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Vertebrate Use of Habitats Created by Installation of Field-Scale Erosion Control Structures

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ABSTRACT

Installation of field-scale erosion control structures or drop pipes is a common method for controlling knickpoint gully erosion in fields adjacent to incised streams. These structures transfer runoff water from field level to stream level through a metal drain pipe. The shape of the gully side collection basin at the pipe inlet allows small terrestrial and wetland habitats to develop with associated shallow pools that may be permanently or seasonally flooded. This study evaluated vertebrate use of habitats created by the installation of drop pipes. Four different habitats were categorized based on water depth and surrounding vegetation. Category 1 habitat has the smallest temporary pool, least vegetative structure, and is a terrestrial habitat. Categories consecutively increase to Category 4 which has the deepest pool, most vegetative structure, and is a wetland habitat. Study sites were surveyed for the five major vertebrate classes. Mean species richness and percentage capture abundance for all vertebrate classes increased from Category 1 habitats to Category 3 or 4 habitats. In all drop pipe habitat categories, amphibians had the highest percent capture abundance, fish were second, birds were third, mammals were fourth, and reptiles had the lowest percent capture abundance.

INTRODUCTION

Concentrated runoff from agricultural fields into adjacent streams causes the development of erosional knickpoints, creating gullies. Installation of a drop pipe structure places a dam at the gully mouth with a sloping metal drain pipe passing through the dam. The drain pipe transfers runoff water from field level to stream level (Figure 1). The installation of drop pipes to control gully erosion in the United States was reported as early as 1929 (Uhland and Wooley 1929) and is used internationally (Gray and Crothers 1989). Installation of a drop pipe is the most common method employed to control head-cutting gully erosion in the Demonstration Erosion Control (DEC) Project in the Yazoo Basin of Mississippi (Cooper et al. 1996). Over 2,000 drop pipes were planned for installation or constructed as part of this project. The shape of the gully side collection basin at the pipe inlet allows small terrestrial and wetland habitats to develop with associated shallow pools that may be permanent or ephemeral.

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A preliminary survey of habitats created by drop pipe installation revealed that a variety of terrestrial and wetland habitats were being created and becoming available for use by local vertebrates. Subsequently, we conducted an extensive survey of vertebrates utilizing these habitats.

METHODS

Habitat classification

An initial survey of habitats created by installation of drop pipes in north central Mississippi revealed that four major habitat types exist. In general, these habitats are small, riparian terrestrial or wetland habitats surrounded by agricultural fields. Habitat categories were classified using the methods of Cowardin et al. (1979). The primary habitat characteristics were water depth and vegetative structure. The categories were: temporarily flooded upland meadow (Category 1), saturated emergent wetland (Category 2), scrub-shrub wetland (Category 3), and intermittent riverine wetland (Category 4). These habitats receive water from precipitation and storm runoff from the captured watershed which normally includes the surrounding agricultural fields. Four sites in each category were chosen as study sites (16 sites) in Panola County, Mississippi. While ecological characteristics enabled categorization, sites actually exhibited a continuum from Category 1 through Category 4. Study sites were surveyed for the five major vertebrate classes from June to August 1994.

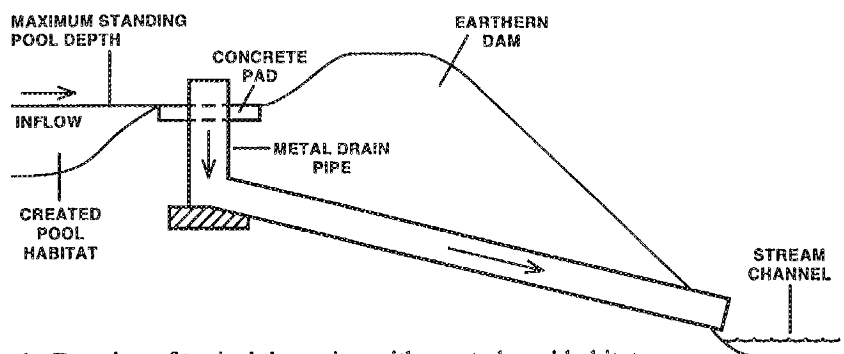

Figure 1. Drawing of typical drop pipe with created pool habitat.

Bird Surveys

We conducted bimonthly bird surveys at each study site. Birds were surveyed for 10 minutes from a fixed observation point on the dam. Additionally, birds were identified while walking to and from sites. Bird surveys were conducted between times of visible light and 11:00 am (CST).

Aquatic Vertebrates

We used a variety of methods to collect aquatic vertebrates. Category 3 and 4 habitats were sampled with a seine (6.1 m and 15.2 m, mesh sizes 0.3 and 0.9 cm) twice. If the water depth was too shallow, the sites were sampled with a dipnet. All seinable sites were thoroughly sampled in Category 3 habitats; however, greater depth of Category 4 pools made complete seine coverage impractical; therefore, all available microhabitats within the pool were sampled. The number of seine pulls completed at each site ranged from 1 - 4 and number of dipnet sweeps ranged from 13 - 30 depending on the amount of water present. Animals captured were identified, counted, and released. Animals unidentifiable in the field and voucher specimens were preserved and taken to the laboratory.

We used baited hoop nets (1.8 m length , 0.9 m hoops, mesh size 2.5 cm) to capture fish and aquatic turtles. One hoop net was set in each Category 4 pool and trapped for one week. Animals were identified and released. In addition, study sites were sampled with a dipnet independently from the seine sample. All accessible microhabitats were sampled with dipnet; the number of dipnet pulls made in each site ranged from 4 - 19.

Terrestrial vertebrates

We placed pitfall (19 L buckets buried flush with ground surface) and Sherman folding live traps on the periphery of the habitats to capture amphibians, reptiles, and small mammals. There were two trapping periods in this study. Only 12 sites were sampled during the first trapping period (28 June 94 to 1 July 94) because of incomplete installation of traps at other study sites. All study sites were trapped in July (18 July 94 - 27 July 94).

Other sampling

One night survey was conducted to increase our capture of amphibians and reptiles. Every site was systematically searched for amphibians and reptiles for 5 - 45 minutes, depending on the size and complexity of the habitat. Captured animals were identified and released or used as voucher specimens. Additional opportunistic observations made independently of the sampling protocols for any particular group were also recorded (i.e. identifying tracks, scat, new captures, and sightings).

Statistical analysis

To test for differences in mean vertebrate species richness (mean number of species) between habitat categories, we used a Single Factor Analysis of Variance (ANOVA) (alpha = .05) coupled with Student-Newman-Keuls Method (SNK test) performed on the SigmaStat for Windows version 1.0 (Jandel Corporation 1994) statistical software package. Data from all survey techniques except opportunistic sampling were included in this analysis. The assumptions of ANOVA were confirmed prior to statistical analysis using Kolmogorov-Smirnov (normality) and Levene Median (equal variance) tests.

Percent capture abundance is the percentage of total captures; data from all survey techniques except opportunistic sampling were used. Due to unequal catchability, no statistical test was used to determine differences in percent capture abundances. However, the data were visually examined for trends.

Table 1. Fish, amphibians, reptiles, mammals, and birds captured/sighted in drop pipe created habitats. Nomenclature is as follows. fish (Page and Burr 1991), amphibians and reptiles (Conant and Collins 1991), mammals (Burt and Grossenheider 1980), and birds (National Geographic Society 1992).

Scientific name (common name)	Habitat Category			
	1	2	3	4
Fish				
Fundulus olivaceus (Blackspotted topminnow)				X
Lepomis macrochirus (Bluegill)				X
Lepomis cyanellus (Green sunfish)				X
Lepomis megalotis (Longear sunfish)				X
Pomoxis nigromaculatus (Black crappie)				X
Notemigonus crysoleucas (Golden shiner)				X
Amphibians				
Ambystoma talpoideum (Mole salamander)			X	X
Bufo americanus (American toad)			X	X
Bufo species (Toad species)			X	X
Bufo woodhousii (Woodhouse's toad)				X
Gastrophryne carolinenesis (Eastern narrowmouth toad)	X	X	X	X
Hyla chrysoscelis (Grey treefrog)			X	X
Hyla cinerea (Green treefrog)				X
Hyla species (Treefrog species)			X	X
Notophthalmus viridescens (Red-spotted newt)				X
Rana catesbeiana (Bullfrog)				X
Rana clamitans (Green frog)				X
Rana utricularia (Southern leopard frog		X	X	X
(Unidentified frog)	X			
(Unidentified tadpoles)			X	
Reptiles				
Agkistrodon contortrix (Southern copperhead)			X	
Agkistrodon piscivorus (Western cottonmouth)	X			X
Chelydra serpentina (Snapping turtle)				X
Coluber constrictor (Southern black racer)			X	
Eumeces fasciatus (Five-lined skink)				X
Nerodia species (Water snake species)				X
Scincella lateralis (Ground skink)		X	X	X
Terrapene carolina (Eastern box turtle)				X
Thamnophis sauritus (Eastern ribbon snake)			X	X
Trachemys scripta (Red-eared slider)			X	X
(Unidentified snake)				X
(Unidentified turtle)				X
Mammals				
Blarina brevicauda (Shorttail shrew)	X	X	X	X
Canis latrans (Coyote)			X	
Cryptotis parva (Least shrew)		X		
Odocoileus virginianus (Whitetail deer)		X		
Peromyscus gossypinus (Cotton mouse)		X	X	X
Peromyscus leucopus (White-footed mouse)		X	X	
Pitymys pinetorum (Pine vole)		X	X	
Procyon lotor (Raccoon)			X	
Riethrodontomys humulis (Eastern harvest mouse)			X	
Sigmodon hispidus (Hispid cotton rat)	X	X	X	X
Sorex longirostris (Southeastern shrew)		X		
Sylvilagus floridanus (Eastern cottontail)		X	X	
(Unidentified mouse)		X	X	

Table 1 (continued)

Scientific name (com
Birds
Agelaius phoeniceus
Archilochus colubris
Ardea herodias (Grea
Butorides striatus (G
Cardinalis cardinalis
Carduelis tristis (Am
Ceryle alcyon (Belted
Charadrius vociferus
Contopus virens (Eas
Cyanocitta cristata (
Dendroica petechia (
Egretta caerulea (Lit
Geothlypis trichas (C
Guiraca caerulea (Bl
Hirundo pyrrhonota
Hirundo rustica (Bar
Icteria virens (Yello
Parus carolinensis (
Passerina cyanea (In
Quiscalus quiscula (
Sialia sialis (Eastern
Spiza americana (Di
Stelgidopteryx serrip
Thryothorus ludovic
Toxostoma rufum (B
Turdus migratorius
Tyrannus tyrannus (
Vireo griseus (Whit
Zenaida macroura (
(Unidentified bird)
(Unidentified duck)

A total of 1,8
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southern leopard
shorttail shrew (
hispid cotton rat
yellowthroat (*G*
cardinal (*Cardin*
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Table 1 (continued)

Scientific name (common name)	Habitat Category			
	1	2	3	4
Birds				
Agelaius phoeniceus (Red-winged blackbird)		X	X	X
Archilochus colubris (Ruby-throated hummingbird)		X		X
Ardea herodias (Great blue heron)				X
Butorides striatus (Green-backed heron)			X	X
Cardinalis cardinalis (Northern cardinal)		X	X	X
Carduelis tristis (American goldfinch)				X
Ceryle alcyon (Belted kingfisher)				X
Charadrius vociferus (Killdeer)				X
Contopus virens (Eastern wood-peewee)				X
Cyanocitta cristata (Blue jay)			X	X
Dendroica petechia (Yellow warbler)			X	X
Egretta caerulea (Little blue heron)			X	X
Geothlypis trichas (Common yellowthroat)		X	X	X
Guiraca caerulea (Blue grosbeak)	X			
Hirundo pyrrhonota (Cliff swallow)	X			X
Hirundo rustica (Barn swallow)	X	X	X	X
Icteria virens (Yellow-breasted chat)		X		X
Parus carolinensis (Carolina chickadee)			X	X
Passerina cyanea (Indigo bunting)	X	X	X	X
Quiscalus quiscula (Common grackle)		X		
Sialia sialis (Eastern bluebird)				X
Spiza americana (Dickcissel)		X		
Stelgidopteryx serripennis (Northern rough-winged swallow)				X
Thryothorus ludovicianus (Carolina wren)				X
Toxostoma rufum (Brown thrasher)			X	X
Turdus migratorius (American robin)			X	
Tyrannus tyrannus (Eastern kingbird)	X			X
Vireo griseus (White-eyed vireo)			X	
Zenaida macroura (Mourning dove)	X			
(Unidentified bird)	X	X	X	X
(Unidentified duck)				X

RESULTS

A total of 1,807 animals representing 76 species were captured or sighted (Table 1). This included a total of six fish species, 14 amphibian species, 12 reptile species, 13 mammal species, and 31 bird species in all drop pipe habitats combined. Members of 11 species were either captured or sighted in three or more drop pipe habitat categories [eastern narrowmouth toad (*Gastrophrhyne carolinensis*), southern leopard frog (*Rana utricularia*), ground skink (*Scincella lateralis*), shorttail shrew (*Blarina brevicauda*), cotton mouse (*Peromyscus gossypinus*), hispid cotton rat (*Sigmodon hispidus*), barn swallow (*Hirundo rustica*), common yellowthroat (*Geothlypis trichas*), indigo bunting (*Passerina cyanea*), northern cardinal (*Cardinalis cardinalis*), red-winged blackbird (*Agelaius phoeniceus*)].

Habitat type had a significant effect on vertebrate species richness ($F_{3,15} = 25$, $P < 0.0001$). Mean vertebrate species richness increased from Category 1 to Category 4. Mean species richness in all habitat categories except Category 1 and 2 was significantly different from each other (SNK, $P<0.05$). Mean species richness increased from Category 1 habitats to Category 4 habitats for all vertebrate classes except mammals. Mammal mean species richness peaked at Category 2 and 3 habitats and decreased slightly in Category 4 habitats (Figure 2).

Percent capture abundance of all vertebrate classes in drop pipe habitat categories increased sequentially from the lowest in Category 1 to the highest in Category 4 habitats. Additionally, slightly over half of all vertebrate captures were made in Category 4 habitats. In all drop pipe habitats, amphibians had the highest percent capture abundance, fish were second, birds were third, mammals were fourth, and reptiles had the lowest percent capture abundance. Percent capture abundance increased from Category 1 habitats to Category 4 habitats for all vertebrate classes except amphibians and mammals. Percent capture abundance of amphibians and mammals increased from Category 1 habitats to Category 3 habitats and decreased slightly in Category 4 habitats (Figure 3).

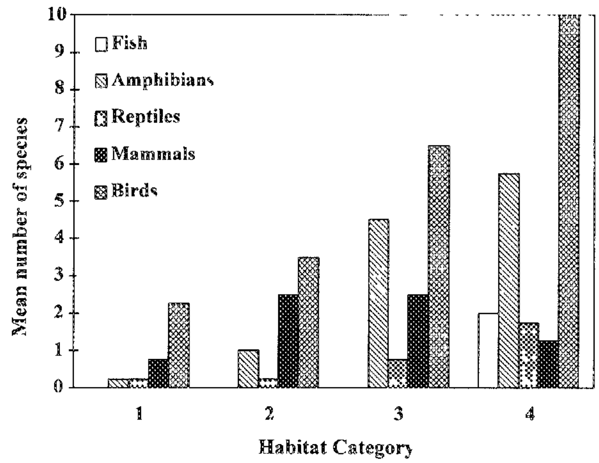

Figure 2. Mean species richness for each vertebrate class in drop pipe habitats

DISCUSSION

The continuous increase of mean vertebrate species richness and percent capture abundance from Category 1 habitats to Category 4 was related to the increase in habitat size/complexity and pool size. Pool size probably played a dominant role in the increase of mean vertebrate species richness and percent capture abundance. Those habitats with largest pools (Category 3 and 4) had significantly higher mean vertebrate species richness and greatly increased percent capture abundance over shallower pools (Category 1 and 2). This increase was attributed to creation of suitable habitats for aquatic vertebrates such as fish and amphibians.

Vertebrate species richness and percent capture abundance of these created wetland habitats (Categories 2, 3, and 4) compared favorably with another wetland habitat (i.e. the red maple swamp). Golet et al. (1993) reviewed the literature on vertebrate communities of red maple (*Acer rubrum*) swamps in the glaciated northeast. They reported species richness of amphibians and reptiles ranging from seven to 17 species and number of captures ranging from 251 to 2,035 individuals. By comparison, the total number of amphibian and reptile species captured in drop

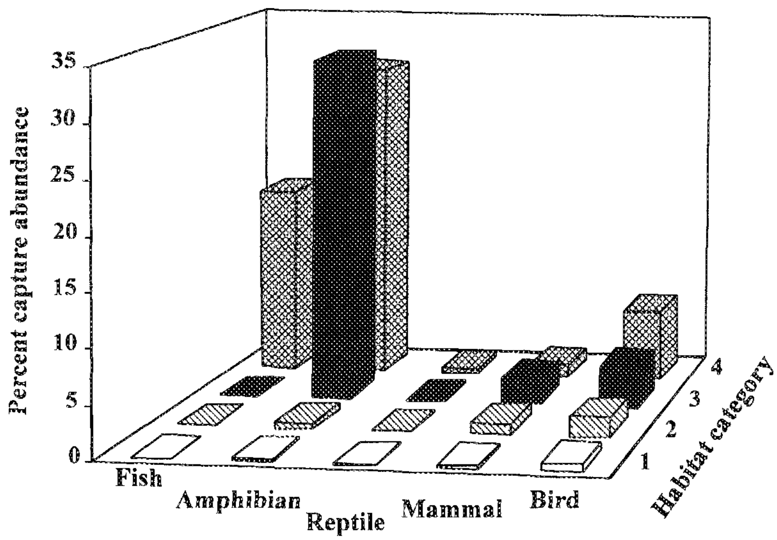

Figure 3. Percent capture abundance for each vertebrate class in drop pipe habitats.

pipe habitats ranged from three in Category 2 habitats to 22 species in Category 4 habitats. The number of captures of amphibians and reptiles in drop pipe habitats ranged from 10 in Category 2 habitats to 592 in Category 3 habitats. Number of captures decreased slightly in Category 4 habitats for these animals. When compared to red maple swamps, it appeared that the Category 3 and 4 habitats were supporting similar species richness but lower numbers per study site of amphibians and reptiles.

Golet et al. (1993) discussed the results of seven censuses and reported that 63 species of birds utilized red maple swamps. For all drop pipe habitats 31 bird species were sighted. Individually, 10, 14, and 25 species of birds were identified in Category 2, 3, and 4 habitats, respectively. Since this study was conducted in the summer, the majority of bird species sighted in our study were passerine birds. However, three species of wading birds [Great blue heron (*Ardea herodias*), Green-backed heron (*Butorides striatus*), Little blue heron (*Egretta caerulea*)] and one unidentified duck were sighted at Category 3 and 4 habitats, further suggesting the importance of pool formation in providing habitat.

In two studies of small mammal communities in red maple swamps, Golet et al. (1993) found a small mammal species richness of six and 12. The white footed mouse (*Peromyscus leucopus*) and northern short-tailed shrew (*B.brevicauda*) were among the three most frequently captured mammal species in both studies. Nine species of small mammals were associated with drop pipe habitats (eight, seven, and two species in Category 2, 3, and 4 habitats, respectively). In descending order, three species of small mammals most often captured in all drop pipe wetland habitats were hispid cotton rat (*S.hispidus*), cotton mouse (*P. gossipinus*), and short-tailed shrew (*B.brevicauda*).

Fish communities of red maple swamps were not discussed by Golet et al. (1993). Water level fluctuations excluded fish populations in many cases. In contrast, we found two Category 4 habitats capable of supporting fish populations.

Six fish species occurred in these two sites with a total of 324 captures which constituted 17.93% of all vertebrate captures.

Our study demonstrates that the installation of drop pipes allows the natural development of habitats capable of supporting populations of all major vertebrate classes. To date, we have recorded no endangered or endemic species associated with drop pipe habitats. Habitat use by a large number of common vertebrate species indicates these created habitats are of suitable quality to support these species. Thus, properly designed field-scale grade control pipes reduce field erosion and create habitats for vertebrates.

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LITERATURE CITED

Burt, W.H., and R.P. Grossenheider. 1980. A field guide to the mammals: North America north of Mexico. Houghton Mifflin Co., Boston, 289 pg.

Cooper, C.M., F. D. Hudson, and K. Bray. 1996. The Demonstration Erosion Control (DEC) Project in the Yazoo Basin. Sixth Federal Interagency Sedimentation Conference, Las Vegas, NV, March 1996. Vol. 2, P-43-46.

Conant, R., and J.T. Collins. 1991. A field guide to reptiles and amphibians: Eastern and Central North America. Houghton Mifflin Co., Boston, 450 pg.

Cowardin, L.M., V. Carter, F.C. Golet, and E.T. LaRoe. 1979. Classification of wetlands and deep water habitats of the United States. U.S. Fish and Wildlife Service, Washington, DC., 131 pg.

Golet, F.C., A.J.K. Calhoun, W.R. DeRagon, D.J. Lowry, and A.J. Gold. 1993. Ecology of red maple swamps in the glaciated northeast: A community profile. Biological Report 12. U.S. Department of Interior, Fish and Wildlife Service. Washington, D.C., 151 pg.

Gray, H.J., and R.B. Crothers, 1989. Gully control structures for grazing lands in Southern Queensland. Queensland Agricultural Journal (Brisbane) 115:116-120.

Jandel Corporation. 1994. SigmaStat for Windows version 1.0 statistical software. San Rafael, CA 94912-7005.

National Geographic Society. 1992. Field guide to the birds of North America. Washington, D.C., 464 pg.

Okagbue, C.O. and J.I. Ezechi. 1988. Geotechnical characteristics of soils susceptible to severe gullying in Eastern Nigeria. Bulletin of the International Association of Engineering Geology. Issue 38, 9 pg.

Page, L.M., and B.M. Burr. 1991. A field guide to freshwater fishes: North America north of Mexico. Houghton Mifflin Co., Boston, 432 pg.

Uhland, R.E., and J.C. Wooley, 1929. The control of gullies. Bulletin of University of Missouri Agricultural Experiment Station. 271, 23 pg.

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