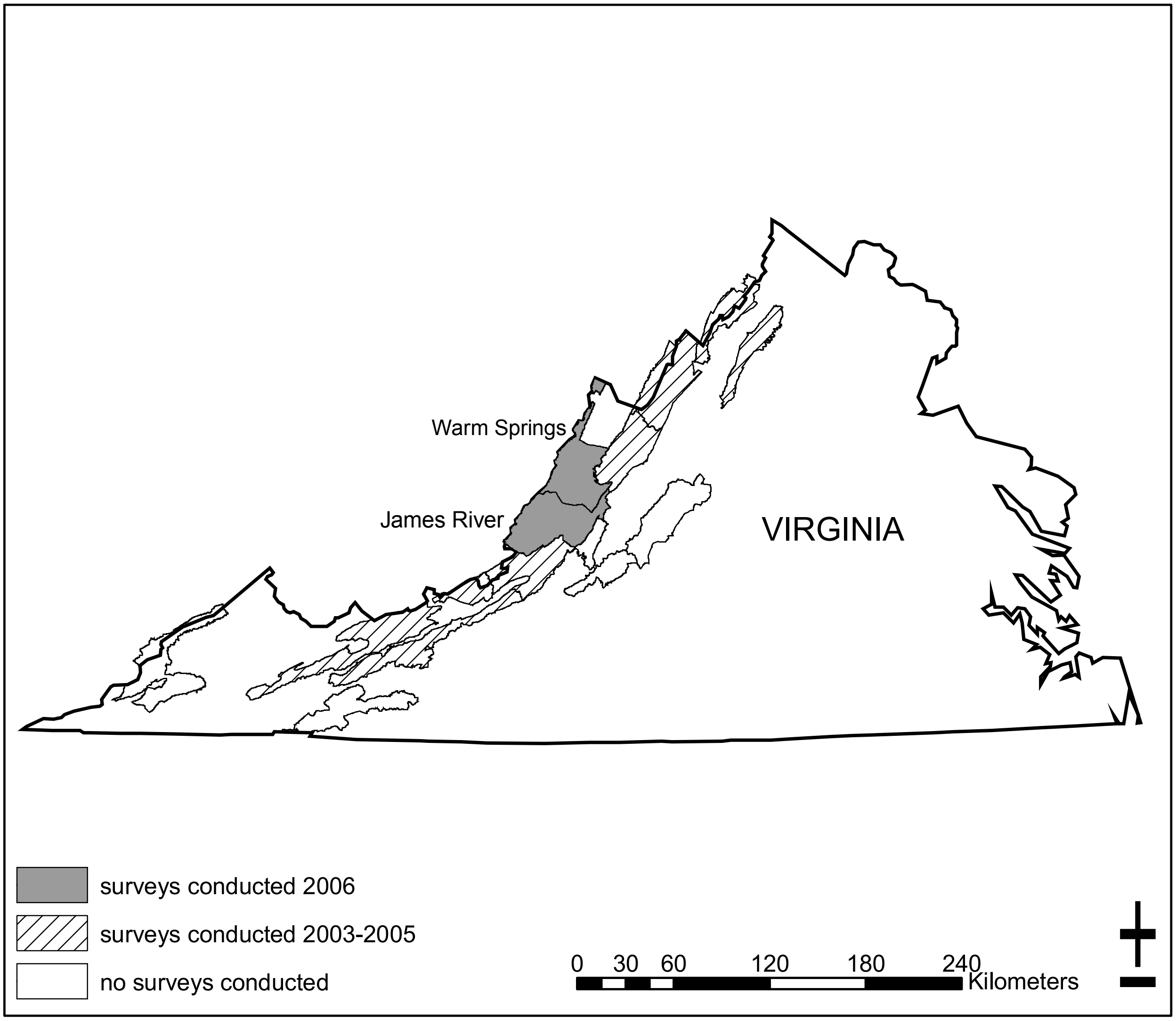

Figure A1. Ranger Districts on the George Washington-Jefferson National Forest where road-stream crossing surveys were conducted from 2003 to 2006. The results of inventories conducted by Fish and Aquatic Ecology Unit - East on Dry River and Lee Ranger Districts in 2003-2004 are presented in Coffman et al. 2007, and the results from 2005 surveys are presented in Coffman et al. 2005.

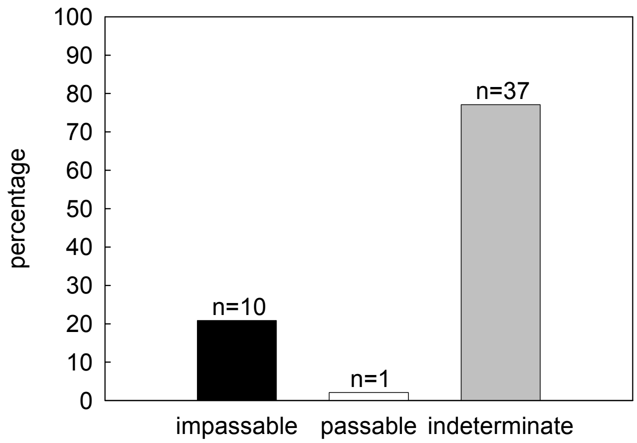

Figure A2. Percentage of crossings classified as impassable, passable, or indeterminate by Filter A; George Washington-Jefferson National Forest, summer 2006 (n=48).

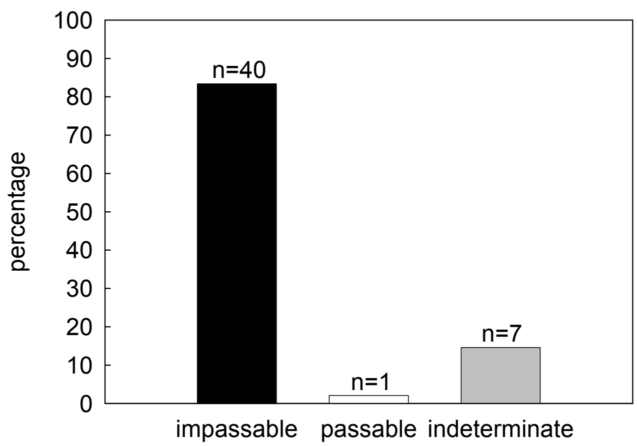

Figure A3. Percentage of crossings classified as impassable, passable, or indeterminate by Filter B; George Washington-Jefferson National Forest, summer 2006 (n=48).

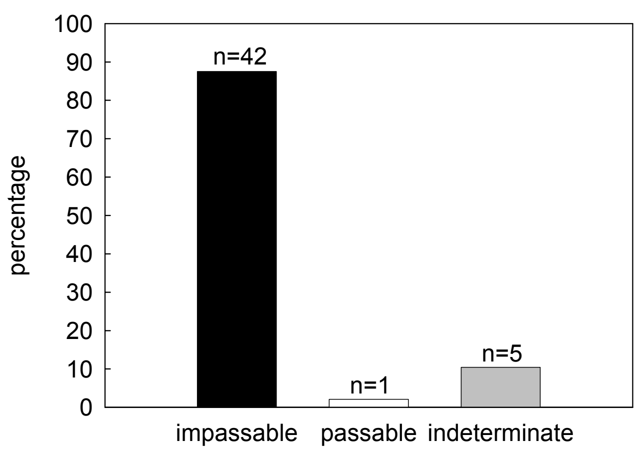

Figure A4. Percentage of crossings classified as impassable, passable, or indeterminate by Filter C; George Washington-Jefferson National Forest, summer 2006 (n=48).

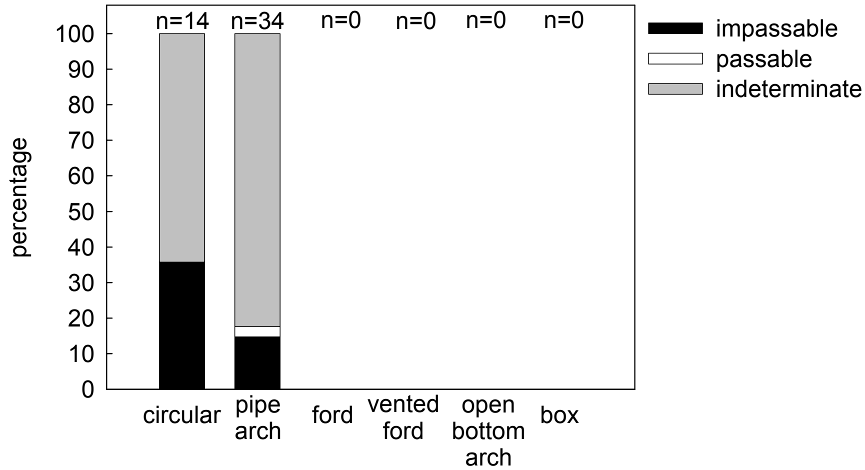

Figure A5. Percentage of each crossing type classified as impassable, passable, or indeterminate by Filter A; George Washington-Jefferson National Forest, summer 2006 (N=48).

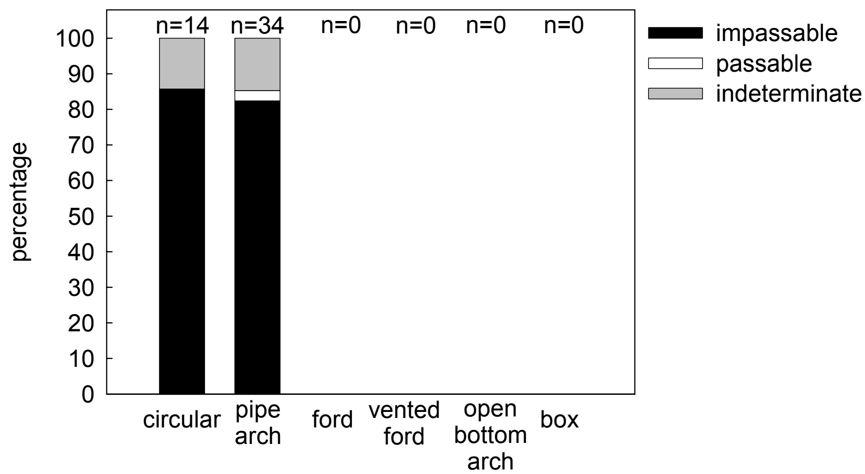

Figure A6. Percentage of each crossing type classified as impassable, passable, or indeterminate by Filter B; George Washington-Jefferson National Forest, summer 2006 (N=48).

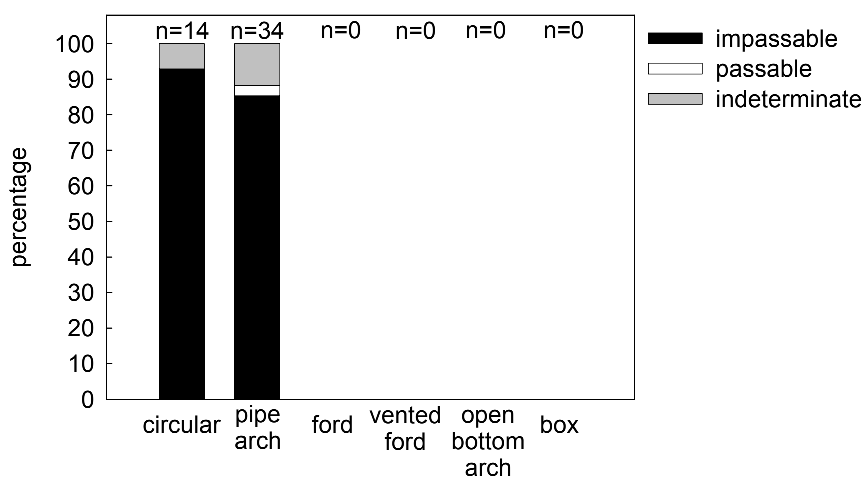

Figure A7. Percentage of each crossing type classified as impassable, passable, or indeterminate by Filter C; George Washington-Jefferson National Forest, summer 2006 (N=48).

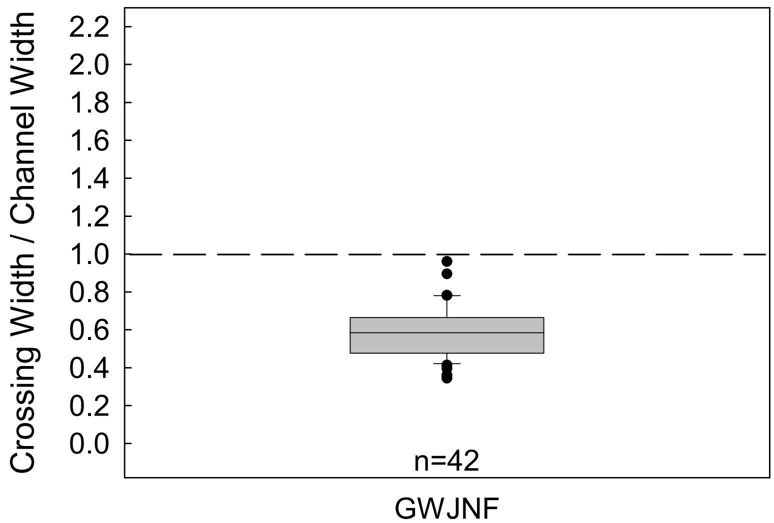

Figure A8. Crossing width to bankfull channel width ratio for crossings surveyed in summer 2006 on the George Washington-Jefferson National Forest (excluding fords, vented fords, and multiple structure crossings). A ratio of 1.0 (dashed line) or greater indicates the crossing structure opening is greater than or equal to the bankfull channel width. The top and bottom of the boxes represent the 25th and 75th percentiles, the bar in the center of each box represents the median, whiskers represent the 10th and 90th percentiles, and closed circles represent the entire range of the data.

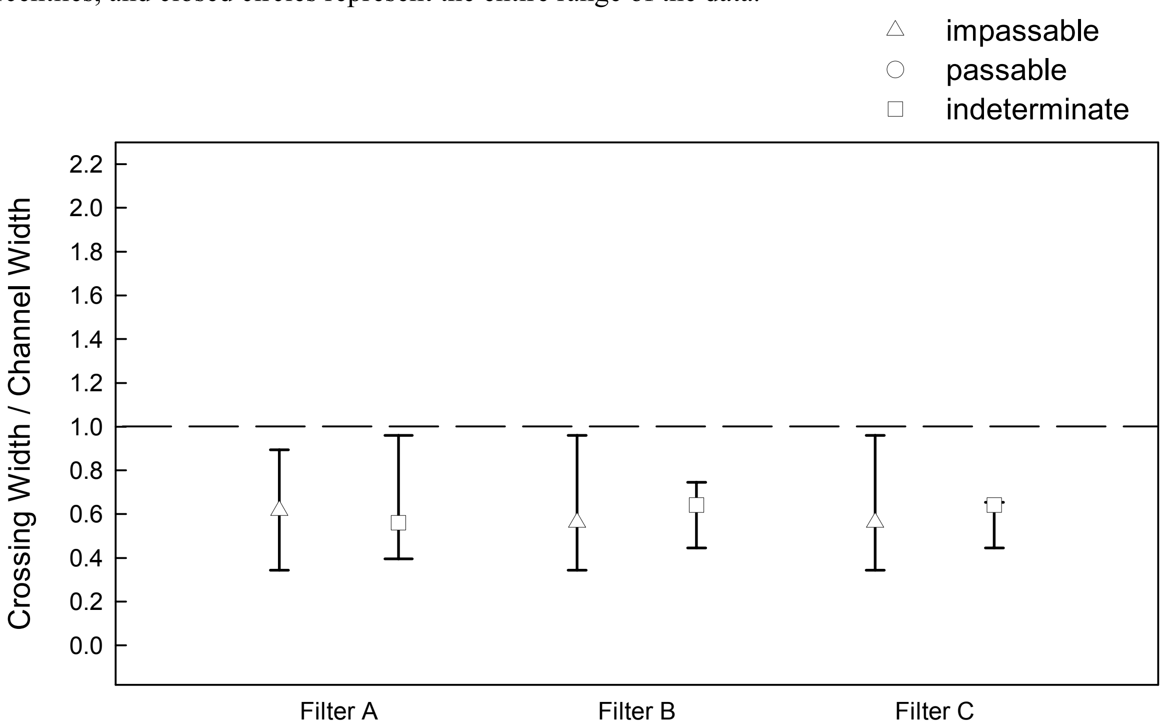

Figure A9. Crossing width to bankfull channel width ratio for crossings classified as impassable, passable, or indeterminate in summer 2006 on the George Washington-Jefferson National Forest (excluding fords, vented fords, and multiple structure crossings). A ratio of 1.0 (dashed line) or greater indicates the crossing structure opening is greater than or equal to the bankfull channel width. The symbol inside each set of whiskers represents the median, and the top and bottom of the whiskers represent the maximum and minimum values.

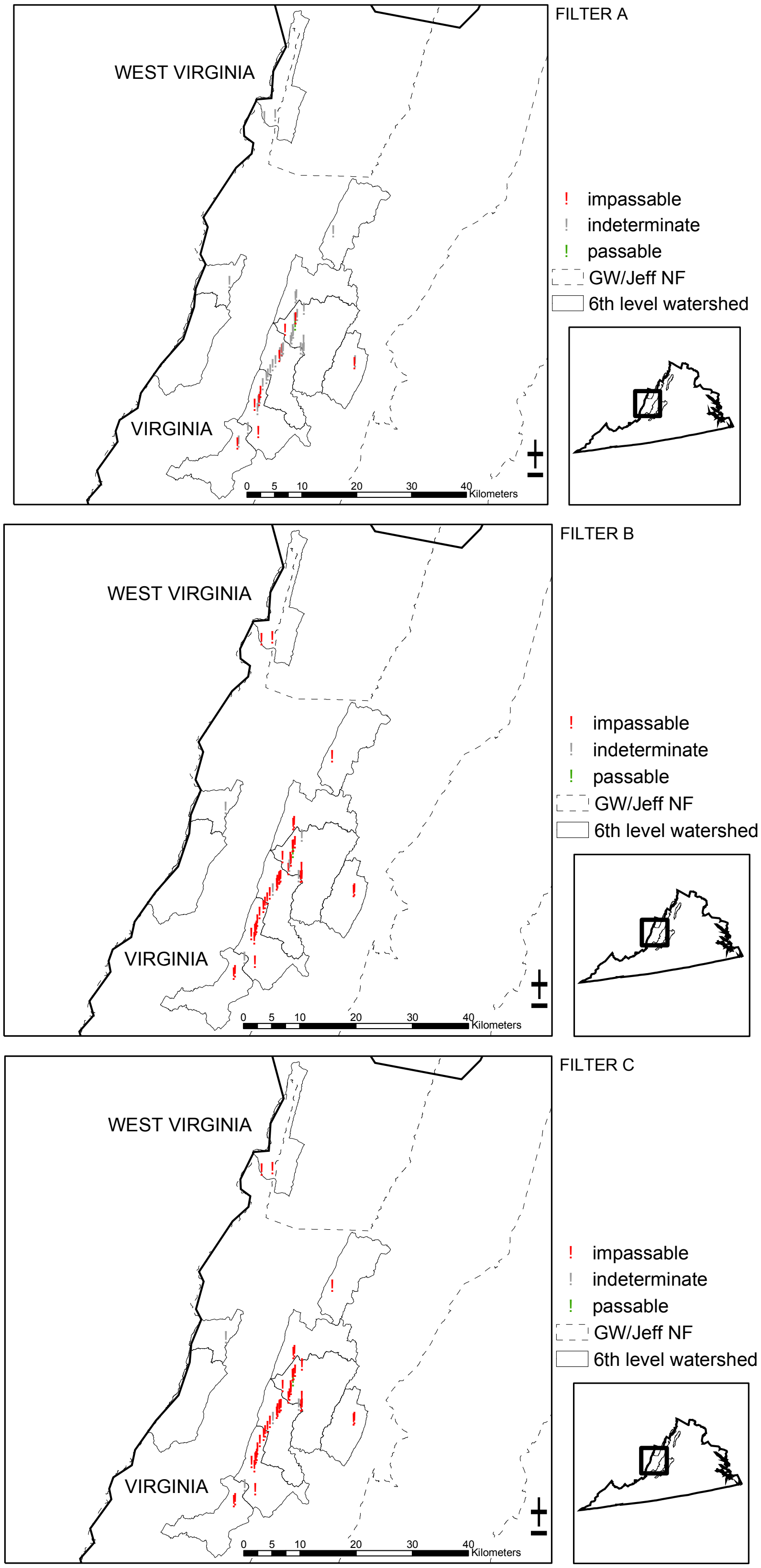

Figure A10. Location of crossings classified for fish passage by coarse filters A, B, and C within 6th level watersheds on the George Washington-Jefferson National Forest, summer 2006.

Table A1. Number of crossings documented (Total crossings documented) and not surveyed (Crossings not surveyed) on the George Washington-Jefferson National Forests in summer 2006. Reasons for not surveying a documented site include: no suitable fish habitat upstream of crossing (NH); no access to site due to closed roads or private gates (NA); crossing was a natural ford (NF); crossing was a bridge (BR).

Forest	Total crossings documented	Crossings not surveyed (n, [%])				
		NH	NA	NF	BR	Total not surveyed
GWJNF	66	14 (78)	0 (0)	4 (22)	0 (0)	18 (27)

Table A2. Number of crossings surveyed (Total surveyed) with coarse filter results for the George Washington-Jefferson National Forests in summer 2006. Coarse filter results are presented for Filter A, Filter B, and Filter C (see filter descriptions, Fig 3 – 5).

Forest	Total surveyed	Coarse filter results								
		Impassable (n, [%])			Passable (n, [%])			Indeterminate (n, [%])		
		A	B	C	A	B	C	A	B	C
GWJNF	48	10 (21)	40 (83)	42 (88)	1 (2)	1 (2)	1 (2)	37 (77)	7 (15)	5 (10)

Table A3. Location of crossings surveyed on the George Washington-Jefferson National Forest during the summer of 2006. Site ID consists of the Forest abbreviation (GWJ), road the crossing is on (258), and the distance (miles) from the junction road (0.2).

Site ID	# of Pipes	District	Junction Road	Stream Name	Quad	6th Level Watershed
GWJ258-0.2	1	Warm Springs	600	Sheets Hollow	Mustoe	020802010201
GWJ258-3.4	2	Warm Springs	600	Ruckman Draft	Paddy Knob	020802010201
GWJ226-0.1	2	Warm Springs	39	O'Roarke Draft	Mountain Grove	020802010204
GWJ125-1.2	1	James River	625	UT Pounding Mill Creek	Covington	020802010504
GWJ125-1.5	1	James River	625	UT Pounding Mill Creek	Covington	020802010504
GWJ125-4.8	1	James River	625	Piney Branch	Covington	020802010504
GWJ125-5.0	1	Warm Springs	606	Left Prong Wilson Creek	Healing Springs	020802010506
GWJ125-5.8	1	Warm Springs	606	UT Left Prong Wilson Creek	Healing Springs	020802010506
GWJ125-6.4	1	Warm Springs	606	Lick Block Run	Healing Springs	020802010506
GWJ125-7.2	1	Warm Springs	606	UT Left Prong Wilson Creek	Healing Springs	020802010506
GWJ125-7.4	1	Warm Springs	606	UT Left Prong Wilson Creek	Healing Springs	020802010506
GWJ125-7.6	1	Warm Springs	606	UT Left Prong Wilson Creek	Healing Springs	020802010506
GWJ125-7.9	1	Warm Springs	606	UT Left Prong Wilson Creek	Healing Springs	020802010506
GWJ125-8.1	1	Warm Springs	606	UT Left Prong Wilson Creek	Healing Springs	020802010506
GWJ125-8.2	1	Warm Springs	606	UT Left Prong Wilson Creek	Healing Springs	020802010506
GWJ125-8.4	1	Warm Springs	606	UT Left Prong Wilson Creek	Healing Springs	020802010506
GWJ361A-0.1	1	Warm Springs	361	Dry Run	Healing Springs	020802010506
GWJ125-0.2	1	James River	606	UT Piney Branch	Covington	020802010507
GWJ125-1.0	1	James River	606	UT Smith Creek	Clifton Forge	020802010507
GWJ125-1.1	1	James River	606	UT Smith Creek	Clifton Forge	020802010507
GWJ125-1.4	1	James River	606	UT Smith Creek	Healing Springs	020802010507
GWJ125-2.2	1	James River	606	UT Smith Creek	Healing Springs	020802010507
GWJ125-3.2	1	Warm Springs	606	UT Smith Creek	Healing Springs	020802010507
GWJ125-4.0	1	Warm Springs	606	UT Smith Creek	Healing Springs	020802010507
GWJ125-4.4	1	Warm Springs	606	Smith Creek	Healing Springs	020802010507

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Site ID	# of Pipes	District	Junction Road	Stream Name	Quad	6th Level Watershed
GWJ125-5.9	1	James River	625	UT Piney Branch	Clifton Forge	020802010507
GWJ337-3.5	1	James River	606	UT Jackson River	Covington	020802010507
GWJ1144-2.0	1	Warm Springs	624	UT Wide Draft Hollow	Bath Alum	020802010701
GWJ364-1.4	1	Warm Springs	39	Barney Run	Warm Springs	020802010703
GWJ364-1.6	1	Warm Springs	39	UT Mare Run	Warm Springs	020802010703
GWJ1901-2.9	1	Warm Springs	194	Porters Mill Creek	Healing Springs	020802010801
GWJ194-1.1	1	Warm Springs	629	Slim Ridge Branch	Healing Springs	020802010801
GWJ194-1.7	1	Warm Springs	629	UT Porters Mill Creek	Healing Springs	020802010801
GWJ194-2.7	1	Warm Springs	629	UT Porters Mill Creek	Healing Springs	020802010801
GWJ194-3.0	1	Warm Springs	629	Porters Mill Creek	Healing Springs	020802010801
GWJ194-3.9	2	Warm Springs	629	Little Wilson Creek	Healing Springs	020802010801
GWJ194-5.0	1	Warm Springs	629	Stouts Creek	Healing Springs	020802010801
GWJ194-5.1	1	Warm Springs	629	UT Stouts Creek	Healing Springs	020802010801
GWJ194-5.7	1	Warm Springs	629	UT Stouts Creek	Healing Springs	020802010801
GWJ194-7.4	1	Warm Springs	629	UT Limekiln Hollow	Bath Alum	020802010801
GWJ361-0.45	1	Warm Springs	629	Gillam Run	Healing Springs	020802010801
GWJ361-1.7	1	Warm Springs	629	UT Gillam Run	Healing Springs	020802010801
GWJ361-1.9	1	Warm Springs	629	Gillam Run	Healing Springs	020802010801
GWJ129-2.9	1	Warm Springs	633	UT South Fork	Nimrod Hall	020802010802
GWJ129-3.1	1	Warm Springs	633	UT South Fork	Nimrod Hall	020802010802

Table A4. Coarse filter A, B, and C, classifications for crossings surveyed on the George Washington-Jefferson National Forest, summer 2006.

Site ID	Pipe #	Filter A	Filter B	Filter C
GWJ258-0.2	1	indeterminate	impassable	impassable
GWJ258-3.4	1	indeterminate	impassable	impassable
GWJ258-3.4	2	indeterminate	impassable	impassable
GWJ226-0.1	1	indeterminate	indeterminate	indeterminate
GWJ226-0.1	2	indeterminate	impassable	impassable
GWJ125-1.2	1	impassable	impassable	impassable
GWJ125-1.5	1	indeterminate	impassable	impassable
GWJ125-4.8	1	indeterminate	indeterminate	indeterminate
GWJ125-5.0	1	indeterminate	impassable	impassable
GWJ125-5.8	1	indeterminate	impassable	impassable
GWJ125-6.4	1	indeterminate	indeterminate	indeterminate
GWJ125-7.2	1	impassable	impassable	impassable
GWJ125-7.4	1	indeterminate	impassable	impassable
GWJ125-7.6	1	indeterminate	impassable	impassable
GWJ125-7.9	1	indeterminate	impassable	impassable
GWJ125-8.1	1	impassable	impassable	impassable
GWJ125-8.2	1	indeterminate	impassable	impassable
GWJ125-8.4	1	indeterminate	impassable	impassable
GWJ361A-0.1	1	indeterminate	indeterminate	indeterminate
GWJ125-0.2	1	impassable	impassable	impassable
GWJ125-1.0	1	indeterminate	impassable	impassable
GWJ125-1.1	1	impassable	impassable	impassable
GWJ125-1.4	1	indeterminate	impassable	impassable
GWJ125-2.2	1	impassable	impassable	impassable
GWJ125-3.2	1	indeterminate	impassable	impassable
GWJ125-4.0	1	indeterminate	impassable	impassable
GWJ125-4.4	1	indeterminate	impassable	impassable
GWJ125-5.9	1	indeterminate	impassable	impassable
GWJ337-3.5	1	impassable	impassable	impassable
GWJ1144-2.0	1	indeterminate	impassable	impassable
GWJ364-1.4	1	indeterminate	impassable	impassable
GWJ364-1.6	1	indeterminate	impassable	impassable
GWJ1901-2.9	1	impassable	impassable	impassable
GWJ194-1.1	1	indeterminate	impassable	impassable
GWJ194-1.7	1	indeterminate	indeterminate	impassable
GWJ194-2.7	1	indeterminate	impassable	impassable
GWJ194-3.0	1	indeterminate	impassable	impassable
GWJ194-3.9	1	indeterminate	indeterminate	indeterminate
GWJ194-3.9	2	passable	passable	passable

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Site ID	Pipe #	Filter A	Filter B	Filter C
GWJ194-5.0	1	indeterminate	impassable	impassable
GWJ194-5.1	1	impassable	impassable	impassable
GWJ194-5.7	1	indeterminate	impassable	impassable
GWJ194-7.4	1	indeterminate	indeterminate	impassable
GWJ361-0.45	1	indeterminate	impassable	impassable
GWJ361-1.7	1	indeterminate	impassable	impassable
GWJ361-1.9	1	indeterminate	impassable	impassable
GWJ129-2.9	1	indeterminate	impassable	impassable
GWJ129-3.1	1	impassable	impassable	impassable

Table A5. Description of crossings surveyed on the George Washington-Jefferson National Forest, summer 2006. Shape abbreviations: C= circular, PA= pipe arch, OBA= open bottom arch, and F= ford. Channel width is the mean bankfull channel width. N= no natural substrate, N (discontin)= discontinuous substrate, Y= continuous natural substrate. An NA (not applicable) indicates outlet drop (no outlet pool or tailwater control) or outlet perch (stream dry) could not be calculated. Negative outlet drop or perch values indicate a submerged outlet (structure partially backwatered). Residual inlet depth values ≥ 0.0 indicate the structure is fully backwatered.

Site ID	Pipe #	Shape	Pipe Condition	Mean Channel Width (ft)	Continuous Substrate in Structure	Pipe Slope (%)	Pipe Width: Channel Width ratio	Outlet Drop (in)	Outlet Perch (in)	Residual Inlet Depth (in)	Pipe Length (ft)	Slope (%) * Length (ft)
GWJ258-0.2	1	C	poor	12.6	N (discontin)	5.30	0.40	1.68	0.96	0.00	43.4	230.0
GWJ258-3.4	1	PA	poor	16.9	N	5.45	0.41	15.36	11.88	0.00	35.6	194.0
GWJ258-3.4	2	PA	poor	16.9	N	5.08	0.41	15.96	12.84	0.00	35.4	180.0
GWJ226-0.1	1	PA	fair	10.2	N (discontin)	2.13	0.43	-2.88	0.48	0.00	24.0	51.0
GWJ226-0.1	2	PA	fair	10.2	N	3.70	0.43	-0.48	1.56	0.00	25.4	94.0
GWJ125-1.2	1	PA	fair	7.4	N (discontin)	6.88	0.45	26.34	25.14	0.00	33.0	227.0
GWJ125-1.5	1	PA	good	8.0	N	4.44	0.44	5.76	3.12	0.00	29.5	131.0
GWJ125-4.8	1	PA	good	10.9	N (discontin)	1.76	0.64	-2.77	-5.29	0.00	37.0	65.0
GWJ125-5.0	1	PA	fair	9.3	N	5.00	0.53	23.64	22.44	0.00	32.5	162.5
GWJ125-5.8	1	PA	poor	10.7	N	4.92	0.47	6.24	4.38	0.00	32.5	160.0
GWJ125-6.4	1	PA	poor	11.2	N (discontin)	3.38	0.45	-0.24	1.02	0.00	33.0	111.5
GWJ125-7.2	1	C	fair	8.7	N	7.41	0.34	16.92	5.16	0.00	35.2	261.0
GWJ125-7.4	1	C	poor	9.7	N (discontin)	5.10	0.41	12.48	11.28	0.00	34.8	177.5
GWJ125-7.6	1	PA	poor	9.8	N (discontin)	4.99	0.46	18.66	16.74	0.00	36.4	181.5
GWJ125-7.9	1	PA	good	9.8	N	4.77	0.51	10.92	9.24	0.00	40.5	193.0
GWJ125-8.1	1	C	fair	5.6	N	8.34	0.36	5.76	4.86	0.00	30.7	256.0
GWJ125-8.2	1	C	good	6.1	N	6.45	0.49	16.74	13.68	0.00	34.1	220.0
GWJ125-8.4	1	PA	fair	7.5	N	5.47	0.53	5.88	6.78	0.00	30.6	167.5
GWJ361A-0.1	1	C	fair	5.4	N	2.02	0.65	1.92	-0.24	0.00	29.9	60.5
GWJ125-0.2	1	PA	fair	5.0	N	9.69	0.89	28.92	NA	0.00	36.0	349.0
GWJ125-1.0	1	PA	good	9.3	N	6.65	0.68	7.92	6.72	0.00	45.4	302.0
GWJ125-1.1	1	C	good	7.7	N	3.80	0.52	27.30	9.00	0.00	40.1	152.5
GWJ125-1.4	1	PA	fair	9.8	N (discontin)	3.82	0.56	13.32	9.66	0.00	36.7	140.2

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Site ID	Pipe #	Shape	Pipe Condition	Mean Channel Width (ft)	Continuous Substrate in Structure	Pipe Slope (%)	Pipe Width: Channel Width ratio	Outlet Drop (in)	Outlet Perch (in)	Residual Inlet Depth (in)	Pipe Length (ft)	Slope (%) * Length (ft)
GWJ125-2.2	1	PA	poor	9.3	N (discontin)	5.62	0.62	30.96	27.66	0.00	45.2	254.0
GWJ125-3.2	1	PA	fair	9.1	N	4.09	0.66	22.62	21.30	0.00	36.7	150.0
GWJ125-4.0	1	PA	fair	11.0	N	3.83	0.50	19.08	19.26	0.00	36.6	140.0
GWJ125-4.4	1	PA	good	4.4	N	6.02	0.61	NA	13.26	0.00	28.9	174.0
GWJ125-5.9	1	PA	fair	21.9	N (discontin)	4.33	0.62	-6.66	-9.78	0.00	40.3	174.5
GWJ337-3.5	1	PA	fair	7.2	N	7.55	0.69	16.68	16.62	0.00	38.7	292.0
GWJ1144-2.0	1	PA	fair	5.5	N	2.85	0.96	NA	8.04	0.00	31.2	89.0
GWJ364-1.4	1	PA	good	8.6	N (discontin)	4.13	0.73	9.36	6.84	0.00	34.9	144.0
GWJ364-1.6	1	PA	good	5.7	N	4.91	0.78	18.84	14.88	0.00	27.1	133.0
GWJ1901-2.9	1	PA	good	8.5	N	10.27	0.64	18.06	15.78	0.00	42.3	434.5
GWJ194-1.1	1	C	good	5.1	N	4.48	0.78	8.04	6.36	0.00	48.2	216.0
GWJ194-1.7	1	C	good	5.4	N (discontin)	1.81	0.75	9.12	2.88	0.00	44.3	80.0
GWJ194-2.7	1	PA	poor	6.3	N	3.19	0.78	14.52	13.32	0.00	37.9	121.0
GWJ194-3.0	1	PA	fair	10.9	N	5.78	0.54	10.56	6.60	0.00	49.0	283.0
GWJ194-3.9	1	PA	fair	11.1	N	2.51	0.62	NA	-2.88	0.00	35.9	90.0
GWJ194-3.9	2	PA	fair	11.1	Y	3.10	0.59	-0.60	-1.32	0.00	34.8	108.0
GWJ194-5.0	1	PA	good	9.6	N	5.25	0.48	13.56	10.08	0.00	38.5	202.0
GWJ194-5.1	1	C	good	6.6	N	6.97	0.61	24.96	23.28	0.00	42.2	294.0
GWJ194-5.7	1	C	fair	6.4	N	5.28	0.62	21.84	20.40	0.00	44.3	234.0
GWJ194-7.4	1	PA	fair	6.8	N	3.41	0.56	6.00	0.48	0.00	49.8	170.0
GWJ361-0.45	1	PA	fair	12.8	N	1.83	0.44	19.56	16.98	0.00	33.9	62.0
GWJ361-1.7	1	C	poor	5.8	N	4.67	0.61	10.74	10.80	0.00	31.4	146.5
GWJ361-1.9	1	C	poor	6.2	N	5.82	0.49	13.80	0.00	0.00	46.6	271.0
GWJ129-2.9	1	PA	fair	12.1	N	3.83	0.66	13.92	26.76	0.00	44.4	170.0
GWJ129-3.1	1	C	poor	8.5	N	7.20	0.70	29.28	34.08	0.00	56.8	409.0

Appendix B: Results for the Cherokee National Forest

We completed surveys at 59 (48%) of 122 documented crossing structures on the Ocoee/Hiwassee, Tellico/Hiwassee, Nolichucky/Unaka, and Watagua Ranger Districts in 2006 (Figure B1, Tables B1 and B2). Filter A (strong swimmers and leapers) classified 25% (n=15) of crossings as impassable, 24% (n=14) as passable, and 51% (n=30) as indeterminate (Figure B2, Table B2). Filter B (moderate swimmers and leapers) classified 80% (n=47) of crossings as impassable, 5% (n=3) as passable, and 15% (n=9) as indeterminate (Figure B3, Table B2). Filter C (weak swimmers and leapers) classified 90% (n=53) of crossings as impassable, 5% (n=3) as passable, and 5% (n=3) as indeterminate (Figure B4, Table B2). Characteristics and filter classifications for each crossing are presented in Tables B3-B5.

The majority of the crossings surveyed were circular culverts (85%, n=50) while pipe arches (12%, n=7), open bottom arches (1.5%, n=1), box culverts (1.5%, n=1), vented fords (0%, n=0), and fords (0%, n=0) were less frequently encountered or not encountered. Filter A classified 30% of circular culverts and 0% of pipe arches, open bottom arches and box culverts as impassable (Figure B5). Filter B classified 84% of circular culverts, 57% of pipe arches, and 100% of box culverts as impassable (Figure B6). Filter C classified 92% of circular culverts, 86% of pipe arches, and 100% of box culverts as impassable (Figure B7). The mean crossings width to channel width ratio (excluding fords and multiple structure crossings) was 0.43 ± 0.17 (mean ± SD) (n=41), and only one crossing was greater than or equal to the mean bankfull channel width (Figure B8). The mean crossing width to channel width ratio for surveyed crossings classified impassable by Filter A was 0.40 ± 0.15 (n=15). The mean ratio for crossings classified impassable by Filter B was 0.41 ± 0.15 (n=35), and was 0.41 ± 0.15 (n=37) for Filter C (Figure B9). The mean crossing width to channel width ratio for crossings classified passable by Filter A was 0.60 ± 0.25 (n=5). The mean ratio for crossings classified passable by Filter B was 0.81 ± 0.31 (n=2), and was 0.81 ± 0.31 (n=2) for Filter C (Figure B9).

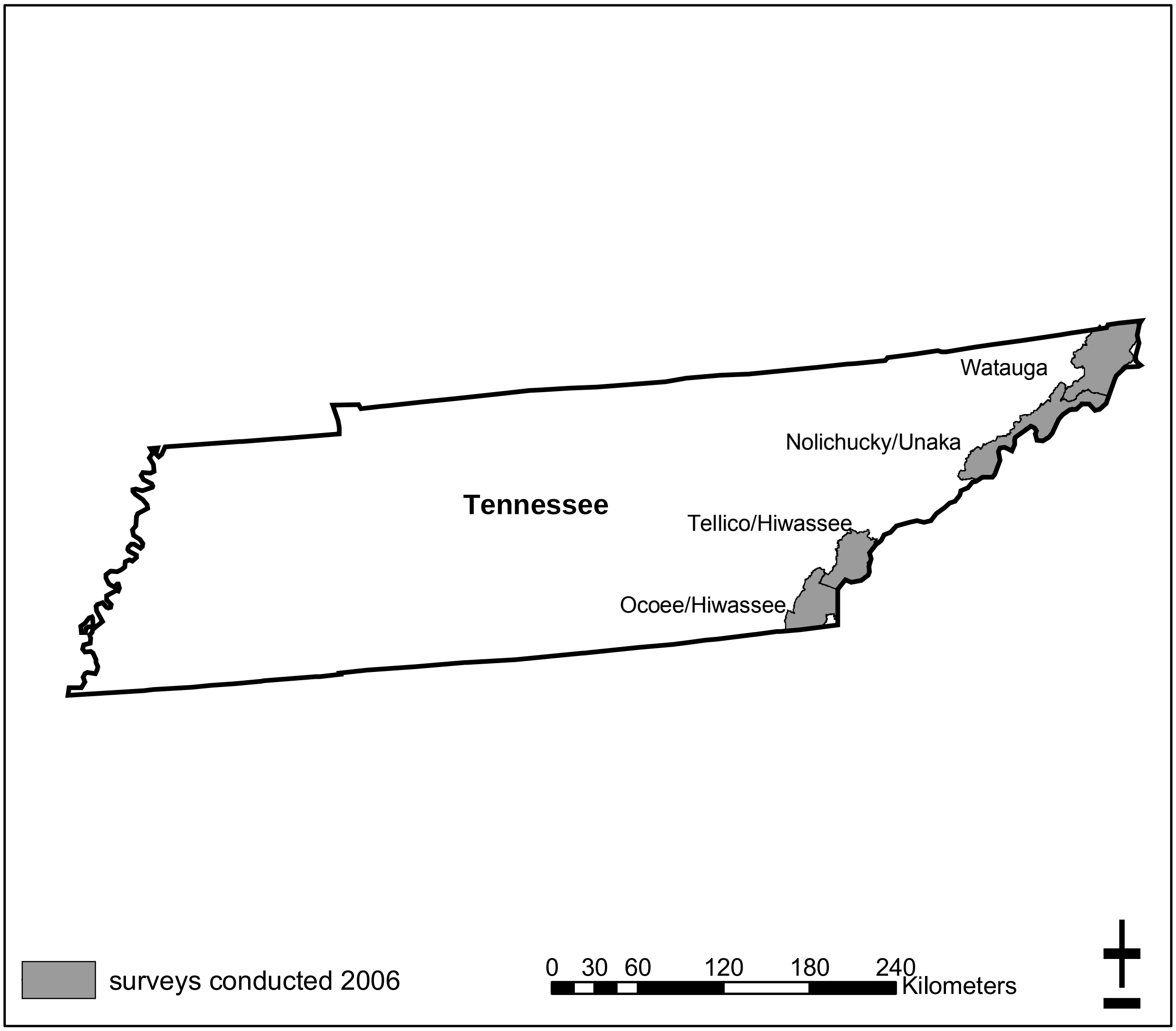

Figure B1. Ranger Districts on the Cherokee National Forest where road-stream crossing surveys were conducted, summer 2006.

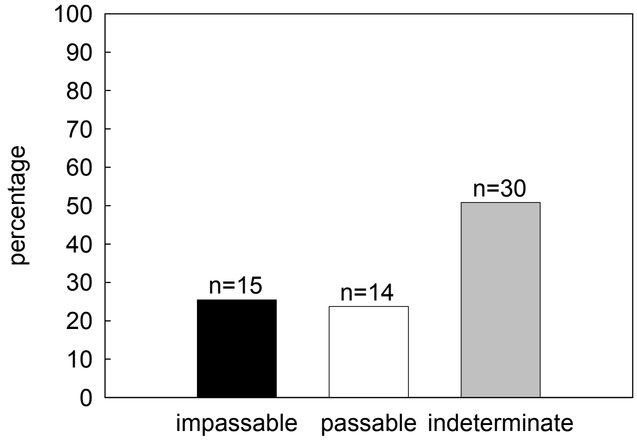

Figure B2. Percentage of crossings classified as impassable, passable, or indeterminate by Filter A; Cherokee National Forest, summer 2006 (N=59).

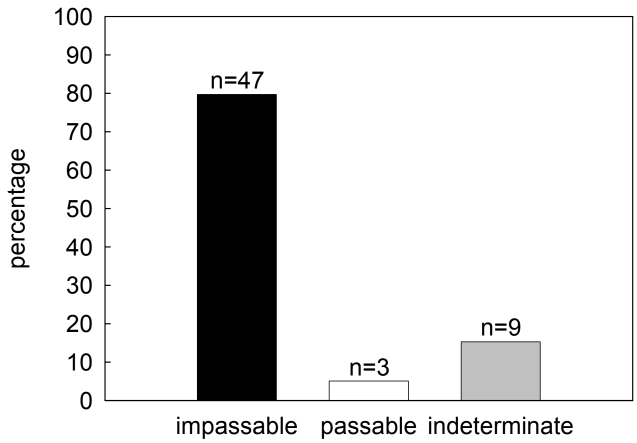

Figure B3. Percentage of crossings classified as impassable, passable, or indeterminate by Filter B; Cherokee National Forest, summer 2006 (N=59).

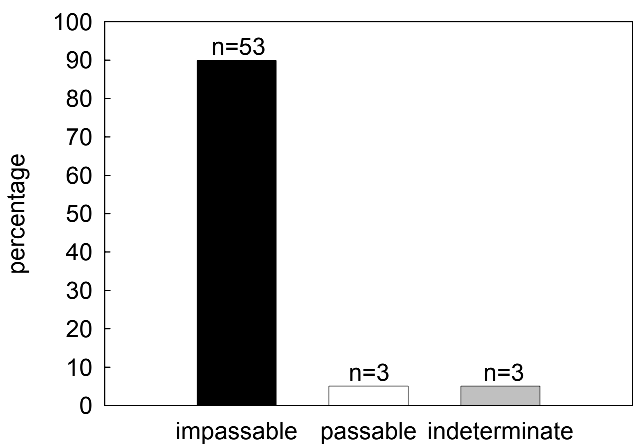

Figure B4. Percentage of crossings classified as impassable, passable, or indeterminate by Filter C; Cherokee National Forest, summer 2006 (N=59).

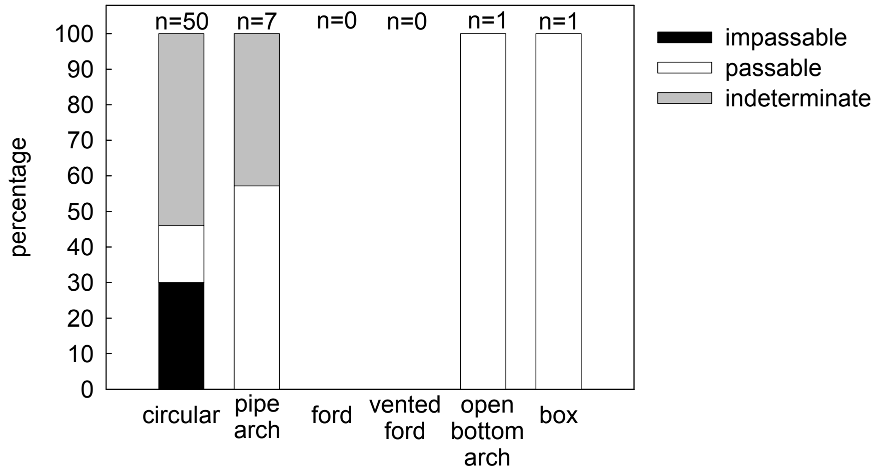

Figure B5. Percentage of each crossing type classified as impassable, passable, or indeterminate for Filter A; Cherokee National Forest, summer 2006 (N=59).

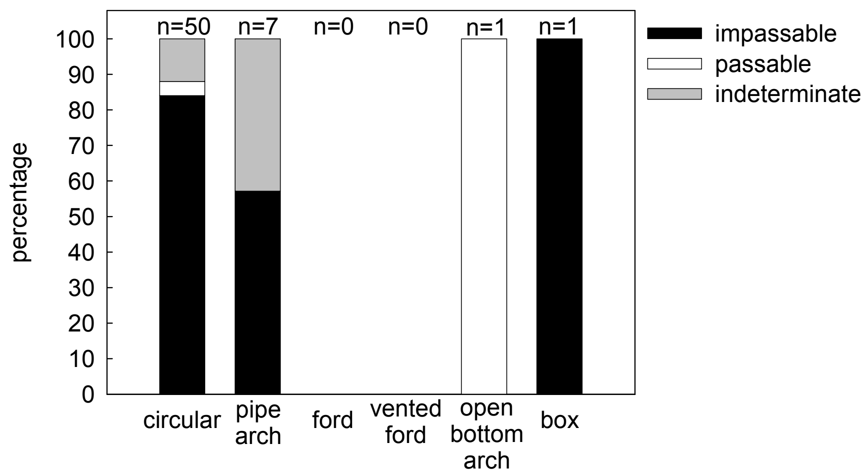

Figure B6. Percentage of each crossing type classified as impassable, passable, or indeterminate for Filter B; Cherokee National Forest, summer 2006 (N=59).

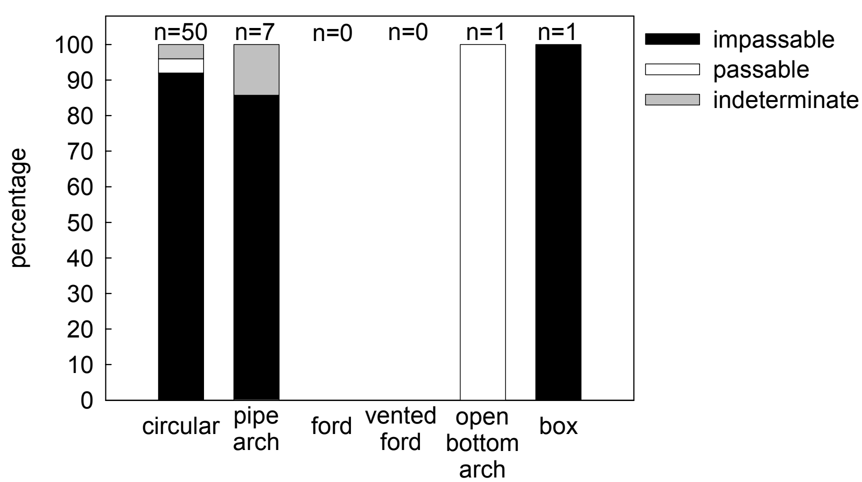

Figure B7. Percentage of each crossing type classified as impassable, passable, or indeterminate for Filter C; Cherokee National Forest, summer 2006 (N=59).

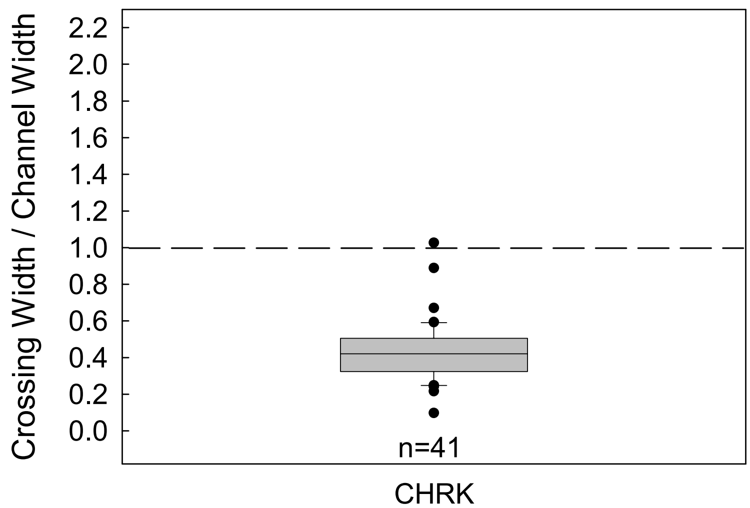

Figure B8. Crossing width to bankfull channel width ratio for crossings surveyed in summer 2006 on the Cherokee National Forest (excluding fords, vented fords and multiple structure crossings). A ratio of 1.0 (dashed line) or greater indicates the crossing structure opening is greater than or equal to the bankfull channel width. The top and bottom of the boxes represent the 25th and 75th percentiles, the bar in the center of each box represents the median, whiskers represent the 10th and 90th percentiles, and closed circles represent the entire range of the data.

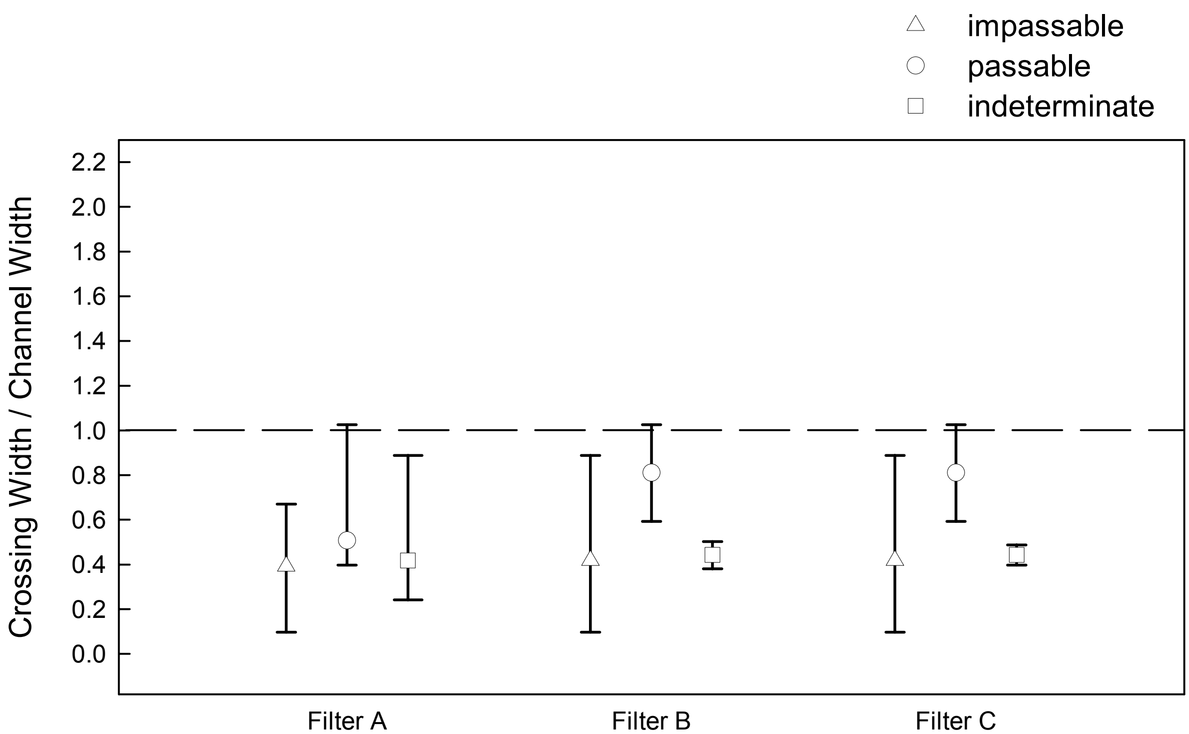

Figure A9. Crossing width to bankfull channel width ratio for crossings classified as impassable, passable, or indeterminate in summer 2006 on the Cherokee National Forest (excluding fords, vented fords, and multiple structure crossings). A ratio of 1.0 (dashed line) or greater indicates the crossing structure opening is greater than or equal to the bankfull channel width. The symbol inside each set of whiskers represents the median, and the top and bottom of the whiskers represent the maximum and minimum values.

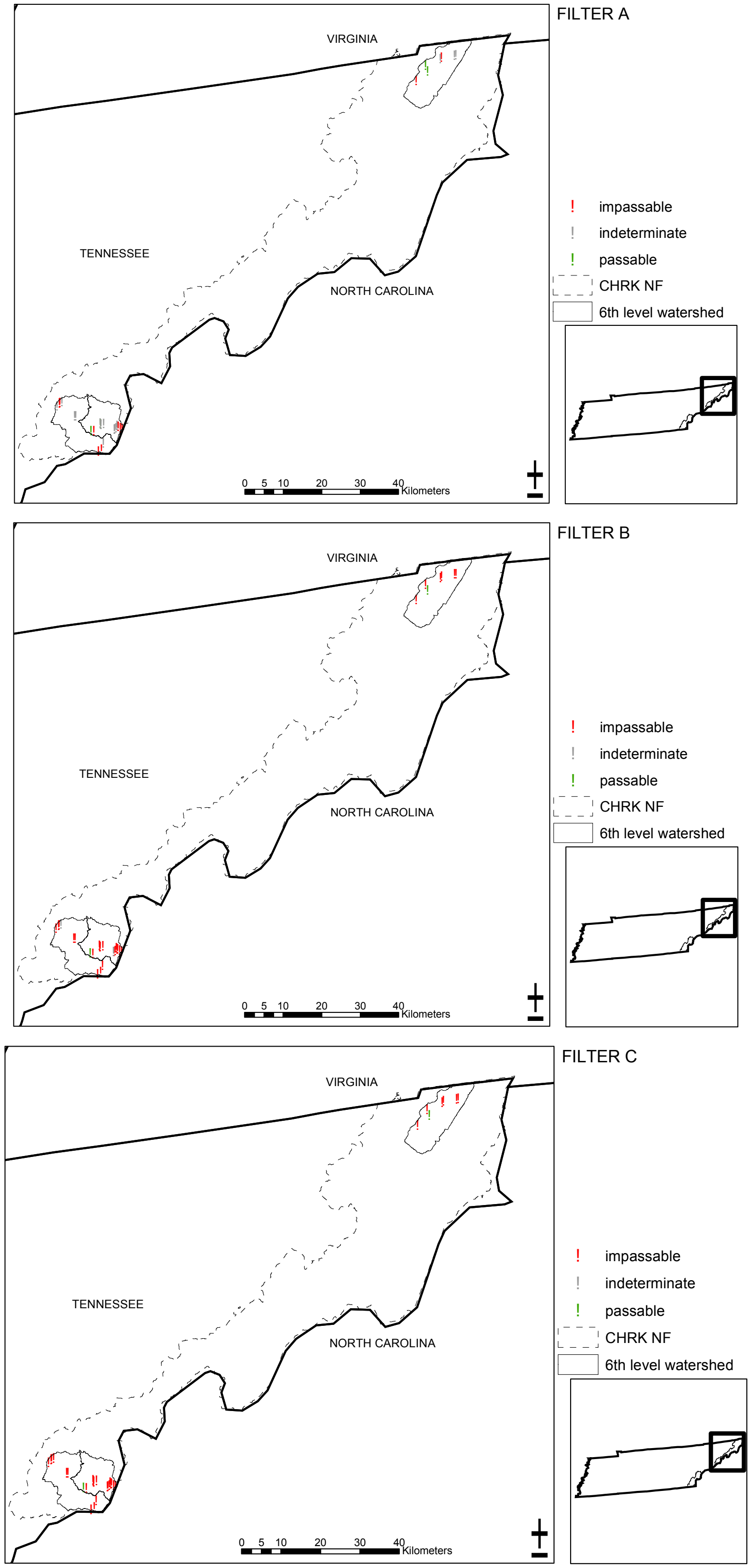

Figure B10. Location of crossings classified for fish passage by coarse filters A, B, and C within 6th level watersheds on the northern portion of the Cherokee National Forest, summer 2006.

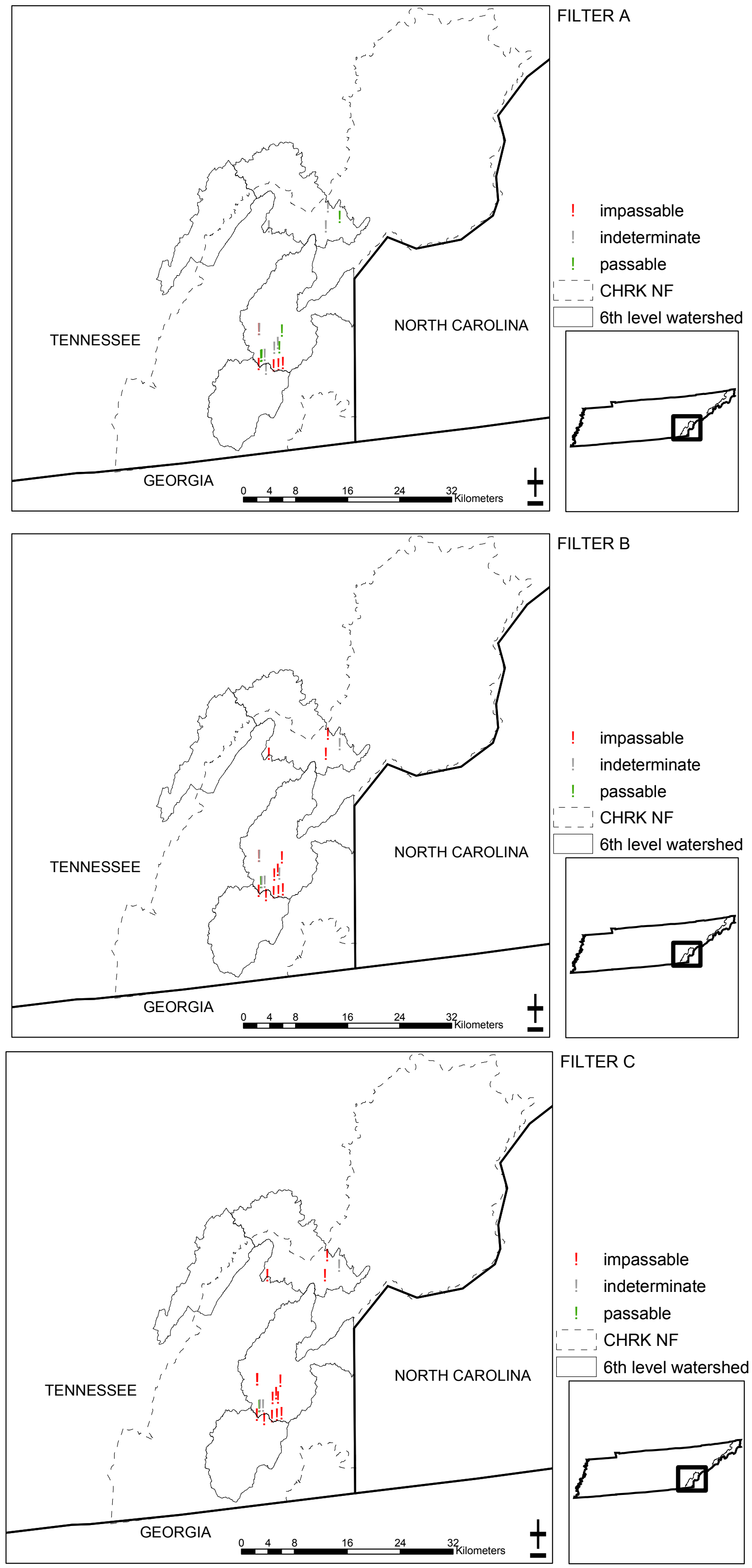

Figure B11. Location of crossings classified for fish passage by coarse filters A, B, and C within 6th level watersheds on the southern portion of the Cherokee National Forest, summer 2006.

Table B1. Number of crossings documented (Total crossings documented) and not surveyed (Crossings not surveyed) on the Cherokee National Forest in summer 2006. Reasons for not surveying a documented site include: no suitable fish habitat upstream of crossing (NH); no access to site due to closed roads or private gates (NA); crossing was a natural ford (NF); crossing was a bridge (BR).

Forest	Total crossings documented	Crossings not surveyed (n, [%])				
		NH	NA	NF	BR	Total not surveyed
CHRKNF	122	42 (67)	0 (0)	16 (25)	5 (8)	63 (52)

Table B2. Number of crossings surveyed (Total surveyed) with coarse filter results for the Cherokee National Forest in summer 2006. Coarse filter results are presented for Filter A, Filter B, and Filter C (see filter descriptions, Fig 3 – 5).

Forest	Total surveyed	Coarse filter results								
		Impassable (n, [%])			Passable (n, [%])			Indeterminate (n, [%])		
		A	B	C	A	B	C	A	B	C
CHRKNF	59	15 (25)	47 (80)	53 (90)	14 (24)	3 (5)	3 (5)	30 (51)	9 (15)	3 (5)

Table B3. Location of crossings surveyed on the Cherokee National Forest during the summer of 2006. Site ID consists of the Forest abbreviation (CHNF), road the crossing is on (300), and the distance (miles) from the junction road (0.8).

Site ID	# of Pipes	District	Junction Road	Stream Name	Quad	6th level watershed
CHNF300-0.8	1	Watauga	133	Tank Hollow	Laurel Bloomery	060101020104
CHNF300-1.0	1	Watauga	133	UT Tank Hollow	Laurel Bloomery	060101020104
CHNF60802-0.1	1	Watauga	69	Heaberlin Branch	Shady Valley	060101020104
CHNF60804-0.2	1	Watauga	34	Low Gap Branch	Shady Valley	060101020104
CHNF60833-0.2	1	Watauga	6083	UT Beaverdam Creek	Laurel Bloomery	060101020104
CHNF60833-0.7	1	Watauga	6083	Dark Hollow	Laurel Bloomery	060101020104
CHNF69B-0.8	2	Watauga	69	Marshall Branch	Shady Valley	060101020104
CHNF107-0.3	1	Nolichucky-Unaka	1182	UT Lemon Prong	Lemon Gap	060101050801
CHNF107-0.7	1	Nolichucky-Unaka	1182	UT Lemon Prong	Lemon Gap	060101050801
CHNF107-1.4	1	Nolichucky-Unaka	1182	Shelton Branch	Lemon Gap	060101050801
CHNF107-1.8	2	Nolichucky-Unaka	1182	Rattlesnake Branch	Lemon Gap	060101050801
CHNF209-0.6	1	Nolichucky-Unaka	209	Spicewood Branch	Waterville	060101050801
CHNF209-1.0	1	Nolichucky-Unaka	209	UT Spicewood Branch	Waterville	060101050801
CHNF209-1.1	1	Nolichucky-Unaka	209	UT Spicewood Branch	Waterville	060101050801
CHNF209-1.2	1	Nolichucky-Unaka	209	UT Spicewood Branch	Waterville	060101050801
CHNF22441-1.0	1	Nolichucky-Unaka	209	UT Hunter Creek	Waterville	060101050801
CHNF22441-2.1	2	Nolichucky-Unaka	209	Hunter Creek	Waterville	060101050801
CHNF3249-0.1	2	Nolichucky-Unaka	gate	UT Big Creek	Lemon Gap	060101050801
CHNF3249-0.1-1	2	Nolichucky-Unaka	107	UT Big Creek	Lemon Gap	060101050801
CHNF3249-0.2	2	Nolichucky-Unaka	gate	Big Creek	Lemon Gap	060101050801
CHNF96-0.2	1	Nolichucky-Unaka	107	Shelton Branch	Lemon Gap	060101050801
CHNFbluemill-0.4	1	Nolichucky-Unaka	22421	UT Big Creek	Lemon Gap	060101050801
CHNF2251012-0.9	1	Nolichucky-Unaka	2251-4	UT Middle Prong Gulf Cr	Waterville	060101050802
CHNF225102-1.1	1	Nolichucky-Unaka	2251-3	Gap Creek	Waterville	060101050802
CHNF2251-4-0.5	1	Nolichucky-Unaka	2251-3	UT Bearpen Branch	Waterville	060101050802
CHNF402-1.6	1	Nolichucky-Unaka	702	UT Carney Branch	Neddy Mountain	060101050802
CHNF403-0.5	1	Nolichucky-Unaka	402	UT Deer Hill Branch	Neddy Mountain	060101050802
CHNF403-0.6	1	Nolichucky-Unaka	402	Deer Hill Branch	Neddy Mountain	060101050802
CHNF403-1.7	1	Nolichucky-Unaka	402	Fine Trail Branch	Neddy Mountain	060101050802
CHNF5141a-1.0	1	Nolichucky-Unaka	5141	Piney Branch	Waterville	060101050802

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Site ID	# of Pipes	District	Junction Road	Stream Name	Quad	6th level watershed
CHNF5141a-1.5	1	Nolichucky-Unaka	5141	Pauldo Branch	Waterville	060101050802
CHNF103-7.2	1	Ocoee-Hiwassee	30	Mary Branch	McFarland	060200020301
CHNF103-7.5	1	Ocoee-Hiwassee	30	Mary Branch	McFarland	060200020301
CHNF1176-1-2.6	1	Ocoee-Hiwassee	23	UT Rymer Camp Branch	Ducktown	060200020301
CHNF1176-1-3.5	1	Ocoee-Hiwassee	23	UT Rymer Camp Branch	Ducktown	060200020301
CHNF1176-4.3	1	Ocoee-Hiwassee	23	Rymer Camp Branch	Ducktown	060200020301
CHNF23-0.1	1	Ocoee-Hiwassee	80	Bearpen Branch	McFarland	060200020301
CHNF23-0.6	4	Ocoee-Hiwassee	80	Big Lost Creek	McFarland	060200020301
CHNF23-1.3	1	Ocoee-Hiwassee	68	Piney Flats Branch	Ducktown	060200020301
CHNF23-1.4	2	Ocoee-Hiwassee	68	Standing Rock Branch	Ducktown	060200020301
CHNF23-1.7	1	Ocoee-Hiwassee	68	Puncheon Camp Branch	Ducktown	060200020301
CHNF23-2.5	1	Ocoee-Hiwassee	103	UT Piney Flats Branch	McFarland	060200020301
CHNF23-6.5	1	Ocoee-Hiwassee	68	Smith Creek	McFarland	060200020301
CHNF68-11.2	1	Ocoee-Hiwassee	68	Piney Flats Branch	Ducktown	060200020301
CHNF341-2.1	1	Tellico-Hiwassee	68	UT Conasauga Creek	Tellico Plains	060200020401
CHNF341-4.6	1	Tellico-Hiwassee	68	UT Conasauga Creek	Tellico Plains	060200020401
CHNF603-1.6	1	Tellico-Hiwassee	68	Hooper Branch	Tellico Plains	060200020401
CHNF652-1.0	1	Ocoee-Hiwassee	653	UT Dry Creek	Mecca	060200020401
CHNF33172-1.7	1	Ocoee-Hiwassee	68	UT Gassaway Creek	Ducktown	060200030207

Table B4. Coarse filter A, B, and C, classifications for crossings surveyed on the Cherokee National Forest, summer 2006.

Site ID	Pipe #	Filter A	Filter B	Filter C
CHNF300-0.8	1	indeterminate	impassable	impassable
CHNF300-1.0	1	indeterminate	impassable	impassable
CHNF60802-0.1	1	passable	passable	passable
CHNF60804-0.2	1	impassable	impassable	impassable
CHNF60833-0.2	1	indeterminate	impassable	impassable
CHNF60833-0.7	1	impassable	impassable	impassable
CHNF69B-0.8	1	passable	impassable	impassable
CHNF69B-0.8	2	passable	impassable	impassable
CHNF107-0.3	1	impassable	impassable	impassable
CHNF107-0.7	1	impassable	impassable	impassable
CHNF107-1.4	1	indeterminate	impassable	impassable
CHNF107-1.8	1	indeterminate	impassable	impassable
CHNF107-1.8	2	indeterminate	impassable	impassable
CHNF209-0.6	1	indeterminate	impassable	impassable
CHNF209-1.0	1	passable	impassable	impassable
CHNF209-1.1	1	indeterminate	impassable	impassable
CHNF209-1.2	1	indeterminate	impassable	impassable
CHNF22441-1.0	1	impassable	impassable	impassable
CHNF22441-2.1	1	passable	passable	passable
CHNF22441-2.1	2	indeterminate	impassable	impassable
CHNF3249-0.1	1	indeterminate	impassable	impassable
CHNF3249-0.1	2	indeterminate	impassable	impassable
CHNF3249-0.1-1	1	indeterminate	impassable	impassable
CHNF3249-0.1-1	2	indeterminate	impassable	impassable
CHNF3249-0.2	1	indeterminate	indeterminate	impassable
CHNF3249-0.2	2	indeterminate	indeterminate	impassable
CHNF96-0.2	1	impassable	impassable	impassable
CHNFbluemill-0.4	1	indeterminate	impassable	impassable
CHNF2251012-0.9	1	indeterminate	impassable	impassable
CHNF225102-1.1	1	impassable	impassable	impassable
CHNF2251-4-0.5	1	impassable	impassable	impassable
CHNF402-1.6	1	indeterminate	indeterminate	impassable
CHNF403-0.5	1	impassable	impassable	impassable
CHNF403-0.6	1	impassable	impassable	impassable
CHNF403-1.7	1	indeterminate	impassable	impassable
CHNF5141a-1.0	1	indeterminate	impassable	impassable
CHNF5141a-1.5	1	indeterminate	impassable	impassable
CHNF103-7.2	1	impassable	impassable	impassable
CHNF103-7.5	1	indeterminate	indeterminate	impassable
CHNF1176-1-2.6	1	impassable	impassable	impassable
CHNF1176-1-3.5	1	impassable	impassable	impassable
CHNF1176-4.3	1	impassable	impassable	impassable
CHNF23-0.1	1	indeterminate	impassable	impassable
CHNF23-0.6	1	passable	impassable	impassable
CHNF23-0.6	2	passable	indeterminate	impassable

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Site ID	Pipe #	Filter A	Filter B	Filter C
CHNF23-0.6	3	passable	impassable	impassable
CHNF23-0.6	4	passable	impassable	impassable
CHNF23-1.3	1	passable	passable	passable
CHNF23-1.4	1	passable	indeterminate	impassable
CHNF23-1.4	2	passable	indeterminate	indeterminate
CHNF23-1.7	1	indeterminate	indeterminate	indeterminate
CHNF23-2.5	1	indeterminate	impassable	impassable
CHNF23-6.5	1	passable	impassable	impassable
CHNF68-11.2	1	impassable	impassable	impassable
CHNF341-2.1	1	indeterminate	impassable	impassable
CHNF341-4.6	1	indeterminate	impassable	impassable
CHNF603-1.6	1	passable	indeterminate	indeterminate
CHNF652-1.0	1	indeterminate	impassable	impassable
CHNF33172-1.7	1	indeterminate	impassable	impassable

Table B5. Description of crossings surveyed on Cherokee National Forest, summer 2006. Shape abbreviations: C= circular, PA= pipe arch, OBA= open bottom arch, and F= ford. Channel width is the mean bankfull channel width. N= no natural substrate, N (discontin)= discontinuous substrate, Y= continuous natural substrate. An NA (not applicable) indicates outlet drop (no outlet pool or tailwater control) or outlet perch (stream dry) could not be calculated. Negative outlet drop or perch values indicate a submerged outlet (structure partially backwatered). Residual inlet depth values ≥ 0.0 indicate the structure is fully backwatered.

Site ID	Pipe #	Shape	Pipe Condition	Mean Channel Width (ft)	Continuous Substrate in Structure	Pipe Slope (%)	Pipe Width: Channel Width ratio	Outlet Drop (in)	Outlet Perch (in)	Residual Inlet Depth (in)	Pipe Length (ft)	Slope (%)* Length (ft)
CHNF300-0.8	1	C	fair	15.0	N	5.83	0.53	15.84	13.80	0.00	61.2	357.0
CHNF300-1.0	1	C	fair	11.3	N	6.59	0.40	18.00	16.32	0.00	34.6	228.0
CHNF60802-0.1	1	C	good	11.8	Y	1.19	0.59	3.12	-3.72	0.00	44.4	53.0
CHNF60804-0.2	1	C	poor	6.0	N	7.75	0.33	5.04	3.96	0.00	20.2	156.5
CHNF60833-0.2	1	C	good	11.8	N	4.05	0.42	18.60	18.36	0.00	42.7	173.0
CHNF60833-0.7	1	C	fair	14.7	N	5.71	0.34	37.68	34.32	0.00	40.6	232.0
CHNF69B-0.8	1	C	good	9.9	N	1.28	0.30	14.40	12.96	0.00	30.5	39.0
CHNF69B-0.8	2	C	good	9.9	N	1.26	0.30	15.00	12.48	0.00	34.9	44.0
CHNF107-0.3	1	C	poor	7.0	N (discontin)	9.81	0.43	4.50	2.76	0.00	23.5	230.5
CHNF107-0.7	1	C	fair	9.2	N (discontin)	10.41	0.22	NA	1.56	0.00	27.0	281.0
CHNF107-1.4	1	C	fair	7.9	N (discontin)	4.92	0.25	17.82	6.00	0.00	31.0	152.5
CHNF107-1.8	1	C	fair	9.1	N	4.33	0.22	2.70	1.50	0.00	20.9	90.5
CHNF107-1.8	2	C	fair	9.1	N	3.94	0.22	5.76	2.22	0.00	20.7	81.5
CHNF209-0.6	1	C	good	9.0	N	3.77	0.33	-4.44	-6.78	0.00	20.7	78.0
CHNF209-1.0	1	C	good	6.1	N	1.26	0.49	10.08	8.04	0.00	20.6	26.0
CHNF209-1.1	1	C	good	6.4	N	4.47	0.47	2.52	-0.24	0.00	20.8	93.0
CHNF209-1.2	1	C	good	6.4	N	3.87	0.47	14.28	12.36	0.00	20.8	80.5
CHNF22441-1.0	1	C	fair	6.0	N	11.06	0.67	NA	6.00	0.00	34.0	376.0
CHNF22441-2.1	1	C	good	7.8	Y	3.28	0.45	7.80	2.64	0.00	35.1	115.0
CHNF22441-2.1	2	C	good	7.8	N	5.58	0.51	4.32	2.76	0.00	34.4	192.0
CHNF3249-0.1	1	C	good	7.9	N	6.10	0.51	15.66	11.58	0.00	34.7	211.5
CHNF3249-0.1	2	C	good	7.9	N	4.99	0.51	19.68	5.52	0.00	34.7	173.0
CHNF3249-0.1-1	1	C	fair	11.9	N	6.28	0.42	NA	12.60	0.00	29.3	184.0
CHNF3249-0.1-1	2	C	fair	11.9	N	3.85	0.42	NA	9.48	0.00	31.0	119.5
CHNF3249-0.2	1	C	good	14.0	N	2.31	0.54	8.88	4.86	0.00	40.3	93.0
CHNF3249-0.2	2	C	good	14.0	N	2.37	0.54	7.20	6.84	0.00	40.3	95.5

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Site ID	Pipe #	Shape	Pipe Condition	Mean Channel Width (ft)	Continuous Substrate in Structure	Pipe Slope (%)	Pipe Width: Channel Width ratio	Outlet Drop (in)	Outlet Perch (in)	Residual Inlet Depth (in)	Pipe Length (ft)	Slope (%) * Length (ft)
CHNF96-0.2	1	C	good	6.9	N	8.55	0.58	NA	16.92	0.00	40.6	347.0
CHNFbluemill-0.4	1	C	good	8.3	N	4.71	0.24	1.44	0.12	0.00	20.8	98.0
CHNF2251012-0.9	1	C	fair	8.0	N	5.85	0.25	3.72	2.28	0.00	41.0	240.0
CHNF225102-1.1	1	C	fair	5.2	N	13.45	0.10	-0.48	-0.90	0.00	40.0	538.0
CHNF2251-4-0.5	1	C	fair	4.2	N	12.78	0.36	15.60	14.64	0.00	38.0	485.5
CHNF402-1.6	1	C	poor	5.3	N	2.85	0.38	4.56	4.68	0.00	30.2	86.0
CHNF403-0.5	1	C	fair	4.8	N	7.37	0.31	16.44	15.36	0.00	26.2	193.0
CHNF403-0.6	1	C	fair	4.0	N	8.85	0.25	18.36	12.36	0.00	39.0	345.0
CHNF403-1.7	1	C	fair	3.6	N	5.46	0.42	3.12	3.24	0.00	25.1	137.0
CHNF5141a-1.0	1	C	fair	9.6	N	2.49	0.42	23.52	22.56	0.00	46.5	116.0
CHNF5141a-1.5	1	C	fair	11.5	N	2.33	0.48	10.68	8.88	0.00	49.3	115.0
CHNF103-7.2	1	C	good	19.0	N	2.63	0.42	25.68	11.76	0.00	97.8	257.0
CHNF103-7.5	1	PA	good	18.5	N (discontin)	1.79	0.50	6.36	4.80	0.00	82.8	148.0
CHNF1176-1-2.6	1	C	poor	8.6	N	7.06	0.58	13.98	12.24	0.00	50.6	357.0
CHNF1176-1-3.5	1	C	fair	6.5	N	12.48	0.54	34.20	30.84	0.00	42.6	531.5
CHNF1176-4.3	1	C	good	9.1	N	11.44	0.49	44.52	46.44	0.00	46.6	533.0
CHNF23-0.1	1	C	fair	8.1	N	6.00	0.31	10.20	7.68	0.00	32.5	195.0
CHNF23-0.6	1	PA	good	30.4	N	1.40	0.18	12.84	11.04	0.00	21.4	30.0
CHNF23-0.6	2	PA	good	30.4	N	1.40	0.18	9.48	8.04	0.00	21.4	30.0
CHNF23-0.6	3	PA	good	30.4	N	1.32	0.18	10.20	9.00	0.00	20.5	27.0
CHNF23-0.6	4	PA	good	30.4	N	1.07	0.18	18.36	13.08	0.00	20.5	22.0
CHNF23-1.3	1	OBA	good	11.4	Y	1.52	1.03	-5.16	-6.06	8.16	16.5	25.0
CHNF23-1.4	1	C	fair	8.2	N	2.27	0.18	4.08	3.06	0.00	20.0	45.5
CHNF23-1.4	2	C	fair	8.2	N	2.22	0.18	3.78	2.76	0.00	20.0	44.5
CHNF23-1.7	1	PA	good	10.3	N	2.25	0.49	NA	1.02	0.00	32.5	73.0
CHNF23-2.5	1	PA	fair	4.6	N	4.20	0.89	10.44	8.52	0.00	34.5	145.0
CHNF23-6.5	1	B	good	19.7	N	0.85	0.51	15.24	11.16	0.00	28.2	24.0
CHNF68-11.2	1	C	fair	6.4	N	9.94	0.39	NA	13.14	0.00	41.0	407.5
CHNF341-2.1	1	C	fair	5.5	N	4.83	0.51	12.78	14.70	0.00	28.7	138.5
CHNF341-4.6	1	C	fair	10.4	N	4.66	0.43	23.04	21.72	0.00	28.3	132.0

table continued next page…

Site ID	Pipe #	Shape	Pipe Condition	Mean Channel Width (ft)	Continuous Substrate in Structure	Pipe Slope (%)	Pipe Width: Channel Width ratio	Outlet Drop (in)	Outlet Perch (in)	Residual Inlet Depth (in)	Pipe Length (ft)	Slope (%) * Length (ft)
CHNF603-1.6	1	C	good	7.6	N	1.37	0.40	0.60	-1.08	0.00	30.0	41.0
CHNF652-1.0	1	C	fair	5.9	N	3.91	0.26	18.48	16.80	0.00	20.1	78.5
CHNF33172-1.7	1	C	poor	10.0	N (discontin)	6.34	0.30	13.44	11.04	0.00	28.4	180.0

Appendix C: Results for the National Forests in Alabama

We completed surveys at 72 (70%) of 103 documented crossing structures on the Talladega (Talladega and Oakmulgee Ranger Districts), Tuskegee, and Conecuh National Forests in 2006 (Figure C1, Tables C1 and C2). Filter A (strong swimmers and leapers) classified 10% (n=7) of crossings as impassable, 50% (n=36) as passable, and 40% (n=29) as indeterminate (Figure C2, Table C2). Filter B (moderate swimmers and leapers) classified 36% (n=26) of crossings as impassable, 29% (n=21) as passable, and 35% (n=25) as indeterminate (Figure C3, Table C2). Filter C (weak swimmers and leapers) classified 46% (n=33) of crossing as impassable, 21% (n=15) as passable, and 33% (n=24) as indeterminate (Figure C4, Table C2). Characteristics and filter classifications for each crossing are presented in Tables C3-C5.

The majority of the crossings surveyed were circular culverts (49%, n=35), and pipe arches (35%, n=25), while box culverts (12%, n=9), vented fords (4%, n=3), fords (0%, n=0), and open bottom arches (0%, n=0) were less frequently encountered or not encountered. Filter A classified 6% of circular culverts and 16% of pipe arches as impassable (Figure C5). Filter B classified 37% of circular culverts, and 48% of pipe arches as impassable (Figure C6). Filter C classified 43% of circular culverts, 52% of pipe arches, and 100% of vented fords as impassable (Figure C7). The mean crossing width to channel width ratio (excluding fords, vented fords, and multiple structure crossings) was 0.78 ± 0.30 (mean ± SD) (n=29), and 7 crossings were greater than or equal to the bankfull channel width (Figure C8). The mean crossing width to channel width ratio for surveyed crossings classified impassable by Filter A was 0.76 ± 0.13 (n=3). The mean ratio for crossings classified impassable by Filter B was 0.80 ± 0.23 (n=7), and was 0.70 ± 0.28 (n=10) for Filter C (Figure C9). The mean crossing width to channel width ratio for surveyed crossings classified passable by Filter A was 0.87 ± 0.32 (n=18). The mean ratio for crossings classified passable by Filter B was 0.93 ± 0.35 (n=10), and was 0.95 ± 0.29 (n=8) for Filter C (Figure C9).

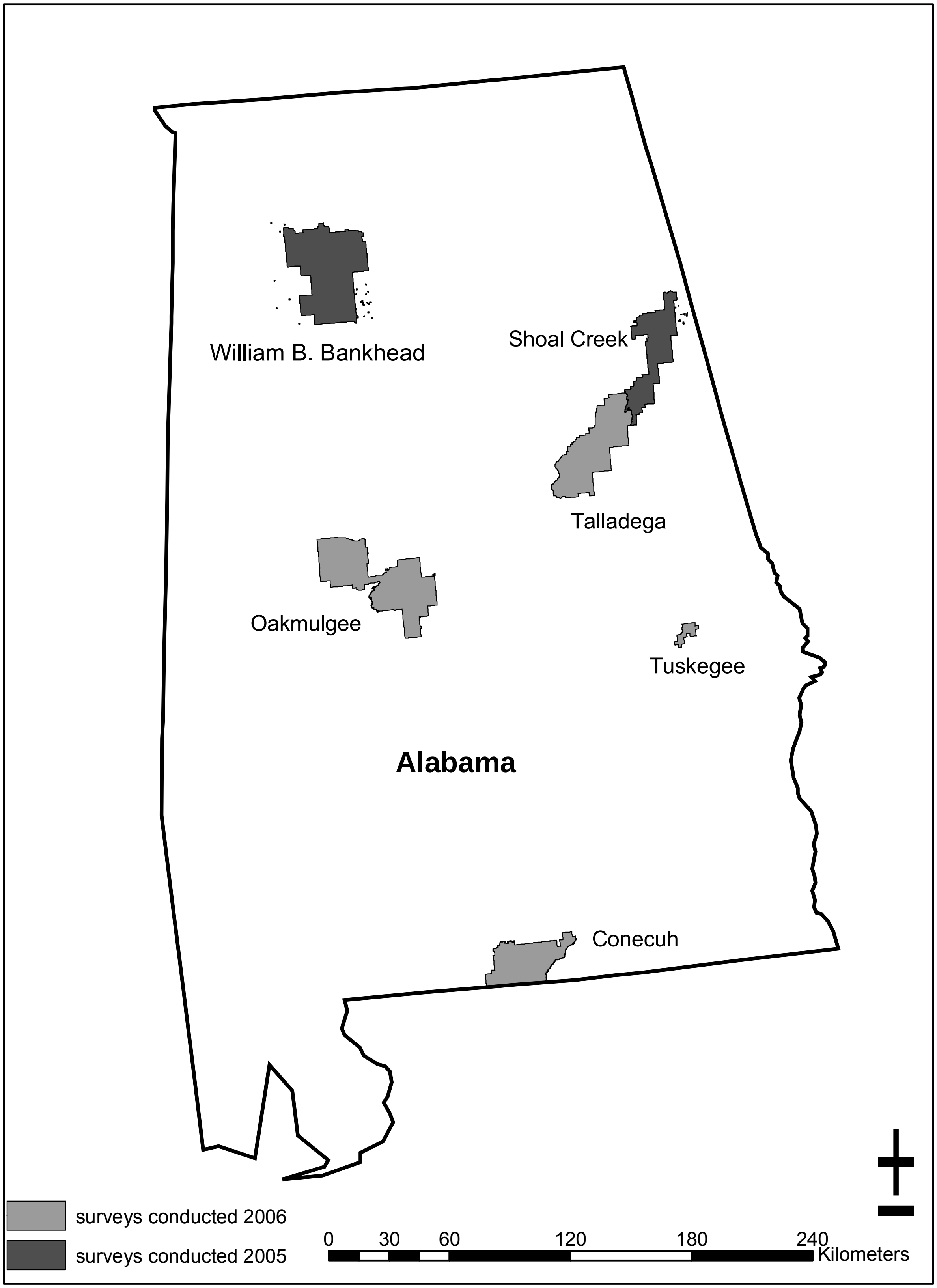


Figure C1. Ranger Districts on the National Forests in Alabama where road-stream crossing surveys were conducted, in 2005 and 2006. Results from 2005 surveys are presented in Coffman et al. 2005.

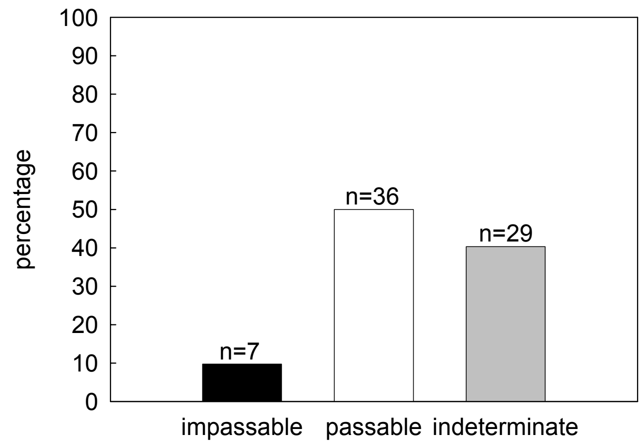


Figure C2. Percentage of crossings classified as impassable, passable, or indeterminate for Filter A; National Forests in Alabama, summer 2006 (N=72).

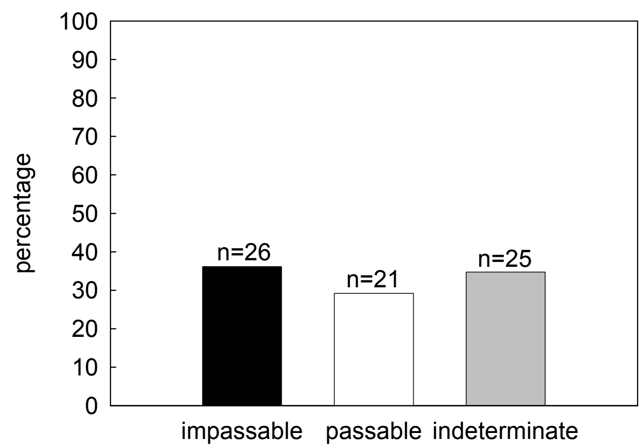


Figure C3. Percentage of crossings classified as impassable, passable, or indeterminate for Filter B; National Forests in Alabama, summer 2006 (N=72).

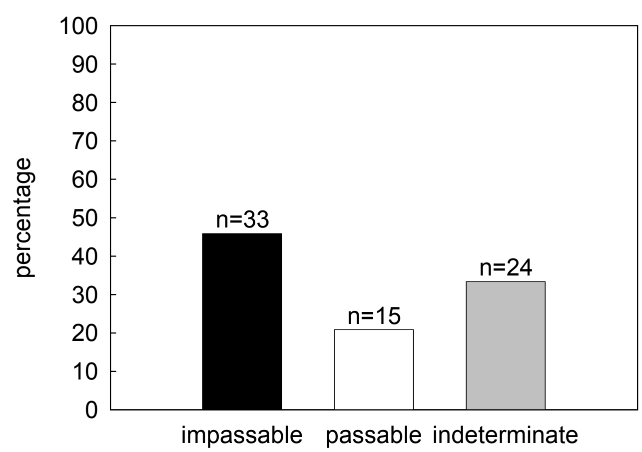


Figure C4. Percentage of crossings classified as impassable, passable, or indeterminate for Filter C; National Forests in Alabama, summer 2006 (N=72).

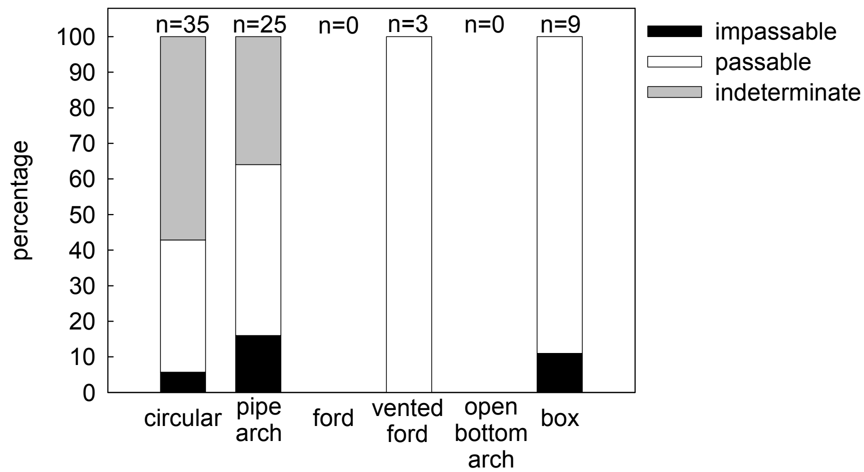


Figure C5. Percentage of each crossing type classified as impassable, passable, or indeterminate for Filter A; National Forests in Alabama, summer 2006 (N=72).

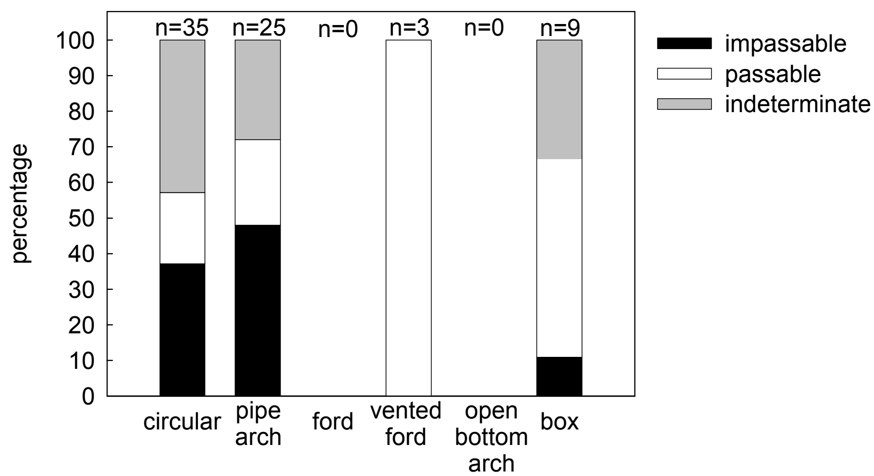


Figure C6. Percentage of each crossing type classified as impassable, passable, or indeterminate for Filter B; National Forests in Alabama, summer 2006 (N=72).

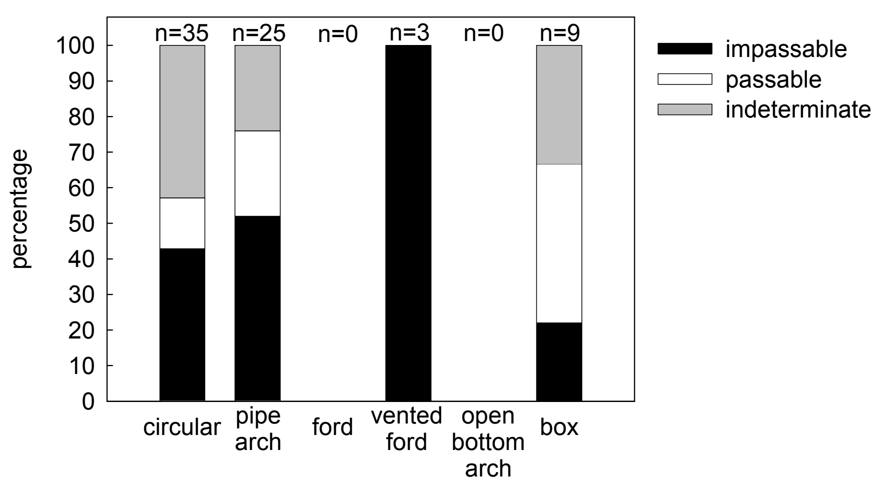


Figure C7. Percentage of each crossing type classified as impassable, passable, or indeterminate for Filter C; National Forests in Alabama, summer 2006 (N=72).

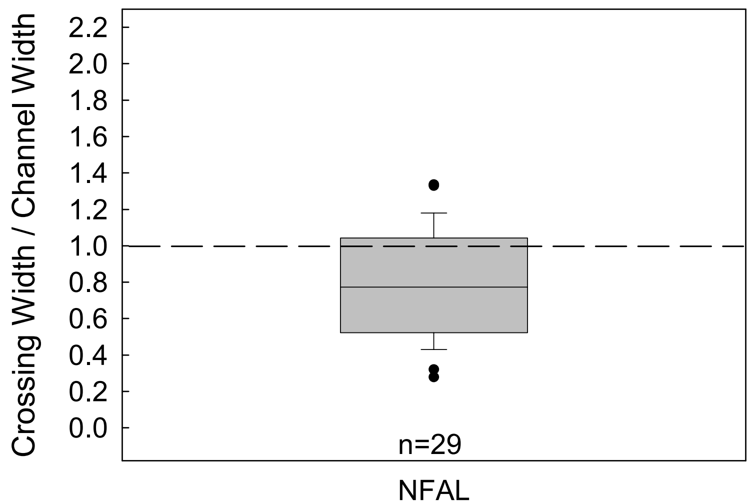


Figure C8. Crossing width to bankfull channel width ratio for crossings surveyed in summer 2006 on the National Forests in Alabama (excluding fords, vented fords, and multiple structure crossings). A ratio of 1.0 (dashed line) or greater indicates the crossing structure opening is greater than or equal to the bankfull channel width. The top and bottom of the boxes represent the 25th and 75th percentiles, the bar in the center of each box represents the median, whiskers represent the 10th and 90th percentiles, and closed circles represent the entire range of the data.

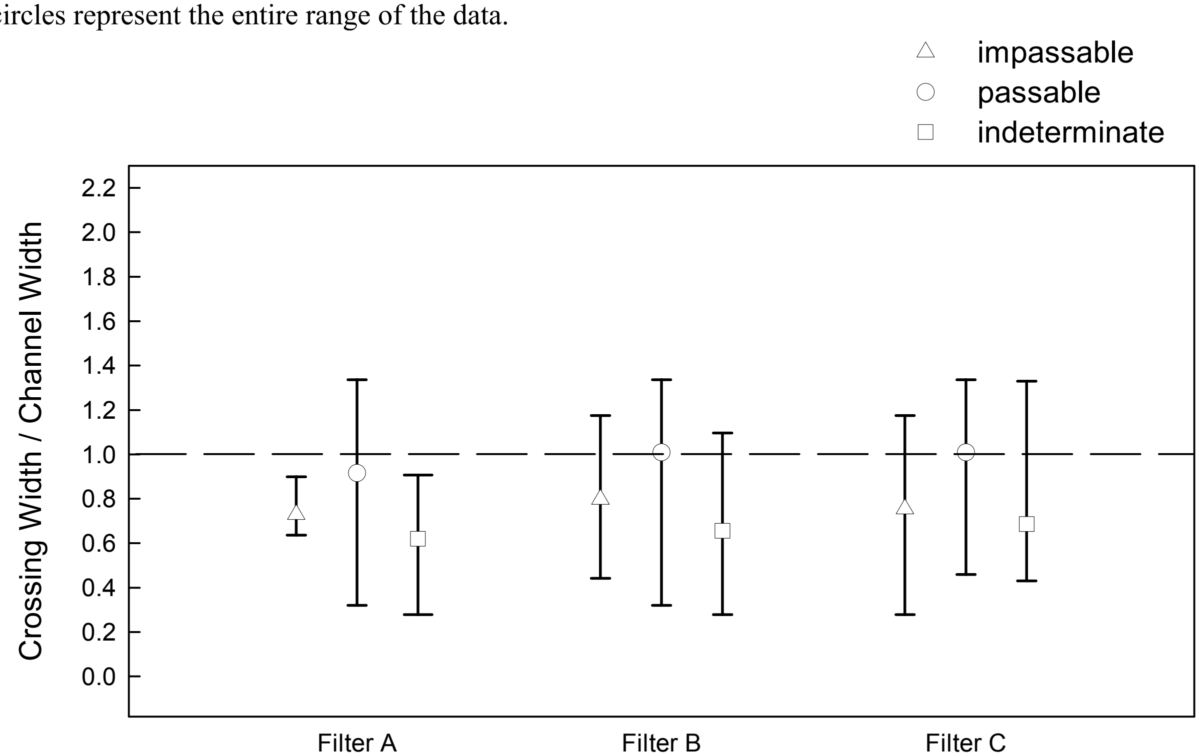


Figure C9. Crossing width to bankfull channel width ratio for crossings classified as impassable, passable, or indeterminate in summer 2006 on the National Forests in Alabama (excluding fords, vented fords, and multiple structure crossings). A ratio of 1.0 (dashed line) or greater indicates the crossing structure opening is greater than or equal to the bankfull channel width. The symbol inside each set of whiskers represents the median, and the top and bottom of the whiskers represent the maximum and minimum values.

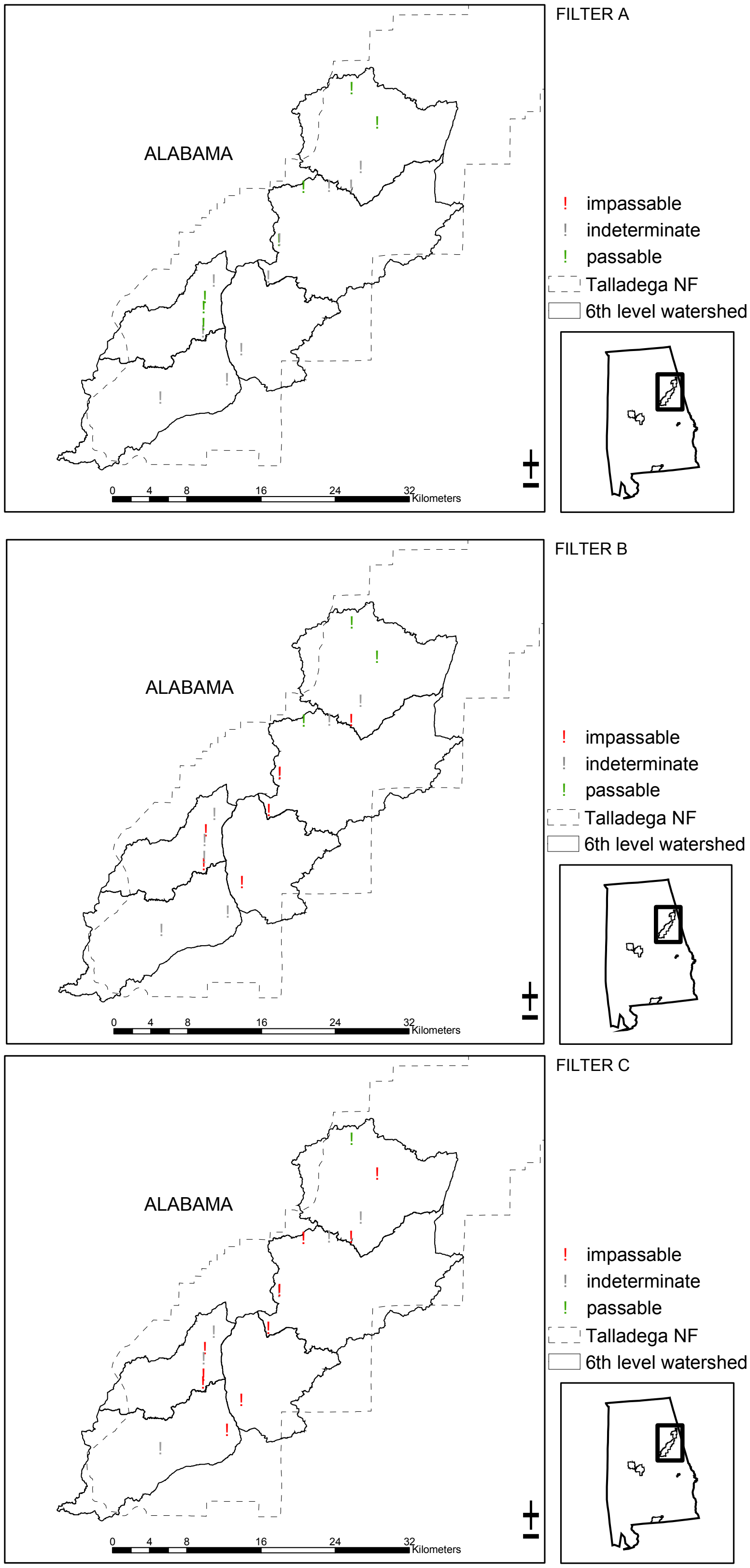
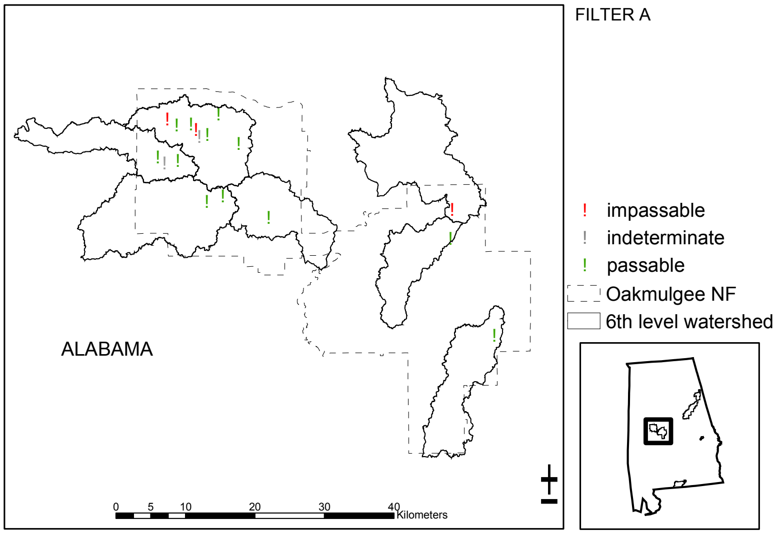
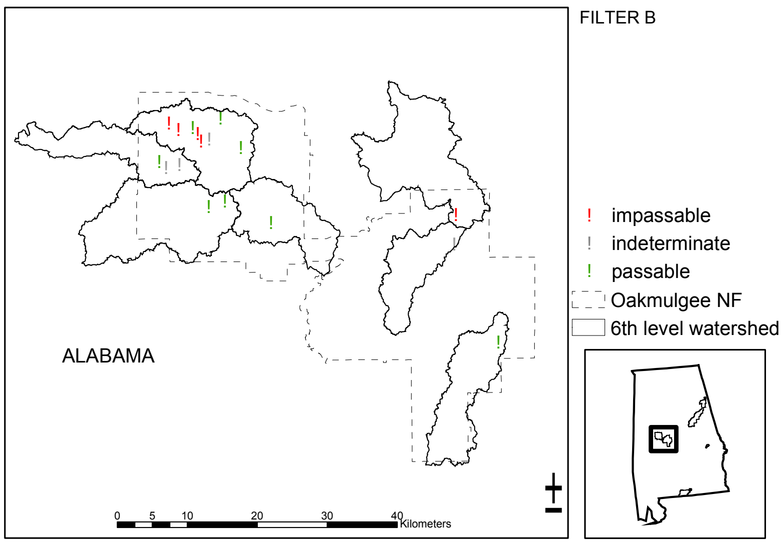


Figure C10. Location of crossings classified for fish passage by coarse filters A, B, and C within 6th level watersheds, on the Talladega National Forest Talladega Ranger District, summer 2006.





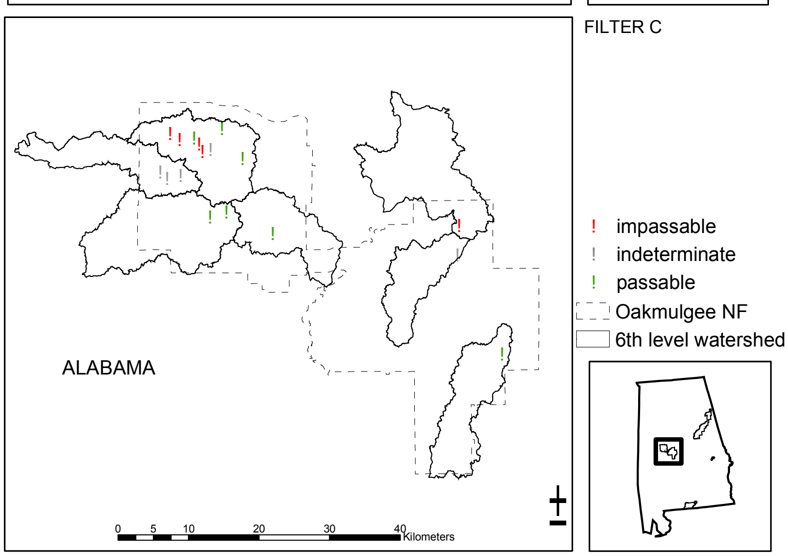


Figure C11. Location of crossings classified for fish passage by coarse filters A, B, and C within 6[th] level watersheds, on the Talladega National Forest Oakmulgee Ranger District, summer 2006.

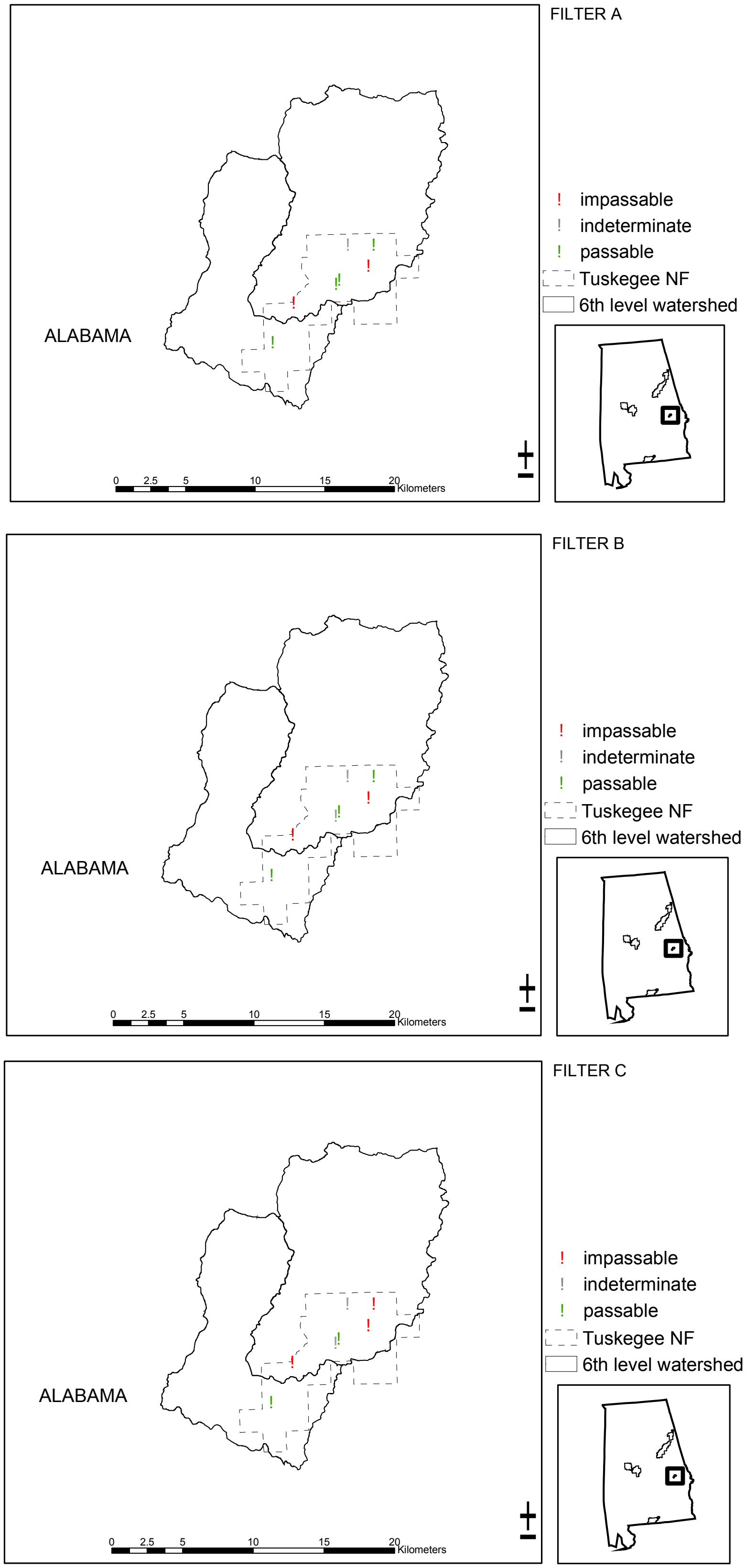


Figure C12. Location of crossings classified for fish passage by coarse filters A, B, and C within 6^{th} level watersheds, on the Tuskegee National Forest, summer 2006.

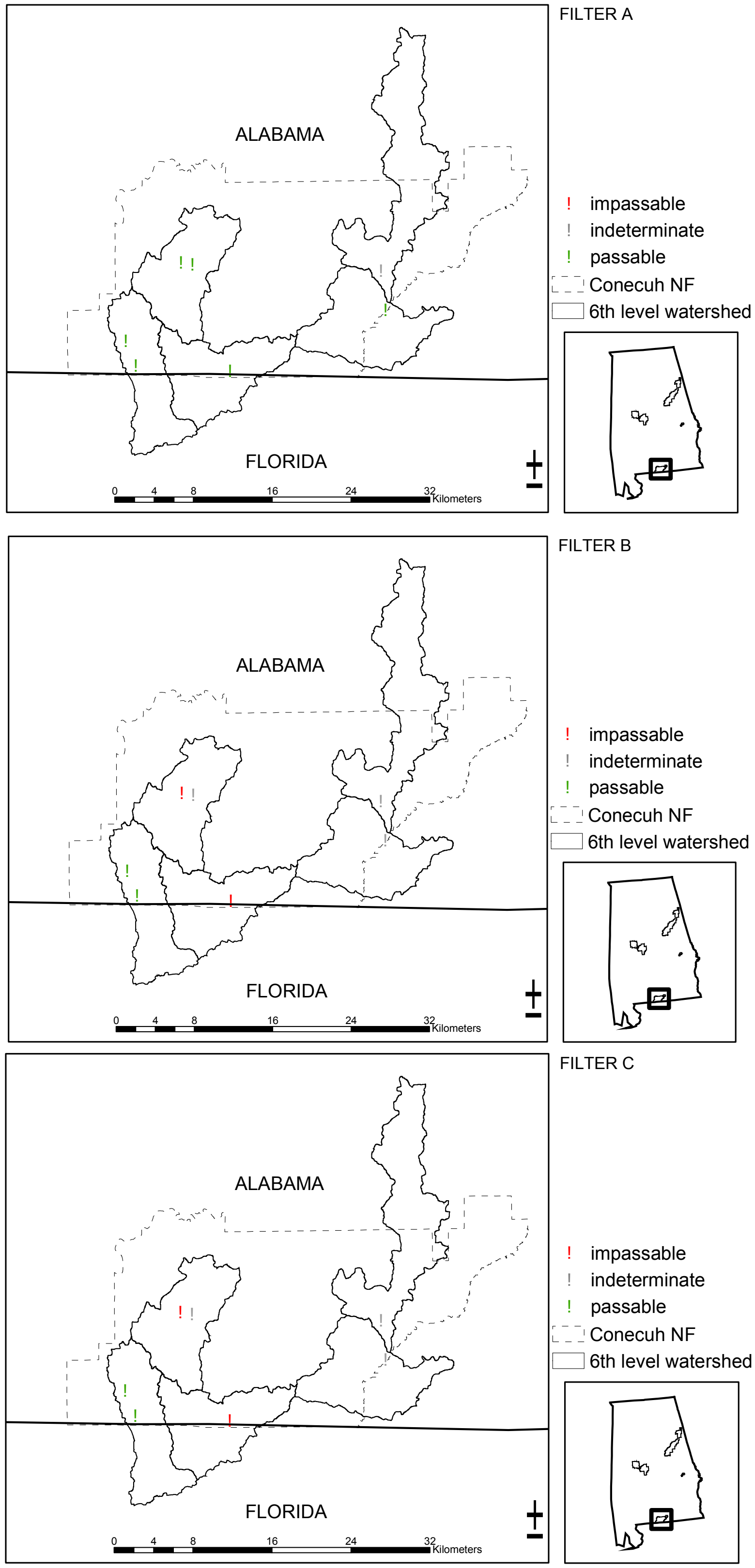


Figure C13. Location of crossings classified for fish passage by coarse filters A, B, and C within 6th level watersheds, on the Conecuh National Forest, summer 2006.

Table C1. Number of crossings documented (Total crossing documented) and not surveyed (Crossings not surveyed) on the National Forests in Alabama (Talladega, Tuskegee, and Conecuh NFs) in summer 2006. Reasons for not surveying a documented site include: no suitable fish habitat upstream of crossing (NH); no access to site due to closed roads or private gates (NA); crossing was a natural ford (NF); crossing was a bridge (BR).

Forest	Total crossings documented	Crossings not surveyed (n, [%])				
		NH	NA	NF	BR	Total not surveyed
NFAL	103	14 (45)	0 (0)	0 (0)	17 (55)	31 (30)

Table C2. Number of crossings surveyed (Total surveyed) with coarse filter results for the National Forests in Alabama (Talladega, Tuskegee, and Conecuh NFs) in summer 2006. Coarse filter results are presented for Filter A, Filter B, and Filter C (see filter descriptions, Fig 3 – 5).

Forest	Total surveyed	Coarse filter results								
		Impassable (n, [%])			Passable (n, [%])			Indeterminate (n, [%])		
		A	B	C	A	B	C	A	B	C
NFAL	72	7 (10)	26 (36)	33 (46)	36 (50)	21 (29)	15 (21)	29 (40)	25 (35)	24 (33)

Table C3. Location of crossings surveyed on the National Forests in Alabama during the summer of 2006. Site ID consists of the Forest abbreviation (CNF), road the crossing is on (337), and the distance (miles) from the junction road (1.1).

Site ID	# of Pipes	Forest #	District	Junction Road	Stream Name	Quad	6th Level Watershed
CNF337-1.1	1	5	Conecuh	24	Pond Creek	Wing	031401030303
CNF337-3.8	1	6	Conecuh	24	Tributary of the Yellow River	Wing	031401030401
CONF305-2.3	2	4	Conecuh	11	Wolf Pit Branch	Bradley	031401040102
CONF305-3.0	2	3	Conecuh	11	Bear Branch	Bradley	031401040102
CONF374-0.6	1	8	Conecuh	180	UT Boggy Hollow Creek	Bradley	031401040104
CONF346b-0.6	1	--	Conecuh	38	UT Rock Creek	Parker Springs	031401040106
CONF346b-1.4	2	9	Conecuh	11	Wagon Body Branch	Parker Springs	031401040106
TANF637-0.5	1	20	Talladega	103	Horse Creek	Ironaton	031501060608
TANF637-2.2	3	21	Talladega	103	Fayne Creek	Ironaton	031501060608
TNF385-1.5	3	42	Talladega	105	Tater Creek	Ironaton	031501060608
TNF637-3.2	3	28	Talladega	385	Cheaha Creek	Ironaton	031501060608
TANF308-0.9	2	45	Talladega	77	UT Blue Creek	Porter Gap	031501060701
TANF699-0.6	1	22	Talladega	77	Shepherd Branch	Porter Gap	031501060701
TANF699-0.8	1	31	Talladega	77	UT Shepherd Branch	Porter Gap	031501060701
TNF103-1.8	1	43	Talladega	310	Mump Creek	Ironaton	031501060701
TNF310-1.2	1	41	Talladega	103	UT Mump Creek	Ironaton	031501060701
TANF616-0.6	1	39	Talladega	607	UT Tallasseehatchee Creek	Bulls Gap	031501070201
TNF601-3.1	3	23	Talladega	148	UT Tallasseehatchee Creek	Sylacauga East	031501070201
TANF615-4.0	2	19	Talladega	607	Swept Creek	Porter Gap	031501070202
TNF615-1.1	2	26	Talladega	615L	UT Swept Creek	Porter Gap	031501070202
TNF615-2.9	3	25	Talladega	615L	UT Emanhee Creek	Porter Gap	031501070202
TNF615-3.6	2	24	Talladega	615L	UT Emanhee Creek	Porter Gap	031501070202
TNFcr-0.6	2	40	Talladega	615	Smelley Creek	Porter Gap	031501070202
TANF662A-0.7	2	29	Talladega	7	UT Hatchet Creek	Bulls Gap	031501070801
TKNF905-0.1	1	49	Tuskegee	906	UT Choctafaula Creek	Little Texas	031501100401

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Site ID	Pipe #	Forest #	District	Junction Road	Stream Name	Quad	6th Level Watershed
TKNF905-0.3	1	50	Tuskegee	906	UT Choctafaula Creek	Little Texas	031501100401
TKNF910-0.9	3	54	Tuskegee	54	Hodnett Creek	Loachapoka	031501100401
TKNF916-0.7	2	57	Tuskegee	908	UT Choctafaula Creek	Little Texas	031501100401
TUNF900-0.9	1	48	Tuskegee	913	UT Choctafaula Creek	Tuskegee	031501100401
TUNFcr54-1.0	1	58	Tuskegee	915	UT Choctafaula Creek	Loachapoka	031501100401
TUNF937-0.1	1	56	Tuskegee	29	UT Uphapee Creek	Tuskegee	031501100402
ONF29/35-1.5	1	73	Oakmulgee	82	Little Creek	Centreville East	031502020503
ONFyaeger-.001	3	78	Oakmulgee	44	Miller Branch	Pondville	031502020506
ONF35-0.2	1	76	Oakmulgee	19	UT Beaverdam Creek	Oakmulgee	031502020801
ONF421-1.9	1	59	Oakmulgee	426	Little Oakmulgee Creek	Plantersville	031502020804
TANF707-1.8	1	--	Oakmulgee	731	UT Elliots Creek	Payne Lake	031601130202
TANF707-2.5	1	62	Oakmulgee	731	UT South Sandy Creek	Payne Lake	031601130202
TANF707-4.5	1	61	Oakmulgee	731	UT South Sandy Creek	Duncanville	031601130202
TANF707-5.6	2	60	Oakmulgee	731	UT South Sandy Creek	Duncanville	031601130202
TANF726-0.4	1	67	Oakmulgee	721	UT Wiggins Creek	Duncanville	031601130202
TANF731-1.2	1	69	Oakmulgee	726	UT Ragland Branch	Pondville	031601130202
TANF751-2.0	1	70	Oakmulgee	726	UT Wiggins Creek	Payne Lake	031601130202
TANF751-3.5	1	72	Oakmulgee	726	UT South Sandy Creek	Duncanville	031601130202
TANF50-0.6	1	74	Oakmulgee	49	UT Elliots Creek	Payne Lake	031601130301
TANF50-2.6	1	75	Oakmulgee	49	UT Elliots Creek	Payne Lake	031601130301
TANF708-0.2	1	63	Oakmulgee	50	UT Elliots Creek	Payne Lake	031601130301
TANF715-1.6	1	66	Oakmulgee	726	UT Fivemile Creek	Payne Lake	031601130401
TANF726-0.7	2	68	Oakmulgee	25	UT Fivemile Creek	Payne Lake	031601130401

Table C4. Coarse filters A, B, and C, classifications for surveyed crossings on the National Forests in Alabama, summer 2006.

Site ID	Pipe #	Forest #	Filter A	Filter B	Filter C
CNF337-1.1	1	5	indeterminate	indeterminate	indeterminate
CNF337-3.8	1	6	passable	indeterminate	indeterminate
CONF305-2.3	1	4	indeterminate	impassable	impassable
CONF305-2.3	2	4	indeterminate	impassable	impassable
CONF305-3.0	1	3	indeterminate	indeterminate	indeterminate
CONF305-3.0	2	3	indeterminate	indeterminate	indeterminate
CONF374-0.6	1	8	passable	impassable	impassable
CONF346b-0.6	1	--	passable	passable	passable
CONF346b-1.4	1	9	passable	passable	passable
CONF346b-1.4	2	9	passable	indeterminate	indeterminate
TANF637-0.5	1	20	indeterminate	indeterminate	indeterminate
TANF637-2.2	1	21	indeterminate	impassable	impassable
TANF637-2.2	2	21	indeterminate	impassable	impassable
TANF637-2.2	3	21	indeterminate	impassable	impassable
TNF385-1.5	1	42	passable	passable	passable
TNF385-1.5	2	42	passable	passable	passable
TNF385-1.5	3	42	passable	passable	passable
TNF637-3.2	1	28	passable	passable	impassable
TNF637-3.2	2	28	passable	passable	impassable
TNF637-3.2	3	28	passable	passable	impassable
TANF308-0.9	1	45	indeterminate	impassable	impassable
TANF308-0.9	2	45	indeterminate	impassable	impassable
TANF699-0.6	1	22	passable	indeterminate	indeterminate
TANF699-0.8	1	31	indeterminate	impassable	impassable
TNF103-1.8	1	43	indeterminate	indeterminate	indeterminate
TNF310-1.2	1	41	passable	passable	impassable
TANF616-0.6	1	39	indeterminate	indeterminate	impassable
TNF601-3.1	3	23	indeterminate	indeterminate	indeterminate
TANF615-4.0	1	19	indeterminate	indeterminate	impassable
TANF615-4.0	2	19	passable	impassable	impassable
TNF615-1.1	1	26	indeterminate	impassable	impassable
TNF615-1.1	2	26	indeterminate	impassable	impassable
TNF615-2.9	1	25	passable	indeterminate	indeterminate
TNF615-2.9	2	25	passable	indeterminate	indeterminate
TNF615-2.9	3	25	indeterminate	impassable	impassable
TNF615-3.6	1	24	passable	impassable	impassable
TNF615-3.6	2	24	passable	impassable	impassable
TNFcr-0.6	1	40	indeterminate	indeterminate	indeterminate
TNFcr-0.6	2	40	indeterminate	indeterminate	indeterminate

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Site ID	Pipe #	Forest #	Filter A	Filter B	Filter C
TANF662A-0.7	1	29	indeterminate	impassable	impassable
TANF662A-0.7	2	29	indeterminate	impassable	impassable
TKNF905-0.1	1	49	passable	passable	passable
TKNF905-0.3	1	50	passable	indeterminate	indeterminate
TKNF910-0.9	1	54	indeterminate	indeterminate	indeterminate
TKNF910-0.9	2	54	indeterminate	indeterminate	indeterminate
TKNF910-0.9	3	54	indeterminate	indeterminate	indeterminate
TKNF916-0.7	1	57	impassable	impassable	impassable
TKNF916-0.7	2	57	impassable	impassable	impassable
TUNF900-0.9	1	48	impassable	impassable	impassable
TUNFcr54-1.0	1	58	passable	indeterminate	impassable
TUNF937-0.1	1	56	passable	passable	passable
ONF29/35-1.5	1	73	impassable	impassable	impassable
ONFyaeger-.001	1	78	passable	indeterminate	indeterminate
ONFyaeger-.001	2	78	passable	passable	passable
ONFyaeger-.001	3	78	passable	passable	passable
ONF35-0.2	1	76	indeterminate	indeterminate	indeterminate
ONF421-1.9	1	59	passable	passable	passable
TANF707-1.8	1	--	indeterminate	impassable	impassable
TANF707-2.5	1	62	impassable	impassable	impassable
TANF707-4.5	1	61	passable	impassable	impassable
TANF707-5.6	1	60	impassable	impassable	impassable
TANF707-5.6	2	60	impassable	impassable	impassable
TANF726-0.4	1	67	passable	passable	passable
TANF731-1.2	1	69	passable	passable	passable
TANF751-2.0	1	70	passable	indeterminate	indeterminate
TANF751-3.5	1	72	passable	passable	passable
TANF50-0.6	1	74	passable	indeterminate	indeterminate
TANF50-2.6	1	75	passable	passable	indeterminate
TANF708-0.2	1	63	indeterminate	indeterminate	indeterminate
TANF715-1.6	1	66	passable	passable	passable
TANF726-0.7	1	68	passable	passable	passable
TANF726-0.7	2	68	passable	passable	indeterminate

Table C5. Description of crossings surveyed on the National Forests in Alabama, summer 2006. Shape abbreviations: C= circular, PA= pipe arch, OBA= open bottom arch, V= vented ford, B= box, and F= ford. Channel width is the mean bankfull channel width. N= no natural substrate, N (discontin)= discontinuous substrate, Y= continuous natural substrate. An NA (not applicable) indicates outlet drop (no outlet pool or tailwater control) or outlet perch (stream dry) could not be calculated. Negative outlet drop or perch values indicate a submerged outlet (structure partially backwatered). Residual inlet depth values ≥ 0.0 indicate the structure is fully backwatered.

Site ID	Pipe #	Forest #	Shape	Pipe Condition	Mean Chnl Width (ft)	Continuous Substrate in Structure	Pipe Slope (%)	Pipe Width : Chnl Width ratio	Outlet Drop (in)	Outlet Perch (in)	Residual Inlet Depth (in)	Pipe Length (ft)	Slope (%) * Length (ft)
CNF337-1.1	1	5	C	fair	11.2	N	2.97	0.49	NA	-28.80	0.00	34.0	101.0
CNF337-3.8	1	6	C	poor	6.9	N	1.06	0.72	NA	1.32	0.00	36.0	38.0
CONF305-2.3	1	4	PA	good	6.0	N	1.83	1.01	14.76	-2.04	0.00	68.7	126.0
CONF305-2.3	2	4	PA	good	6.0	N	1.54	1.01	17.88	-1.56	0.00	64.8	100.0
CONF305-3.0	1	3	PA	fair	NA	N	1.48	NA	NA	-18.36	0.00	53.3	79.0
CONF305-3.0	2	3	PA	fair	NA	N	1.06	NA	NA	-15.96	0.00	53.0	56.0
CONF374-0.6	1	8	PA	fair	6.4	N	0.29	1.17	15.48	14.16	0.00	48.1	14.0
CONF346b-0.6	1	--	PA	fair	4.1	N	0.39	1.10	1.02	-1.32	0.72	37.5	14.5
CONF346b-1.4	1	9	PA	fair	4.8	N	0.95	0.73	-12.6	-10.56	7.92	41.0	39.0
CONF346b-1.4	2	9	PA	fair	4.8	N	0.63	0.73	-0.72	-6.72	0.00	41.0	26.0
TANF637-0.5	1	20	C	good	7.1	N	2.01	0.77	-6.00	-6.84	0.00	54.6	110.0
TANF637-2.2	1	21	C	fair	17.7	N	1.57	0.40	18.48	18.00	0.00	36.4	57.0
TANF637-2.2	2	21	C	fair	17.7	N	1.54	0.40	17.76	15.96	0.00	36.4	56.0
TANF637-2.2	3	21	C	fair	17.7	N	2.06	0.40	17.10	15.00	0.00	36.4	75.0
TNF385-1.5	2	42	B	good	20.8	Y	0.13	0.67	NA	1.92	0.00	39.2	5.0
TNF385-1.5	3	42	B	good	20.8	Y	0.64	0.67	NA	5.52	0.00	41.9	27.0
TNF637-3.2	1	28	VF	good	42.3	N (discontin)	0.57	0.07	8.76	2.40	0.00	44.1	25.0
TNF637-3.2	2	28	VF	good	42.3	N	0.28	0.07	8.64	2.04	0.00	43.1	12.0
TNF637-3.2	3	28	VF	good	42.3	N	0.46	0.07	9.00	0.36	0.00	45.6	21.0
TANF308-0.9	1	45	C	fair	7.0	N	2.83	0.29	20.52	15.06	0.00	39.2	111.0
TANF308-0.9	2	45	C	fair	7.0	N	3.23	0.29	10.44	8.04	0.00	39.2	5.0

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Site ID	Pipe #	Forest #	Shape	Pipe Condition	Mean Chnl Width (ft)	Continuous Substrate in Structure	Pipe Slope (%)	Pipe Width : Chnl Width ratio	Outlet Drop (in)	Outlet Perch (in)	Residual Inlet Depth (in)	Pipe Length (ft)	Slope (%) * Length (ft)
TANF699-0.6	1	22	B	good	13.5	N	1.15	0.45	-2.76	-3.60	0.00	35.6	41.0
TANF699-0.8	1	31	PA	good	6.4	N	5.39	0.91	-0.84	16.32	0.00	46.6	251.0
TNF103-1.8	1	43	C	good	7.0	N	3.22	0.55	0.24	-1.08	0.00	43.8	141.0
TNF310-1.2	1	41	C	poor	6.2	N (discontin)	0.53	0.32	9.00	7.92	0.00	32.1	17.0
TANF616-0.6	1	39	C	poor	10.8	N	2.99	0.28	-1.80	31.56	0.00	62.2	186.0
TNF601-3.1	3	23	C	fair	6.8	N	2.68	0.37	-2.64	-5.40	0.00	25.0	67.0
TANF615-4.0	1	19	PA	fair	10.6	N	1.46	0.71	7.32	3.24	0.00	42.5	62.0
TANF615-4.0	2	19	PA	fair	10.6	N	0.76	0.71	10.02	6.36	0.00	42.5	32.5
TNF615-1.1	1	26	C	poor	8.0	N	2.06	0.63	13.68	12.36	0.00	36.0	74.0
TNF615-1.1	2	26	C	poor	8.0	N	1.63	0.63	15.24	10.92	0.00	36.3	59.0
TNF615-2.9	1	25	C	poor	11.8	N	2.24	0.25	0.00	-0.48	0.00	14.7	33.0
TNF615-2.9	2	25	C	poor	11.8	N	3.33	0.25	-3.00	-3.48	0.00	14.7	49.0
TNF615-2.9	3	25	C	poor	11.8	N	3.51	0.25	-2.88	-3.36	0.00	14.8	52.0
TNF615-3.6	1	24	PA	fair	9.6	N	0.00	0.64	12.00	11.04	0.00	32.1	0.0
TNF615-3.6	2	24	PA	fair	9.6	N	0.72	0.64	11.52	10.18	0.00	32.1	23.0
TNFcr-0.6	1	40	PA	fair	13.4	N	1.65	0.57	2.16	2.16	0.00	40.1	66.0
TNFcr-0.6	2	40	PA	fair	13.4	N	1.64	0.57	2.16	1.68	0.00	40.2	66.0
TNF662A-0.7	1	29	C	fair	7.0	N	3.09	0.58	10.68	17.28	0.00	31.1	96.0
TNF662A-0.7	2	29	C	fair	7.0	N	2.83	0.58	10.98	12.06	0.00	31.3	88.5
TKNF905-0.1	1	49	PA	fair	9.3	Y	0.73	0.64	NA	-1.56	0.00	36.9	27.0
TKNF905-0.3	1	50	PA	fair	8.0	N	1.04	0.63	NA	1.86	0.00	39.0	40.5
TKNF910-0.9	1	54	C	good	36.9	N	2.08	0.08	3.54	6.60	0.00	35.5	74.0
TKNF910-0.9	2	54	C	good	36.9	N	2.03	0.08	3.54	6.06	0.00	35.5	72.0
TKNF910-0.9	3	54	C	good	36.9	N	1.92	0.08	3.54	5.40	0.00	35.5	68.0
TKNF916-0.7	1	57	PA	fair	10.3	N	1.47	0.54	NA	27.18	0.00	38.4	56.5
TKNF916-0.7	2	57	PA	fair	10.3	N	1.90	0.48	NA	28.14	0.00	38.4	73.0

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Site ID	Pipe #	Forest #	Shape	Pipe Condition	Mean Chnl Width (ft)	Continuous Substrate in Structure	Pipe Slope (%)	Pipe Width : Chnl Width ratio	Outlet Drop (in)	Outlet Perch (in)	Residual Inlet Depth (in)	Pipe Length (ft)	Slope (%) * Length (ft)
TUNF900-0.9	1	48	C	fair	6.7	N	2.54	0.90	46.20	47.52	0.00	54.4	138.0
TUNFcr54-1.0	1	58	B	good	7.7	N	0.87	0.78	7.56	7.56	0.00	42.1	36.5
TUNF937-0.1	1	56	C	good	6.5	Y	0.19	0.46	-0.60	1.08	0.00	27.0	5.0
ONF29/35-1.5	1	73	B	fair	13.7	N	0.38	0.73	43.32	24.12	0.00	55.5	21.0
ONFyaeger-.001	1	78	C	fair	11.8	N	0.84	0.26	1.56	1.08	0.00	31.1	26.0
ONFyaeger-.001	2	78	C	fair	11.8	N	0.13	0.26	1.68	-1.92	0.00	31.1	4.0
ONFyaeger-.001	3	78	C	fair	11.8	N	0.26	0.26	3.48	-2.64	0.00	31.1	8.0
ONF35-0.2	1	76	C	good	8.0	N	1.93	0.69	1.32	0.24	0.00	39.8	77.0
ONF421-1.9	1	59	B	good	9.0	N (discontin)	0.14	1.34	-6.00	-9.24	6.36	20.8	3.0
TANF707-1.8	1	--	PA	fair	6.0	N	4.00	0.80	9.72	7.68	0.00	40.3	161.0
TANF707-2.5	1	62	C	good	4.7	N	2.57	0.64	34.02	27.72	0.00	38.9	100.0
TANF707-4.5	1	61	C	fair	5.7	N	0.40	0.44	13.80	8.40	0.00	25.0	10.0
TANF707-5.6	1	60	PA	good	9.8	N	2.50	0.61	60.60	55.68	0.00	45.6	114.0
TANF707-5.6	2	60	PA	good	9.8	N	5.61	0.61	44.64	34.20	0.00	45.0	252.5
TANF726-0.4	1	67	PA	good	7.7	N (discontin)	0.29	0.92	-0.12	-2.88	0.00	52.8	15.5
TANF731-1.2	1	69	C	poor	3.0	N	0.30	1.18	-1.32	5.16	0.30	28.0	8.5
TANF751-2.0	1	70	C	good	6.4	N	0.56	1.10	0.00	-2.16	0.00	60.7	34.0
TANF751-3.5	1	72	PA	fair	5.5	Y	0.30	0.91	-0.78	-2.88	0.00	26.9	8.0
TANF50-0.6	1	74	B	good	6.1	Y	0.72	0.99	NA	-4.20	0.00	54.1	39.0
TANF50-2.6	1	75	B	fair	4.5	Y	0.46	1.33	NA	-1.32	0.00	54.6	25.0
TANF708-0.2	1	63	C	fair	4.7	N	2.00	0.43	2.88	1.20	0.00	51.5	103.0
TANF715-1.6	1	66	PA	good	5.0	Y	0.67	1.10	NA	-2.64	0.00	37.5	25.0
TANF726-0.7	1	68	C	fair	4.9	N	0.02	0.62	NA	-1.32	0.00	43.0	1.0
TANF726-0.7	2	68	C	fair	4.9	N	0.49	0.62	NA	1.92	0.00	42.6	21.0

Appendix D: Results for the Francis Marion-Sumter National Forest

We completed surveys at 91 (76%) of 120 documented crossing structures on the Long Cane and Andrew Pickens Ranger Districts in 2006 (Figure D1, Tables D1 and D2). Filter A (strong swimmers and leapers) classified 4% (n=4) of crossings as impassable, 64% (n=58) as passable, and 32% (n=29) as indeterminate (Figure D2, Table D2). Filter B (moderate swimmers and leapers) classified 20% (n=18) of crossings as impassable, 46% (n=42) as passable, and 34% (n=31) as indeterminate (Figure D3, Table D2). Filter C (weak swimmers and leapers) classified 36% (n=33) of crossings as impassable, 42% (n=38) as passable, and 22% (n=20) as indeterminate (Figure D4, Table D2). Characteristics and filter classifications for each crossing are presented in Tables D3-D5.

The majority of the crossings surveyed were circular culverts (68%, n=62), while vented fords (10%, n=9), open bottom arches (10%, n=9), pipe arches (7%, n=6), box culverts (3%, n=3), and fords (2%, n=2) were less frequently encountered. Filter A classified 2% of circular culverts, 0% of vented fords, open bottom arches, and pipe arches, and 33% of box culverts as impassable (Figure D5). Filter B classified 21% of circular culverts, 0% of vented fords and open bottom arches, 17% of pipe arches, and 67% of box culverts as impassable (Figure D6). Filter C classified 37% of circular culverts, 22% of vented fords, 0% of open bottom arches, 50% of pipe arches, and 100% of box culverts as impassable (Figure D7). The 2 fords surveyed were impassable for all 3 filters. The mean crossing width to channel width ratio (excluding fords, vented fords, and multiple structure crossings) was 0.76 ± 0.35 (mean ± SD) (n=63), and 17 crossings were greater than or equal to the bankfull channel width (Figure D8). The mean crossing width to channel width ratio for surveyed crossings classified impassable by Filter A was 1.22 ± 0.00 (n=1). The mean ratio for crossings classified impassable by Filter B was 0.73 ±0.25 (n=13), and was 0.65 ± 0.27 (n=22) for Filter C (Figure D9). The mean crossing width to channel width ratio for surveyed crossings classified passable by Filter A was 0.79 ± 0.39 (n=39). The mean ratio for crossings classified passable by Filter B was 0.83 ±0.42 (n=28), and was 0.86 ± 0.41 (n=26) for Filter C (Figure D9).

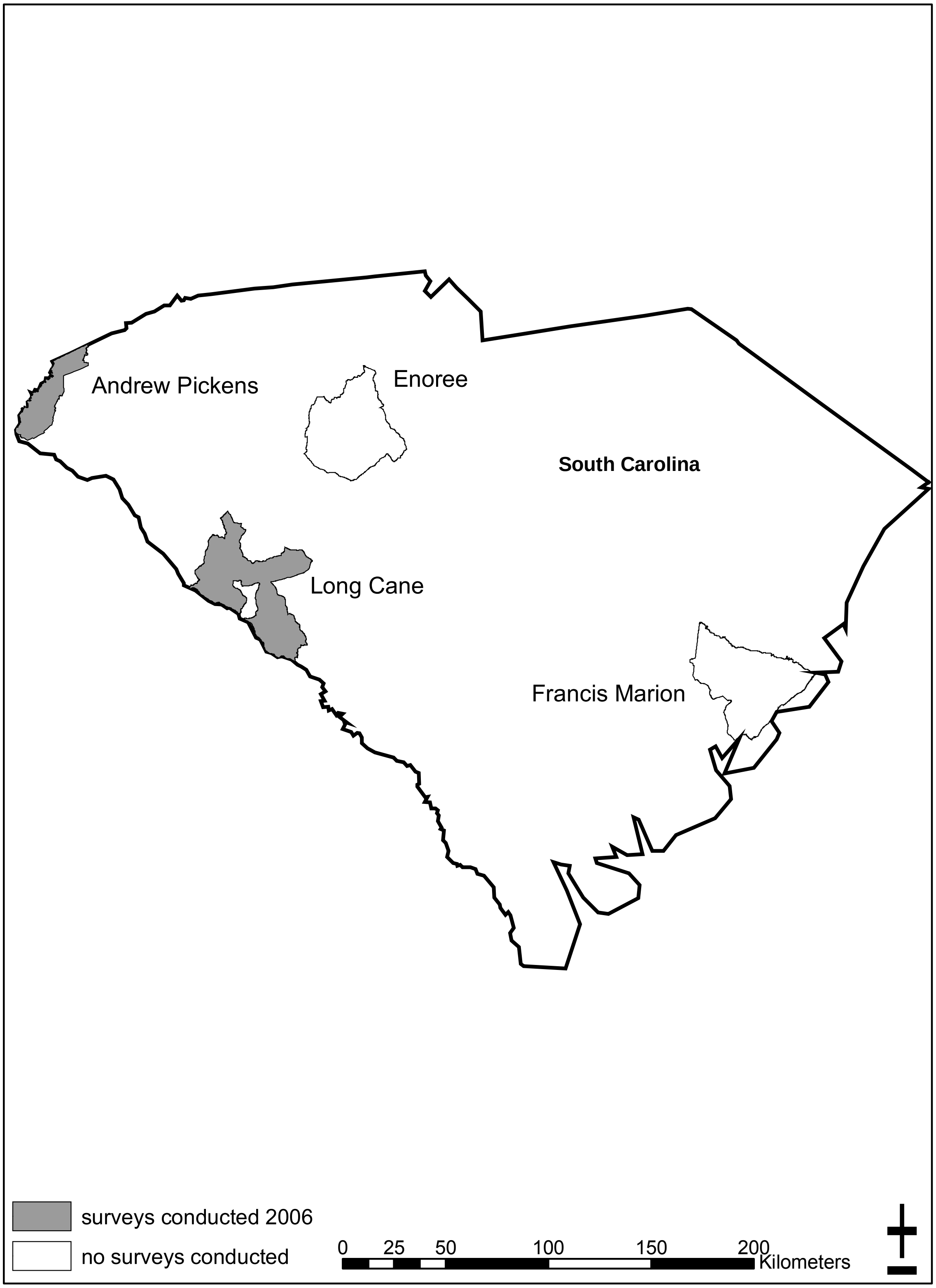

Figure D1. Ranger Districts on the Francis Marion-Sumter National Forest road-stream crossing surveys were conducted, April 2006.

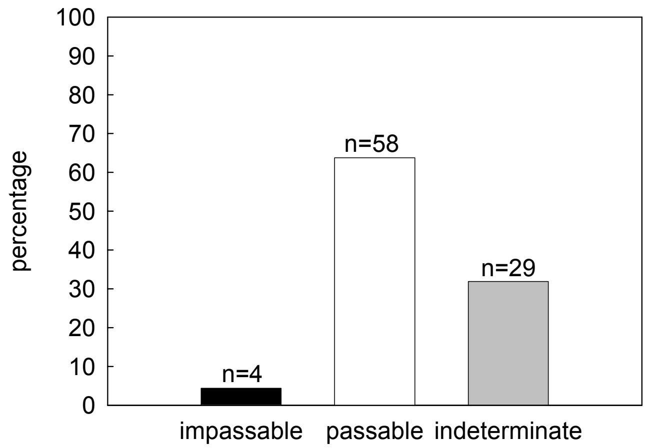

Figure D2. Percentage of crossings classified as impassable, passable, or indeterminate for Filter A; Francis Marion-Sumter National Forest, April 2006 (N=91).

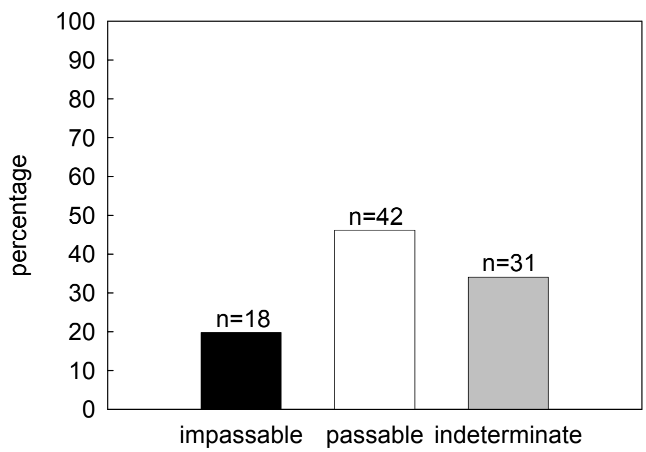

Figure D3. Percentage of crossings classified as impassable, passable, or indeterminate for Filter B; Francis Marion-Sumter National Forest, April 2006 (N=91).

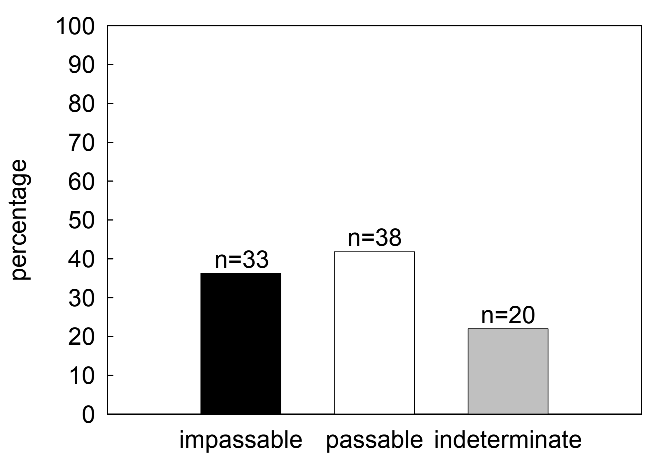

Figure D4. Percentage of crossings classified as impassable, passable, or indeterminate for Filter C; Francis Marion-Sumter National Forest, April 2006 (N=91).

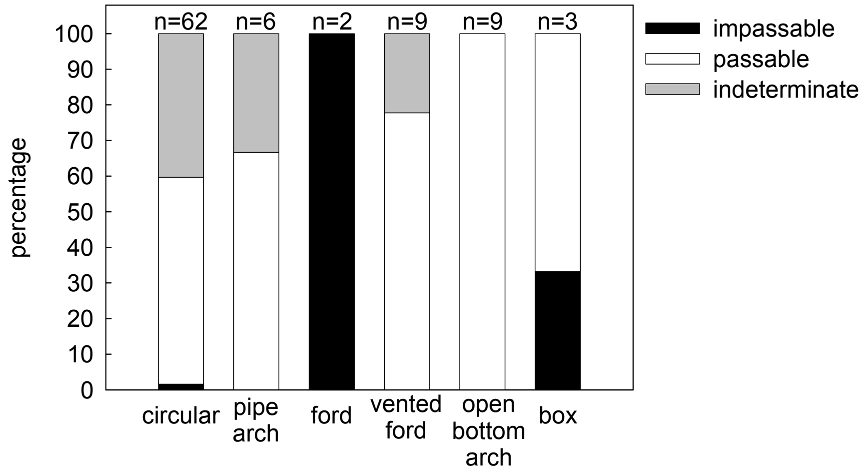

Figure D5. Percentage of each crossing type classified as impassable, passable, or indeterminate for Filter A; Francis Marion-Sumter National Forest, April 2006 (N=91).

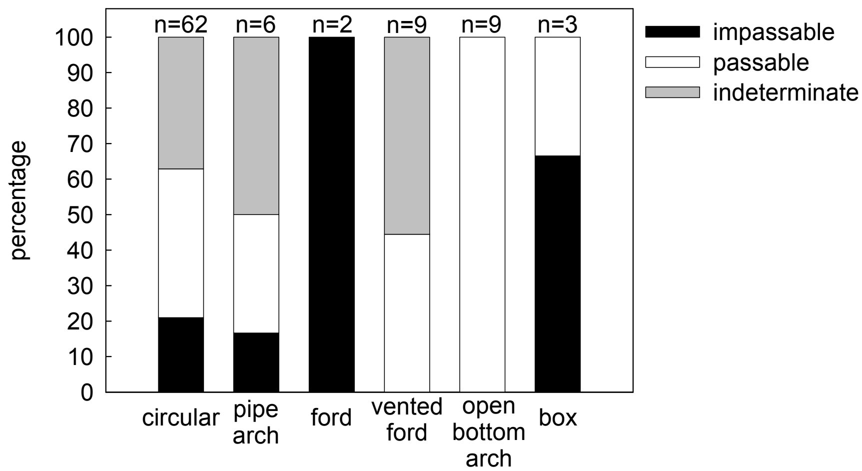

Figure D6. Percentage of each crossing type classified as impassable, passable, or indeterminate for Filter B; Francis Marion-Sumter National Forest, April 2006 (N=91).

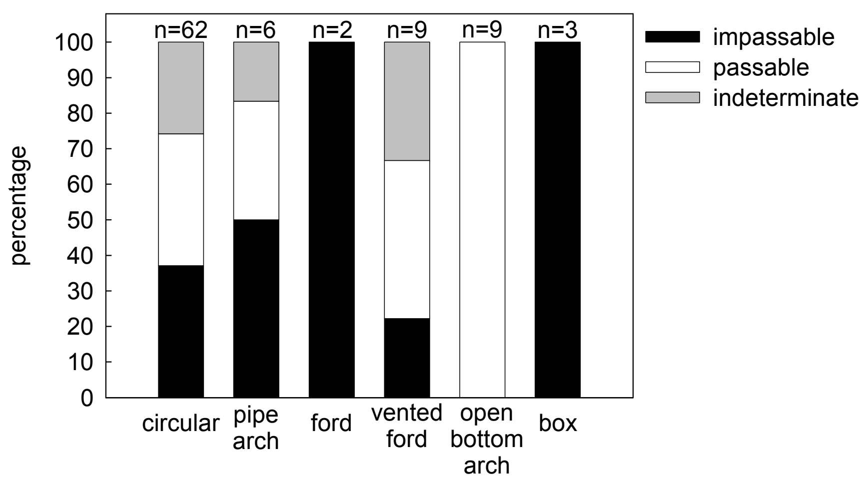

Figure D7. Percentage of each crossing type classified as impassable, passable, or indeterminate for Filter C; Francis Marion-Sumter National Forest, April 2006 (N=91).

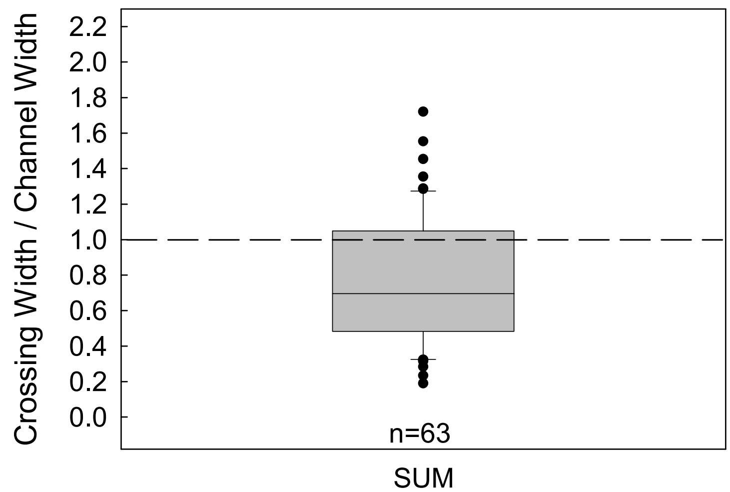

Figure D8. Crossing width to bankfull channel width ratio for crossings surveyed in April 2006 on the Francis Marion-Sumter National Forest (excluding fords, vented fords, and multiple structure crossings). A ratio of 1.0 (dashed line) or greater indicates the crossing structure opening is greater than or equal to the bankfull channel width. The top and bottom of the boxes represent the 25th and 75th percentiles, the bar in the center of each box represents the median, whiskers represent the 10th and 90th percentiles, and closed circles represent the entire range of the data.

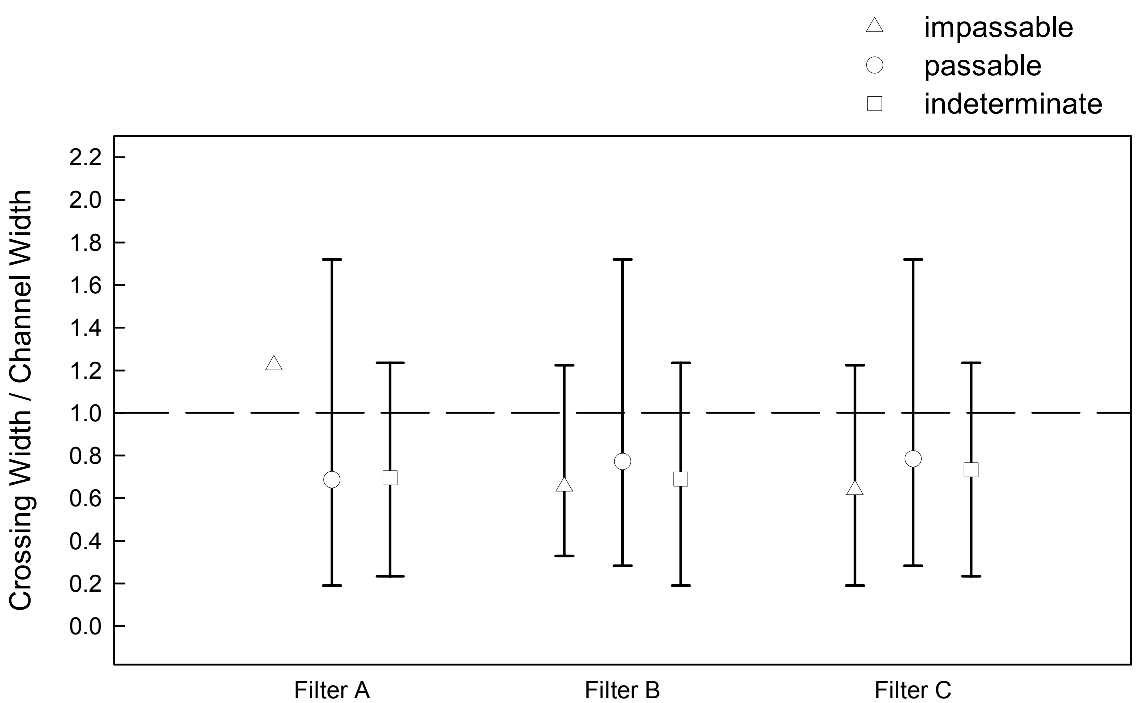

Figure D9. Crossing width to bankfull channel width ratio for crossings classified as impassable, passable, or indeterminate in April 2006 on the Francis Marion-Sumter National Forest (excluding fords, vented fords, and multiple structure crossings). A ratio of 1.0 (dashed line) or greater indicates the crossing structure opening is greater than or equal to the bankfull channel width. The symbol inside each set of whiskers represents the median, and the top and bottom of the whiskers represent the maximum and minimum values.

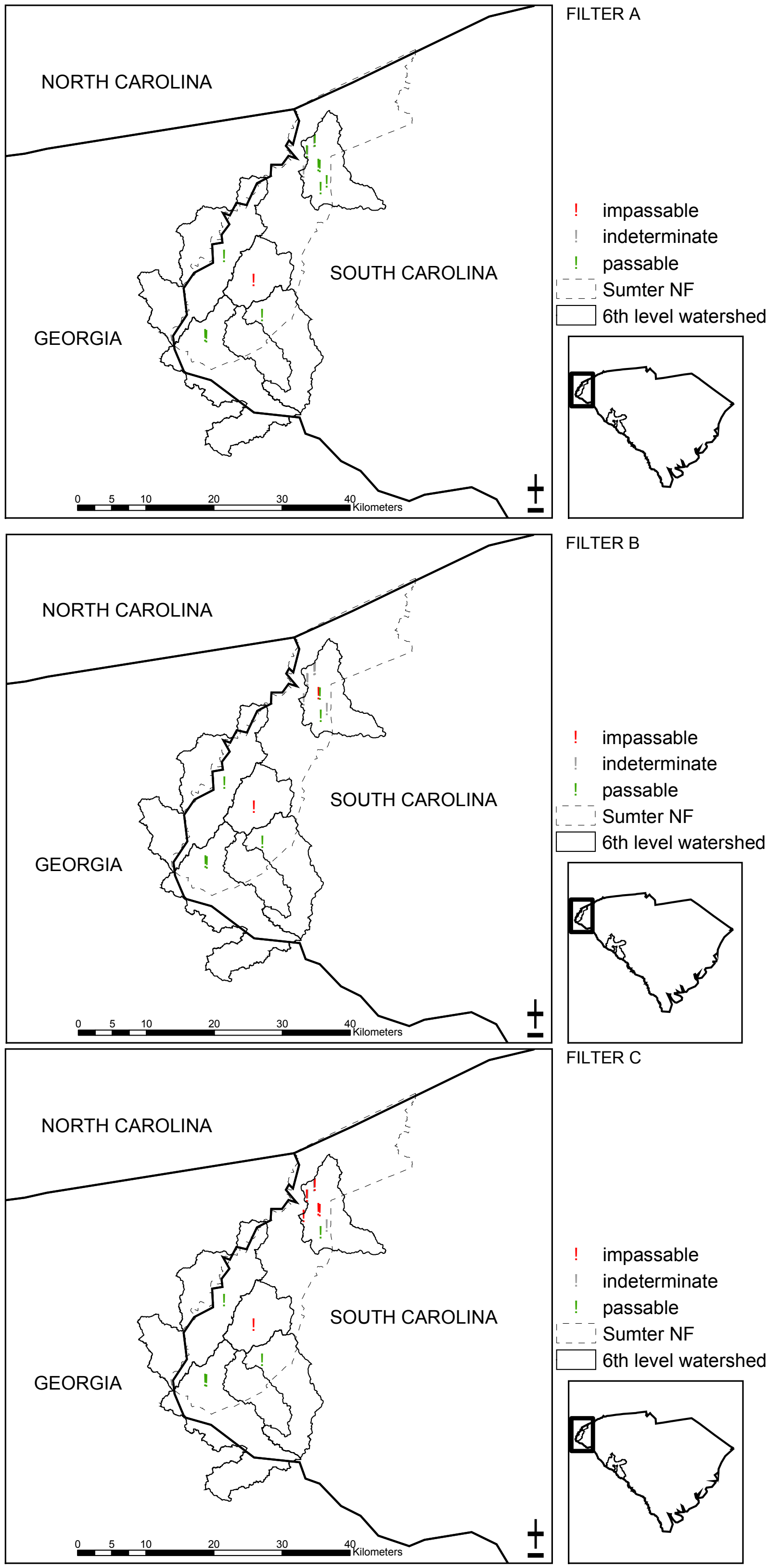

Figure D10. Location of crossings classified for fish passage by coarse filters A, B, and C within 6th level watersheds on the Francis Marion-Sumter National Forest Andrew Pickens Ranger District, April 2006.

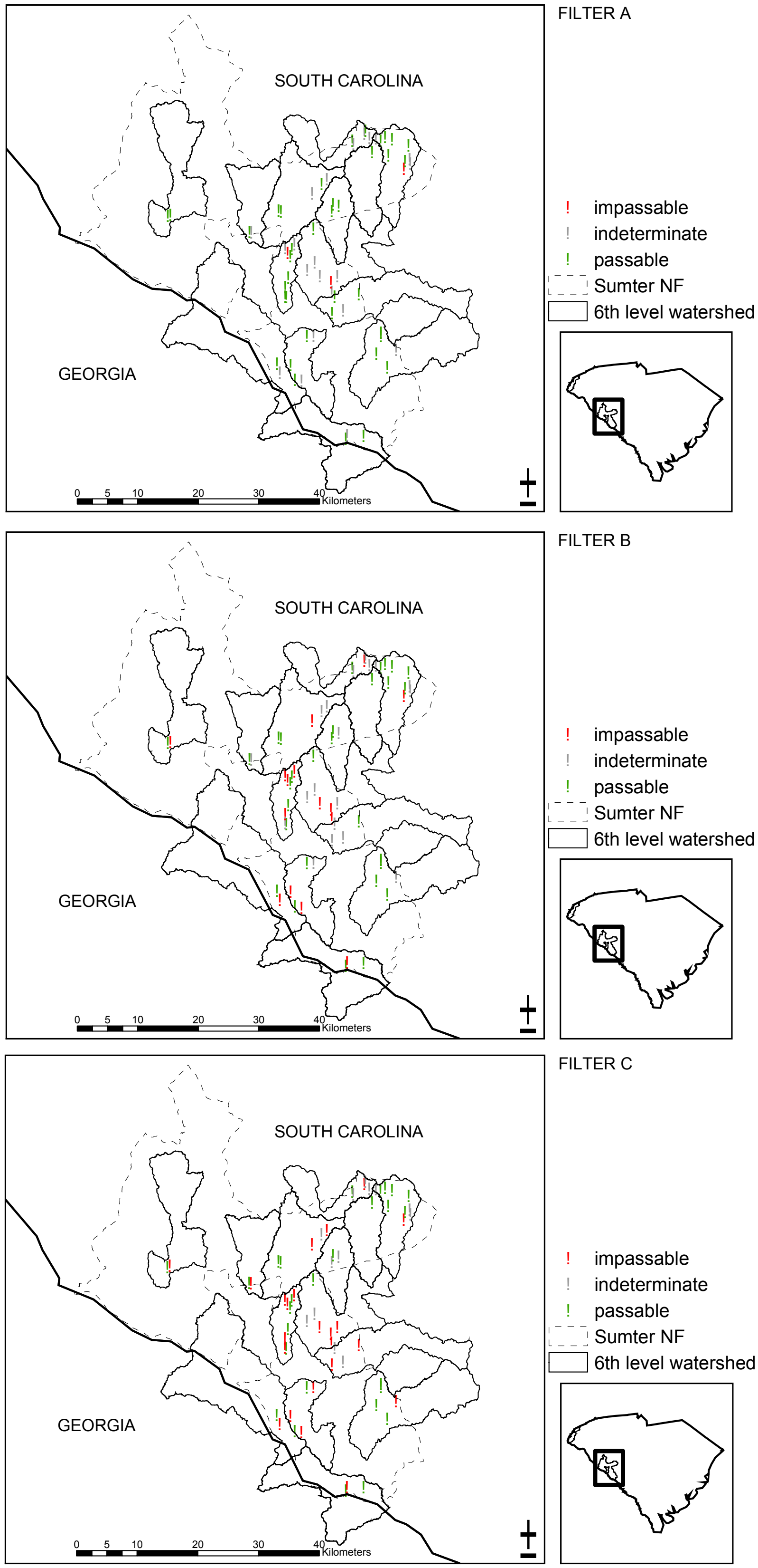

Figure D11. Location of crossings classified for fish passage by coarse filters A, B, and C within 6th level watersheds on the Francis Marion-Sumter National Forest Long Cane Ranger District, April 2006.

Table D1. Number of crossings documented (Total crossings documented) and not surveyed (Crossings not surveyed) on the Francis Marion-Sumter National Forest, April 2006. Reasons for not surveying a documented site include: no suitable fish habitat upstream of crossing (NH); no access to site due to closed roads or private gates (NA); crossing was a natural ford (NF); crossing was a bridge (BR).

Forest	Total crossings documented	Crossings not surveyed (n, [%])				
		NH	NA	NF	BR	Total not surveyed
SNF	120	18 (62)	7 (24)	4 (14)	0 (0)	29 (24)

Table D2. Number of crossings surveyed (Total surveyed) with coarse filter results for the Francis Marion-Sumter National Forest, April 2006. Coarse filter results are presented for Filter A, Filter B, and Filter C (see filter descriptions, Fig 3 – 5).

Forest	Total surveyed	Coarse filter results								
		Impassable (n, [%])			Passable (n, [%])			Indeterminate (n, [%])		
		A	B	C	A	B	C	A	B	C
SNF	91	4 (4)	18 (20)	33 (36)	58 (64)	42 (46)	38 (42)	29 (32)	31 (34)	20 (22)

Table D3. Location of crossings surveyed in Francis-Marion-Sumter National Forest, April 2006. Site ID consists of the Forest abbreviation (SNF), road the crossing is on (108), and the distance (miles) from the junction road (1.3).

Site ID	# of Pipes	District	Junction Road	Stream Name	Quad	6th Level Watershed
SNF108-1.3	1	Andrew Pickens	107	UT Crane Creek	Tamassee	SNF108-1.3
SNF709-0.4	1	Andrew Pickens	107	UT Moody Creek	Tamassee	SNF709-0.4
SNF710-0.7	1	Andrew Pickens	107	Crane Creek	Tamassee	SNF710-0.7
SNF710-3.1	1	Andrew Pickens	107	Cane Creek	Tamassee	SNF710-3.1
SNF710-3.3	1	Andrew Pickens	107	West Fork Townes	Tamassee	SNF710-3.3
SNF715a-0.6	1	Andrew Pickens	107	Wash Branch	Tamassee	SNF715a-0.6
SNF722-0.4	1	Andrew Pickens	107	UT Moody Creek	Tamassee	SNF722-0.4
SNF733-0.5	1	Andrew Pickens	710	Jumping Branch	Tamassee	SNF733-0.5
SNF750-0.45	1	Andrew Pickens	fh108	Tamassee Creek	Tamassee	SNF750-0.45
SNF745-0.4	1	Andrew Pickens	C37PU7	Fall Creek	Whetstone	SNF745-0.4
SNFFH104-1.4	1	Andrew Pickens	fh104	Double Branch	Tugaloo Lake	SNFFH104-1.4
SNF709-0.3	1	Andrew Pickens	pavement to gravel	Brasstown Creek	Tugaloo Lake	SNF709-0.3
SNF733-0.51	1	Andrew Pickens	290	UT Chauga River	Whetstone	SNF733-0.51
SNF751-0.15	1	Andrew Pickens	Rocky Fork Road	Rocky Fork Creek	Holly Springs	SNF751-0.15
SNF632A-1.0	1	Long Cane	632	UT Stevens Creek	Clarks Hill	SNF632A-1.0
SNF652-0.9	1	Long Cane	384	UT Ray Creek	Clarks Hill	SNF652-0.9
SNF565-0.8	1	Long Cane	570	UT Clarks Hill Lake	McCormick	SNF565-0.8
SNF565-1.2	1	Long Cane	570	UT Clarks Hill Lake	McCormick	SNF565-1.2
SNF656-0.3	1	Long Cane	659b	Stevens Creek	Martinez	SNF656-0.3
SNF660-0.8	2	Long Cane	28	Maulden Branch	Martinez	SNF660-0.8
SNF660E-0.4	1	Long Cane	660	UT Savannah	Martinez	SNF660E-0.4
SNF576a-1.1	1	Long Cane	378	UT Hard Labor Creek	Winterseat	SNF576a-1.1
SNF576a-1.3	1	Long Cane	378	UT Hard Labor Creek	Winterseat	SNF576a-1.3
SNF24589-0.4	4	Long Cane	104	UT Horsepen Creek	Kirksey	SNF24589-0.4
SNF589-0.2	1	Long Cane	30	UT Horsepen Creek	Good Hope	SNF589-0.2
SNF589A-0.5	1	Long Cane	24589	UT Horsepen Creek	Kirksey	SNF589a-0.5
SNF589A-0.8	1	Long Cane	24589	UT Horsepen Creek	Kirksey	SNF589a-0.8
SNF589D-0.2	1	Long Cane	589	UT Horsepen Creek	Kirksey	030601070106
SNF574-0.6	1	Long Cane	316	UT Cuffytown Creek	Limestone	030601070107
SNF668-0.4	1	Long Cane	668A	UT Little Horsepen Creek	Limestone	030601070107
SNF668-1.2	1	Long Cane	668A	UT Little Horsepen Creek	Limestone	030601070107

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Site ID	# of Pipes	District	Junction Road	Stream Name	Quad	6th Level Watershed
SNF679A-0.35	1	Long Cane	519	UT Lick Creek	Winterseat	030601070107
SNF679A-0.65	1	Long Cane	519	UT Lick Creek	Winterseat	030601070107
SNF138-0.3	1	Long Cane	605	Byrd Creek	Winterseat	030601070110
SNF602-0.2	1	Long Cane	604	Byrd Creek	Winterseat	030601070110
SNF604-0.5	1	Long Cane	138	Byrd Creek	Winterseat	030601070110
SNF604-1.2	1	Long Cane	138	UT Byrd Creek	Winterseat	030601070110
SNF613B-0.2	1	Long Cane	118	UT Byrd Creek	Parksville	030601070110
SNF615-1.8	1	Long Cane	138	UT Byrd Creek	Parksville	030601070110
SNF615-2.0	2	Long Cane	138	UT Byrd Creek	Parksville	030601070110
SNF672-1.0	1	Long Cane	138	UT Byrd Creek	Parksville	030601070110
SNF688-0.6	1	Long Cane	283	UT Byrd Creek	Parksville	030601070110
SNF590A-0.1	1	Long Cane	590	UT Flat Rock Branch	Good Hope	030601070203
SNF590A-0.7	1	Long Cane	590	UT Flat Rock Branch	Good Hope	030601070203
SNF591-1.0	1	Long Cane	38	UT Sleepy Creek	Good Hope	030601070203
SNF592D-0.3	1	Long Cane	592	UT Sleepy Creek	Good Hope	030601070203
SNF592E-0.1	3	Long Cane	592D	Sleepy Creek	Good Hope	030601070203
SNF595-0.1	2	Long Cane	594	Ephriam Branch	Good Hope	030601070203
SNF595-1.5	3	Long Cane	594	Ephriam Branch	Owdoms	030601070203
SNF595-2.0	2	Long Cane	594	UT Ephriam Branch	Owdoms	030601070203
SNF665-1.7	1	Long Cane	591	UT Ephriam Branch	Owdoms	030601070203
SNF665A 0.6	1	Long Cane	C41-665	UT Ephriam Branch	Owdoms	030601070203
SNF609-0.4	1	Long Cane	137	UT Cyper Creek	Red Hill	030601070204
SNF610A-0.6	1	Long Cane	610B	Cyper Creek	Parksville	030601070204
SNF610B-0.7	1	Long Cane	283	UT Bryd Creek	Parksville	030601070204
SNF611-0.3	1	Long Cane	137	Broadwater Branch	Red Hill	030601070204
SNF611-1.4	1	Long Cane	137	UT Turkey Cree	Red Hill	030601070204
SNF621-0.9	1	Long Cane	137	Goff Branch	Red Hill	030601070204
SNF624-0.2	1	Long Cane	621	UT Turkey Creek	Red Hill	030601070204
SNF663-0.6	2	Long Cane	378	UT Cyper Creek	Limestone	030601070204
SNF458-0.3	1	Long Cane	30	UT Talbert Branch	Good Hope	030601070205
SNF585B-0.2	2	Long Cane	585	Stockman Branch	Limestone	030601070207
SNF585B-1.0	1	Long Cane	585	UT Stockman Branch	Limestone	030601070207
SNF585C-0.3	1	Long Cane	585	Wilson Branch	Limestone	030601070207

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Site ID	# of Pipes	District	Junction Road	Stream Name	Quad	6th Level Watershed
SNF624-0.8	1	Long Cane	621	UT Beaverdam Creek	Red Hill	030601070301
SNF625-0.1	1	Long Cane	51	UT Beaverdam Creek	Red Hill	030601070301
SNF625-0.1	2	Long Cane	51	UT Beaverdam Creek	Red Hill	030601070301
SNF625-1.9	1	Long Cane	131	UT Beaverdam Creek	Red Hill	030601070301
SNFC19-625-0.6	1	Long Cane	68	Red Hill Spring Branch	Red Hill	030601070301
SNFC19-625-0.6	2	Long Cane	68	Red Hill Spring Branch	Red Hill	030601070301
SNFC19-625-0.6	3	Long Cane	68	Red Hill Spring Branch	Red Hill	030601070301
SNF629A-0.6	1	Long Cane	629	UT Buzzard Branch	Parksville	030601070401
SNF629C-0.8	1	Long Cane	629	UT Buzzard Branch	Parksville	030601070401
SNF643-0.5	1	Long Cane	644	Buzzard Branch	Clarks Hill	030601070401
SNF644A-0.3	1	Long Cane	644	UT Stevens Creek	Clarks Hill	030601070401
SNF699-0.5	1	Long Cane	28	UT Stevens Creek	Clarks Hill	030601070401
SNF638-1.4	1	Long Cane	C19-638	UT Horn Creek	Colliers	030601070406
SNF640-1.7	1	Long Cane	230	Fork Branch	Colliers	030601070406
SNF641-0.6	1	Long Cane	634	UT Rock Creek	Colliers	030601070406
SNF641-0.9	1	Long Cane	634	UT Rock Creek	Colliers	030601070406
SNF642B-0.2	1	Long Cane	52	UT Horn Creek	Colliers	030601070406

Table D4. Coarse filters A, B, and C, classifications for surveyed crossings in Francis Marion-Sumter National Forest, April 2006.

Site ID	Pipe #	Filter A	Filter B	Filter C
SNF108-1.3	1	passable	indeterminate	indeterminate
SNF709-0.4	1	passable	indeterminate	impassable
SNF710-0.7	1	indeterminate	indeterminate	impassable
SNF710-3.1	1	passable	impassable	impassable
SNF710-3.3	1	passable	passable	impassable
SNF715a-0.6	1	passable	passable	passable
SNF722-0.4	1	passable	passable	passable
SNF733-0.5	1	indeterminate	indeterminate	indeterminate
SNF750-0.45	1	passable	passable	passable
SNF745-0.4	1	impassable	impassable	impassable
SNF709-0.3	1	indeterminate	indeterminate	indeterminate
SNFFH104-1.4	1	passable	passable	passable
SNF733-0.51	1	passable	indeterminate	impassable
SNF751-0.15	1	passable	passable	passable
SNF632A-1.0	1	passable	passable	passable
SNF652-0.9	1	indeterminate	impassable	impassable
SNF565-0.8	1	passable	impassable	impassable
SNF565-1.2	1	passable	passable	passable
SNF656-0.3	1	passable	passable	passable
SNF660-0.8	1	impassable	impassable	impassable
SNF660-0.8	2	indeterminate	impassable	impassable
SNF660E-0.4	1	passable	passable	passable
SNF576a-1.1	1	passable	passable	passable
SNF576a-1.3	1	indeterminate	indeterminate	impassable
SNF24589-0.4	3	passable	passable	passable
SNF24589-0.4	4	passable	passable	passable
SNF589-0.2	1	indeterminate	indeterminate	indeterminate
SNF589a-0.5	1	indeterminate	impassable	impassable
SNF589a-0.8	1	passable	indeterminate	indeterminate
SNF589d-0.2	1	indeterminate	indeterminate	indeterminate
SNF574-0.6	1	indeterminate	impassable	impassable
SNF668-0.4	1	passable	indeterminate	indeterminate
SNF668-1.2	1	indeterminate	indeterminate	impassable
SNF679a-0.35	1	passable	passable	passable
SNF679a-0.65	1	passable	passable	passable
SNF138-0.3	1	indeterminate	impassable	impassable
SNF602-0.2	1	indeterminate	impassable	impassable
SNF604-0.5	1	passable	passable	passable
SNF604-1.2	1	impassable	impassable	impassable
SNF613B-0.2	1	passable	impassable	impassable
SNF615-1.8	1	passable	passable	passable
SNF615-2.0	1	indeterminate	impassable	impassable
SNF615-2.0	2	passable	indeterminate	impassable
SNF672-1.0	1	passable	passable	passable
SNF688-0.6	1	passable	passable	passable

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Site ID	Pipe #	Filter A	Filter B	Filter C
SNF590a-0.1	1	indeterminate	indeterminate	indeterminate
SNF590A-0.7	1	passable	passable	passable
SNF591-1.0	1	passable	passable	passable
SNF592D-0.3	1	passable	passable	passable
SNF592E-0.1	1	passable	passable	passable
SNF592E-0.1	2	passable	passable	passable
SNF592E-0.1	3	passable	passable	passable
SNF595-0.1	1	passable	indeterminate	impassable
SNF595-0.1	2	passable	passable	passable
SNF595-1.5	1	passable	indeterminate	indeterminate
SNF595-1.5	2	passable	indeterminate	indeterminate
SNF595-1.5	3	indeterminate	indeterminate	indeterminate
SNF595-2.0	1	indeterminate	indeterminate	indeterminate
SNF595-2.0	2	indeterminate	indeterminate	indeterminate
SNF665-1.7	1	passable	passable	passable
SNF665A 0.6	1	indeterminate	indeterminate	indeterminate
SNF609-0.4	1	indeterminate	impassable	impassable
SNF610a-0.6	1	indeterminate	indeterminate	indeterminate
SNF610b-0.7	1	indeterminate	indeterminate	indeterminate
SNF611-0.3	1	impassable	impassable	impassable
SNF611-1.4	1	indeterminate	indeterminate	impassable
SNF621-0.9	1	passable	passable	passable
SNF624-0.2	1	indeterminate	impassable	impassable
SNF663-0.6	1	passable	passable	passable
SNF663-0.6	2	passable	passable	passable
SNF458-0.3	1	passable	passable	passable
SNF585b-0.2	1	passable	passable	passable
SNF585b-0.2	2	passable	passable	passable
SNF585b-1.0	1	passable	indeterminate	indeterminate
SNF585c-0.3	1	passable	passable	indeterminate
SNF624-0.8	1	passable	indeterminate	indeterminate
SNF625-0.1	1	passable	passable	impassable
SNF625-0.1	2	passable	passable	impassable
SNF625-1.9	1	indeterminate	indeterminate	indeterminate
SNFC19-625-0.6	2	passable	indeterminate	impassable
SNFC19-625-0.6	3	indeterminate	indeterminate	impassable
SNF629A-0.6	1	indeterminate	indeterminate	impassable
SNF629C-0.8	1	passable	passable	passable
SNF643-0.5	1	passable	passable	passable
SNF644A-0.3	1	indeterminate	impassable	impassable
SNF699-0.5	1	passable	impassable	impassable
SNF638-1.4	1	passable	passable	passable
SNF640-1.7	1	passable	passable	passable
SNF641-0.6	1	passable	passable	passable
SNF641-0.9	1	passable	passable	passable
SNF642B-0.2	1	indeterminate	indeterminate	impassable

Table D5. Description of crossings surveyed in Francis Marion-Sumter National Forest, April 2006. Shape abbreviations: C= circular, PA= pipe arch, OBA= open bottom arch, and F= ford. Channel width is the mean bankfull channel width. N= no natural substrate, N (discontin)= discontinuous substrate, Y= continuous natural substrate. An NA (not applicable) indicates outlet drop (no outlet pool or tailwater control) or outlet perch (stream dry) could not be calculated. Negative outlet drop or perch values indicate a submerged outlet (structure partially backwatered). Residual inlet depth values ≥ 0.0 indicate the structure is fully backwatered.

Site ID	Pipe #	Shape	Pipe Condition	Mean Channel Width (ft)	Continuous Substrate in Structure	Pipe Slope (%)	Pipe Width: Channel Width ratio	Outlet Drop (in)	Outlet Perch (in)	Residual Inlet Depth (in)	Pipe Length (ft)	Slope (%) * Length (ft)
SNF108-1.3	1	PA	fair	8.6	N (discontin)	0.52	1.12	NA	-4.68	0.00	52.0	27.0
SNF709-0.4	1	C	good	8.3	N	1.23	0.36	7.26	2.40	0.00	30.5	37.5
SNF710-0.7	1	C	fair	7.7	N	1.61	0.32	5.16	-9.72	0.00	56.4	91.0
SNF710-3.1	1	B	good	14.7	N	1.84	0.58	16.26	11.16	0.00	22.8	42.0
SNF710-3.3	1	B	good	12.5	N	1.04	0.32	8.40	3.42	0.00	19.8	20.5
SNF715a-0.6	1	VF	good	16.6	Y	1.47	0.30	-12.96	-20.52	17.40	25.2	37.0
SNF722-0.4	1	OBA	good	9.1	Y	0.15	1.45	NA	-1.92	0.00	59.3	9.0
SNF733-0.5	1	C	fair	3.8	N	3.13	0.33	-1.44	-4.68	0.00	17.9	56.0
SNF750-0.45	1	OBA	good	19.8	Y	0.01	0.79	-7.38	-15.66	7.32	47.1	0.5
SNF745-0.4	1	F	fair	9.6	N	17.00	NA	3.84	-0.48	0.00	31.0	527.0
SNF709-0.3	1	C	good	8.3	N	2.03	0.48	NA	-4.08	0.00	28.1	57.0
SNFFH104-1.4	1	OBA	good	21.3	Y	1.78	0.78	-7.80	-10.74	11.34	16.6	29.5
SNF733-0.51	1	C	fair	7.9	N	1.77	0.19	5.28	1.38	0.00	17.5	31.0
SNF751-0.15	1	OBA	good	10.8	Y	2.24	1.26	NA	1.62	0.00	39.0	87.5
SNF632A-1.0	1	OBA	good	13.0	Y	0.05	1.08	-5.04	-5.52	5.16	20.6	1.0
SNF652-0.9	1	C	good	7.7	N	0.96	0.52	12.48	7.20	0.00	59.5	57.0
SNF565-0.8	1	C	good	6.3	N	0.40	0.79	17.70	14.70	0.00	36.5	14.5
SNF565-1.2	1	C	fair	9.4	Y	0.62	0.37	-10.44	-13.08	6.36	55.0	34.0
SNF656-0.3	1	C	poor	10.1	Y	1.86	1.29	NA	13.32	0.00	48.3	90.0
SNF660-0.8	1	C	fair	5.9	N	0.97	1.02	24.96	23.04	0.00	64.0	62.0
SNF660-0.8	2	C	fair	5.9	N	3.00	1.02	15.60	13.56	0.00	61.4	184.0

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Site ID	Pipe #	Shape	Pipe Condition	Mean Channel Width (ft)	Continuous Substrate in Structure	Pipe Slope (%)	Pipe Width: Channel Width ratio	Outlet Drop (in)	Outlet Perch (in)	Residual Inlet Depth (in)	Pipe Length (ft)	Slope (%) * Length (ft)
SNF660E-0.4	1	C	fair	5.8	N	0.05	0.43	NA	-10.20	0.00	41.2	2.0
SNF576A-1.1	1	PA	poor	7.9	Y	1.04	0.63	-9.72	-10.80	4.62	40.9	42.5
SNF576A-1.3	1	PA	poor	6.3	N	2.92	0.56	NA	2.34	0.00	60.9	178.0
SNF24589-0.4	3	C	good	14.1	N (discontin)	0.41	0.43	-3.00	-8.16	1.20	37.0	15.0
SNF24589-0.4	4	C	good	14.1	N (discontin)	0.50	0.43	-0.78	-2.04	3.00	37.0	18.5
SNF589-0.2	1	C	fair	8.6	N	2.53	0.23	2.64	-0.96	0.00	22.7	57.5
SNF589A-0.5	1	C	poor	4.1	N	4.49	0.73	-3.48	-7.56	0.00	35.0	157.0
SNF589A-0.8	1	C	good	6.6	N	1.11	0.46	1.56	-0.84	0.00	32.0	35.5
SNF589D-0.2	1	C	fair	6.1	N	1.56	0.74	-0.06	-2.88	0.00	40.6	63.5
SNF574-0.6	1	C	good	7.6	N	2.32	0.33	18.00	16.44	0.00	25.0	58.0
SNF668-0.4	1	C	good	5.6	N	0.90	1.07	0.18	-0.78	0.00	55.4	50.0
SNF668-1.2	1	C	good	3.7	N	2.83	1.09	5.76	3.06	0.00	38.2	108.0
SNF679A-0.35	1	C	poor	6.0	N	0.35	0.58	-9.24	-9.12	11.28	48.5	17.0
SNF679A-0.65	1	C	poor	6.5	N	1.71	0.77	-12.90	-11.58	3.36	46.5	79.5
SNF138-0.3	1	C	good	8.1	N	3.42	1.14	-7.80	-10.56	0.00	61.7	211.0
SNF602-0.2	1	C	fair	8.6	N	3.52	0.58	0.48	0.72	0.00	30.4	107.0
SNF604-0.5	1	OBA	good	11.9	Y	1.67	1.17	-5.04	-5.40	1.32	18.6	31.0
SNF604-1.2	1	F	poor	10.3	N	0.75	0.00	25.20	21.96	0.00	16.6	12.5
SNF613B-0.2	1	C	fair	8.0	N	0.12	0.63	20.52	24.78	0.00	32.7	4.0
SNF615-1.8	1	C	poor	8.8	N	2.32	0.28	-5.28	-6.12	12.24	25.0	58.0
SNF615-2.0	1	PA	poor	6.4	N	4.21	0.36	8.46	9.36	4.02	24.7	104.0
SNF615-2.0	2	PA	poor	6.4	N	1.06	0.23	7.80	8.70	0.00	26.0	27.5
SNF672-1.0	1	PA	fair	10.1	N (discontin)	0.49	0.79	-3.06	-3.78	0.60	42.0	20.5
SNF688-0.6	1	OBA	good	10.3	Y	3.15	1.55	-6.72	-7.32	0.00	20.8	65.5
SNF590A-0.1	1	C	good	5.1	N	2.69	1.24	-1.20	-3.60	0.00	34.7	93.5

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Site ID	Pipe #	Shape	Pipe Condition	Mean Channel Width (ft)	Continuous Substrate in Structure	Pipe Slope (%)	Pipe Width: Channel Width ratio	Outlet Drop (in)	Outlet Perch (in)	Residual Inlet Depth (in)	Pipe Length (ft)	Slope (%) * Length (ft)
SNF590A-0.7	1	C	fair	5.1	N (discontin)	0.51	1.29	-3.84	-5.64	1.32	41.5	21.0
SNF591-1.0	1	C	good	6.2	N	0.27	0.48	-10.08	-12.96	8.28	56.3	15.0
SNF592D-0.3	1	C	good	3.9	N	0.10	0.64	0.24	-1.68	0.24	38.3	4.0
SNF592E-0.1	1	VF	good	6.3	N	0.98	0.16	-1.20	-3.60	3.12	16.3	16.0
SNF592E-0.1	2	VF	good	6.3	N	0.00	0.16	-1.92	-4.32	1.92	16.3	0.0
SNF592E-0.1	3	VF	good	6.3	N	0.37	0.16	-0.84	-3.24	0.12	16.3	6.0
SNF595-0.1	1	C	fair	8.3	N	1.67	0.36	6.96	19.80	0.00	21.0	35.0
SNF595-0.1	2	C	fair	8.3	N	5.62	0.36	-19.08	-6.24	4.92	21.0	118.0
SNF595-1.5	1	VF	good	8.0	N	1.98	0.12	-1.14	-2.58	0.00	25.2	50.0
SNF595-1.5	2	VF	good	8.0	N	1.93	0.12	-1.14	-2.58	0.00	26.2	50.5
SNF595-1.5	3	VF	good	8.0	N	2.21	0.12	-1.14	-2.58	0.00	26.2	58.0
SNF595-2.0	1	C	good	5.3	N	2.48	0.75	1.92	-0.36	0.00	37.5	93.0
SNF595-2.0	2	C	good	5.3	N	2.61	0.75	2.88	0.60	0.00	37.5	98.0
SNF665-1.7	1	C	fair	12.7	N	1.44	0.32	-6.48	4.68	10.32	22.2	32.0
SNF665A 0.6	1	C	poor	8.2	N	2.06	0.68	0.96	0.48	0.00	59.7	123.0
SNF609-0.4	1	C	fair	7.7	N	1.29	0.91	10.02	9.54	0.00	40.2	52.0
SNF610A-0.6	1	C	good	8.2	N	2.14	0.73	-2.10	-4.38	0.00	40.4	86.5
SNF610B-0.7	1	C	good	5.1	N	1.96	0.79	-2.52	-3.12	0.00	32.6	64.0
SNF611-0.3	1	B	good	8.2	N	0.97	1.22	NA	17.52	0.00	36.1	35.0
SNF611-1.4	1	C	poor	8.7	N	0.96	0.81	7.68	6.00	0.00	56.4	54.0
SNF621-0.9	1	OBA	good	NA	Y	NA	NA	NA	NA	NA	NA	NA
SNF624-0.2	1	C	poor	9.2	N	2.20	0.65	17.76	15.24	0.00	50.0	110.0
SNF663-0.6	1	C	poor	7.0	N	0.94	0.29	-4.02	-6.42	1.26	24.5	23.0
SNF663-0.6	2	C	poor	7.0	N	0.65	0.29	-0.48	8.52	2.10	20.7	13.5
SNF458-0.3	1	C	good	5.8	N	1.78	0.69	2.52	-0.24	7.56	47.3	84.0

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Site ID	Pipe #	Shape	Pipe Condition	Mean Channel Width (ft)	Continuous Substrate in Structure	Pipe Slope (%)	Pipe Width: Channel Width ratio	Outlet Drop (in)	Outlet Perch (in)	Residual Inlet Depth (in)	Pipe Length (ft)	Slope (%) * Length (ft)
SNF585B-0.2	1	C	fair	10.9	N (discontin)	1.41	0.64	-12.48	-15.96	5.52	41.0	58.0
SNF585B-0.2	2	C	fair	10.9	N (discontin)	0.71	0.64	-5.40	-8.88	8.88	41.0	29.0
SNF585B-1.0	1	C	fair	6.5	N	0.79	0.93	3.24	-4.80	0.00	38.2	30.0
SNF585C-0.3	1	C	good	8.7	N	0.62	0.46	-1.56	-2.76	0.00	28.9	18.0
SNF624-0.8	1	C	poor	4.0	N	0.62	0.62	-0.24	0.60	0.00	51.5	32.0
SNF625-0.1	1	C	fair	7.1	N	0.52	0.63	6.84	0.72	0.00	48.0	25.0
SNF625-0.1	2	C	fair	7.1	N	0.13	0.63	8.52	2.40	0.00	48.0	6.0
SNF625-1.9	1	C	fair	6.3	N	2.09	1.03	-1.92	-3.72	0.00	45.0	94.0
SNFC19-625-0.6	2	VF	good	11.5	N	1.32	0.13	7.02	4.14	0.00	24.3	32.0
SNFC19-625-0.6	3	VF	good	11.5	N	1.73	0.13	7.02	4.14	0.00	24.3	42.0
SNF629A-0.6	1	C	fair	6.5	N	2.48	0.70	8.94	8.94	0.00	40.1	99.5
SNF629C-0.8	1	C	fair	7.7	N (discontin)	1.78	0.52	-22.98	-17.28	15.12	36.9	65.5
SNF643-0.5	1	C	fair	5.0	N	0.22	0.80	1.68	-12.24	0.00	48.2	10.5
SNF644A-0.3	1	C	fair	6.6	N	1.41	0.75	10.56	9.00	0.00	51.6	73.0
SNF699-0.5	1	C	fair	3.8	N	0.70	0.66	12.36	11.76	0.00	37.3	26.0
SNF638-1.4	1	C	good	6.2	N	0.20	0.40	2.52	0.84	0.00	35.1	7.0
SNF640-1.7	1	OBA	good	8.1	Y	3.72	1.72	-5.52	-8.16	18.12	28.2	105.0
SNF641-0.6	1	C	fair	10.3	Y	1.04	1.35	NA	-7.32	0.00	49.8	52.0
SNF641-0.9	1	C	fair	8.1	Y	2.00	1.05	-0.48	-3.72	0.00	67.1	134.0
SNF642B-0.2	1	C	fair	8.3	N	2.37	0.48	NA	4.80	0.00	51.0	121.0

Appendix E: Results for the National Forests in Mississippi

We completed surveys at 69 (72%) of 96 documented crossing structures on the Homochitto and Holly Springs National Forests in 2006 (Figure E1, Tables E1 and E2). Filter A (strong swimmers and leapers) classified 7% (n=5) of crossings as impassable, 54% (n=37) as passable, and 39% (n=27) as indeterminate (Figure E2, Table E2). Filter B (moderate swimmers and leapers) classified 28% (n=19) of crossings as impassable, 30% (n=21) as passable, and 42% (n=29) as indeterminate (Figure E3, Table E2). Filter C (weak swimmers and leapers) classified 38% (n=26) of crossing as impassable, 27% (n=19) as passable, and 35% (n=24) as indeterminate (Figure E4, Table E2). Characteristics and filter classifications for each crossing are presented in Tables E3-E5.

The majority of the crossings surveyed were circular culverts (65%, n=45), while box culverts (25%, n=17), pipe arches (7%, n=5), fords (3%, n=2), vented fords (0%, n=0), and open bottom arches (0%, n=0) were less frequently encountered or not encountered. Filter A classified 8% of circular culverts, 6% of box culverts, 0% of pipe arches, and fords as impassable (Figure E5). Filter B classified 27% of circular culverts, 29% of box culverts, 20% of pipe arches, and 50% of fords as impassable (Figure E6). Filter C classified 38% of circular culverts, 35% of box culverts, 20% of pipe arches, and 100% of fords as impassable (Figure E7). The mean crossing width to channel width ratio (excluding fords, vented fords, and multiple structure crossings) was 0.99 ± 0.49 (mean ± SD) (n=30), and 11 crossings were greater than or equal to the bankfull channel width (Figure E8). The mean crossing width to channel width ratio for surveyed crossings classified impassable by Filter A was 0.60 ± 0.08 (n=4). The mean ratio for crossings classified impassable by Filter B was 0.84 ±0.41 (n=13), and was 0.83 ± 0.39 (n=17) for Filter C (Figure E9). The mean crossing width to channel width ratio for surveyed crossings classified passable by Filter A was 01.26 ± 0.56 (n=15). The mean ratio for crossings classified passable by Filter B was 1.35 ±0.61 (n=8), and was 1.48 ± 0.53 (n=7) for Filter C (Figure E9).

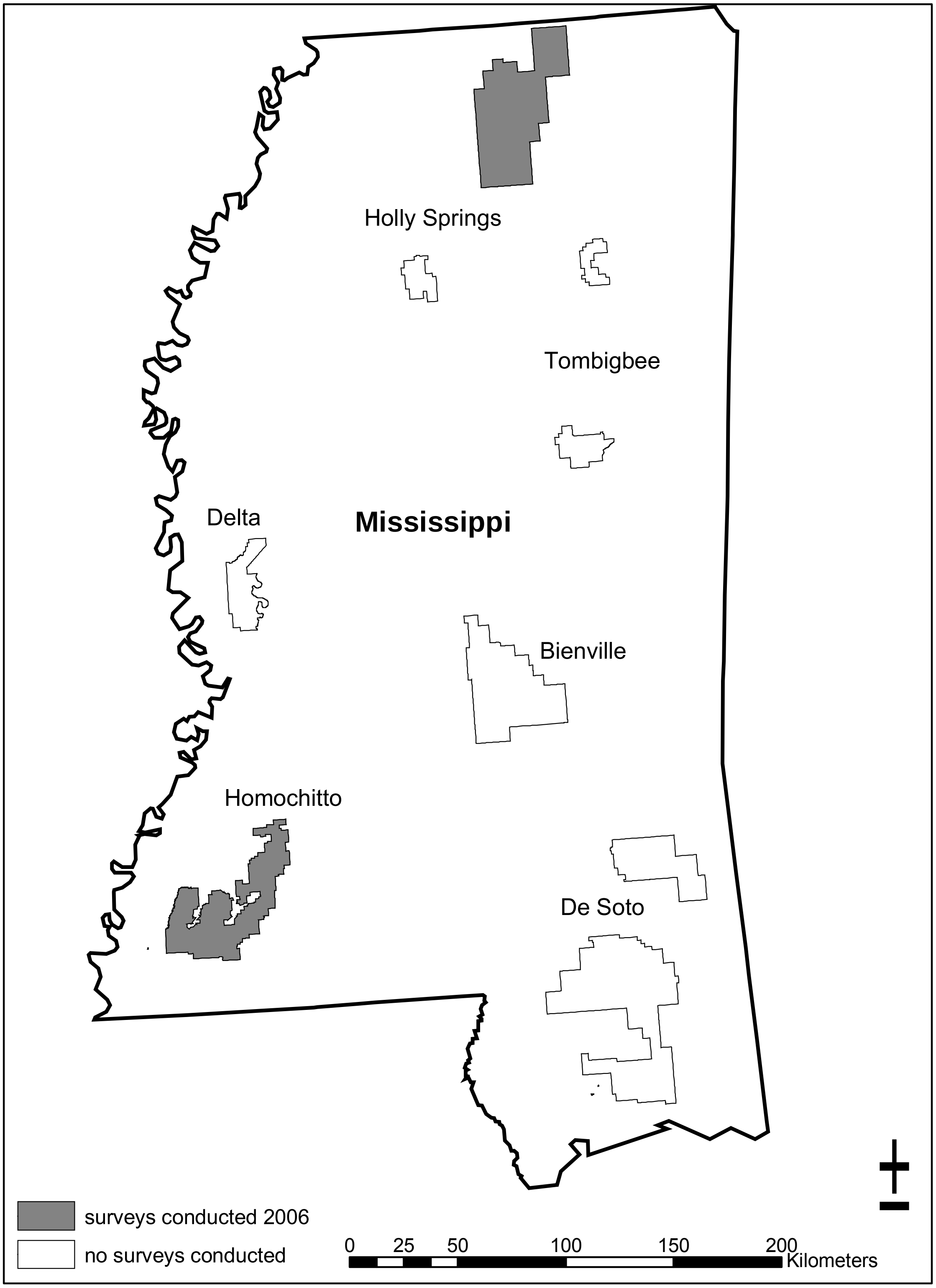

Figure E1. Ranger Districts on the National Forests in Mississippi road-stream crossing surveys were conducted, summer 2006.

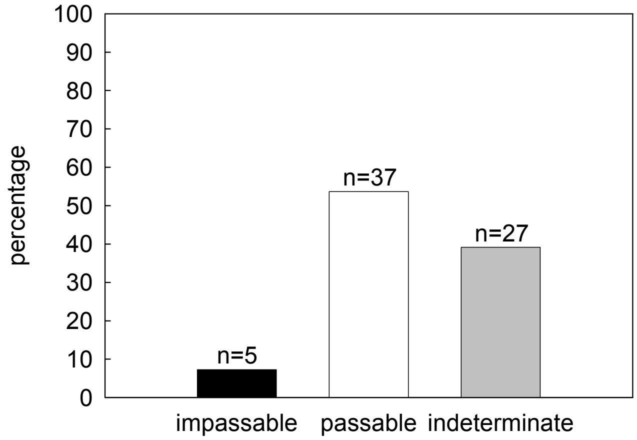

Figure E2. Percentage of crossings classified as impassable, passable, or indeterminate for Filter A; National Forests in Mississippi, summer 2006 (N=69).

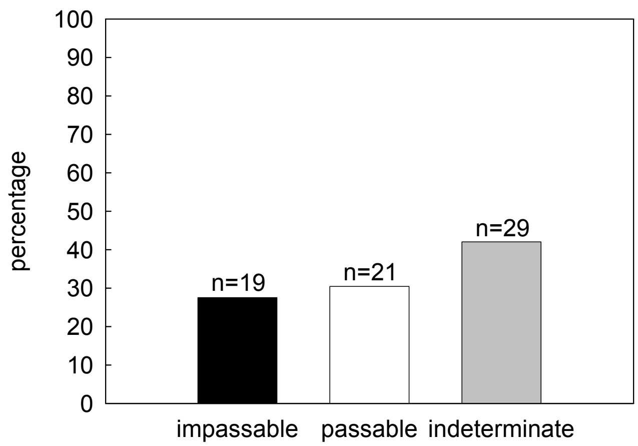

Figure E3. Percentage of crossings classified as impassable, passable, or indeterminate for Filter B; National Forests in Mississippi, summer 2006 (N=69).

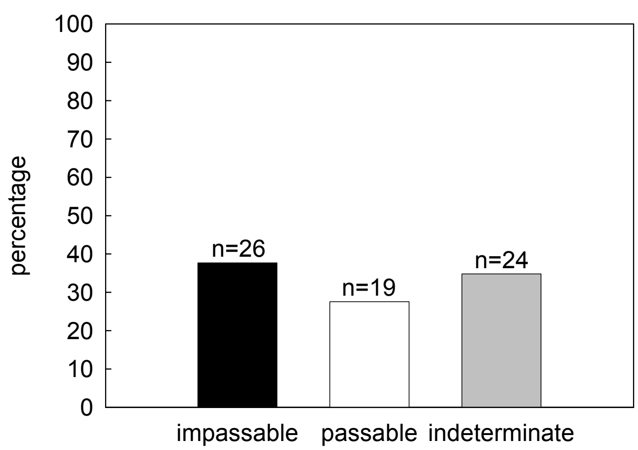

Figure E4. Percentage of crossings classified as impassable, passable, or indeterminate for Filter C; National Forests in Mississippi, summer 2006 (N=69).

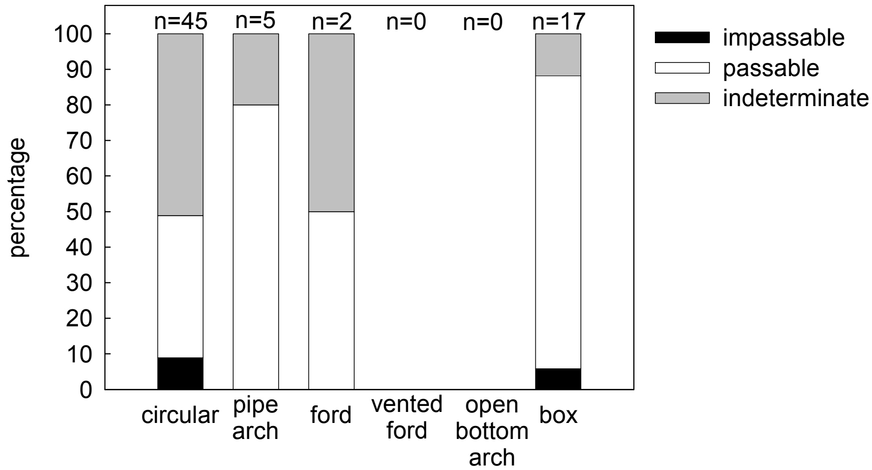

Figure E5. Percentage of each crossing type classified as impassable, passable, or indeterminate for Filter A; National Forests in Mississippi, summer 2006 (N=69).

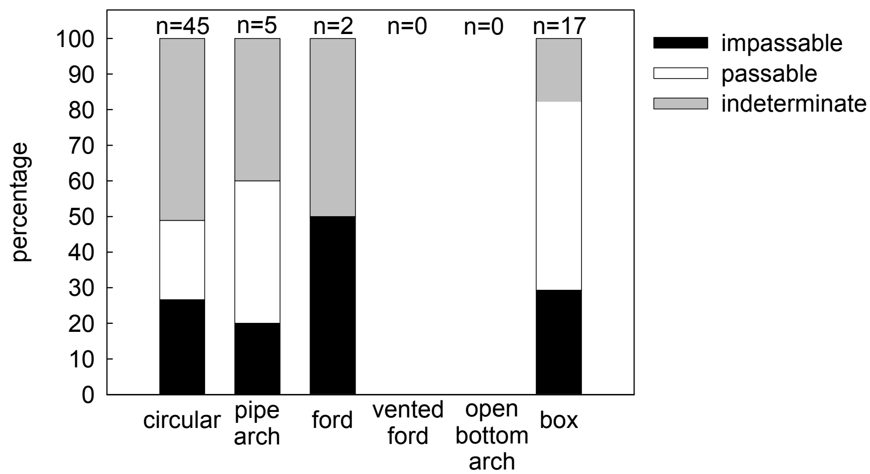

Figure E6. Percentage of each crossing type classified as impassable, passable, or indeterminate for Filter B; National Forests in Mississippi, summer 2006 (N=69).

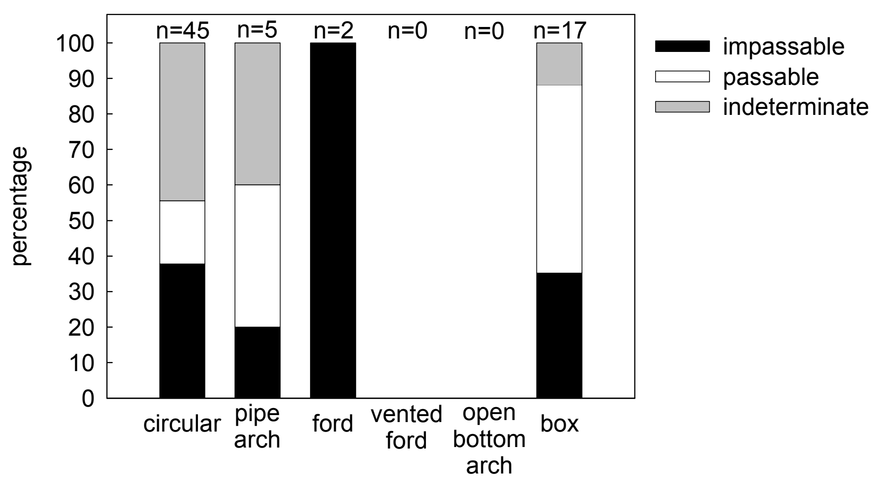

Figure E7. Percentage of each crossing type classified as impassable, passable, or indeterminate for Filter C; National Forests in Mississippi, summer 2006 (N=69).

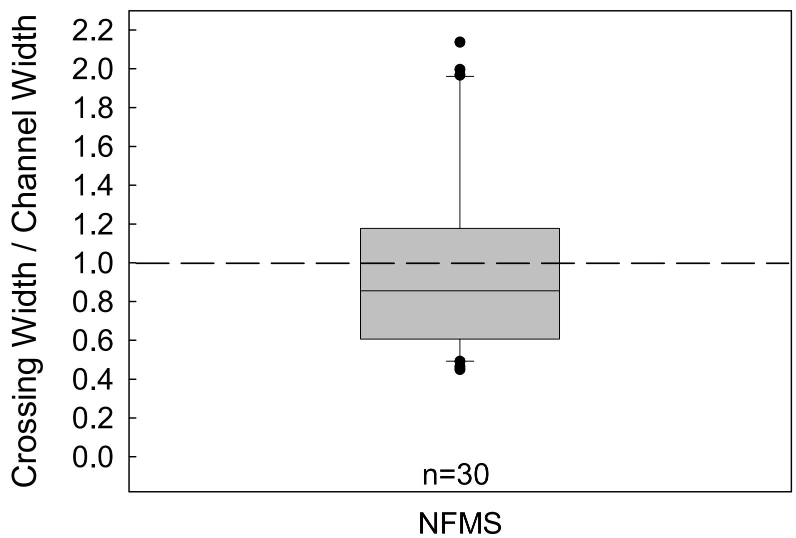

Figure E8. Crossing width to bankfull channel width ratio for crossings surveyed in summer 2006 on the National Forests in Mississippi (excluding fords, vented fords, and multiple structure crossings). A ratio of 1.0 (dashed line) or greater indicates the crossing structure opening is greater than or equal to the bankfull channel width. The top and bottom of the boxes represent the 25th and 75th percentiles, the bar in the center of each box represents the median, whiskers represent the 10th and 90th percentiles, and closed circles represent the entire range of the data.

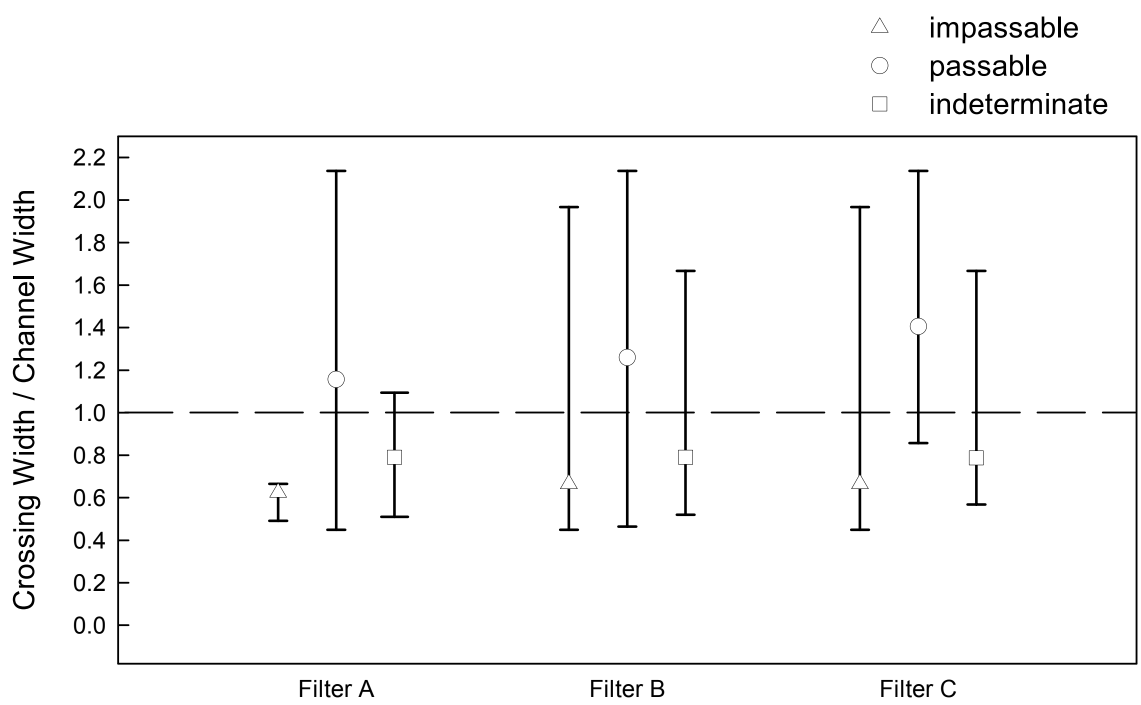

Figure E9. Crossing width to bankfull channel width ratio for crossings classified impassable, passable, or indeterminatein summer 2006 on the National Forests in Mississippi (excluding fords, vented fords, and multiple structure crossings). A ratio of 1.0 (dashed line) or greater indicates the crossing structure opening is greater than or equal to the bankfull channel width. The symbol inside each set of whiskers represents the median, and the top and bottom of the whiskers represent the maximum and minimum values.

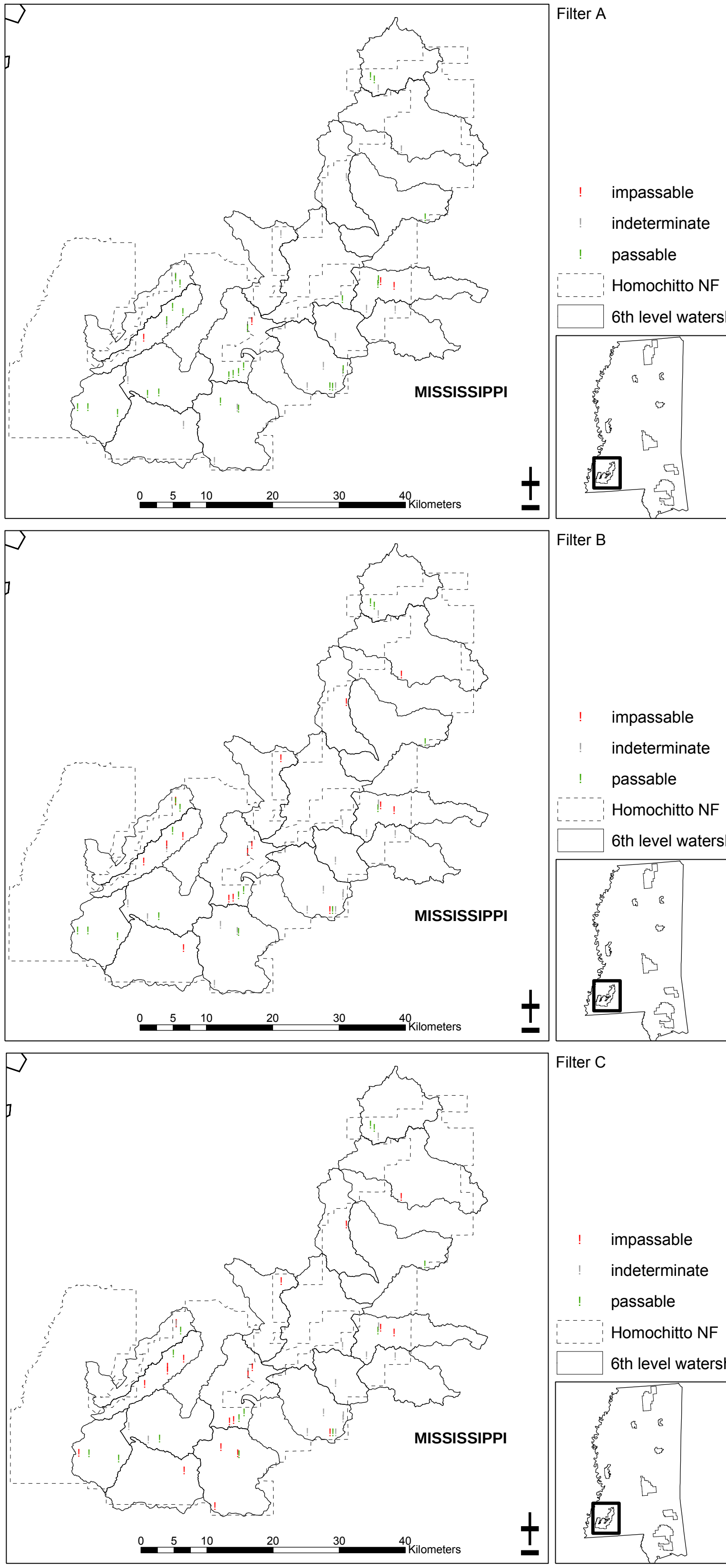

Figure E10. Location of crossings classified for fish passage by coarse filters A, B, and C within 6th level watersheds (draft) on the Homochitto National Forest, summer 2006.

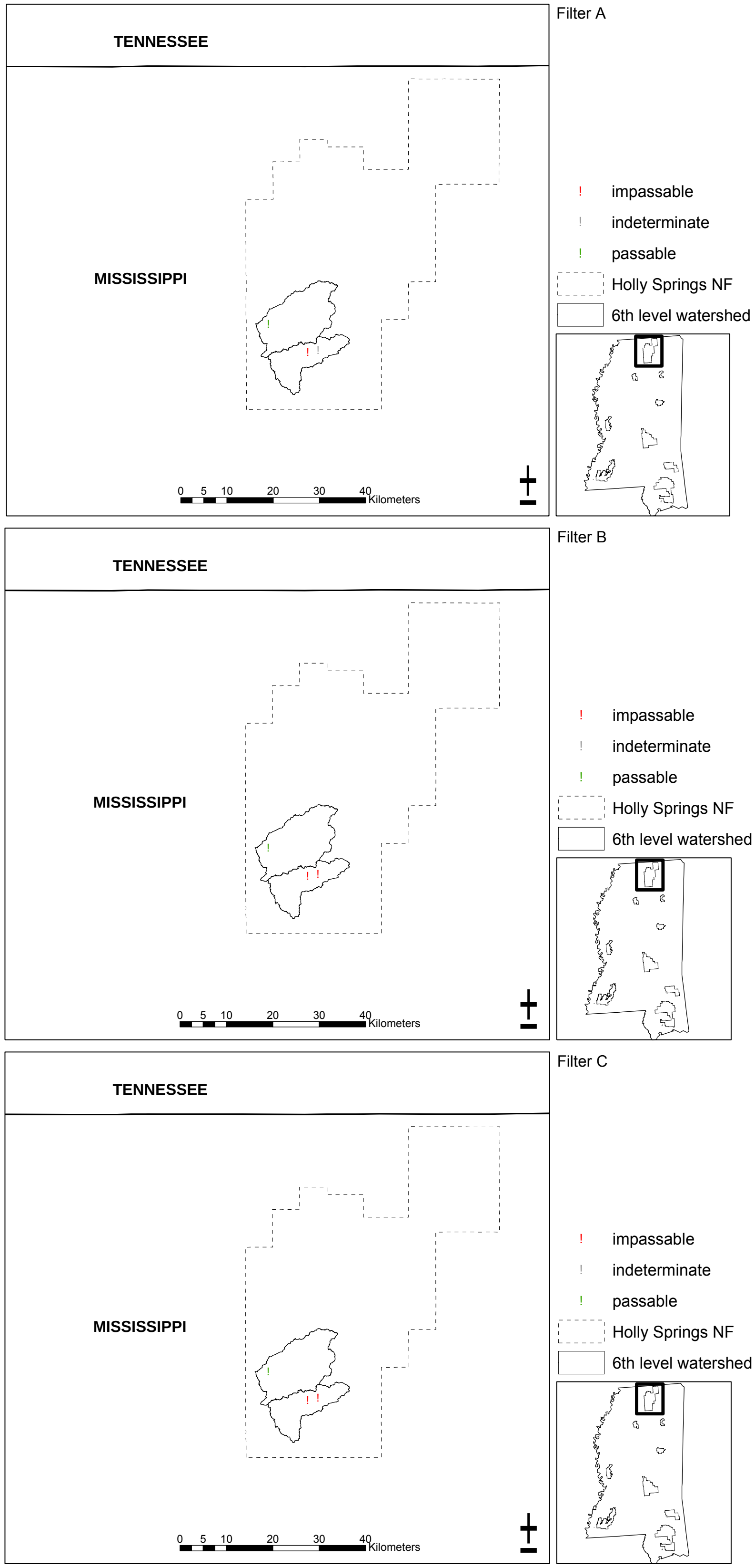

Figure E11. Location of crossings classified for fish passage by coarse filters A, B, and C within 6th level watersheds (draft) on the Holly Springs National Forest, summer 2006.

Table E1. Number of crossings documented (Total crossings documented) and not surveyed (Crossings not surveyed) on the National Forests in Mississippi summer 2006. Reasons for not surveying a documented site include: no suitable fish habitat upstream of crossing (NH); no access to site due to closed roads or private gates (NA); crossing was a natural ford (NF); crossing was a bridge (BR).

Forest	Total crossings documented	Crossings not surveyed (n, [%])				
		NH	NA	NF	BR	Total not surveyed
NFMS	96	14 (52)	1 (4)	11 (40)	1 (4)	27 (28)

Table E2. Number of crossings surveyed (Total surveyed) with coarse filter results for the National Forests in Mississippi summer 2006. Coarse filter results are presented for Filter A, Filter B, and Filter C (see filter descriptions, Fig 3 – 5).

Forest	Total surveyed	Coarse filter results								
		Impassable (n, [%])			Passable (n, [%])			Indeterminate (n, [%])		
		A	B	C	A	B	C	A	B	C
NFMS	69	5 (7)	19 (28)	26 (38)	37 (54)	21 (30)	19 (27)	27 (39)	29 (42)	24 (35)

Table E3. Location of crossings surveyed on the National Forests in Mississippi, summer of 2006. Site ID consists of the Forest abbreviation (HNF), road the crossing is on (101), and the distance (miles) from the junction road (0.5).

Site ID	# of Pipes	Forest #	District	Junction Road	Stream Name	Quad	6th Level Watershed
HNF128A-0.9	1	210	Homochitto	552	Foster Creek	Union Church	080602030601
HNF128A-1.4	1	208	Homochitto	552	UT Foster Creek	Union Church	080602030601
HNF128B-0.8	1	211	Homochitto	128A	Pierce Branch	Union Church	080602030601
HNF135A-0.5	2	256	Homochitto	115	UT Homochitto River	Caseyville	080602050102
HNF112A-0.6	2	270	Homochitto	112	UT Molls Creek	McCall Creek	080602050104
HNF113C-0.3	1	195	Homochitto	113	UT Fifteen Mile Creek	Eddicetown	080602050105
HNF145B-0.01	3	276	Homochitto	108	UT Homochitto River	Bude	080602050106
HNF199B-0.3	2	291	Homochitto	199	UT Porter Creek	Bude	080602050107
HNF196E-0.6	2	302	Homochitto	196B	UT Cane Mill Branch	Little Springs	080602050302
HNF145F-1.6	1	279	Homochitto	145	UT McGehee Creek	Bude	080602050303
HNF147-0.001	1	281	Homochitto	196B	UT McGehee Creek	Bude	080602050303
HNF147-0.4	1	284	Homochitto	196B	UT McGehee Creek	Bude	080602050303
HNF147G-2.3	1	294	Homochitto	Horse Creek Rd	UT McGehee Creek	Little Springs	080602050303
HNFplsvl-1.7	1	282	Homochitto	196	UT McGehee Creek	Bude	080602050303
HNF110C-1.5	2	--	Homochitto	110	UT Middle Fk Homochitto R	Kirby	080602050403
HNF118-0.7	1	24	Homochitto	165	Gresham Branch	Homochitto	080602050501
HNF118-1.3	1	25	Homochitto	165	Sulfur Springs Branch	Homochitto	080602050501
HNF118-1.9	1	26	Homochitto	165	UT Homochitto River	Homochitto	080602050501
HNF118-2.2	1	27	Homochitto	165	UT Homochitto River	Homochitto	080602050501
HNFC103-3.7	2	95	Homochitto	84	Quarterlot Branch	Meadville	080602050501
HNFC103-4.4	1	96	Homochitto	84	King Branch	Meadville	080602050501
HNF107LJ-0.4	1	11	Homochitto	107	UT Middleton Creek	Busy Corner	080602050502
HNF153A-1.2	3	9	Homochitto	153	Tanyard Creek	Busy Corner	080602050502
HNF153A-1.5	1	10	Homochitto	153	UT Tanyard Creek	Busy Corner	080602050502
HNF153A1-0.3	2	8	Homochitto	153	UT Tanyard Creek	Busy Corner	080602050502
HNF153B-0.7	1	7	Homochitto	153	UT Middleton Creek	Busy Corner	080602050502
HNF153B-1.0	2	6	Homochitto	153	UT Middleton Creek	Busy Corner	080602050502
HNF153D-0.9	2	4	Homochitto	153	UT Middleton Creek	Busy Corner	080602050502
HNF156E-1.3	1	--	Homochitto	156	UT Red Branch	Bewelcome	080602050504
HNF160-0.1	1	49	Homochitto	106	UT Birdman Branch	Homochitto	080602050504
HNF160-0.2	1	48	Homochitto	106	UT Walker Creek	Homochitto	080602050504

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Site ID	# of Pipes	Forest #	District	Junction Road	Stream Name	Quad	6th Level Watershed
HNFCR118-1.5	1	35	Homochitto	118	UT Homochitto River	Homochitto	080602050504
HNF191B-2.1	1	71	Homochitto	33	UT Homochitto River	Crosby	080602050505
HNF191B-3.1	1	68	Homochitto	33	UT Homochitto River	Crosby	080602050505
HNF196-0.9	2	78	Homochitto	33	UT Zeigler Creek	Crosby	080602050505
HNF122-0.3	1	61	Homochitto	33	UT Foster Creek	Crosby	080602050507
HNF193-2.4	3	136	Homochitto	127	Cahal Creek	Garden City	080602050601
HNF193-3.3	1	134	Homochitto	127	Turkey Creek	Garden City	080602050601
HNFkng-0.4	2	75	Homochitto	127	UT Dry Creek	Crosby	080602050601
HNF101-0.5	1	154	Homochitto	101	Wearly Branch	Knoxville	080602050602
HNF101-3.1	1	159	Homochitto	182	Rocky Branch	Knoxville	080602050602
HNF101C-0.2	1	158	Homochitto	101	Rocky Branch	Knoxville	080602050602
HNF102D-0.7	1	164	Homochitto	101	Dry Creek	Knoxville	080602050602
HNF184-0.1	2	161	Homochitto	101	Rocky Branch	Knoxville	080602050602
HNF101A-0.7	2	165	Homochitto	101	UT Tony Creek	Knoxville	080602050605
HNF101A-1.8	2	167	Homochitto	101	UT Tony Creek	Knoxville	080602050605
HNF190A-0.01	1	168	Homochitto	101	UT Tony Creek	Knoxville	080602050605
HSNF216-0.5	1	--	Holly Springs	245	UT Cypress Creek	Puskus Lake	080302010505
HNF246-0.1	1	--	Holly Springs	216	UT Puskus Creek	Puskus Lake	080302010505
HSNF244-0.4	2	--	Holly Springs	T4	Bagley Creek	Malone	080302010507

Table E4. Coarse filters A, B, and C, classifications for surveyed crossings on the National Forest in Mississippi, summer 2006.

Site ID	Pipe #	Forest #	Filter A	Filter B	Filter C
HNF128A-0.9	1	210	passable	passable	passable
HNF128A-1.4	1	208	passable	passable	passable
HNF128B-0.8	1	211	indeterminate	indeterminate	indeterminate
HNF135A-0.5	2	256	indeterminate	impassable	impassable
HNF112A-0.6	1	270	passable	passable	passable
HNF112A-0.6	2	270	passable	passable	passable
HNF113C-0.3	1	195	indeterminate	impassable	impassable
HNF145B-0.01	1	276	passable	indeterminate	indeterminate
HNF145B-0.01	2	276	passable	indeterminate	indeterminate
HNF145B-0.01	3	276	passable	indeterminate	indeterminate
HNF199B-0.3	1	291	indeterminate	indeterminate	indeterminate
HNF199B-0.3	2	291	indeterminate	indeterminate	indeterminate
HNF196E-0.6	1	302	indeterminate	indeterminate	indeterminate
HNF196E-0.6	2	302	indeterminate	indeterminate	indeterminate
HNF145F-1.6	1	279	indeterminate	indeterminate	indeterminate
HNF147-0.001	1	281	passable	indeterminate	indeterminate
HNF147-0.4	1	284	passable	passable	passable
HNF147G-2.3	1	294	impassable	impassable	impassable
HNFplsvl-1.7	1	282	impassable	impassable	impassable
HNF110C-1.5	1	--	indeterminate	impassable	impassable
HNF110C-1.5	2	--	indeterminate	impassable	impassable
HNF118-0.7	1	24	passable	passable	passable
HNF118-1.3	1	25	passable	passable	passable
HNF118-1.9	1	26	passable	impassable	impassable
HNF118-2.2	1	27	passable	impassable	impassable
HNFC103-3.7	2	95	impassable	impassable	impassable
HNFC103-4.4	1	96	passable	impassable	impassable
HNF107lJ-0.4	1	11	indeterminate	indeterminate	indeterminate
HNF153A-1.2	1	9	indeterminate	indeterminate	indeterminate
HNF153A-1.2	2	9	passable	passable	passable
HNF153A-1.2	3	9	passable	passable	passable
HNF153A-1.5	1	10	passable	impassable	impassable
HNF153A1-0.3	1	8	indeterminate	indeterminate	indeterminate
HNF153A1-0.3	2	8	indeterminate	indeterminate	indeterminate
HNF153B-0.7	1	7	indeterminate	indeterminate	indeterminate
HNF153B-1.0	1	6	passable	indeterminate	indeterminate
HNF153B-1.0	2	6	indeterminate	indeterminate	indeterminate
HNF153D-0.9	1	4	indeterminate	indeterminate	indeterminate
HNF153D-0.9	2	4	indeterminate	indeterminate	indeterminate
HNF156E-1.3	1	--	indeterminate	indeterminate	impassable
HNF160-0.1	1	49	indeterminate	indeterminate	impassable
HNF160-0.2	1	48	passable	passable	passable
HNFCR118-1.5	1	35	passable	indeterminate	impassable
HNF191B-2.1	1	71	passable	indeterminate	indeterminate
HNF191B-3.1	1	68	passable	passable	passable

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Site ID	Pipe #	Forest #	Filter A	Filter B	Filter C
HNF196-0.9	1	78	indeterminate	impassable	impassable
HNF196-0.9	2	78	indeterminate	indeterminate	indeterminate
HNF122-0.3	1	61	indeterminate	impassable	impassable
HNF193-2.4	1	136	indeterminate	indeterminate	impassable
HNF193-2.4	2	136	passable	indeterminate	indeterminate
HNF193-2.4	3	136	passable	passable	passable
HNF193-3.3	1	134	passable	passable	impassable
HNFkng-0.4	1	75	passable	passable	passable
HNFkng-0.4	2	75	passable	passable	passable
HNF101-0.5	1	154	impassable	impassable	impassable
HNF101-3.1	1	159	passable	impassable	impassable
HNF101C-0.2	1	158	indeterminate	indeterminate	impassable
HNF102D-0.7	1	164	passable	impassable	impassable
HNF184-0.1	1	161	passable	indeterminate	indeterminate
HNF184-0.1	2	161	passable	passable	passable
HNF101A-0.7	1	165	passable	passable	passable
HNF101A-0.7	2	165	passable	passable	passable
HNF101A-1.8	1	167	passable	passable	impassable
HNF101A-1.8	2	167	passable	indeterminate	indeterminate
HNF190A-0.01	1	168	indeterminate	impassable	impassable
HSNF216-0.5	1	--	indeterminate	impassable	impassable
HSNF244-0.4	1	--	passable	passable	passable
HSNF244-0.4	2	--	passable	passable	passable
HSNF246-0.1	1	--	impassable	impassable	impassable

Table E5. Description of crossings surveyed on the National Forests in Mississippi summer 2006. Shape abbreviations: C= circular, PA= pipe arch, OBA= open bottom arch, and F= ford. Channel width is the mean bankfull channel width. N= no natural substrate, N (discontin)= discontinuous substrate, Y= continuous natural substrate. An NA (not applicable) indicates outlet drop (no outlet pool or tailwater control) or outlet perch (stream dry) could not be calculated. Negative outlet drop or perch values indicate a submerged outlet (structure partially backwatered). Residual inlet depth values ≥ 0.0 indicate the structure is fully backwatered.

Site ID	Pipe #	Forest #	Shape	Pipe Condition	Mean Chnl Width (ft)	Continuous Substrate in Structure	Pipe Slope (%)	Pipe Width : Chnl Width ratio	Outlet Drop (in)	Outlet Perch (in)	Residual Inlet Depth (in)	Pipe Length (ft)	Slope (%) * Length (ft)
HNF128A-0.9	1	210	B	good	6.3	Y	1.07	1.90	0.00	-0.12	0.00	43.5	46.5
HNF128A-1.4	1	208	B	good	10.8	Y	1.91	1.11	-0.24	NA	0.00	43.0	82.0
HNF128B-0.8	1	211	B	good	12.2	N (discontin)	1.22	0.90	-3.18	-3.30	0.00	44.4	54.0
HNF135A-0.5	2	256	C	good	10.9	N	2.38	0.51	15.72	15.72	0.00	40.8	97.0
HNF112A-0.6	1	270	C	fair	10.3	N	0.58	0.49	-3.36	1.32	6.60	46.4	27.0
HNF112A-0.6	2	270	C	fair	10.3	N	0.84	0.49	-11.50	-11.90	6.84	46.5	39.0
HNF113C-0.3	1	195	C	fair	7.2	N	0.71	1.04	12.72	10.92	0.00	80.6	57.0
HNF145B-0.01	1	276	C	good	10.2	N	0.83	0.54	NA	NA	0.00	57.5	47.5
HNF145B-0.01	2	276	C	good	10.2	N	0.88	0.54	NA	NA	0.00	56.9	50.0
HNF145B-0.01	3	276	C	good	10.2	N	0.83	0.54	NA	NA	0.00	57.0	47.5
HNF199B-0.3	1	291	C	poor	10.0	N (discontin)	1.24	0.70	0.60	0.00	0.00	62.2	77.0
HNF199B-0.3	2	291	C	poor	10.0	N (discontin)	1.68	0.70	2.64	9.72	0.00	61.8	104.0
HNF196E-0.6	1	302	C	good	10.1	N	1.23	0.64	-1.32	2.70	0.00	49.3	60.5
HNF196E-0.6	2	302	C	good	10.1	N	1.08	0.64	0.78	2.94	0.00	48.7	52.5
HNF145F-1.6	1	279	C	fair	9.5	N (discontin)	2.63	0.79	-9.48	-4.92	0.00	55.8	147.0
HNF147-0.001	1	281	B	good	6.0	N (discontin)	0.28	1.67	-2.64	-4.56	0.00	119.3	33.0
HNF147-0.4	1	284	PA	good	6.9	N (discontin)	0.25	0.95	-1.08	-4.74	0.00	36.2	9.0
HNF147G-2.3	1	294	C	poor	7.5	N	0.55	0.67	34.38	13.62	0.00	30.1	16.5
HNFplsvl-1.7	1	282	C	fair	4.9	N	5.74	0.62	46.56	54.48	0.00	40.0	229.5

Table continued next page…

Site ID	Pipe #	Forest #	Shape	Pipe Condition	Mean Chnl Width (ft)	Continuous Substrate in Structure	Pipe Slope (%)	Pipe Width : Chnl Width ratio	Outlet Drop (in)	Outlet Perch (in)	Residual Inlet Depth (in)	Pipe Length (ft)	Slope (%) * Length (ft)
HNF110C-1.5	1	--	C	good	11.2	N	3.50	0.53	14.16	2.28	0.00	76.9	269.0
HNF110C-1.5	2	--	C	good	11.2	N	3.71	0.53	13.44	11.88	0.00	77.1	286.0
HNF118-0.7	1	24	B	good	9.8	Y	0.18	1.41	1.26	NA	0.90	101.0	18.0
HNF118-1.3	1	25	B	good	8.8	Y	0.26	2.00	NA	1.44	0.00	123.7	32.5
HNF118-1.9	1	26	B	good	8.1	N	0.77	1.24	11.88	9.48	0.00	58.8	45.0
HNF118-2.2	1	27	B	good	6.1	N	0.76	1.97	10.32	14.16	0.00	60.7	46.0
HNFC103-3.7	2	95	B	poor	13.1	N (discontin)	0.71	0.76	33.54	21.60	0.00	63.6	45.0
HNFC103-4.4	1	96	B	good	15.0	N (discontin)	0.44	0.67	21.06	18.84	0.00	68.2	30.0
HNF107lJ-0.4	1	11	C	good	9.9	N (discontin)	2.17	0.57	NA	-2.04	0.00	48.4	105.0
HNF153A-1.2	1	9	C	good	19.0	N	0.96	0.29	0.48	NA	0.00	60.7	58.0
HNF153A-1.2	2	9	C	good	19.0	N	0.23	0.29	3.60	NA	0.00	60.7	14.0
HNF153A-1.2	3	9	C	good	19.0	N	0.12	0.29	3.36	NA	0.00	60.7	7.0
HNF153A-1.5	1	10	PA	fair	8.5	N (discontin)	0.17	0.86	11.16	10.80	0.00	30.0	5.0
HNF153A1-0.3	1	8	C	poor	10.5	N	1.46	0.57	3.84	1.56	0.00	59.2	88.0
HNF153A1-0.3	2	8	C	poor	10.5	N	1.93	0.57	3.84	-0.24	0.00	59.5	115.0
HNF153B-0.7	1	7	PA	fair	8.9	N	1.75	0.79	0.84	-0.24	0.00	54.2	95.0
HNF153B-1.0	1	6	C	good	23.8	N (discontin)	0.96	0.21	NA	0.48	0.00	49.1	47.0
HNF153B-1.0	2	6	C	good	23.8	N (discontin)	1.15	0.21	NA	-0.48	0.00	48.8	56.0
HNF153D-0.9	1	4	C	poor	13.0	N (discontin)	2.25	0.50	-2.64	-6.48	0.00	37.7	85.0
HNF153D-0.9	2	4	C	poor	13.0	N	3.17	0.50	-0.48	-4.20	0.00	38.2	121.0
HNF156E-1.3	1	--	C	good	5.5	N	2.35	1.09	5.16	3.84	0.00	82.4	194.0
HNF160-0.1	1	49	C	good	7.3	N	1.50	0.52	6.12	3.48	0.00	40.0	60.0
HNF160-0.2	1	48	C	poor	7.5	Y	2.55	0.86	-2.46	9.48	0.00	40.2	102.5
HNFCR118-1.5	1	35	B	good	6.9	N (discontin)	0.50	1.16	9.36	7.56	0.00	84.5	42.0
HNF191B-2.1	1	71	C	fair	9.4	N	0.70	0.75	0.24	1.68	0.00	40.2	28.0

Table continued next page…

Site ID	Pipe #	Forest #	Shape	Pipe Condition	Mean Chnl Width (ft)	Continuous Substrate in Structure	Pipe Slope (%)	Pipe Width : Chnl Width ratio	Outlet Drop (in)	Outlet Perch (in)	Residual Inlet Depth (in)	Pipe Length (ft)	Slope (%) * Length (ft)
HNF191B-3.1	1	68	B	good	6.6	Y	0.23	2.14	3.30	0.60	0.00	76.8	17.5
HNF196-0.9	1	78	C	poor	4.9	N	3.66	0.62	-2.10	1.50	0.00	22.7	83.0
HNF196-0.9	2	78	C	poor	4.9	N	3.49	0.37	-6.12	-1.62	0.00	19.5	68.0
HNF122-0.3	1	61	B	good	5.1	N	1.75	0.99	17.58	15.18	0.00	45.4	79.5
HNF193-2.4	1	136	C	good	8.2	N	0.68	0.73	NA	3.48	0.00	88.5	60.0
HNF193-2.4	2	136	C	good	8.2	N	0.43	0.73	NA	0.24	0.00	88.5	38.0
HNF193-2.4	3	136	C	good	8.2	N	0.09	0.73	NA	-1.91	0.00	88.5	8.0
HNF193-3.3	1	134	C	good	16.6	N	0.23	0.46	7.80	9.00	0.00	70.8	16.0
HNFkng-0.4	1	75	B	good	21.2	Y	0.46	0.76	7.62	4.32	0.00	88.7	41.0
HNFkng-0.4	2	75	B	good	21.2	Y	0.48	0.76	7.62	4.32	0.00	87.9	42.0
HNF101-0.5	1	154	C	fair	9.5	N	0.37	0.63	51.54	19.38	0.00	49.9	18.5
HNF101-3.1	1	159	C	good	17.8	N	0.71	0.45	12.96	8.28	0.00	45.0	32.0
HNF101C-0.2	1	158	F	poor	20.4	N (discontin)	1.24	0.00	4.44	-4.44	0.00	58.8	73.0
HNF102D-0.7	1	164	F	good	25.4	N	1.41	0.00	10.32	9.12	0.00	14.9	21.0
HNF184-0.1	1	161	PA	good	29.1	N (discontin)	0.66	0.24	0.84	2.28	0.00	41.1	27.0
HNF184-0.1	2	161	PA	good	29.1	Y	0.49	0.24	0.24	-0.24	0.00	40.6	20.0
HNF101A-0.7	1	165	C	good	7.4	N (discontin)	2.26	0.87	4.62	3.78	9.06	50.5	114.0
HNF101A-0.7	2	165	C	good	7.4	N	4.27	0.87	5.76	-1.92	20.10	50.5	215.5
HNF101A-1.8	1	167	C	fair	6.6	N (discontin)	0.04	0.83	4.86	4.86	0.00	45.3	2.0
HNF101A-1.8	2	167	C	fair	6.6	N (discontin)	1.12	0.83	-0.24	7.98	0.00	44.7	50.0
HNF190A-0.01	1	168	C	good	8.4	N	3.32	0.83	23.94	22.14	0.00	48.4	160.5
HSNF-216-0.5	1	--	C	fair	8.6	N	3.93	0.58	23.88	24.54	0.00	40.0	157.0
HSNF244-0.4	1	--	B	good	17.5	N	0.87	0.23	-26.60	-30.70	31.92	50.9	44.5
HSNF244-0.4	2	--	B	good	17.5	N	0.73	0.23	-37.90	-42.0	33.48	50.9	37.0
HSNF246-0.1	1	--	C	poor	17.1	N	0.85	0.49	32.10	29.58	0.00	30.7	26.0

Appendix F: Results for the National Forests in Texas

We completed surveys at 92 (73%) of 126 documented crossing structures on the Angelina, Sabine, and Davy Crockett National Forests in 2006 (Figure F1, Tables F1 and F2). Filter A (strong swimmers and leapers) classified 11% (n=10) of crossings as impassable, 63% (n=58) as passable, and 26% (n=24) as indeterminate (Figure F2, Table F2). Filter B (moderate swimmers and leapers) classified 30% (n=28) of crossings as impassable, 45% (n=41) as passable, and 25% (n=23) as indeterminate (Figure F3, Table F2). Filter C (weak swimmers and leapers) classified 50% (n=46) of crossing as impassable, 32% (n=29) as passable, and 18% (n=17) as indeterminate (Figure F4, Table F2). Characteristics and filter classifications for each crossing are presented in Tables F3-F5.

The majority of the crossings surveyed were circular culverts (64%, n=59), while box culverts (21%, n=19), pipe arches (11%, n=10), vented fords (4%, n=4), fords (0%, n=0), and open bottom arches (0%, n=0) were less frequently encountered or not encountered. Filter A classified 5% of circular culverts, 26% of box culverts, 20% of pipe arches, and 0% of vented fords as impassable (Figure F5). Filter B classified 22% of circular culverts, 58% of box culverts, 40% of pipe arches, and 0% of vented fords as impassable (Figure F6). Filter C classified 44% of circular culverts, 74% of box culverts, 60% of pipe arches, and 0% of vented fords as impassable (Figure F7). The mean crossing width to channel width ratio (excluding fords, vented fords, and multiple structure crossings) was 0.85 ± 0.30 (mean ± SD) (n=62), and 15 crossings were greater than or equal to the bankfull channel width (Figure F8). The mean crossing width to channel width ratio for surveyed crossings classified impassable by Filter A was 0.97 ± 0.37 (n=8). The mean ratio for crossings classified impassable by Filter B was 0.88 ± 0.39 (n=21), and was 0.87 ± 0.34 (n=33) for Filter C (Figure F9). The mean crossing width to channel width ratio for surveyed crossings classified passable by Filter A was 0.85 ± 0.26 (n=35). The mean ratio for crossings classified passable by Filter B was 0.83 ± 0.23 (n=23), and was 0.79 ± 0.21 (n=16) for Filter C (Figure F9).

Figure F1. National Forests in Texas where road-stream crossing surveys were conducted, summer 2006.

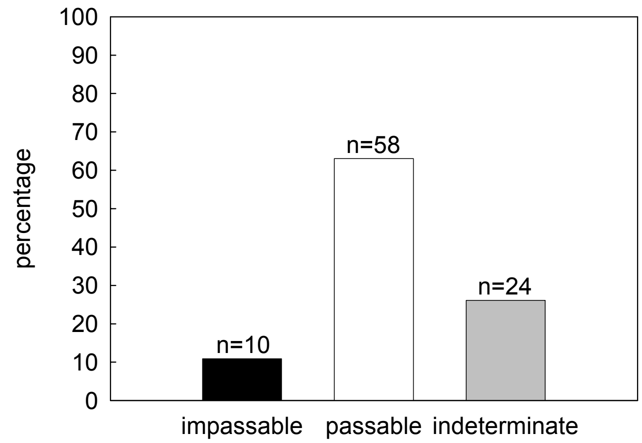

Figure F2. Percentage of crossings classified as impassable, passable, or indeterminate for Filter A; National Forests in Texas, summer 2006 (N=92).

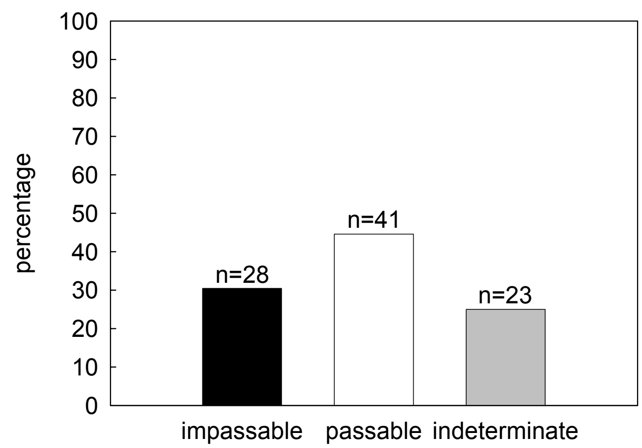

Figure F3. Percentage of crossings classified as impassable, passable, or indeterminate for Filter B; National Forests in Texas, summer 2006 (N=92).

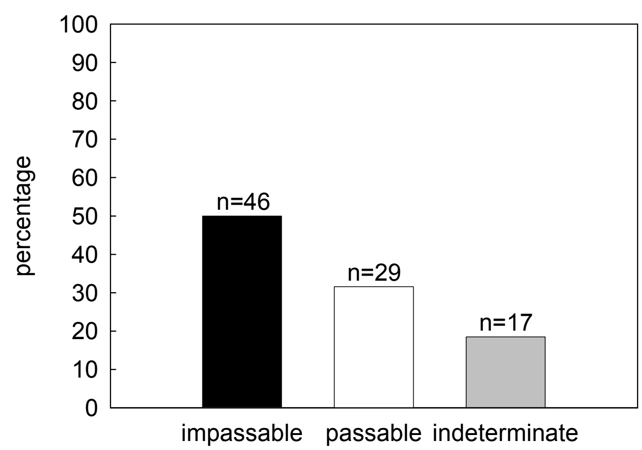

Figure F4. Percentage of crossings classified as impassable, passable, or indeterminate for Filter C; National Forests in Texas, summer 2006 (N=92).

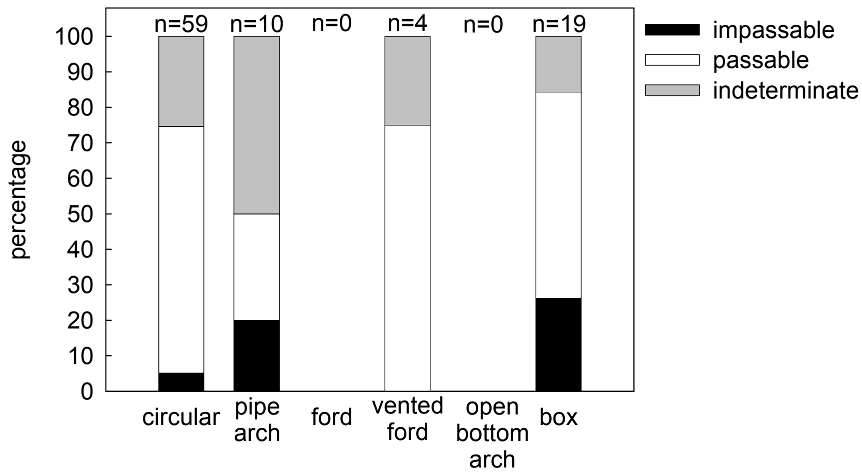

Figure F5. Percentage of each crossing type classified as impassable, passable, or indeterminate for Filter A; National Forests in Texas, summer 2006 (N=92).

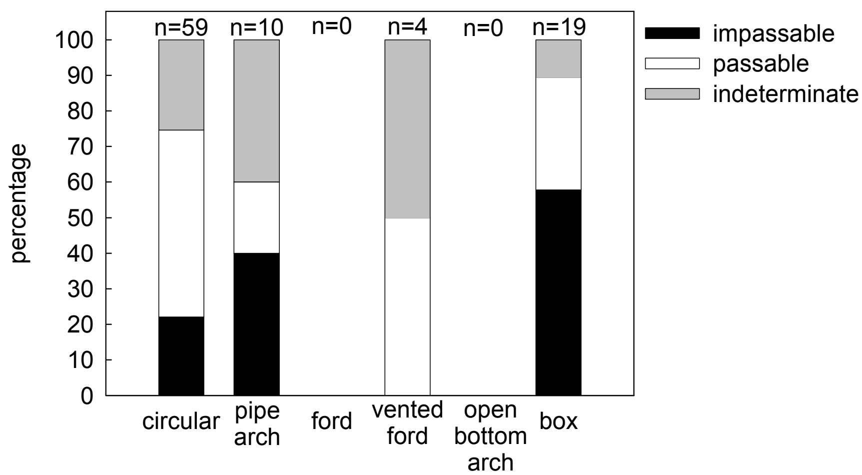

Figure F6. Percentage of each crossing type classified as impassable, passable, or indeterminate for Filter B; National Forests in Texas, summer 2006 (N=92).

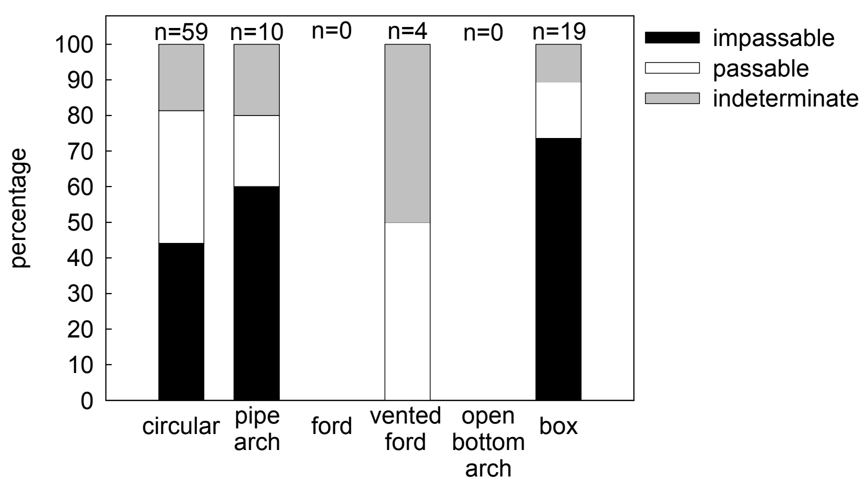

Figure F7. Percentage of each crossing type classified as impassable, passable, or indeterminate for Filter C; National Forests in Texas, summer 2006 (N=92).

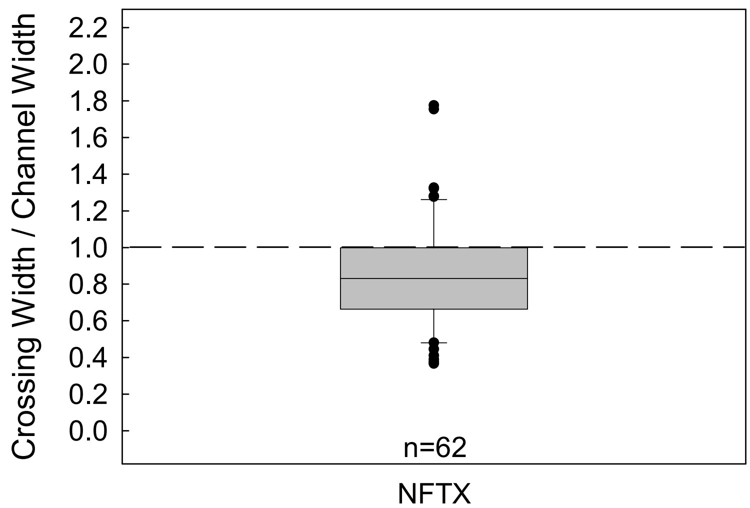

Figure F8. Crossing width to bankfull channel width ratio for crossings surveyed in summer 2006 on the National Forests in Texas (excluding fords, vented fords, and multiple structure crossings). A ratio of 1.0 (dashed line) or greater indicates the crossing structure opening is greater than or equal to the bankfull channel width. The top and bottom of the boxes represent the 25th and 75th percentiles, the bar in the center of each box represents the median, whiskers represent the 10th and 90th percentiles, and closed circles represent the entire range of the data.

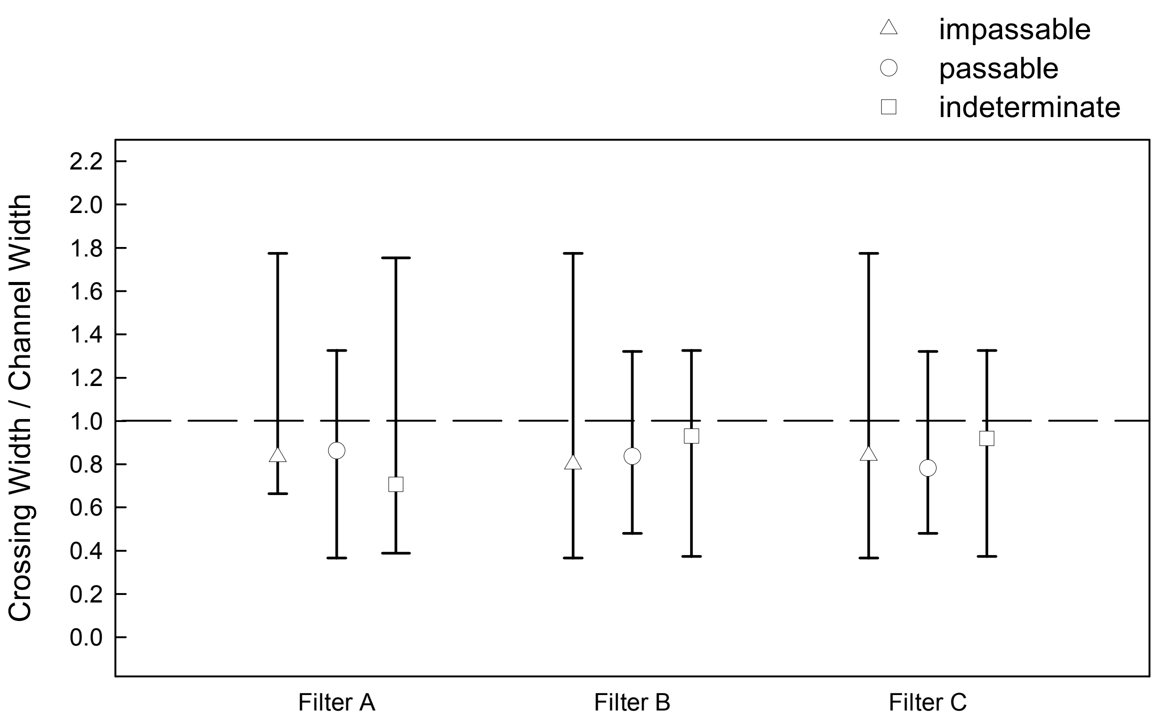

Figure F9. Crossing width to bankfull channel width ratio for crossings classified impassable, passable, or indeterminate in summer 2006 on the National Forests in Texas (excluding fords, vented fords, and multiple structure crossings). A ratio of 1.0 (dashed line) or greater indicates the crossing structure opening is greater than or equal to the bankfull channel width. The symbol inside each set of whiskers represents the median, and the top and bottom of the whiskers represent the maximum and minimum values.

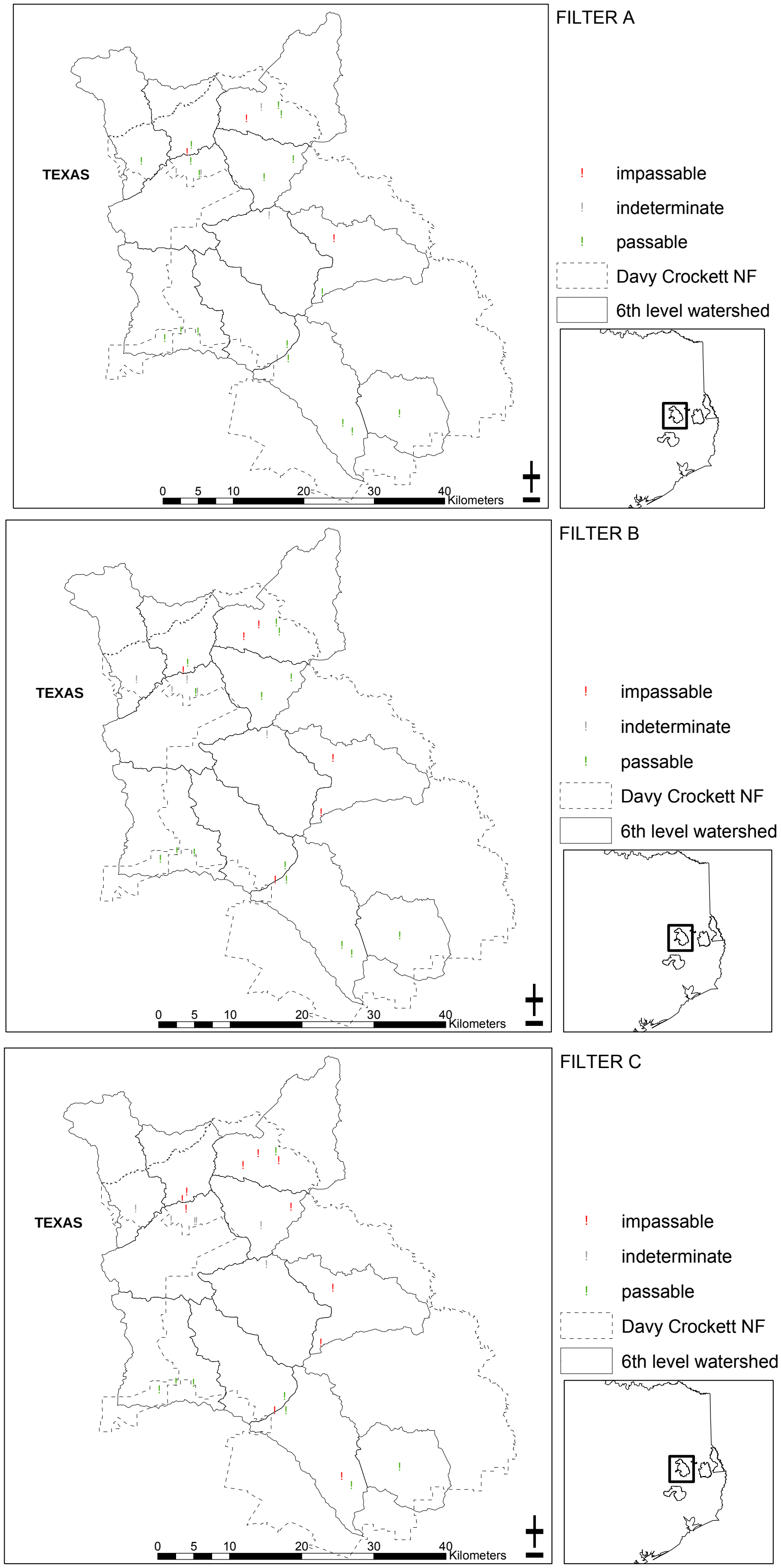

Figure F10. Location of crossings classified for fish passage by coarse filters A, B, and C within 6th level watersheds (draft) on the Davy Crockett National Forest, summer 2006.

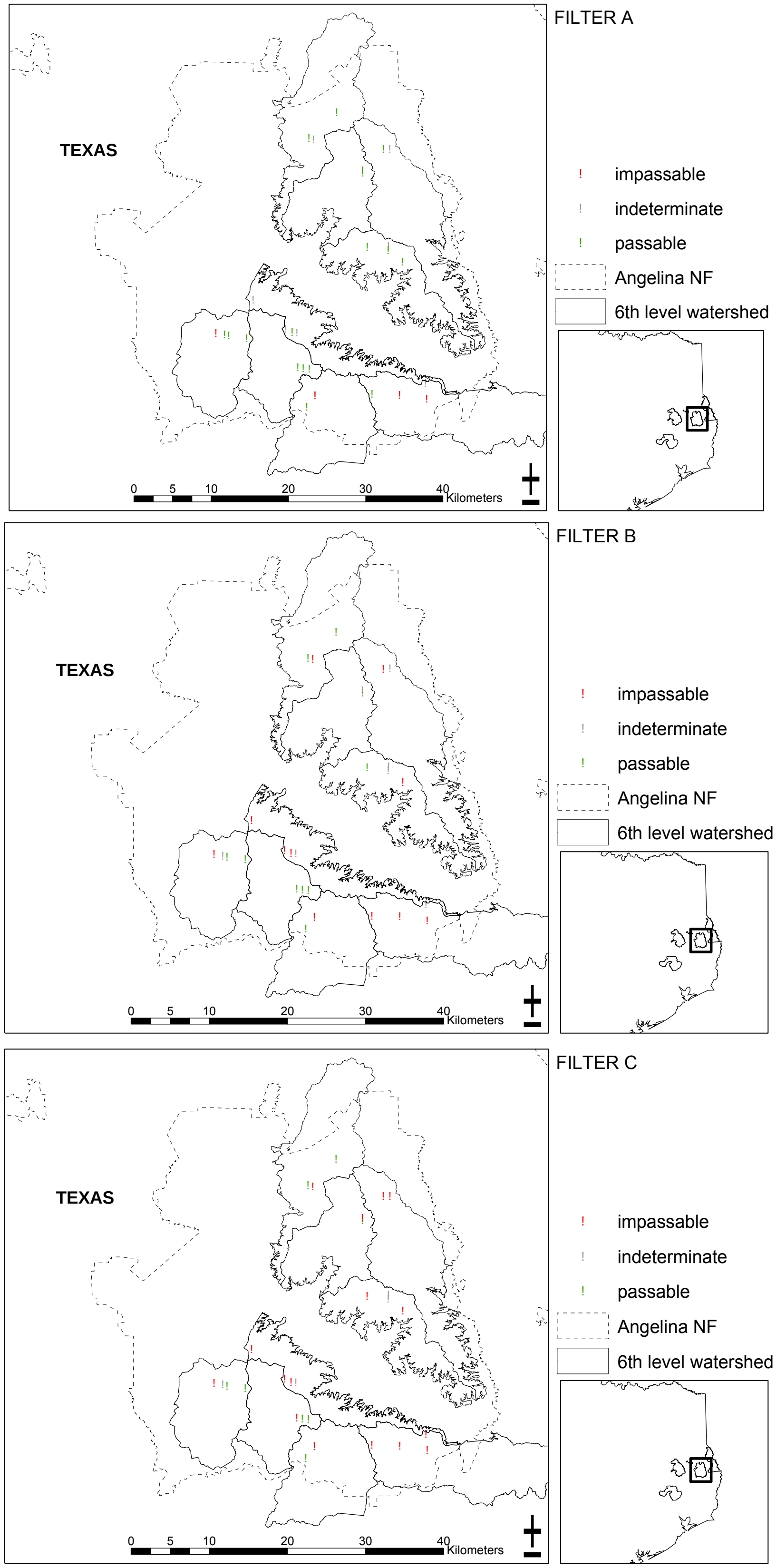

Figure F11. Location of crossings classified for fish passage by coarse filters A, B, and C within 6th level watersheds (draft) on the Angelina National Forest, summer 2006.

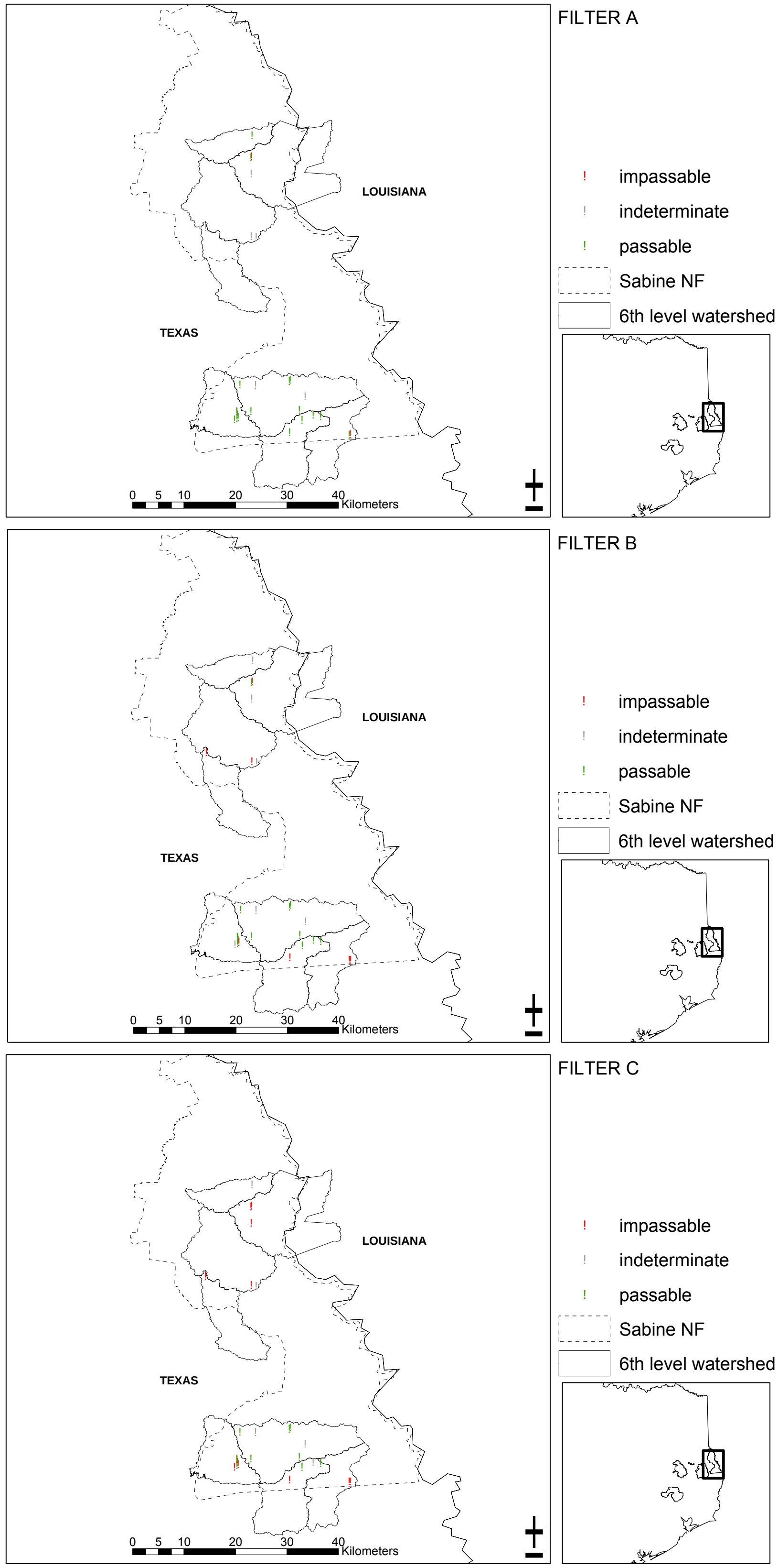

Figure F12. Location of crossings classified for fish passage by coarse filters A, B, and C within 6th level watersheds (draft) on the Sabine National Forest, summer 2006.

Table F1. Number of crossings documented (Total crossings documented) and not surveyed (Crossings not surveyed) on the National Forests in Texas (Angelina, Sabine, and Davy Crockett NFs), summer 2006. Reasons for not surveying a documented site include: no suitable fish habitat upstream of crossing (NH); no access to site due to closed roads or private gates (NA); crossing was a natural ford (NF); crossing was a bridge (BR).

Forest	Total crossings documented	Crossings not surveyed (n, [%])				
		NH	NA	NF	BR	Total not surveyed
NFTX	126	31 (91)	1 (3)	1 (3)	1 (3)	34 (27)

Table F2. Number of crossings surveyed (Total surveyed) with coarse filter results for the National Forests in Texas (Angelina, Sabine, and Davy Crockett NFs), summer 2006. Coarse filter results are presented for Filter A, Filter B, and Filter C (see filter descriptions, Fig 3 – 5).

Forest	Total surveyed	Coarse filter results								
		Impassable (n, [%])			Passable (n, [%])			Indeterminate (n, [%])		
		A	B	C	A	B	C	A	B	C
NFTX	92	10 (11)	28 (30)	46 (50)	58 (63)	41 (45)	29 (32)	24 (26)	23 (25)	17 (18)

Table F3. Location of crossings surveyed on the National Forests in Texas, summer of 2006. Site ID consists of the Forest abbreviation (ANF), road the crossing is on (300A), and the distance (miles) from the junction road (1.6).

Site ID	Pipe #	District	Junction Road	Stream Name	Quad	6th Level Watershed
ANF3053-0.8	1	Angelina	4-4	UT Cypress Creek	Zavalla	120200030102
ANF4-4-0.2	1	Angelina	paved to gravel	Mill Creek	Zavalla	120200030102
ANF4-4-1.1	1	Angelina	paved to gravel	Cypress Creek	Cassells-Boykin Park	120200030102
ANF4-4-2.3	1	Angelina	paved to gravel	Oil Well Creek	Cassells-Boykin Park	120200030102
ANF302-1.5	1	Angelina	303	UT holly branch	Boykin Spring	120200030104
ANF302-1.9	1	Angelina	303	UT Holly Branch	Boykin Spring	120200030104
ANF302-2.3	1	Angelina	303	UT White Oak Branch	Boykin Spring	120200030104
ANF313-2-0.1	1	Angelina	313	UT Boykin Creek	Boykin Spring	120200030105
ANF313-2-0.15	1	Angelina	313	UT Boykin Creek	Boykin Spring	120200030105
ANF326A-0.7	2	Angelina	326	Boykin Creek	Boykin Spring	120200030105
ANF300W-3.1	1	Angelina	147	UT Prairie Creek	Broaddus	120200050309
ANF300W-3.4	1	Angelina	147	Prairie Creek	Broaddus	120200050309
ANF301-0.4	1	Angelina	147	Running Branch	Norwood	120200050309
ANF307-1.3	1	Angelina	300E	UT Sandy Creek	Harvey Creek	120200050601
ANF307-1.7	1	Angelina	300E	Wash Branch	Harvey Creek	120200050601
ANF300A-1.6	1	Angelina	300E	Franklin Branch	Harvey Creek	120200050701
ANF300A-1.8	1	Angelina	300E	UT Franklin Branch	Harvey Creek	120200050701
ANF308-1.4	1	Angelina	2743	Julia Creek	Cassells-Boykin Park	120200050702
ANF354-0.4	1	Angelina	ANG4-4	Caney Creek	Cassells-Boykin Park	120200050702
ANF354-0.9	1	Angelina	ANG4-4	UT Caney Creek	Cassells-Boykin Park	120200050702
ANF354-1.2	1	Angelina	ANG4-4	UT Caney Creek	Cassells-Boykin Park	120200050702
ANF304E-1.7	1	Angelina	705	Blackland Branch	Veach	120200050703
ANF304E-3.4	1	Angelina	705	UT Beach Basin	Veach	120200050703
ANF3094-0.1	1	Angelina	304E	UT Beach Basin	Veach	120200050703
ANF317-1.4	1	Angelina	304E	Parker Creek	Veach	120200050703
ANF332-0.2	1	Angelina	335	UT Wards Branch	Ebenezer	120200050801
ANF333-0.2	2	Angelina	63	Buck Branch	Ebenezer	120200050801
ANF333A-2.0	1	Angelina	333	Trout Creek	Ebenezer	120200050801
ANF335-0.2	2	Angelina	63	UT Wards Branch	Ebenezer	120200050801
DCNF1560A-1.1	1	Davy Crockett	1560	Austin Branch	Crockett NE	120200010705
DCNF524-1.0	1	Davy Crockett	21	Johnson Creek	Crockett NE	120200010706

Table continued next page…

Site ID	Pipe #	District	Junction Road	Stream Name	Quad	6th Level Watershed
DCNF5261-0.2	1	Davy Crockett	526A	UT Spur Creek	Crockett NE	120200010706
DCNF511-0.1	2	Davy Crockett	526	Bluff Creek	Weches	120200020101
DCNF511-0.7	2	Davy Crockett	526	Camp Creek	Weches	120200020101
DCNF526-3.0	1	Davy Crockett	FM 227	Pole Branch	Weches	120200020101
DCNF526-4.5	1	Davy Crockett	FM 227	UT Camp Creek	Weches	120200020101
DCNF524-0.5	2	Davy Crockett	526	Johnson Creek	Crockett NE	120200020102
DCNF5241-0.5	2	Davy Crockett	524A	Gum Creek	Crockett NE	120200020102
DCNF524B-0.8	1	Davy Crockett	524	Johnson Creek	Crockett NE	120200020102
DCNF524B-1.0	1	Davy Crockett	524	Johnson Creek	Crockett NE	120200020102
DCNF511-4.2	2	Davy Crockett	526	Walnut Creek	Ratcliff	120200020103
DCNF556-1.1	1	Davy Crockett	1170	Hickory Creek	Ratcliff	120200020103
DCNF521-1.2	1	Davy Crockett	227	UT Lee Creek	Ratcliff	120200020202
DCNF4740-1.7	1	Davy Crockett	7	Brushy Creek	Kennard NE	120200020203
DCNF527-4.4	1	Davy Crockett	525	Garrison Creek	Centralia	120200020203
DCNF589-0.3	2	Davy Crockett	568	UT Alabama Creek	Apple Springs	120200020304
DCNF502-2.4	2	Davy Crockett	357	UT Piney Creek	Pennington	120200020401
DCNF570-0.5	2	Davy Crockett	3154	UT Piney Creek	Pennington	120200020401
DCNF502-3.4	2	Davy Crockett	357	UT Piney Creek	Pennington	120200020402
DCNF523-1.9	1	Davy Crockett	528	UT Piney Creek	Groveton East	120200020402
DCNF528B-1.1	1	Davy Crockett	528	UT Piney Creek	Groveton East	120200020402
DCNF508B-1.1	2	Davy Crockett	508	E Fork White Rock Creek	Berea	120302020701
DCNF587-0.4	2	Davy Crockett	508	Tanyard Creek	Fodice	120302020701
DCNF587-1.9	2	Davy Crockett	508	Big Branch	Fodice	120302020701
SBNF156-0.9	2	Sabine	1384	North Blue Bayou	Patroon North	120100040502
SBNF126-1.3	1	Sabine	2261	UT Brittain Creek	Patroon North	120100040505
SBNF126-3.3	1	Sabine	2261	UT Sanders Creek	Patroon North	120100040505
SBNF126-3.4	1	Sabine	2261	Sanders Creek	Patroon North	120100040505
SBNF131A-0.9	1	Sabine	131	UT Bourghs Creek	Patroon South	120100040702
SBNF131A-1.5	1	Sabine	131	UT Bourghs Creek	Patroon South	120100040702
SBNF108-1.8	1	Sabine	Boggy Creek Rd	El Labanillo Creek	Patroon South	120100040902
SBNF114A-1.5	1	Sabine	114	UT Sixmile Creek	Pineland South	120100041101
SBNF109-0.3	1	Sabine	87	UT Conner Creek	Hemphill	120100041101

Table continued next page…

Site ID	Pipe #	District	Junction Road	Stream Name	Quad	6th Level Watershed
SBNF109-0.5	1	Sabine	87	Conner Creek	Hemphill	120100041101
SBNF111-2.7	2	Sabine	87	UT Sixmile Creek	Hurricane Creek	120100041101
SBNF152-1.1	1	Sabine	2426	Pigeon Creek	Pineland North	120100041101
SBNF152-4.0	1	Sabine	2426	Sixmile Creek	Pineland North	120100041101
SBNF175-0.4	1	Sabine	111A	UT Toledo Bend Reservoir	Hurricane Creek	120100041101
SBNF117-0.9	1	Sabine	144	UT Hyden Branch	Hurricane Creek	120100041102
SBNF111B-0.2	1	Sabine	111	UT Big Sandy Creek	Hurricane Creek	120100041102
SBNF144A-0.2	2	Sabine	144	UT Big Sandy Creek	Hurricane Creek	120100041102
SBNF144B-0.3	2	Sabine	144	UT Big Sandy Creek	Hurricane Creek	120100041102
SBNF113-0.8	1	Sabine	87	UT Shingle Branch	Fairmount	120100041103
SBNF113-0.9	1	Sabine	87	UT Shingle Branch	Fairmount	120100041103
SBNF114-2.5	1	Sabine	2426	UT Little Creek	Pineland South	120200050604
SBNF114-2.8	1	Sabine	2426	Little Creek	Pineland South	120200050604
SBNF114B-0.1	1	Sabine	114	UT Little Creek	Pineland South	120200050604
SBNF114B-0.4	1	Sabine	114	UT Little Creek	Pineland South	120200050604
SBNF114-0.1	1	Sabine	114A	UT Curry Creek	Pineland South	120200050604
SBNF114-0.2	1	Sabine	114A	UT Curry Creek	Pineland South	120200050604

Table F4. Coarse filters A, B, and C, classifications for surveyed crossings on the National Forest in Texas, summer 2006.

Site ID	Pipe #	Filter A	Filter B	Filter C
ANF3053-0.8	1	passable	indeterminate	indeterminate
ANF4-4-0.2	1	impassable	impassable	impassable
ANF4-4-1.1	1	passable	passable	passable
ANF4-4-2.3	1	passable	passable	passable
ANF302-1.5	1	passable	passable	impassable
ANF302-1.9	1	passable	passable	passable
ANF302-2.3	1	passable	passable	passable
ANF313-2-0.1	1	impassable	impassable	impassable
ANF313-2-0.15	1	indeterminate	indeterminate	impassable
ANF326A-0.7	1	passable	passable	passable
ANF326A-0.7	2	passable	passable	passable
ANF300W-3.1	1	indeterminate	impassable	impassable
ANF300W-3.4	1	passable	passable	passable
ANF301-0.4	1	passable	passable	passable
ANF307-1.3	1	passable	impassable	impassable
ANF307-1.7	1	indeterminate	indeterminate	impassable
ANF300A-1.6	1	passable	indeterminate	impassable
ANF300A-1.8	1	passable	passable	passable
ANF308-1.4	1	indeterminate	impassable	impassable
ANF354-0.4	1	indeterminate	impassable	impassable
ANF354-0.9	1	passable	impassable	impassable
ANF354-1.2	1	indeterminate	indeterminate	indeterminate
ANF304E-1.7	1	passable	impassable	impassable
ANF304E-3.4	1	indeterminate	indeterminate	indeterminate
ANF3094-0.1	1	passable	indeterminate	indeterminate
ANF317-1.4	1	passable	passable	impassable
ANF332-0.2	1	indeterminate	indeterminate	impassable
ANF333-0.2	1	passable	impassable	impassable
ANF333-0.2	2	passable	impassable	impassable
ANF333A-2.0	1	impassable	impassable	impassable
ANF335-0.2	1	impassable	impassable	impassable
ANF335-0.2	2	impassable	impassable	impassable
DCNF1560A-1.1	1	passable	indeterminate	indeterminate
DCNF524-1.0	1	impassable	impassable	impassable
DCNF5261-0.2	1	passable	passable	impassable
DCNF511-0.1	2	passable	passable	passable
DCNF511-0.7	1	passable	passable	impassable
DCNF511-0.7	2	passable	passable	impassable
DCNF526-3.0	1	impassable	impassable	impassable
DCNF526-4.5	1	indeterminate	impassable	impassable
DCNF524-0.5	2	passable	indeterminate	impassable
DCNF5241-0.5	1	indeterminate	indeterminate	indeterminate
DCNF524B-0.8	1	passable	passable	indeterminate
DCNF524B-1.0	1	indeterminate	indeterminate	indeterminate
DCNF511-4.2	1	passable	passable	impassable
DCNF511-4.2	2	passable	passable	impassable

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Site ID	Pipe #	Filter A	Filter B	Filter C
DCNF556-1.1	1	passable	passable	indeterminate
DCNF521-1.2	1	indeterminate	indeterminate	indeterminate
DCNF4740-1.7	1	impassable	impassable	impassable
DCNF527-4.4	1	passable	impassable	impassable
DCNF589-0.3	2	passable	passable	passable
DCNF502-2.4	2	passable	passable	passable
DCNF570-0.5	1	indeterminate	impassable	impassable
DCNF570-0.5	2	indeterminate	impassable	impassable
DCNF502-3.4	1	passable	passable	passable
DCNF502-3.4	2	passable	passable	passable
DCNF523-1.9	1	passable	passable	impassable
DCNF528B-1.1	1	passable	passable	passable
DCNF508B-1.1	2	passable	passable	passable
DCNF587-0.4	1	indeterminate	impassable	impassable
DCNF587-0.4	2	passable	passable	passable
DCNF587-1.9	2	passable	passable	passable
SBNF156-0.9	1	indeterminate	indeterminate	indeterminate
SBNF156-0.9	2	passable	indeterminate	indeterminate
SBNF126-1.3	1	indeterminate	indeterminate	impassable
SBNF126-3.3	1	passable	passable	impassable
SBNF126-3.4	1	impassable	impassable	impassable
SBNF131A-0.9	1	indeterminate	impassable	impassable
SBNF131A-1.5	1	indeterminate	indeterminate	indeterminate
SBNF108-1.8	1	indeterminate	impassable	impassable
SBNF109-0.3	1	passable	passable	passable
SBNF109-0.5	1	passable	passable	passable
SBNF111-2.7	1	passable	indeterminate	indeterminate
SBNF111-2.7	2	passable	passable	passable
SBNF114A-1.5	1	passable	passable	passable
SBNF152-1.1	1	indeterminate	indeterminate	indeterminate
SBNF152-4.0	1	passable	passable	passable
SBNF175-0.4	1	indeterminate	indeterminate	indeterminate
SBNF111B-0.2	1	passable	passable	passable
SBNF117-0.9	1	passable	impassable	impassable
SBNF144A-0.2	1	passable	passable	passable
SBNF144A-0.2	2	passable	passable	passable
SBNF144B-0.3	1	passable	passable	indeterminate
SBNF144B-0.3	2	indeterminate	indeterminate	impassable
SBNF113-0.8	1	passable	impassable	impassable
SBNF113-0.9	1	impassable	impassable	impassable
SBNF114-0.1	1	indeterminate	indeterminate	impassable
SBNF114-0.2	1	passable	passable	passable
SBNF114-2.5	1	passable	passable	passable
SBNF114-2.8	1	passable	impassable	impassable
SBNF114B-0.1	1	passable	passable	passable
SBNF114B-0.4	1	passable	indeterminate	impassable

Table F5. Description of crossings surveyed on the National Forests in Texas, summer 2006. Shape abbreviations: C= circular, PA= pipe arch, OBA= open bottom arch, F= ford, and O= Other. Channel width is the mean bankfull channel width. N= no natural substrate, N (discontin)= discontinuous substrate, Y= continuous natural substrate. An NA (not applicable) indicates outlet drop (no outlet pool or tailwater control) or outlet perch (stream dry) could not be calculated. Negative outlet drop or perch values indicate a submerged outlet (structure partially backwatered). Residual inlet depth values ≥ 0.0 indicate the structure is fully backwatered.

Site ID	Pipe #	Shape	Pipe Condition	Mean Channel Width (ft)	Continuous Substrate in Structure	Pipe Slope (%)	Pipe Width: Channel Width ratio	Outlet Drop (in)	Outlet Perch (in)	Residual Inlet Depth (in)	Pipe Length (ft)	Slope (%) * Length (ft)
ANF3053-0.8	1	C	poor	7.0	N	1.19	0.37	0.24	2.52	0.00	25.3	30.0
ANF4-4-0.2	1	C	fair	9.8	N	0.34	0.66	25.80	15.84	0.00	32.1	11.0
ANF4-4-1.1	1	C	poor	9.1	N	0.66	0.52	-6.48	0.00	4.08	30.5	20.0
ANF4-4-2.3	1	PA	good	11.4	N	0.43	0.48	-5.34	-6.36	3.78	30.2	13.0
ANF302-1.5	1	C	good	6.4	N	0.35	1.08	9.12	10.80	0.00	47.9	17.0
ANF302-1.9	1	C	poor	4.9	N	0.67	0.80	-4.44	-3.66	0.60	48.0	32.0
ANF302-2.3	1	C	good	7.6	Y	0.05	1.32	NA	3.36	0.00	66.3	3.0
ANF313-2-0.1	1	PA	fair	5.0	N	2.78	1.23	29.40	27.96	0.00	70.6	196.0
ANF313-2-0.15	1	PA	poor	6.2	Y	1.54	0.99	5.40	4.20	0.00	79.3	122.0
ANF326A-0.7	1	VF	good	12.1	Y	0.19	0.41	-6.96	-6.48	6.12	37.1	7.0
ANF326A-0.7	2	VF	good	12.1	Y	0.77	0.41	-6.72	-6.24	3.30	37.1	28.5
ANF300W-3.1	1	PA	poor	6.2	N	6.63	0.49	8.22	-0.48	0.00	45.3	300.5
ANF300W-3.4	1	PA	good	7.3	Y	NA	NA	NA	NA	0.00	NA	NA
ANF301-0.4	1	C	fair	9.2	N	1.17	0.54	-7.20	-7.68	3.30	27.8	32.5
ANF307-1.3	1	B	good	11.6	N	1.00	0.79	18.78	14.94	0.00	41.6	41.5
ANF307-1.7	1	C	fair	7.5	N (discontin)	2.27	1.06	5.64	-0.18	0.00	56.5	128.0
ANF300A-1.6	1	C	poor	6.7	N (discontin)	0.81	0.95	7.68	NA	0.00	54.2	44.0
ANF300A-1.8	1	C	fair	5.1	N	0.07	0.95	0.30	-0.48	0.00	48.9	3.5
ANF308-1.4	1	B	fair	7.9	N	0.89	1.02	17.76	18.24	0.00	69.6	62.0
ANF354-0.4	1	C	fair	10.6	N	1.88	0.44	14.04	13.32	0.00	34.0	64.0
ANF354-0.9	1	C	poor	6.6	N	1.20	0.37	12.72	9.72	0.00	36.6	44.0

Table continued next page…

Site ID	Pipe #	Shape	Pipe Condition	Mean Channel Width (ft)	Continuous Substrate in Structure	Pipe Slope (%)	Pipe Width: Channel Width ratio	Outlet Drop (in)	Outlet Perch (in)	Residual Inlet Depth (in)	Pipe Length (ft)	Slope (%) * Length (ft)
ANF354-1.2	1	PA	fair	7.1	N	1.58	0.71	-5.40	-9.00	0.00	49.3	78.0
ANF304E-1.7	1	C	poor	7.2	N	0.47	0.69	15.00	15.00	0.00	30.1	14.0
ANF304E-3.4	1	C	poor	6.8	N	1.52	0.81	3.48	5.52	0.00	33.6	51.0
ANF3094-0.1	1	C	fair	7.2	N	0.68	1.33	NA	0.00	0.00	47.4	32.0
ANF317-1.4	1	C	poor	7.2	N	0.29	0.98	4.56	3.72	0.00	55.9	16.0
ANF332-0.2	1	C	fair	4.0	N	2.20	1.00	4.32	0.60	0.00	40.5	89.0
ANF333-0.2	1	B	good	9.6	N	0.35	0.75	14.52	11.16	0.00	37.6	13.0
ANF333-0.2	2	B	good	9.6	N	0.03	0.75	15.96	12.60	0.00	37.5	1.0
ANF333A-2.0	1	B	good	11.7	N	0.00	0.86	38.76	37.68	0.00	50.2	0.0
ANF335-0.2	1	B	good	10.3	N	0.90	0.97	30.84	6.96	0.00	49.8	45.0
ANF335-0.2	2	B	good	10.3	N	0.98	0.97	30.24	10.56	0.00	49.8	49.0
DCNF1560A-1.1	1	C	good	9.6	N (discontin)	0.83	0.94	NA	-3.90	0.00	48.0	40.0
DCNF524-1.0	1	C	good	3.8	N	5.14	0.80	25.08	24.60	0.00	32.7	168.0
DCNF5261-0.2	1	C	poor	6.0	N	0.70	1.01	9.42	3.54	0.00	32.0	22.5
DCNF511-0.1	2	B	good	6.4	Y	1.31	1.53	3.42	NA	4.44	50.0	65.5
DCNF511-0.7	1	B	good	12.8	N (discontin)	0.10	0.70	4.92	0.90	0.00	25.7	2.5
DCNF511-0.7	2	B	good	12.8	N	0.11	0.70	4.86	1.20	0.00	26.1	3.0
DCNF526-3.0	1	B	poor	5.6	N	0.54	1.78	45.18	51.00	0.00	47.6	25.5
DCNF526-4.5	1	B	good	5.7	N	1.28	1.75	16.44	16.14	0.00	60.3	77.0
DCNF524-0.5	2	B	good	5.7	N (discontin)	0.76	1.76	6.66	6.90	0.00	38.6	29.5
DCNF5241-0.5	1	C	fair	5.9	N (discontin)	1.04	1.20	0.54	0.72	0.00	49.3	51.5
DCNF524B-0.8	1	B	good	6.3	N (discontin)	0.39	1.28	1.92	3.00	0.00	61.2	24.0
DCNF524B-1.0	1	B	good	8.4	N (discontin)	1.02	0.96	NA	-4.26	0.00	53.6	54.5
DCNF511-4.2	1	C	fair	9.5	N	0.12	0.49	4.98	2.04	0.00	40.1	5.0
DCNF511-4.2	2	C	fair	9.5	N	0.64	0.49	7.26	5.34	0.00	40.1	25.5
DCNF556-1.1	1	C	good	8.7	N (discontin)	0.49	0.92	-2.28	0.00	0.00	42.0	20.5

Table continued next page…

Site ID	Pipe #	Shape	Pipe Condition	Mean Channel Width (ft)	Continuous Substrate in Structure	Pipe Slope (%)	Pipe Width: Channel Width ratio	Outlet Drop (in)	Outlet Perch (in)	Residual Inlet Depth (in)	Pipe Length (ft)	Slope (%) * Length (ft)
DCNF521-1.2	1	C	good	7.4	N	1.41	0.68	1.68	0.36	0.00	38.3	54.0
DCNF4740-1.7	1	O	fair	10.1	N	0.07	0.84	35.22	33.36	0.00	44.5	3.0
DCNF527-4.4	1	B	good	9.1	N	0.15	1.09	20.82	20.52	0.00	65.9	10.0
DCNF589-0.3	2	C	poor	7.7	N (discontin)	0.34	0.78	-0.96	0.72	0.00	29.2	10.0
DCNF502-2.4	2	C	poor	10.1	Y	5.36	0.40	-5.76	0.60	0.00	26.5	142.0
DCNF570-0.5	1	C	fair	8.8	N	1.30	0.68	15.24	19.56	0.00	47.7	62.0
DCNF570-0.5	2	C	fair	8.8	N	1.06	0.68	16.32	20.64	0.00	51.0	54.0
DCNF502-3.4	1	C	fair	9.0	N (discontin)	3.05	0.48	3.12	8.64	10.92	38.4	117.0
DCNF502-3.4	2	C	fair	9.0	N (discontin)	0.18	0.53	-3.72	1.32	4.56	38.6	7.0
DCNF523-1.9	1	C	fair	9.5	N	0.21	0.48	6.48	5.52	0.00	48.6	10.0
DCNF528B-1.1	1	C	poor	8.3	Y	6.08	0.60	15.36	10.92	12.60	38.3	233.0
DCNF508B-1.1	2	C	poor	10.6	N (discontin)	0.03	0.47	-1.80	NA	1.68	39.3	1.00
DCNF587-0.4	1	C	poor	10.4	N (discontin)	1.78	0.77	11.16	3.30	0.00	40.1	71.5
DCNF587-0.4	2	C	poor	10.4	N (discontin)	0.25	0.77	1.14	0.84	0.00	33.9	8.5
DCNF587-1.9	2	C	fair	8.3	N (discontin)	0.91	0.97	-1.98	-1.32	6.30	39.4	36.0
SBNF156-0.9	1	VF	fair	NA	N	1.32	NA	NA	-7.80	0.00	40.5	53.5
SBNF156-0.9	2	VF	fair	NA	N	1.12	NA	NA	-7.80	0.00	40.5	45.5
SBNF126-1.3	1	C	fair	5.2	N	1.74	0.39	6.36	2.28	0.00	66.0	115
SBNF126-3.3	1	C	fair	6.0	N	0.13	0.66	8.22	12.00	0.00	43.5	5.5
SBNF126-3.4	1	B	poor	12.1	N	0.72	0.83	33.84	21.60	0.00	53.6	38.5
SBNF131A-0.9	1	C	fair	5.1	N	3.41	0.41	14.64	15.00	0.00	37.8	129.0
SBNF131A-1.5	1	C	fair	8.2	N	2.11	0.49	0.25	-0.83	0.00	40.2	85.0
SBNF108-1.8	1	C	poor	5.4	N	1.86	0.55	15.36	12.96	0.00	29.0	54.0
SBNF109-0.3	1	B	fair	7.3	Y	0.07	0.96	-1.20	-4.56	0.72	36.6	2.5
SBNF109-0.5	1	B	good	7.9	Y	0.09	0.76	NA	-0.24	0.00	75.5	7.0

Table continued next page…

Site ID	Pipe #	Shape	Pipe Condition	Mean Channel Width (ft)	Continuous Substrate in Structure	Pipe Slope (%)	Pipe Width: Channel Width ratio	Outlet Drop (in)	Outlet Perch (in)	Residual Inlet Depth (in)	Pipe Length (ft)	Slope (%) * Length (ft)
SBNF111-2.7	2	C	fair	9.4	N	0.14	0.53	0.72	-8.64	0.00	29.6	4.0
SBNF114A-1.5	1	C	fair	4.6	N	0.22	0.87	-0.84	-0.90	0.00	40.1	9.0
SBNF152-1.1	1	PA	fair	8.6	N	2.40	0.70	0.00	0.12	0.00	34.6	83.0
SBNF152-4.0	1	C	good	8.1	Y	1.01	0.86	-6.72	0.00	11.64	40.7	41.0
SBNF175-0.4	1	C	fair	8.7	N	1.35	0.92	-7.68	-7.92	0.00	48.2	65.0
SBNF111B-0.2	1	C	fair	4.2	N	0.51	0.84	-6.00	0.00	3.96	33.1	17.0
SBNF117-0.9	1	C	poor	4.7	N	0.61	1.28	10.86	12.96	0.00	39.5	28.5
SBNF144A-0.2	1	C	fair	9.2	N	0.69	0.82	-5.52	-5.52	1.68	46.1	32.0
SBNF144A-0.2	2	C	fair	9.2	N	0.11	0.82	-5.04	-5.04	4.44	46.1	5.0
SBNF144B-0.3	1	C	poor	12.5	N	0.51	0.53	0.12	2.28	0.00	46.9	24.0
SBNF144B-0.3	2	C	poor	12.5	N	1.39	0.53	5.52	6.36	0.00	46.1	64.0
SBNF113-0.8	1	C	fair	4.4	N	0.99	0.69	11.16	15.72	0.00	30.4	30.0
SBNF113-0.9	1	C	fair	6.7	N	1.04	0.75	27.96	27.60	0.00	34.6	36.0
SBNF114-0.1	1	PA	fair	6.9	N	2.36	0.51	6.84	6.36	0.00	25.4	60.0
SBNF114-0.2	1	C	good	7.2	N	0.40	0.70	-2.16	0.00	0.60	32.7	13.0
SBNF114-2.5	1	C	good	6.9	N	1.27	0.72	-6.06	0.00	10.98	32.2	41.0
SBNF114-2.8	1	PA	fair	9.2	N	0.97	1.09	11.22	-6.96	0.00	38.7	37.5
SBNF114B-0.1	1	C	fair	6.9	N	0.20	0.74	-4.32	0.00	5.04	30.3	6.0
SBNF114B-0.4	1	C	poor	6.3	N	0.77	1.04	4.20	9.48	0.00	43.1	33.0
SBNF111-2.7	2	C	fair	9.4	N	0.14	0.53	0.72	-8.64	0.00	29.6	4.0