U.S. Fish & Wildlife Service

A Survey of Aquatic Life and Terrestrial Wildlife Habitats on the Proposed Spruce No. 1 Surface Mine in Logan County, West Virginia

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ABSTRACT

Hobet Mining, Inc. has applied for an NPDES permit in connection with its proposed Spruce No. 1 Surface Mine in Logan County, West Virginia. The mine will affect 3,113 acres of mountainous forest land in headwater streams of the Spruce Fork of Little Coal River. Four stream valleys -- Seng Camp Branch, Pigeonroost Branch, Oldhouse Branch, and White Oak Branch, all tributaries to Spruce Fork -- will be filled with overburden from mountaintop removal. If authorized as proposed, this project will be the largest surface mine ever constructed in West Virginia.

The Fish and Wildlife Service conducted an aquatic life survey in July 1998 on three of the project area's four streams. The results demonstrated that, despite the small size of these streams, each supported a diverse and healthy benthic invertebrate community indicative of good water quality and habitat. Fish were present at some stations, and numerous crayfish and salamanders were observed. The streams meet the West Virginia mining regulations' definition of "perennial," and clearly support aquatic life uses.

A reconnaissance survey of terrestrial wildlife habitat was conducted in October 1998, by a team of Environmental Protection Agency, Fish and Wildlife Service, and Geological Survey/Biological Resources Division biologists. The forested valley habitats, enhanced by the perennial streams as a water supply, were found to be capable of supporting high wildlife species diversity. Assuming that standard reclamation methods are used, this site is not likely to support many of these species, particularly migrant forest interior birds, following mining.

A SURVEY OF AQUATIC LIFE AND TERRESTRIAL WILDLIFE HABITATS ON THE PROPOSED SPRUCE NO. 1 SURFACE MINE IN LOGAN COUNTY, WEST VIRGINIA

INTRODUCTION

Hobet Mining, Inc., has applied for an NPDES permit in connection with its proposed Spruce No. 1 Surface Mine in Logan County, West Virginia. The mine will affect 3,113 acres of mountainous forest land through surface mine, auger mine, and high wall, thin-seam mine operations in headwater streams of the Spruce Fork of Little Coal River. Part of the project will be a mountaintop removal operation involving mining by dragline. Four stream valleys -- Seng Camp Branch, Pigeonroost Branch, Oldhouse Branch, and White Oak Branch, all tributaries to Spruce Fork -- will be filled with overburden. The Spruce No.1 mine would convert almost uninterrupted deciduous forest on steep slopes into rolling grasslands. If authorized as originally proposed, this project will be the largest surface mine ever constructed in West Virgnia.

In the process of evaluating the potential impacts of the Spruce No. 1 mine on fish and wildlife resources, the Service conducted two field investigations; an aquatic life survey of streams in July 1998, and a reconnaissance survey of terrestrial habitats in the project area in October 1998. In addition, Service biologists reviewed a 1998 environmental assessment of the site prepared by Hobet's consultant, Sturm Environmental Services. This report summarizes the results of our investigations, and compares the results of the aquatic life surveys to those obtained in the earlier study.

AQUATIC LIFE SURVEY

On July 27 and 28, 1998, Service biologists surveyed three of the four streams proposed to be filled: Pigeonroost Branch, Oldhouse Branch, and White Oak Branch. Two or three stations, roughly corresponding to locations previously sampled by Hobet's consultant, were visited on each stream (Figure 1). A fourth stream, Seng Camp Branch, was reportedly already affected by ongoing mountaintop removal operations and was not included in our field investigation. We were accompanied throughout our surveys by David Fisher of Sturm Environmental Services, Hobet's consultant.

Methods

The purpose of the aquatic life survey was to characterize benthic macroinvertebrate taxa present in each stream proposed for valley filling. Aquatic benthic macroinvertebrates were qualitatively sampled using a one-foot-wide D-frame net. Three areas, each approximately 1 foot by 3 feet, were kicked at each station and the net contents composited. Riffles were the first choice for sampling, with runs second. Some limited rock picks were also done, and a handful of coarse particulate organic matter (COM.) was also sampled at each site and composited with the kick samples.

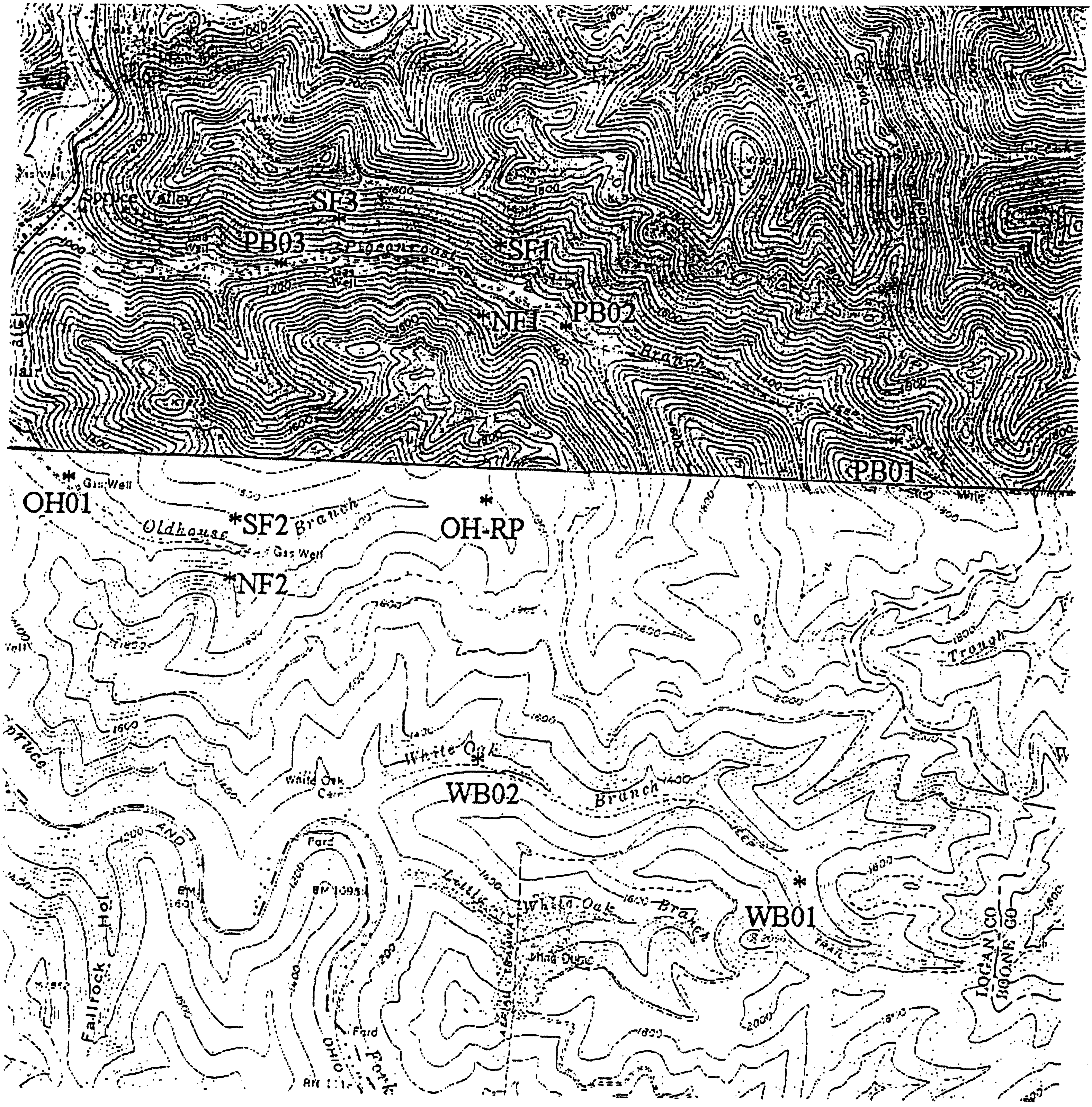

Figure 1. Location of aquatic and terrestrial survey stations. From U.S.G.S. 7.5-minute quadrangles, Amherstdale and Clothier.

The samples were preserved in the field using 10% buffered formalin, and delivered to the Pennsylvania Cooperative Fish and Wildlife Research Unit (Unit) at the Pennsylvania State University in University Park, Pennsylvania, where the invertebrates were identified to genus-level (family level for Diptera). The basic taxonomic reference used was Merritt and Cummins (1984).

Fish were collected at some locations using a Coffelt backpack unit. At other locations, fish were observed and noted. Collected fish were field identified and released; a limited number were preserved in 10% buffered formalin and identified by the Unit.

Results

The Unit reported that some benthic macroinvertebrate identifications were difficult because of the small size of individuals, but all stations had a mix of small and large macroinvertebrate individuals (Table 1). The presence of genera such as *Pteronarcys* (Plecoptera, Pteronarcyidae), and the large size of some individuals indicate that these streams support a benthic population throughout most, if not, all of the year, despite other indications (e.g., small size of some individuals, size of the watershed) that the stream experiences low flows.

In general, the streams' benthic communities have distributions of functional feeding groups typical of headwater streams. The major functional feeding groups of interest in these streams are:

- ***Collectors*** (utilizing detritus, algae, and fine particulate organic matter [FPOM]; this group is usually subdivided into ***collector-gatherers*** [using COM.] and ***collector-filterers*** [using FPOM]),
- ***Scrapers*** (using periphyton),
- ***Shredders*** (using COM., wood, and living macrophytes), and
- ***Predators*** (preying on other invertebrates)

A headwater stream will normally have a number of taxa in each functional feeding group (Merritt and Cummins, 1996), a reflection of the variety of food sources available in the system.

Pigeonroost Branch. Three stations were sampled (Figure 1). The upper (PB01) and mid-reach (PB02) stations are proposed to be filled; the stream at the lower station (PB03) would be eliminated by the construction of a sedimentation pond. The drainage areas above each station were approximately 109 acres, 834 acres, and 1,161 acres, respectively.

Pigeonroost Branch is shown as an intermittent stream on the 7.5-minute USGS quadrangle (Clothier, WV). It is a second-order stream at its mouth. Flow was low at the time of sampling, although steep, eroded banks indicated periodic high flows. At all three stations, the bottom substrate was mostly boulders, cobble and gravel, with little sand or silt. The wetted channel was 2-5 feet wide (Figure 2), and contained mostly runs, with few pools or riffles. Numerous crayfish and salamanders were observed at all stations.

Table 1. Benthic macroinvertebrates collected from stations on Pigeonroost Branch (PB), White Oak Branch (WB), and Oldhouse Branch (OH); July 27 and 28, 1998.

Taxa/Station	Functional Feeding Group[1]	PB01	PB02	PB03	WB01	WB02	OH01	OH-RP
Ephemeroptera				2				
Baetidae	CG, Sc	3		3				
Baetiscidae, *Baetisca*	CG, Sc			1				
Ephemeridae, *Ephemera*	CG, P	1	1	2	7	5	3	
Ephemerellidae, *Ephemerella*	CG, Sc			1	2			
Heptageniidae	Sc, CG	8	6	11	9		4	
Heptageniidae, *Leurocuta*	Sc, CG				1			
Heptageniidae, *Stenonema*	Sc, CG	20	24	42	4	27	2	
Heptageniidae, *Heptagenia*	Sc, CG	1			2	4	11	1
Oligoneuridae, *Isonychia*	CF			3				
Leptophlebiidae	CG, Sc				2			1
Plecoptera				2				
Chloroperlidae	P, Sc, CG	1			2			
Leuctridae	Sh	8		2	1			
Leuctridae, *Leuctra*	Sh	15	13	13	6	11	5	
Peltoperlidae, *Peltoperla*	Sh	9						
Perlidae	P	4	1					
Perlidae, *Acroneuria*	P	9		6			4	
Perlodidae, *Isoperla*	P, CG	1			1(?)	1(?)		
Pteronarcyidae, *Pteronarcys*	Sh, P, Sc	8				5	1	
Taeniopterygidae	Sh, CG, Sc						1	
Trichoptera		8		2				
Glossosomatidae, *Glossosoma*	Sc	13						
Hydropsychidae	CF, P					10		
Hydropsychidae, *Cheumatopsyche*	CF	9	1	3				
Hydropsychidae, *Diplectrona*	CF	11		1		1	2	
Hydropsychidae, *Hydropsyche*	CF	22		18		3	6	1
Limnephilidae, *Hydatophylax*	Sh, CG				1			
Limnephilidae, *Limnephilus*	Sh, CG			1				
Philopotamidae	CF					1	1	
Philopotamidae, *Dolophilodes*	CF	6						
Philopotamidae, *Wormaldia*	CF					1		
Polycentropodidae	CF, P			2			1	
Rhyacophildae, *Rhyacophila*	P		1			2	1	
Coleoptera				1				
Elmidae (adult)		2						
Elmidae						1		
Elmidae, *Optioservus*	Sc, CG	1	3	13	3	4		
Elmidae, *Oulimnius*		1						
Lutrochidae, *Lutrochus*		1						
Psephenidae, *Ectopria*	Sc	5		1	2	9	1	
Psephenidae, *Psephenus*	Sc	3	3	23		9	8	
Hemiptera								
Veliidae, *Rhagovelia*	P	9	9	4		4		
Veliidae, *Microvelia*	P					2	2	

(cont.)

Table 1 (continued).

Taxa/Station	Functional Feeding Group[1]	PB01	PB02	PB03	WB01	WB02	OH01	OH-RP
Diptera (# of pupa in parentheses)		3 (5)		16		9	5	
Ceratopogonidae	P, CG	4			8			
Chironomidae	CG, CF, P	64		11	64	24		
Dolichopodidae	P			1				
Dixidae	CG	1						
Empididae	P, CG	9	2					
Tabanidae	P			1	1	11	1	
Simulidae	CF	3						
Tipulidae	Sh, CG	2		3	3		1	
Odonata								
Anisoptera								
Cordulegastridae, *Cordulegaster*	P	1						
Gomphidae, *Gomphus*	P		2	2			1	
Gomphidae, *Arigomphus*	P				2			
Megaloptera								
Corydalidae, *Nigronia*	P			1				1
Lepidoptera							1	
Decapoda, Cambaridae, *Orconectes*	CG	2	3	4	3	2	6	
Collembola			1		2			
Annelida						1		
Other		1			1			
Number of distinct taxa		30	13	24	20	20	20	*
Number of EPT taxa		15	6	14	10	10	12	*

* This sample was a very selective rock pick and was done to demonstrate that aquatic life existed in the extreme upper watershed.
[1] After Merritt and Cummins (1984). CF--collector-filterer, CG--collector-gatherer, P--predator, Sc--scraper, Sh--shredder. See text for details.

Figure 2. Pigeonroost Branch

As shown in Table 1, PB01, located in the headwaters, supports a diverse and balanced benthic macroinvertebrate community. Among the thirty distinct taxa collected, there was a balance of pollution-tolerant, intermediate, and pollution-intolerant taxa, indicating good water quality and a variety of microhabitats. Fifteen EPT (Ephemeroptera, Plecoptera, and Tricoptera) taxa were collected, another indication of good biological condition. Chironomidae (Diptera) were the most numerous. Hydropsychid caddisflies and *Stenonema* sp. (Ephemeroptera, Heptageniidae) were the next most numerous taxa. The functional feeding group distribution was typical of a headwater stream.

Blacknose dace (*Rhinichthys atratulus*) and creek chub (*Semotilus atromaculatus*) were also collected at this station.

The mid-reach station, PB02, supported fewer taxa (thirteen), but six were EPT taxa. *Stenonema* and *Leuctra* (Plecoptera, Leuctridae) were the most numerous genera in the sample. Larval salamanders were collected in the benthic sample as well. Adult salamanders were observed at this station, but not collected. The decrease in the number of taxa at this station, compared to upstream, is difficult to explain, given that all major orders experienced a reduction. Perhaps this station was affected by some recent human activity and is now recovering.

The lower station, PB03, supported 24 taxa of benthic macroinvertebrates. Biological conditions were good, as indicated by the high number of EPT taxa (14), and the balance between tolerant, intermediate, and intolerant taxa, as well as the representation of all major functional feeding groups. *Stenonema* was the most common taxon.

Blacknose dace (*Rhinichthys atratulus*) and creek chub (*Semotilus atromaculatus*) were also collected at this station.

<u>Comparison with Earlier Work</u>. The results obtained by Sturm Environmental Services in 1997 appear to have greatly underestimated the biological productivity of Pigeonroost Branch. Our samples from stations PB01, -02, and -03 yielded 30, 13, and 24 distinct taxa of benthic invertebrates, respectively. Sturm's corresponding samples (Biostations I, III, and IV) yielded only 3, 5, and 6 distinct taxa, respectively. Probable explanations for this difference are the sampling methods used (Sturm sampled by manually picking organisms from the substrate, resulting in underestimates of population densities, especially of organisms residing in the hyporheic zone), and the fact that sampling was performed at a time of extreme low flows.

White Oak Branch. This stream, also appearing as an intermittent stream on the 7.5-minute USGS quadrangle (Amherstdale, WV), was slightly smaller than Pigeonroost Branch. The bottom substrate was similar at both stations sampled. The drainage areas at stations WB01 and WB02 were approximately 122 acres and 576 acres, respectively.

The upstream station, WB01, was barely flowing, although water was moving and pools provided habitat (Figure 3). In spite of the severe hydrologic conditions, 20 taxa of benthic macroinvertebrates were found, ten of which were EPT taxa. Crayfish were also found at this

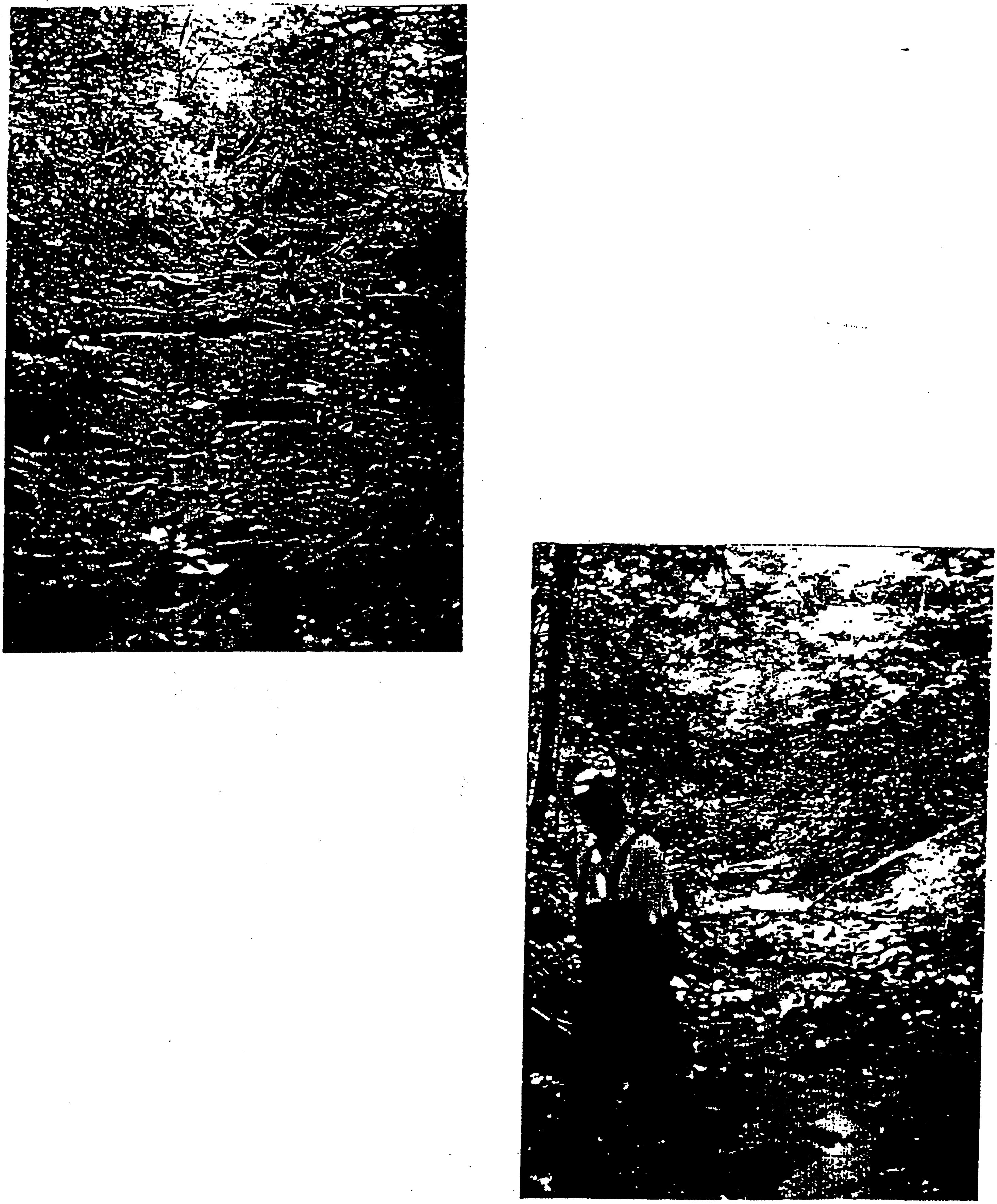

Figure 3. White Oak Branch

site. The sample was dominated by Chironomidae (Diptera). The sample was well-balanced with regard to pollution tolerance; it was less balanced with regard to functional feeding groups. This station may lack collector-filterers, as no hydropsychid caddisflies (Tricoptera) were collected. This may reflect the station's location in the upper watershed, and the very low flows at the time of collection. The filtering of fine particles likely requires a minimum flow, below which filtering organisms cannot survive.

The downstream station, WB02, had higher flows and supported 20 taxa of benthic macroinvertebrates. Similar to the upstream station, about 50% (10) were EPT taxa, indicative of good water quality and habitat variety. The community is balanced between tolerant, intermediate, and intolerant taxa. All functional feeding groups were represented, including, in contrast to upstream, three genera of caddisflies that are collector-filterers. *Stenonema* was the most numerous taxon collected. Crayfish were found, as well as some large (> 25 mm) individuals of *Pteronarcys* (Plecoptera, Pteronarcyidae).

One fish, a slimy sculpin (*Cottus cognatus*), was incidentally collected in the benthic sample. Its presence is indicative of good water quality. No deliberate fish sampling was conducted at this station.

Comparison with Earlier Work. Sturm did not sample this stream, stating that it "had no measurable flow" on October 13 and 14, 1997.

Oldhouse Branch. This stream was dissimilar to the other two in that the bottom substrate was primarily bedrock in many areas. It was more difficult to find suitable sampling locations (Figures 1 and 4). The wetted channel width near its mouth was approximately 2-4 feet. Drainage areas at the two sampling stations, OH01 and OH02, were approximately 38 and 506 acres, respectively. It is important to note that the sample at OH01 was not collected using methods consistent with all of the other samples in this study; it was merely the result of turning over several rocks in the stream.

Twenty taxa of benthic macroinvertebrates were collected and, as in the other two streams, EPT taxa composed about 50% (12). The mix of tolerances and functional feeding groups indicates that, as in the other two streams, this community has experienced little human disturbance affecting water quality. Crayfish were again present, and larval salamanders were again an incidental catch in our collections.

The casual rock pick in the headwaters produced two mayflies and one caddisfly, as well as one predator, *Nigronia* sp. (Megaloptera, Corydalidae). The rock pick was not done with the intent of determining taxa richness, but to demonstrate that aquatic life does exist in the headwater reaches of Oldhouse Branch. The rock pick was notable in that four species, representing four different functional feeding groups (including one predator), were collected.

Comparison to Earlier Work. Sturm's methods and timing again resulted in an underestimate of biological productivity. Of three stations sampled along Oldhouse Branch, they found a maximum of four benthic macroinvertebrate taxa in contrast to the 20 taxa collected in this study.

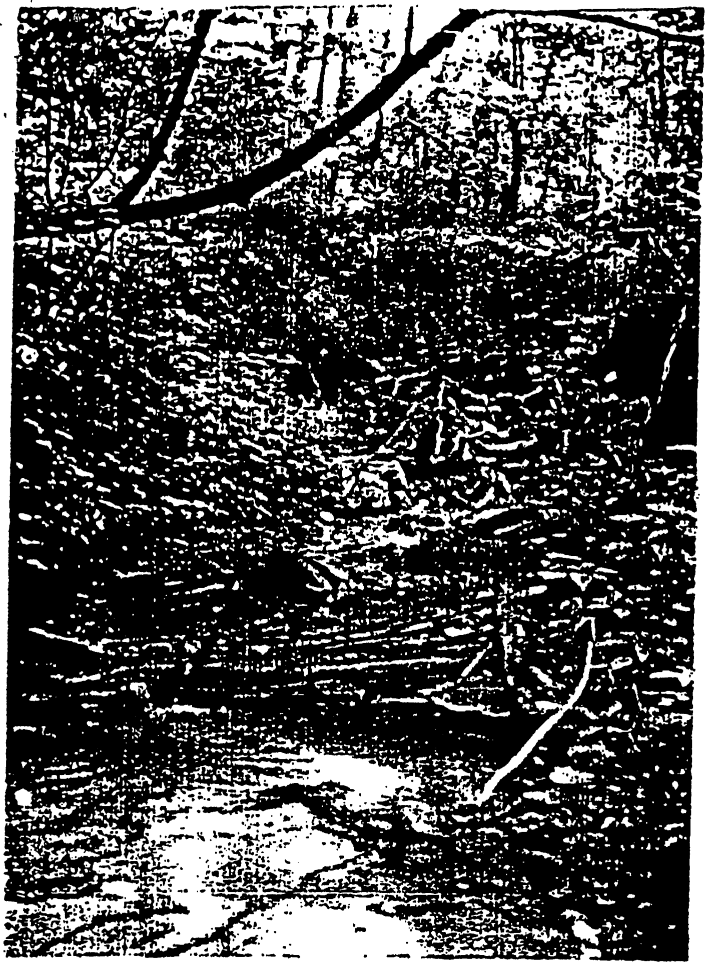

Figure 4. Oldhouse Branch

Discussion

Although all three streams evaluated in this study are small, each supports a diverse benthic invertebrate community. Extremes in flow may be a factor shaping community composition, and this factor is likely to be limiting the fish community. Although the water quality and benthic community are sufficient to support trout, flow and physical habitat appear to be insufficient to support salmonids. Nevertheless, other fish species were found in Pigeonroost Branch and White Oak Branch.

The most diverse station was the headwater station on Pigeonroost Branch (PB01). The watershed above this station is only about 109 acres. The lower Pigeonroost Branch station (PB03) was the next most diverse. This watershed is the largest of the three, therefore its flow is probably the most stable, and the overall diversity is not surprising. Although the bottom substrate of Oldhouse Branch was somewhat dissimilar to the other streams, the benthic community was similar to the other two.

At each station, the high number of EPT taxa, as well as the high proportion of EPT taxa (roughly 50%) are indicative of good water quality and habitat. In addition, each sample contained taxa known to be pollution tolerant or intermediate (e.g., hydropsychid caddisflies, chironomid dipterans), as well as intolerant taxa (e.g., *Pteronarcys* sp., Leuctridae, Glossosomatidae) indicating minimal human disturbance. While there was variation in the community composition at each station, all of the major functional feeding groups were well represented at each station, with the exception of White Oak Branch 01, which appears to lack collector-filterers.

The results of this study differ markedly from the previous work conducted at this site. Benthic macroinvertebrate sampling conducted in October 1997 produced few taxa (Sturm, 1998). Sturm conducted rock picks and did not sample using kick nets, citing low flow conditions. However, we were able to successfully employ a kick net at all stations, including White Oak Branch 01, where the flow was very low. If Sturm had employed a kick net, they would have probably collected more taxa, even if they had sampled in a stagnant pool.

In conversations with Service staff during this survey, Sturm personnel emphasized the small size of many of the individual benthic organisms, and concluded that the streams "dried up" each year and were practically devoid of life (David Fisher, pers. comm.). Given the few taxa collected during the 1997 work, that conclusion is not unreasonable. However, since the earlier sampling was limited to organisms on the undersides of rocks, and was therefore biased against any organisms living in the hyporheic zone, it may have missed many taxa suited for low flow conditions. Even cessation of flow for short periods of time does not mean that pools and other refugia do not exist.

Regulatory definitions of "perennial" or "intermittent" may hinge on surface flow for a specified period, although it is often the benthic macroinvertebrate community that is used as the indicator of flow. West Virginia's mining regulations specify that "perennial" streams must have six months of flow. The macroinvertebrate communities we found here are proof that these three streams have six months of flow and would be considered "perennial" from a regulatory standpoint. The list of taxa collected (Table 1) was sent to two outside experts, and both agreed with this conclusion (M. Bilger, USGS, Lemoyne, PA, pers. comm.; S. Hiner, Virginia Tech University, pers. comm.).

In the current controversy surrounding valley filling, there has been some debate over whether small headwater streams such as Pigeonroost Branch, Oldhouse Branch, and White Oak Branch warrant protection. It is important not to underestimate the value of these headwater streams to the aquatic ecosystem, however. In their evaluation of the importance of headwater streams to downstream areas, Perry and Golden (1997) state:

> *...headwater streams serve as a crucial part of the watershed network. The functions that headwater catchments play in forming the energy and nutrient base, as well as the flow regime for downstream areas is where their true irreplaceable value lies. Transported organic matter processed in upstream areas forms the bulk of downstream energy supplies. Land use, geology, and soil characteristics in small catchments effect the water quality and quantity in the lower reaches of the drainage system. ...in areas that are completely filled all of the critical functions of that tributary are removed from the drainage system. Since water moves unidirectionally downstream, any negative impacts upstream inherently influence downstream areas that may have more commercial, economic and recreational significance than the small headwater areas that are being degraded and lost. Therefore, the value of a stream, small or large, intermittent or perennial, cannot be ascertained solely from measures of biological production. Some measure of the streams [sic] impact and importance to downstream areas must be taken into account.*

Doppelt et al. (1993) are even more explicit in their assessment of the value of headwater areas, asserting that even non-perennial portions of these watersheds are critical to the functioning of the downstream ecosystem:

> *Ecologically healthy watersheds require the maintenance and protection of the lateral, longitudinal, and vertical connectedness of the mosaic of habitat patches and ecosystem components within the watershed over time. However, almost all watersheds nationwide are already highly degraded and fragmented. The remaining, relatively healthy undisturbed headwaters, biotic refuges, benchmark watersheds, riparian areas, floodplains, and biological hot spots, therefore, play a vital role in supporting existing levels of health for the system and in anchoring potential recovery efforts.*
>
> *The small streams at the <u>headwaters</u> of riverine systems are the most vulnerable to human disturbance (especially timber harvesting, road building, grazing and related activities) because they respond dramatically and rapidly to disturbance to their riparian areas. Even where inaccessible to fish, these small streams provide high levels of water quality and quantity, sediment control, nutrients and wood debris for downstream reaches of the watershed. Intermittent and ephemeral headwater streams are, therefore, often largely responsible for maintaining the quality of downstream riverine processes and habitat for considerable distances.*

As for the stream reaches proposed for filling, our results clearly indicate that these reaches support aquatic life uses. The U.S. Environmental Protection Agency (USEPA 1994) states:

> *The fact that sport or commercial fish are not present does not mean that the water may not be supporting an aquatic life protection function. An existing aquatic community composed entirely of invertebrates and plants, such as may be found in a pristine alpine tributary stream, should still be protected whether or not such a stream supports a fishery.*

Regarding protection of "existing uses," USEPA (1994) states further:

> *No activity is allowable under the antidegradation policy which would partially or completely eliminate any existing use whether or not that use is designated in a State's water quality standards. The aquatic protection use is a broad category requiring further explanation. Non-aberrational resident species must be protected, even if not prevalent in number or importance. Water quality should be such that it results in no mortality and no significant growth or reproductive impairment of resident species.*

The Clean Water Act's stated goal of restoring and maintaining the chemical, physical, and biological integrity of the Nation's waters is the basis for the existing use protection requirement.

It follows that federal and State laws protecting "existing uses" (40 CFR 131.12; WV Code 46-1-4) apply to the streams surveyed in this study. Part One of the federal Antidegradation Policy (40 CFR 131.12(a)(1)) states that any existing use, and the water quality necessary to protect that use, must be maintained and protected. The Anti-Degradation Policy contained in West Virginia's Water Quality Standards (W. Va. Code 46-1-4.1.a) follows the federal language. Furthermore, waters in the Spruce Fork drainage are designated under West Virginia Water Quality Standards as "high quality waters," meaning that degradation is allowed, but only where the degradation "shall not result in injury or interference with existing stream water uses or in violation of State or Federal water quality criteria that describe the base levels necessary to sustain the national water quality goal uses of protection and propagation of fish, shellfish and wildlife and recreating in and on the water" (W. Va. Code Section 46-1-4.1.b). Eliminating streams which support healthy aquatic communities and provide fresh water, nutrients, and food organisms to downstream aquatic ecosystems, appears to violate State and federal antidegradation policies and the antidegradation provisions of a high quality water designation, even if numeric water quality criteria would not be exceeded. A 1994 Supreme Court decision affirmed this interpretation of antidegradation by pointing out that States must apply all measures necessary to protect designated and existing uses when sole reliance on numeric water quality criteria will not protect these uses.[1]

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[1]Public Utilities District No. 1 of Jefferson County and City of Tacoma, petitioners, *v.* State of Washington, Dept. of Ecology, Dept. of Fisheries, and Dept. of Wildlife, respondents. The Supreme Court ruled 7-2 on May 31, 1994, in favor of the respondents.

TERRESTRIAL HABITAT SURVEY

A team of Environmental Protection Agency, Fish and Wildlife Service, and Geological Survey biologists conducted a reconnaissance-level terrestrial habitat survey of the Pigeonroost Branch and Oldhouse Branch valleys on October 27, 1998. Dave Fisher of Sturm Environmental Services was present for portions of the investigation.

Methods

Prior to the field work, EPA had arranged for an evaluation of leaf-off color infrared aerial photography of the site to identify habitat cover types. Five cover types were identified within the study area: south-facing slope deciduous forest, north-facing slope deciduous forest, south-facing slope selectively cut, north-facing slope selectively cut, and south-facing slope clearcut. The team selected one representative sample station within each of the five mapped habitat types for field evaluation. The south-facing deciduous slope (SF1) was along Pigeonroost Branch east of the powerline crossing (Figure 1). The south-facing selective cut slope (SF2) was along Oldhouse Branch, approximately half-way between the two water quality stations. The north-facing deciduous slope (NF1) was also along Oldhouse Branch, and across the valley from SF2. The south-facing clear-cut slope (SF3) was along Pigeonroost Branch near the proposed location of the sediment pond for the mine. The north-facing selective cut slope (NF2) was also along Pigeonroost Branch, across the valley from SF3.

At each station, various observations were made of the habitat within a circle having a 50-foot radius from a center point. The center point was selected to represent the variability within each habitat type. The variables measured were selected from various wildlife species models (developed as part of the Fish and Wildlife Service's Habitat Evaluation Procedures), and were based on the general habitat requirements of forest interior wildlife species. The diameter (dbh) of all trees taller than 20 feet was recorded within the circle; trees beyond the 50-foot radius were noted but not measured. Ocular estimates of herbaceous cover, tree canopy closure, tree height, shrub height, stem density, and percent brush cover were recorded. All other variables were measured and averages calculated for each station. All herbaceous and shrub species within sight of the recorder were used for the estimated values, and listed for each sample location.

Results and Discussion

Species lists and measured variables are presented in Tables 2 and 3, respectively. There were obvious differences between plant communities present on north-facing slopes when compared to those on south-facing slopes. The north-facing slopes supported species typically found in moist forests, such as ginseng, sweet Cicely, goldenseal, and Virginia waterleaf. Yellow poplar and sugar maple were co-dominant tree species on north-facing slopes, while oaks and hickories were uncommon. In contrast, south-facing slopes were xeric, with thin or nonexistent organic or

Table 2. Plant species at sample stations, October 27, 1998. Proposed Spruce No. 1 Mine Site in Logan County, West Virginia.

Common Name	Scientific Name	SF1	SF2	SF3	NF1	NF2
Trees						
Red maple	*Acer rubrum*	X	D	D	X	
Sugar maple	*Acer saccharum*	X		X	D	D
Black birch	*Betula lenta*	D	D	X	X	X
Pignut hickory	*Carya ovalis*	X				X
Shagbark hickory	*Carya ovata*	X		D	X	X
Mockernut hickory	*Carya tomentosa*	X		D		
American beech	*Fagus grandifolia*	X	D	X	X	X
White ash	*Fraxinus americana*				X	
Butternut	*Juglans cinera*			X		
Yellow poplar	*Liriodendron tulipifera*	X	X	D	D	D
Cucumber magnolia	*Magnolia acuminata*	X	X	X	X	X
Umbrella magnolia	*Magnolia tripetala*				D	
Black gum	*Nyssa sylvatica*	X	X		X	D
Sourwood	*Oxydendrum arboretum*	X	X	X		
Princess tree	*Paulownia tomentosa*				X	X
White oak	*Quercus alba*	X	X	D		
Scarlet oak	*Quercus coccinea*		X	X		
Chestnut oak	*Quercus prinus*	X		X		
Red oak	*Quercus rubra*	X	X	X		X
Black oak	*Quercus velutina*		X	X		
Black locust	*Robinia pseudo-acacia*	X	X			
Sassafras	*Sassafras albidum*					X
American basswood	*Tilia americana*			X	X	X

Table 2. Plant species at sample stations, October 27, 1998. Proposed Spruce No. 1 Mine Site in Logan County, West Virginia.

Common Name	Scientific Name	SF1	SF2	SF3	NF1	NF2
Shrubs/Vines						
Pawpaw	*Asimina triloba*				X	X
Indigo bush	*Baptisia tinctoria*			X		
American hornbeam	*Carpinus caroliniana*	X			X	
Redbud	*Cercis canadensis*			D	X	
Flowering dogwood	*Cornus florida*	D		X	D	D
Witch hazel	*Hamamelis virginiana*			X		
Spicebush	*Lindera benzoin*				X	X
Ironwood	*Ostraya virginiana*		X	X	X	X
Sumac	*Rhus* sp.			X		
Blackberry	*Rubus* sp.			X		
Common greenbrier	*Smilax rotundifolia*		D	X		
Poison ivy	*Toxicodendron radicans*				X	
Mapleleaf virburnum	*Viburnum acerifolium*		X			
Wild grape	*Vitis* sp.				X	X
Herbaceous						
Maidenhair fern	*Adiantum pedatum*				X	X
Aster	*Aster* spp.	X		X		X
Black Cohosh	*Cimicifuga racemosa*				X	
White snakeroot	*Eupatorium rugosum*	X				
Teaberry	*Gaultheria procumbens*		X			
Goldenseal	*Hydrastis canadensis*				X	
Virginia waterleaf	*Hydrophyllum virginianum*				X	
Wood nettle	*Laportea canadensis*					X

Table 2. Plant species at sample stations, October 27, 1998. Proposed Spruce No. 1 Mine Site in Logan County, West Virginia.

Common Name	Scientific Name	SF1	SF2	SF3	NF1	NF2
Miterwort	*Mitella diphylla*				X	
Sweet Cicely	*Osmorhiza longistylis*				X	X
Ginseng	*Panax quinquefolius*				X	
Panic grass	*Panicum* sp.	X				
Christmas fern	*Polystichum acrostichoides*	D		D	D	D
Bloodroot	*Sanguinaria canadensis*				X	X
Goldenrod	*Solidago* spp.			X		
Wood violet	*Viola* spp.				X	
Golden Alexander	*Ziza aptera*				X	
	Totals	21	16	27	31	23

D = Dominant in the layer
NF1 = North-facing slope deciduous forest
NF2 = North-facing slope selectively cut
SF1 = South-facing slope deciduous forest
SF2 = South-facing slope selectively cut
SF3 = South-facing slope clearcut

Table 3. Measured variables at sample stations; October 27, 1998. Proposed Spruce No. 1 Mine Site in Logan County, West Virginia.

Variable	SF-1	SF-2	SF-3	NF-1	NF-2
Tree Canopy Layer					
% Closure (all trees)	60	50	70	60	50
a. % closure from hard mast trees	20	12	50	1	1
b. % closure from soft mast trees	40	38	20	59	49
Number of mast tree species	12	10	14	10	8
Average dbh for all trees (inches)	6.9	9.1	7.5	9.8	11.0
Average dbh for all mast trees (inches)	7.3	9.5	7.3	9.9	10.6
Average height of canopy trees (feet)	40	55	70	65	75
Number of cavity trees/acre	1	4	3	4	2
Average dbh of snags (inches)	5	8	10	6	7
% Evergreens	0	0	0	0	0
Shrub Canopy Layer					
% Shrub crown cover	15	21	30	18	15
a. % fruiting shrub crown cover	10	10	30	18	15
Number of fruiting shrub species	2	2	6	5	5
Average height of shrubs (feet)	6	6	10	7	15
Dense thickets present?	No	No	No	No	No
Stem density (S=sparse, M=moderate, D=dense)	M	M	M	S	S
Herbaceous Layer					
% Cover	15	1	8	15	5
Average height (inches)	10	5	12	13	9
Depth of leaf litter (inches)	1	2	4	3	2
% Brush piles, stumps, logs, rock piles	20	1	10	10	5

Table 3. Measured variables at sample stations; October 27, 1998. Proposed Spruce No. 1 Mine Site in Logan County, West Virginia.

Variable	SF-1	SF-2	SF-3	NF-1	NF-2
Organic humus layer present?	No	Yes	No	Yes	Yes
Soil moist or dry? (M=moist D=dry)	D	D	D	M	M
Distance to water (feet)	1,000	1,000	2,000	2,000	2,000
Number of spring seeps present	0	0	1	2	0
Number of vernal pools present	0	0	0	1	0
Perennial streams nearby?	Yes	Yes	Yes	Yes	Yes
Openings nearby?	Yes	No	Yes	Yes	No

SF-1 = South-facing slope deciduous forest
SF-2 = South-facing slope selectively cut
SF-3 = South-facing slope
NF-1 = North-facing slope deciduous forest
NF-2 = North-facing slope selectively cut

litter layers[2]. Herbaceous cover was sparse, and the dominant trees were red maple, black birch, American beech, and white oak. Sourwood, mockernut hickory, butternut, white oak, scarlet oak, chestnut oak, black oak, and black locust were only found on the south-facing slopes, whereas white ash, umbrella magnolia, princess tree, and sassafras were only on the north-facing slopes. Species diversity was higher on the north-facing slopes compared to the south-facing slopes. Stem density was higher on south-facing slopes, largely due to a higher number of sapling red maple and black birch. A slight easterly orientation of one of the north-facing slopes (station NF-2) created drier conditions, and several species typical of south-facing slopes were present.

Mast-producing plants provide the main food source for many species of wildlife. "Mast" refers to fruits produced by oak, hickory, beech, gum, cherry, ash, and other tree and shrub species, and of a variety of understory plant species such as flowering dogwood, wild grape, serviceberry, and others (Yoakum and Dasmann, 1969). The valleys in the study area support a diverse mix of 22 mast-producing tree species, and 14 species of fruiting shrubs and vines, that together ensure a reliable supply of food for wildlife throughout the year under a variety of weather conditions, or during mast failures in some species in any given year. By number, soft mast trees dominated the forest canopy on all five sample sites, with yellow poplar, black birch, sugar maple, red maple, and sourwood accounting for 61 percent of the total trees sampled. With the exception of white oak and American beech, all of the hard mast trees occurred in low numbers on both slopes. However, the hard mast trees were consistently the larger trees in the canopy, along with some large specimens of soft mast species (American beech, red maple, and yellow poplar). Fruiting shrubs were equally abundant on both slopes, with flowering dogwood being the dominant species in this stratum.

In general, there was little difference in the other variables measured on north-and south-facing slopes (Table 3). Assuming both sides of the valleys were logged at the same time, the data indicate that the north-slope facing trees may be growing faster, as they have a slightly larger average dbh. Herbaceous cover and species richness may also be higher on north-facing slopes.

The forested valleys in the study area appear to support a diverse wildlife community. During the field investigation, tracks of white-tailed deer and wild boar and feathers from wild turkey were observed. In addition, gray squirrel, chipmunk, ruffed grouse, and several songbirds were either seen or heard by the investigators. If this forest were allowed to mature, more mast would be produced, further enhancing its value for wildlife. The perennial streams and riparian borders in the valley bottoms add to habitat complexity, and provide a reliable supply of water for wildlife.

If the project is constructed as proposed, and the typical mining revegetation plan is followed after mining, the existing steep, forest interior habitat will be replaced by gently rolling grasslands with small, scattered stands of trees and shrubs. Although some mountaintop removal

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[2]The observation regarding the presence or absence of an organic layer bears further investigation. At least one south-facing slope showed evidence of fire, which could have reduced or eliminated the surface organic layer.

operations have avoided small patches of forest and preserved some natural mountain slopes, it is our understanding that this will not be possible at the Spruce No. 1 site due to the need to remove several deeper coal seams.

The Spruce No.1 Mine site is located in the Northern Cumberland Plateau physiographic region of southwestern West Virginia. This portion of West Virginia has been recognized as one of the largest areas of contiguous forest remaining in the Northeast, as a core area for many southern-affinity species of neotropical migrant birds, and as a "hot spot" for forest interior bird species of special concern in the Northeast United States (Rosenberg and Wells, 1995). Breeding bird surveys conducted between 1984 and 1989 documented the occurrence of 46 forest bird species, of which 22 were forest interior species (Buckelew and Hall, 1994). Many of the area-sensitive neo-tropical migrant forest bird species found in southwestern West Virginia, such as the wood thrush, cerulean warbler, black and white warbler, Acadian flycatcher, and worm-eating warbler, are species of special concern to the Service because of declining populations.

Many investigators believe that forest fragmentation has contributed to the decline of these species by reducing microhabitat heterogeneity, increasing isolation of populations, and allowing greater exposure to nest predators and nest parasites such as black rat snakes, racoons, crows, starlings, and brown-headed cowbirds. The five-square mile opening in the forest created by the Spruce No. 1 mine will allow the invasion of these nest predators and nest parasites, some of which travel more than 500 meters from the edge of forest openings in search of nests. Not only will there be the net loss of forested habitat for breeding, but forest interior bird species will be subject to increased exposure to nest predators entering from the edge of the mine after the mine is reclaimed. These forest edges become biological sinks for some neotropical migratory bird species, which are attracted to nest along the edge, but fail to produce any young.

Although there may be many other factors affecting the decline of these bird species that are not easily controlled, forest fragmentation can only be managed through preservation large tracts of unbroken forest. Consequently, the cumulative loss of forest habitats caused by multiple large-scale mining projects in this region may have ecosystem-wide implications.

Other species dependent upon a diversity of mast-producing trees and shrubs, such as gray squirrel, chipmunk, white-footed mouse, and ruffed grouse, will also be eliminated from the mined area. More adaptable habitat generalists, such as the white-tailed deer and wild boar, will use the grasslands created by the mining operation for grazing and cover. Wild turkey will also feed on the more abundant insects present along the forest-grassland interface. Red or gray fox may also come to the opening to feed on small mammals. However, these grasslands alone will not provide for all of these species life requisites. Typical grassland species, such as short-eared owl, northern harrier, meadowlark, chipping sparrow, field sparrow, and grasshopper sparrow, may eventually find and inhabit these grassland habitats after mining.

Finally, the proposed surface mine is also within the range of the Indiana bat (*Myotis sodalis*), a species that is federally listed as endangered. Much of the mature forest present within the project area includes trees that have the potential to support roosting Indiana bats during the summer maternity and foraging period. The Service is concerned that the loss of forested stream valleys associated with mountaintop removal and valley filling could adversely affect this species as more projects of this kind are constructed; accordingly, these projects should be evaluated for their potential individual and cumulative, direct and indirect effects on Indiana bats, and on Indiana bat roosting habitat.

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