The Zoogeography of the Fishes of the Youghiogheny River System, Pennsylvania, Maryland and West Virginia

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ABSTRACT: A total of 266 fish collections were made at 172 stations in the Youghiogheny River drainage, the largest tributary to the Monongahela River. Collections were made using seines, electrofishing gear, gill nets and trap nets.

A comprehensive literature review yielded 99 species of fishes reported from the Youghiogheny River system. Six species collected during this survey (*Amia calva, Carassius auratus, Ericymba buccata, Notropis rubellus, Ictalurus catus* and *Fundulus diaphanus*) established new distributional records for the system, increasing the total to 105 species. Of this total, 78 species were verified either by our collections (57 species), museum records (10) or stocking records (11), whereas 27 could not be verified. Of the 27 unverified species, 21 are expected to occur and six are considered misidentifications or erroneous records. An additional 24 species are expected to have occurred historically in the Youghiogheny or have the potential to do so based on their distribution in the Monongahela or Allegheny rivers.

Of the 78 species of fishes confirmed to have occurred in the Youghiogheny River, 57 were collected during this survey, 11 were unsuccessful introductions and nine have probably been extirpated. One species, *Esox masquinongy,* is considered extant, but was not collected during this study.

The ichthyofauna of the Youghiogheny River system was largely derived from Teays River by dispersal up the newly formed Ohio River after the onset of Pleistocene glaciation. Two species, *Clinostomus elongatus* and *Catostomus catostomus,* dispersed into the Youghiogheny from the N during the Pleistocene. *Rhinichthys atratulus atratulus* dispersed into the Youghiogheny from Potomac River via stream capture. Several species, *Campostoma a. anomalum, Ericymba buccata, Nocomis micropogon, Notropis spilopterus* and *Etheostoma b. blennioides,* may have used Youghiogheny-Potomac stream captures as a dispersal route eastward into the Atlantic slope.

INTRODUCTION

The Youghiogheny River (Fig. 1) is the largest tributary of the Monogahela River with an average annual flow of 82.5 m^3/sec at Sutersville, Pa. (U.S. Geol. Survey, 1976). The main channel is 214 km long (Bryant and McPhilliamy, 1973), occupies a drainage basin of 4585 km^2 (U.S. Environmental Protection Agency [EPA], 1971a) and has an average gradient of 2.5 m/km. EPA (1971b) estimated that there are 4691 km of streams in the system and two large reservoirs have been constructed there. Deep Creek Lake, a 15.8 km^2 hydroelectric impoundment, was completed in the 1920s and Youghiogheny Reservoir, a 14.4 km^2 flood control lake, was impounded in 1944.

Two sections of the river, from Millers Run to Friendsville, Md., and from Confluence to Connellsville, Pa., have been designated for study under the Federal Wild and Scenic Rivers Act (Anon., 1977). The section from Millers Run to Friendsville has

been designated a Maryland Wild and Scenic River and the section from Confluence to Connellsville has been recommended for inclusion in the Pennsylvania Wild and Scenic River system. Both sections occupy rugged steep-sided valleys and are characterized by long rapids and falls such as Swallow Falls and Ohiopyle Falls. The Youghiogheny River is considered one of the best whitewater canoeing and kayaking rivers in the East.

One of the major factors affecting the distribution of fishes in the Youghiogheny River system is water quality. Federal agencies and the states of Pennsylvania and Maryland investigated this and found the major pollutants to be acid mine drainage, municipal sewage, industrial effluents, agricultural runoff and siltation resulting from forestry practices, mining and construction. Acidic coal mine drainage and siltation are the most severe and limiting pollutants to aquatic organisms in the Youghiogheny.

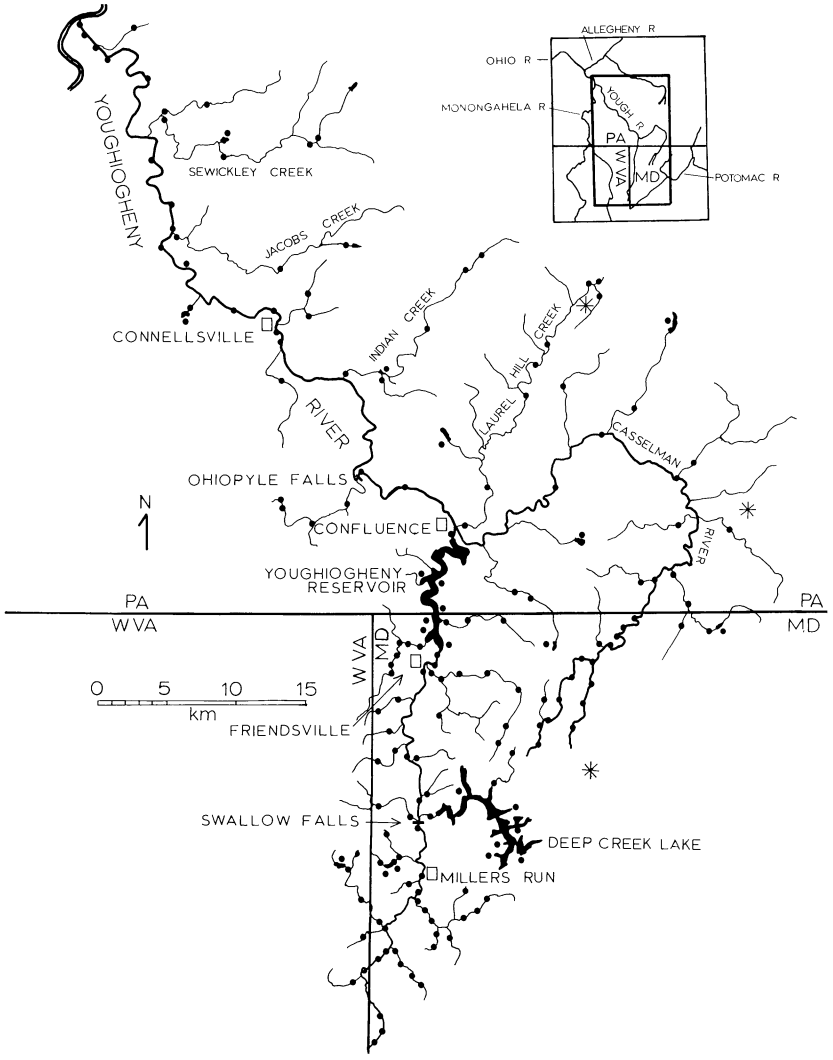

Fig. 1.—The Youghiogheny River system. *-locations of stream capture

Coal mining in the Youghiogheny system began in the 1800s, and peaked during World Wars I and II (Anon., 1971). The Youghiogheny was very acidic in the early years and contained sufficient free acid to kill fish as early as 1890 (EPA, 1971b). Historical water quality data are scarce, but one can assume that the most severe periods of pollution occurred during and after the peaks in coal production throughout the system. The river has improved considerably since 1950 when it was considered practically lifeless (Reppert, 1964). Factors that may have contributed to this improvement are the decrease in coal production, water quality law enforcement and mine drainage abatement projects.

The earliest known collections of fishes from the Youghiogheny River were those of Cope (1865, 1869, 1870), Uhler and Lugger (1876) and Jordan (1878). Fowler (1907, 1909, 1912a, 1912b, 1913, 1919) listed many distributional records from the Youghiogheny. Goldsborough and Clark (1908) reported on the fishes of West Virginia and on several collections from the Youghiogheny River in Maryland (Hendricks *et al.,* 1979). Truitt *et al.* (1929) listed Maryland fishes, including only three species from the Youghiogheny River.

Raney (1938) studied the distribution of fishes in the Ohio drainage basin of western Pennsylvania but relied on literature records for his Youghiogheny material, presumably due to the severity of acid mine pollution. More recent collections in the Youghiogheny River were made by Mansueti (1962), Davis (1973) and Lee *et al.* (1976). Unpublished data included collections by R. J. Mansueti (collections in 1949), F. J. Schwartz (collections in 1953), E. L. Cooper (collections from 1965-1972) and the Pennsylvania Fish Commission (1970 and 1973 collections).

Jenkins *et al.* (1972) summarized the distribution and dispersal of fishes in the central Appalachian drainages. It could be inferred from their checklist that 17 species (Table 1) were known from the Youghiogheny when in fact verified records were available only for the Monongahela River proper (R. E. Jenkins, *in litt.*). Hendricks *et al.* (1979) provided a preliminary checklist of the fishes of the Youghiogheny River system based on collections made in 1977. The purpose of this paper is to update that list and discuss aspects of the zoogeography of the Youghiogheny River.

MATERIALS AND METHODS

A total of 266 fish collections were made at 172 stations (Fig. 1). Collections were made using seines, Coffelt backpack electroshocker, No-Brush generator electroshocker, gill nets and trap nets. The choice of sampling apparatus was made on site, based on water depth, substrate and flow. Each seine and electrofishing station was sampled thoroughly in order to cover each type of habitat at that locality (riffle, pool, run) and to obtain a representative qualitative sample (Hocutt *et al.,* 1974; Hocutt, 1978). Sampling continued at that station until the collectors thought that further sampling would not yield additional species. Collection time at stations which were devoid of fish exceeded 15-30 min. Stations which yielded fish were sampled for 45 min to several hours.

A 1.52 m x 3.05 m x 0.32 cm mesh (5 ft x 10 ft x ⅛ inch mesh) common seine was used at most seining stations. Where space and substrate permitted, a 1.52 m x 7.62 m (5 ft x 25 ft) bag seine was also used. This seine has 3.20 m (10.5 ft) wings of 0.64 (¼ inch) mesh and 1.22 m x 1.22 m x 1.22 m (4 ft x 4 ft x 4 ft) bag with 0.48 cm (3/16 inch) mesh. In fast water, a 1.52 m x 3.05 m x 0.64 mesh (5 ft x 10 ft x ¼ in mesh) seine was used.

Electrofishing voltage depended on the conductivity of the water and was established by trial and error at each station. Normally, direct current was used; however, alternating current was used in fast water to stun specimens more quickly.

Gill net stations were sampled using an experimental mesh gill net 2.54 cm to 7.62 cm (1 inch to 3 inches) stretch mesh. Trap net stations were sampled using a trap net consisting of a rectangular metal frame followed by series of metal hoops enclosed in

nylon netting. A lead was attached to and suspended vertically in front of the trap. Gill nets and trap nets were anchored, fished overnight for a period of 2 nights, and tended daily.

All collections were preserved in 10% formalin and returned to the laboratory for positive identification to species. Keys used for this purpose were those of Moore

TABLE 1.—Checklist of the fishes known from the Youghiogheny River. N = native, I = introduced, UI = unsuccessfully introduced, ? = status unknown, x = collected in this study

Species	Status	Source
PETROMYZONTIDAE		
Lampetra aepyptera	N	X
AMIIDAE		
Amia calva	I	X
CLUPEIDAE		
Alosa pseudoharengus	UI	Mansueti (1962)
A. sapidissima	UI	Mansueti (1962)
Dorosoma cepedianum	N	X
HIODONTIDAE		
Hiodon alosoides	N	Fowler (1907): ANSP 15478-9
SALMONIDAE		
Salmo gairdneri	I	X
S. salar	UI	Ferguson (1877)
S. trutta	I	X
Salvelinus fontinalis	N	X
S. namaycush	UI	Ferguson (1877)
OSMERIDAE		
Osmerus mordax	UI	Maryland Fisheries Administration, Pennsylvania Fish Commission
ESOCIDAE		
Esox a. americanus	I	X
E. lucius	I	X
E. masquinongy	N	Jenkins et al. (1972), Pennsylvania Fish Commission
E. niger	I	X
CYPRINIDAE		
Campostoma anomalum	N	X
Carassius auratus	I	X
Clinostomus elongatus	N	X
Cyprinus carpio	I	X
Ericymba buccata	N	X
Hybopsis dissimilis	N	Cope (1869): ANSP 22288-98
Nocomis micropogon	N	X
Notemigonus crysoleucas	N	X
Notropis atherinoides	N	X
N. chrysocephalus	N	X
N. photogenis	N	X-types, *see* Gilbert (1971)
N. rubellus	N	X
N. spilopterus	N	X
N. stramineus	N	X
N. volucellus	N	X
Pimephales notatus	N	X
P. promelas	I	X
Rhinichthys atratulus	N	X
R. cataractae	N	X
Semotilus atromaculatus	N	X
S. margarita	N	X
Tinca tinca	UI	Baughman (1947)

(1968), Clay (1975) and Scott and Crossman (1973). Nomenclature follows Bailey *et al.* (1970). All specimens were catalogued into the Appalachian Environmental Laboratory Fish Museum and permanently stored in 40% isopropyl alcohol.

TABLE 1.—(cont'd.).

Species	Status	Source
CATOSTOMIDAE		
Carpiodes cyprinus	N	X
C. velifer	N	Fowler (1913): ANSP 22097
Catostomus catostomus	N	X
C. commersoni	N	X
Hypentelium nigricans	N	X
Moxostoma anisurum	N	Cope (1870): ANSP 6954, 6955
M. carinatum	N	Fowler (1919): ANSP 6840
M. duquesnei	N	X
M. erythrurum	N	X
M. macrolepidotum breviceps	N	Cope (1870): ANSP 22104
ICTALURIDAE		
Ictalurus catus	I	X
I. natalis	N	X
I. nebulosus	N	X
I. punctatus	N	X
Noturus flavus	N	X
N. insignis	UI	USNM 170970
Pylodictus olivaris	N	Fowler (1907): ANSP 8357-8
CYPRINODONTIDAE		
Fundulus diaphanus	I	X
ATHERINIDAE		
Labidesthes sicculus	N	Fowler (1907): ANSP 10223-235
PERCICHTHYIDAE		
Morone chrysops	UI	Elser (1961)
M. saxatilis	UI	Elser (1961)
CENTRARCHIDAE		
Ambloplites rupestris	N	X
Lepomis cyanellus	N	X
L. gibbosus	N	X
L. macrochirus	N	X
L. microlophus	UI	Pennsylvania Fish Commission
Micropterus dolomieui	N	X
M. salmoides	N	X
Pomoxis annularis	N	X
P. nigromaculatus	N	X
PERCIDAE		
Etheostoma blennioides	N	X
E. caeruleum	N	X
E. flabellare	N	X
E. nigrum	N	X
Perca flavescens	?	X
Percina caprodes	N	X
P. macrocephala	N	Cope (1869): ANSP 22626 (Lectotype) *see* Collette and Knapp (1966)
Stizostedion vitreum	N	X
SCIANIDAE		
Aplodinotus grunniens	UI	Pennsylvania Fish Commission
COTTIDAE		
Cottus bairdi	N	X

Museums were visited to verify specimens of taxa reported by other authors but not collected during this survey. Museums visited to obtain historical records were the Philadelphia Academy of Natural Science (ANSP) and the National Museum of Natural History (USNM). Museum curators at Cornell University (CU), University of Michigan (UMMZ) and Virginia Institute of Marine Science (VIMS) indicated that their Youghiogheny holdings were minimal and did not justify a visit. Abbreviations for other museums are as follows: University of Louisville (UL), University of North Carolina (UNC), Pennsylvania State University (PSU).

The Mansueti Collection in the McKeldin Library, University of Maryland, was visited to attempt to obtain bibliographic details for references in Manseuti (1962) and to assist in verification of Mansueti's (1962) records for *Semotilus corporalis* and *S. margarita*.

Results and Discussion

A total of 99 species of fishes have been reported in the literature from the Youghiogheny River system. Our collections resulted in the addition of six species (*Amia calva, Carassius auratus, Ericymba buccata, Notropis rubellus, Ictalurus catus* and *Fundulus diaphanus*) to the known fauna of the system (Hendricks *et al.*, 1979). Of the 105 species now reported from the Youghiogheny, 78 were verified by our collections, museum specimens or stocking records (Table 1). Of these, 57 were collected during the survey; 11 species (*Alosa pseudoharengus, A. sapidissima, Salmo salar, Salvelinus namaycush, Osmerus mordax, Tinca tinca, Noturus insignis, Morone chrysops, M. saxatilis, Lepomis microlophus* and *Aplodinotus grunniens*) represent unsuccessful introductions; and nine species (*Hiodon alosoides, Hybopsis dissimilis, Carpiodes velifer, Moxostoma anisurum, M. carinatum, M. macrolepidotum breviceps, Pylodictus olivaris, Labidesthes sicculus* and *Percina macrocephala*) have probably been extirpated. *Esox masquinongy,* native to the Youghiogheny, was not collected during the survey, but is known to be present as a result of introductions. Native populations of *E. masquinongy* have probably been extirpated.

The remaining 27 species reported from the Youghiogheny could not be verified. Twenty-one of these are expected to occur in the Youghiogheny and six reports are presumed to be the result of misidentifications or erroneous locality data. An additional 24 species are expected at present or historically, based on their distribution in the Monongahela and Allegheny rivers. Problematic and expected forms are listed in Table 2. Specific locality data for the present survey are presented in Hendricks (1980).

The checklist presented here (Table 1) is updated from that of Hendricks *et al.* (1979), and incorporates the following changes. First, unsuccessful introductions of *Lepomis microlophus* and *Aplodinotus grunniens* have been added to the current list. Second, *Percina maculata* was erroneously listed from the Youghiogheny by Hendricks *et al.* (1979) based on a specimen (ANSP 22628) that was actually collected in the Kiskiminetas River. Third, *Anguilla rostrata, S. corporalis, Minytrema melanops, Ammocrypta pellucida* and *Stizostedion canadense* were included in the checklist of Hendricks *et al.* (1979), based on literature records by authors deemed qualified to identify those species. These are expected (*S. corporalis* possibly as an introduction) and may indeed have been collected, but are deleted from the current list since no museum specimens exist for verification.

Zoogeography.—Monongahela and Youghiogheny rivers have not always been associated with the Mississippi River basin (Hocutt *et al.*, 1978). Prior to the onset of Pleistocene glaciation, the Monongahela and Youghiogheny formed the headwaters of Old Lower Allegheny River (Leverett, 1902; Tight, 1903) (Fig. 2) which flowed northward to join Pittsburgh River (Tight, 1903) (which occupied the area of the present-day Lake Erie) NW of Erie, Pa. A minor tributary, Old Upper Ohio River, flowed northward from New Martinsville, W. Va., along the course of the present Ohio River (reversed) to join Old Lower Allegheny at Beaver, Pa. (Leverett, 1902). Pittsburgh

TABLE 2.—Problematic and expected species. Uv = Youghiogheny citations for which no museum specimens could be found; Ex = expected to have occurred (nearest records listed); Nx = not expected

Species	Status	Authority
PETROMYZONTIDAE		
Ichthyomyzon greeleyi	Ex	Allegheny R.: Raney (1938) Beaver R.: Raney (1938); Trautman (1957) Little Kanawha R.: USNM 171992
Lampetra lamottei	Ex	Allegheny R.: Raney (1938) West Virginia: Denoncourt et al. (1975)
ACIPENSERIDAE		
Acipenser fulvescens	Ex	Allegheny R.: Fowler (1919) Kiskiminetas R.: Fowler (1919) Ohio R., Oh.: Trautman (1957)
Scaphirhynchus platorhynchus	Ex	Ohio R., Pa.: Rafinesque (1820) Bean (1892) Ohio R., Oh.: Trautman (1957)
POLYODONTIDAE		
Polyodon spathula	Ex	Allegheny R.: Fowler (1919) Kiskiminetas R.: Fowler (1919) Ohio R., Pa.: Fowler (1919) Ohio R., Oh.: Trautman (1957)
LEPISOSTEIDAE		
Lepisosteus osseus	Uv	Youghiogheny R. (Uv): Jenkins *et al.* (1972)
	Ex	Allegheny R.: Fowler (1919) Kiskiminetas R.: Fowler (1919) Monongahela R.: Evermann and Bollman (1886) Ohio R., Pa.: Raney (1938) Ohio R., Oh.: Trautman (1957)
Lepisosteus platostomus	Ex	Ohio R., Pa.: Rafinesque (1820) Ohio R., Oh.: Trautman (1957)
ANGUILLIDAE		
Anguilla rostrata	Uv	Youghiogheny R. (Uv): Fowler (1919)
	Ex	Allegheny R.: Fowler (1919) Kiskiminetas R.: Fowler (1919) Ohio R., Pa.: Fowler (1919) Ohio R., Oh.: Trautman (1957)
CLUPEIDAE		
Alosa chrysochloris	Ex	Kiskiminetas R.: Fowler (1919)[1] Ohio R., Pa.: Rafinesque (1820) Ohio R., Oh.: Trautman (1957)
HIODONTIDAE		
Hiodon tergisus	Uv	Youghiogheny R. (Uv): Hubbs and Lagler (1958)
	Ex	Ohio R., Pa.: Lesueur (1818, type locality) Monongahela R.: Jenkins *et al.* (1972)
SALMONIDAE		
Oncorhynchus nerka	Uv, Nx	Youghiogheny R. (Uv): Jenkins *et al.* (1972

TABLE 2.—(cont'd.)

Species	Status	Authority
CYPRINIDAE		
Exoglossum laurae	Ex	Allegheny R.: Raney (1938) Tygart Valley R., W. Va.: CU 32639
Hybognathus nuchalis	Ex	Kiskiminetas R.: Cope (1881) Ohio R. basin, Oh.: Trautman (1957)
Hybopsis amblops	Ex	Allegheny R.: Raney (1938) Beaver R.: Raney (1938), Trautman (1957) Monongahela R.: CU 32644: USNM 56702, 177896 Ohio R.: Trautman (1957)
H. storeriana	Uv	Youghiogheny R. (Uv): Jenkins *et al.* (1972)
	Ex	Monongahela R.: Evermann and Bollman Ohio R., Oh.: Trautman (1957)
Notropis ariommus	Uv	Youghiogheny R. (Uv): Jenkins *et al.* (1972)
	Ex	Cheat R., W.Va.: CU 25795, USNM 190563
N. blennius	Uv	Youghiogheny R. (Uv): Jenkins *et al.* (1972)
	Ex	Monongahela R.: Evermann and Bollman (1886) Ohio R., Oh.: Trautman (1957)
N. buchanani	Ex	Monongahela R., W.Va.: AEL 737, 738 Monongahela R., Pa.: PSU 1164
N. cornutus	Ex	Ohio R., Oh.: Trautman (1957) Allegheny R.: Gilbert (1980b)
N. dorsalis	Ex	Allegheny R.: Fowler (1909); Raney (1938) Tygart Valley R., W.Va.: UMMZ 108279
N. hudsonius	Uv	Youghiogheny R. (Uv): Jenkins *et al.* (1972)
	Ex	Allegheny R.: Fowler (1919) Monongahela R.: Evermann and Bollman (1886)
N. umbratilis	Ex	Allegheny R.: Raney (1938) Beaver R.: Raney (1938) Ohio R., Oh.: Trautman (1957) Tygart Valley R., W.Va.: UMMZ 108278
Phenacobius mirabilis	Uv	Youghiogheny Reservoir (Uv): Johnson (1952; cited in Mansueti, 1962)
Phoxinus erythrogaster	Ex	Allegheny R.: Raney (1938) Beaver R.: Raney (1938), Trautman (1957) Ohio R., Oh.: Trautman (1957)
Pimephales vigilax	Uv	Youghiogheny R. (Uv): Jenkins *et al.* (1972)
	Ex	Monongahela R.: Evermann and Bollman (1886) Ohio R., Oh.: Trautman (1957)
Semotilus corporalis	Uv, Nx	Youghiogheny R.: Mansueti (1962), Davis (1973)

River was a tributary to the more northern Laurentian River which drained into the Atlantic Ocean (Spencer, 1907; Flint, 1947). Other tributaries to Pittsburgh River

TABLE 2.—(cont'd.)

Species	Status	Authority
CATOSTOMIDAE		
Carpiodes carpio	Uv	Youghiogheny R.: Pennsylvania Fish Commission (1973, unpublished)
	Ex	Beaver R.: Fowler (1913) Ohio R., Oh.: Trautman (1957)
Cycleptus elongatus	Ex	Kiskiminetas R.: Fowler (1907) Ohio R., Pa.: Rafinesque (1820) Ohio R., Oh.: Trautman (1957)
Ictiobus bubalus	Ex	Ohio R., Pa.: Rafinesque (1820) Ohio R., Oh.: Trautman (1957); UL 9777, 9978, 10153
Minytrema melanops	Uv	Youghiogheny R.: Schwartz (1964), Jenkins *et al.* (1972)
	Ex	Beaver R.: Raney (1938) Ohio R., Oh.: Trautman (1957)
Moxostoma valenciennesi	Uv, Nx	Youghiogheny R.: Mansueti (1962)
ICTALURIDAE		
Ictalurus furcatus	Uv	Youghiogheny R.: Jenkins *et al.* 1972)
	Ex	Monongahela R.: Evermann and Bollman (1886) Ohio R., Oh.: Trautman (1957)
I. melas	Uv	Youghiogheny R. (Uv): Jenkins *et al.* (1972)
	Ex	Allegheny R.: Raney (1938) Beaver R.: Raney (1938) Ohio R., Oh.: Trautman (1957)
Noturus eleuthurus	Ex	Allegheny R.: Raney (1938) Beaver R.: Raney (1938) Ohio R., Oh.: Trautman (1957)
N. gyrinus	Uv, Nx	Youghiogheny R. (Uv): Davis (1973)
N. miurus	Uv	Youghiogheny R. (Uv): Jenkins *et al.* (1972)
	Ex	Allegheny R.: McConnell (1906), Raney (1938) Monongahela R.: Taylor (1969) Ohio R., Oh.: Trautman (1957)
PERCOPSIDAE		
Percopsis omiscomaycus	Ex	Allegheny R.: McConnell (1906), Raney (1938) Monongahela R.: Evermann and Bollman (1886) Ohio R., Oh.: Trautman (1957)
CENTRARCHIDAE		
Lepomis gulosus	Ex	Beaver R.: Raney (1938), Trautman (1957) Ohio R., Oh.: Trautman (1957)
L. megalotis	Uv	Youghiogheny R. (Uv): Jenkins *et al.* (1972)
	Ex	Beaver R.: Raney (1938) Kiskiminetas R.: Fowler (1907) Ohio R., Oh.: Trautman (1957)

TABLE 2.—(cont'd.)

Species	Status	Authority
Micropterus punctulatus	Uv	Youghiogheny R. (Uv): Jenkins *et al.* (1972)
	Ex	Ohio R., Oh.; Trautman (1957) Tygart Valley R., W.Va.: AEL 523
PERCIDAE		
Ammocrypta pellucida	Uv	Youghiogheny R. (Uv): Cope (1869), Jordan and Copeland (1877)
	Ex	Allegheny R.: Raney (1938) Monongahela R.: Evermann and Bollman (1886) Ohio R., Oh.: Trautman (1957)
Etheostoma camurum	Uv	Youghiogheny R. (Uv): Jenkins *et al.* (1972)
	Ex	Allegheny R.: Raney (1938) Beaver R.: Raney (1938) Monongahela R.: AEL 73, 504, 537, 572, 574, 599 Ohio R., Oh.; Trautman (1957)
E. maculatum	Ex	Allegheny R.: Raney (1938) Beaver R.: Kirtland (1841, type locality), Raney (1938) Ohio R, Oh.: Trautman (1957)
E. tippocanoe	Ex	Allegheny R.: Raney (1938) Little Kanawha R.: UNC 6732, 6756 Ohio R., Oh.: Trautman (1957)
E. variatum	Uv	Youghiogheny R. (Uv): Jenkins *et al.* (1972)
	Ex	Allegheny R.: Jordan (1877, type locality), McConnell (1906), Raney (1938) Beaver R.: Raney (1938) Monongahela R.: Evermann and Bollman (1886) Ohio R., Oh.: Trautman (1957)
E. zonale	Uv	Youghiogheny R. (Uv): Jenkins *et al.* (1972)
	Ex	Allegheny R.: Raney (1938) Beaver R.: Raney (1938) Monongahela R.: Evermann and Bollman (1886) Ohio R., Oh.: Trautman (1957)
Percina evides	Ex	Allegheny R.: Raney (1938) Ohio R., Oh.: Trautman (1957)
P. maculata	Uv	Youghiogheny R. (Uv): Jenkins *et al.* (1972), Hendricks *et al.* (1979)
	Ex	Allegheny R.: Raney (1938) Beaver R.: Raney (1938) Kiskiminetas R.: Fowler (1919) Monongahela R.: AEL 495, 510, 514, 515, 518 Ohio R.: Raney (1938)
P. oxyrhyncha	Ex	Monongahela R.: Evermann and Bollman (1886)[2]; AEL 60, 65, 72, 81, 82, 557

were Old Middle Allegheny and Old Upper Allegheny rivers, both of which flowed NW to join Pittsburgh River NE of its confluence with Old Lower Allegheny River (Leverett, 1902; Tight, 1903).

The Pliocene Teays River (Fig. 2) headed in the highlands of North Carolina and Virginia and flowed NW along the present course of the New and Kanawha rivers, then N to central Ohio and W across Indiana and Illinois to its confluence with the Mississippi River (Lachner and Jenkins, 1971; Hocutt *et al.,* 1978). The many tributaries of the Teays include the ancestral Big Sandy, Guyandotte, Greenbrier and Gauley rivers. Other tributaries whose drainage patterns were highly modified during the Pleistocene include Marietta, Newark, Old Licking and Old Kentucky rivers.

The Pleistocene was an era of major drainage reorganization in eastern North America. Glacial advances cut off the route of Old Lower Allegheny, Teays, Old Licking and Old Kentucky rivers (Hocutt *et al.,* 1978), forming glacial lakes. In Old Lower Allegheny, this ponding formed "Lake Monongahela" (White, 1896) during the first glacial advance into the region (Tight, 1903). These glacial lakes overflowed through low divides forming the present-day Ohio River drainage. Of primary interest in this paper is the origin of the Youghiogheny fauna and the role of the Youghiogheny in the dispersal of fishes E to the Atlantic slope.

Pleistocene drainage reorganizations had a profound effect on the distribution of the freshwater fishes of the central Appalachian region (Bailey and Allum, 1962; Gerking, 1945; Gibbs, 1957; Hocutt, 1979; Hocutt *et al.,* 1978; Hubbs and Lagler, 1958; Jenkins *et al.,* 1972; Lachner and Jenkins, 1971; Miller, 1968; Ross, 1952, 1958; Underhill, 1957; Wallace, 1973). Three possibilities exist with regard to the origin of the Monongahela/Youghiogheny fauna: the fauna was present in the Old Lower Allegheny River prior to the Pleistocene; the fauna was derived from the Atlantic slope via stream capture with the Potomac River, or the fauna was derived from the greater Mississippi River Basin via the Teays or later Ohio River during or after the Pleistocene. The last possibility is the most plausible based upon the similarity of the Monongahela/Youghiogheny fauna to that of the remainder of the Ohio basin (Stauffer *et al.,* 1982). Conversely, the ichthyofaunas of the Monongahela/Youghiogheny and Potomac drainages show distinct dissimilarities (Stauffer *et al.,* 1982). Little evidence supports the first hypothesis, and indeed the pre-Pleistocene composition of the fauna of the Old Lower Allegheny River is problematic. No relicts or endemics of that fauna are known to exist. It seems likely that primitive species that might have occurred in the Old Lower Allegheny prior to the Pleistocene have been replaced.

Dispersal up the newly formed Ohio River was not the only route of access to the Allegheny River. During periods of glaciation, more northern species dispersed along the glacial front via proglacial lakes, then southward via stream capture. Species thought to have used this route from the Lake Erie drainage to the Allegheny include: *Umbra limi, Esox lucius, Campostoma anomalum pullum, Clinostomus elongatus, Notropis*

TABLE 2.—(cont'd.)

Species	Status	Source
P. phoxocephala	Uv, Nx	Youghiogheny R.: Jenkins *et al.* (1972)
Stizostedion canadense	Uv	Youghiogheny R. (Uv): Fowler (1907, 1919)
	Ex	Allegheny R.: Fowler (1919) Beaver R.: Fowler (1919) Kiskiminetas R.: Fowler (1919) Ohio R., Oh.: Trautman (1957)

[1]According to Fowler (1919), "herring" reported from the Kiskiminetas River probably refer to *Alosa chrysochloris*

[2]According to Thompson (1977), *Percina phoxocephala* collected by Evermann and Bollman (1886) were actually *P. oxyrhyncha*

heterodon, N. hudsonius, Catostomus catostomus and *Culaea inconstans* (Jenkins *et al.,* 1972). Based on their present distributions *Esox a. vermiculatus* (Crossman, 1980), *Notropis d. dorsalis* (Gilbert and Burgess, 1980), *Nocomis biguttatus* (Gilbert, 1980a), *Notropis heterolepis* (Gilbert, 1980c), *Notropis umbratilis cyanocephalus* (Snelson, 1980) and *Phoxinus erythrogaster* (Starnes and Starnes, 1980) could have gained access to the Allegheny via either Lake Erie or Ohio River. Detailed systematic studies may clarify this situation. Two of the above forms, *Clinostomus elongatus* and *Catostomus catostomus,* survived as relict populations in the high altitude streams of Monongahela and Youghiogheny rivers (Hendricks *et al.,* 1979). *Notropis dorsalis* and *N. umbratilis* are known from the Monongahela River, based upon a single collection in 1932 (UMMZ 108278-9). The others are absent from the Monongahela and Youghiogheny rivers due to extirpation, lack of suitable habitat, barriers to dispersal or insufficient time for dispersal.

The presence of several species (*Clinostomus funduloides, Exoglossum laurae* and *Percina oxyrhyncha*) in the headwaters of the Monongahela may be the result of stream capture with Greenbrier River (Jenkins *et al.,* 1972; Hocutt *et al.,* 1978). Hocutt (1979) considered the presence of *E. laurae* in the Monongahela a result of glacial outlets from Old Lower Allegheny to Middle Island Creek and Little Kanawha River (Teays). Considering the route of dispersal of these species into the Monongahela, it is not surprising that they are absent from the Youghiogheny. Other species apparently absent from the Youghiogheny include the following native Monongahela River forms: *Lepisosteus osseus, Hiodon tergisus, Notropis ariommus, N. blennius, N. hudsonius, Pimephales vigilax, Ictalurus furcatus, I. melas, Noturus miurus, Percopsis omiscomaycus, Lepomis megalotis, Micropterus punctulatus, Etheostoma camurum, E. variatum, E. zonale* and *Percina maculata* (Stauffer *et al.,* 1978a; Jenkins *et al.,* 1972). Most of these species are assumed to have dispersed up the newly formed Ohio River from the Teays and must surely have had access to the Youghiogheny. Their absence probably relates to recent extirpation. Many species probably occurred in the Youghiogheny River prior to the onset of acid

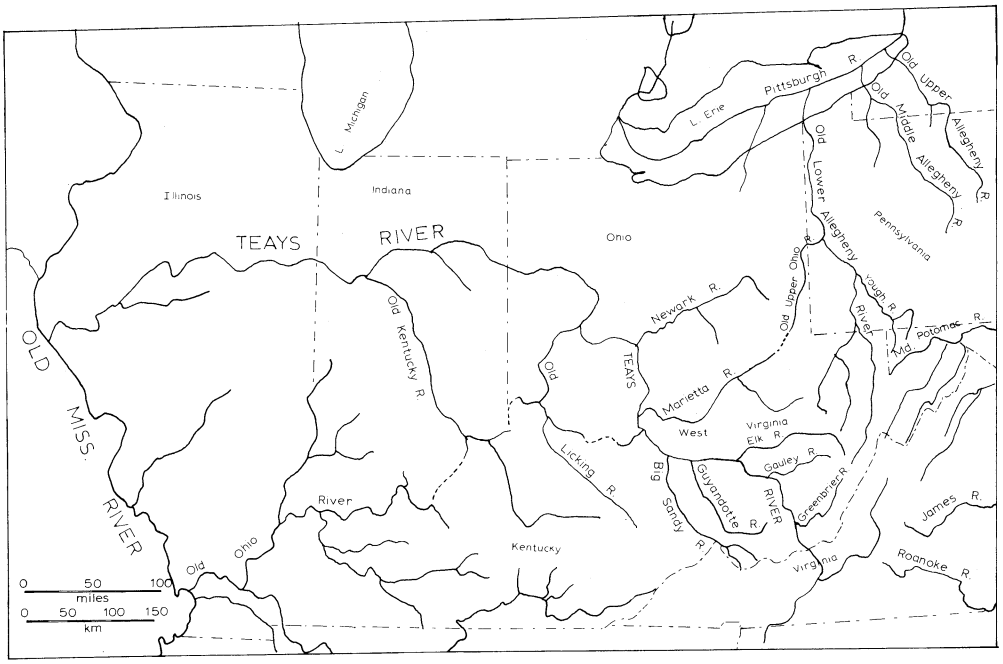

Fig. 2.—Hypothetical prepleistocene drainage patterns in the Ohio Valley (modified from Hocutt *et al.,* 1978, and Hocutt, 1979)

mine drainage but went undetected due to insufficient collecting. Evidence that widespread extirpation occurred in the Youghiogheny is the absence of the following native Youghiogheny species from this survey: *Hiodon alosoides, Hybopsis dissimilis, Carpiodes velifer, Moxostoma anisurum, M. carinatum, M. macrolepidotum breviceps, Pylodictus olivaris, Labidesthes sicculus* and *Percina macrocephala.*

The dispersal of a Mississippi drainage ichthyofauna to the Atlantic slope was recently discussed by Hocutt *et al.* (1978) and Hocutt (1979). The major route for dispersal E from Teays River (Fig. 2) was through stream capture by Roanoke and James rivers (Ross, 1969; Jenkins *et al.,* 1972). Gauley River may also have played an important part in this eastward dispersal (Hocutt, 1979). Dispersal between Atlantic slope drainages occurred during interglacial periods via interconnecting lowland rivers or by lateral stream capture between adjacent drainages. Jenkins *et al.* (1972) listed known theaters of capture and discussed the distribution and dispersal of central Appalachian fishes with regard to the above considerations.

From the distribution of certain fish species on the Atlantic slope, it is apparent that the New-Roanoke-James theater of capture was not the only route of dispersal to the E (Hocutt, 1979). Other routes included Monongahela-Potomac (Ross, 1952; Gibbs, 1957; Hubbs and Lagler, 1958; Miller, 1968; Lachner and Jenkins, 1971; Jenkins *et al.,* 1972; Wallace, 1973), Allegheny-Susquehanna (Lachner and Jenkins, 1971; Denoncourt *et al.,* 1977), and Genesee-Susquehanna (Ross, 1958; Miller, 1968).

Dispersal of fishes from Youghiogheny River to the Atlantic slope has occurred via two recognized theaters of stream capture. Savage River, tributary to North Branch of the Potomac River near Westernport, Md., has captured approximately 207 km² of upper Casselman River (Abbe, 1902; Willis, 1907; Thompson, 1949) (Fig. 3). Species thought to have used this route to Potomac River include *Campostoma anomalum anomalum* (Ross, 1952), *Nocomis micropogon* (Lachner and Jenkins, 1971), *Notropis spilopterus* (Gibbs, 1957), *Etheostoma b. blennioides* (Miller, 1968) and *Ericymba buccata.* The last species was considered to be absent from the Youghiogheny prior to 1977. Wallace (1973) attributed its absence to severe pollution. This survey found it established throughout the drainage, supporting Wallace's (1973) view of it as a native

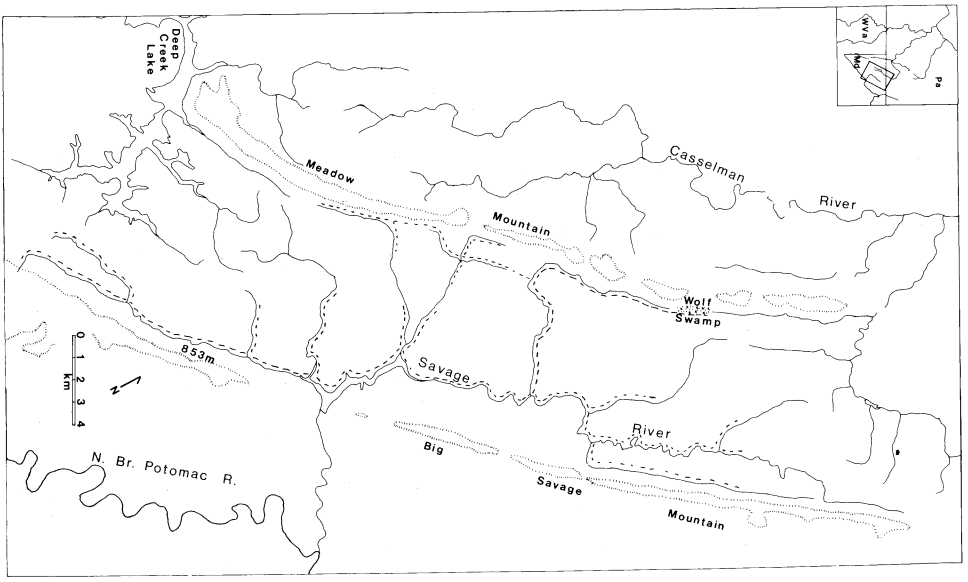

Fig. 3.—Present day (solid line) and hypothetical precapture (dotted line) Savage and Casselman rivers

species that dispersed into the Potomac via the Youghiogheny and which subsequently maintained itself in refugia during periods of excessive acid drainage. The presence of *Etheostoma caeruleum* (Stauffer *et al.,* 1978a; 1978b) in the Potomac may be explained by the Monongahela-Potomac captures discussed by Schwartz (1965). *Semotilus m. margarita* may have used a Monongahela or Youghiogheny route to the Potomac and thence to the Susquehanna, or it may have entered the Susquehanna via a glacial outlet and then dispersed to the Potomac (Jenkins *et al.,* 1972) and then to the Monongahela (Hocutt, 1979).

Stream capture generally results in transfer of fauna from the captured stream to the captor, but the reverse can also occur (Jenkins *et al.,* 1972; Hocutt, 1979). Hubbs and Lagler (1958) found the Youghiogheny to be the only Ohio drainage stream inhabited by the eastern subspecies of the blacknose dace, *Rhinichthys a. atratulus.* Both *R. a. atratulus* and *R. a. meleagris* (western subspecies) were found in the Youghiogheny during the present study. The presence of *R. a. atratulus* in the Youghiogheny is probably the result of a crossover from the Potomac. *Semotilus corporalis,* if Manseuti's (1962) record is reliable, may have crossed the divide into the Youghiogheny in the same way, or more probably, by bait bucket introduction.

A second area of capture between Youghiogheny and Potomac rivers was noted by Thompson (1949). Wills Creek, tributary to North Branch Potomac River at Cumberland, Md., has captured approximately 37 km^2 of drainage from Blue Lick Creek of Casselman River (Fig. 4). This capture has gone unnoticed by zoogeographers perhaps because of its smaller area. Recent evidence (Hendricks *et al.,* 1979) suggests that it may have provided a route for the eastern dispersal of *Etheostoma b. blennioides.*

Schwartz (1965) eliminated the Youghiogheny-Savage river capture as a route for dispersal of *Etheostoma b. blennioides* to the Potomac in favor of a capture between the Monongahela and Potomac. Evidence for this view was the apparent absence of *E. blennioides* from both Savage and Youghiogheny rivers. This view was questioned by Stauffer *et al.* (1978a) and Hocutt (1979). This survey found *E. blennioides* widely distributed throughout the Youghiogheny drainage. Its widespread occurrence on either side of intradrainage barriers such as Youghiogheny Reservoir, Ohiopyle Falls and severely polluted sections of Sewickly Creek and Casselman River, are evidence that it is native to the drainage and not a result of bait bucket introduction. Recent collections in Wills Creek (AEL 387, 388, 414, 415, 418, 428-431) also yielded *E. blennioides.* The presence of *E. blennioides* in both Casselman River and Wills Creek suggests that it may have used the Casselman-Wills Creek capture route to the Potomac.

The Casselman-Savage and Casselman-Wills Creek captures were not the only stream captures by which the Potomac River encroached westward into the Mississippi drainage. Willis (1907) and Thompson (1939) recognized that the drainage divide once existed in the vicinity of the Blue Ridge 130-160 km E of the present divide. By a series of successive piracies and local superposition (Thompson, 1939; 1949), the divide moved steadily westward. This process probably started late in the Jurassic (Willis, 1907; Judson, 1975). Stauffer *et al.* (1978b) theorized that Potomac River had occupied the area W of the Blue Ridge for a long period of time prior to the breaching of Knobly Mountain at Cumberland, Md. Additional divides (Dan's Mountain and Savage Mountain) had to be crossed before the present North Branch Potomac drainage was acquired. These events are not dated. The topography of the drainage area W of Knobly Mountain indicates that it was once part of the greater Monongahela (Old Lower Allegheny River). North Branch of the Potomac River clearly drains the Appalachian Plateau W of Dan's Mountain in an area of high altitude but low relief. It is opposed along a low divide by Blackwater River of the Monongahela drainage. The importance of these early captures in dispersal of fishes is dependent upon their timing with regard to the acquisition of the greater Monongahela fauna. Until these early captures can be dated, their influence on dispersal cannot be assessed.

In addition to the Youghiogheny-Potomac theater of stream piracy, there is evidence that the Youghiogheny captured part of Allegheny River drainage via a Laurel Hill Creek-Quemahoning Creek route. These streams oppose each other along a low divide NW of Somerset, Pa. Laurel Hill Creek heads up near Lavansville, Pa., flows several miles in a northeasterly direction, and then reverses direction and flows SW to its confluence with Casselman River at Confluence, Pa. (Fig. 5). It is suggested that the northeasterly flowing section was once the headwaters of Quemahoning Creek. Several Quemahoning tributaries head up within 0.5 km of opposing Laurel Hill Creek tributaries and are separated by wind gaps less than 13 m higher than the stream beds. This stream capture may help to explain the presence of a small localized population of *Clinostomus elongatus* in the headwaters of Laurel Hill Creek. *Clinostomus elongatus* may have been recently extirpated from most of the Kiskiminetas drainage (of which the Quemahoning is a part) due to severe pollution. It was once, however, rather widely distributed there (Raney, 1938).

Close examination of the distribution of fishes within the Youghiogheny drainage reveals that Ohiopyle Falls and dams at Connellsville and Confluence, Pa., may be barriers to dispersal of fishes up the main channel. Thirteen species: *Lampetra aepyptera, Dorosoma cepedianum, Carassius auratus, Notropis atherinoides, N. stramineus, N. volucellus, Carpiodes cyprinus, Moxostoma duquesnei, M. erythrurum, Ictalurus catus, I. punctatus, Etheostoma caeruleum* and *Percina caprodes,* were collected below the barriers, but not above. At the present time, dams and the 4-m-high Ohiopyle Falls appear to be effective barriers to upstream dispersal and possibly downstream as well. The presence

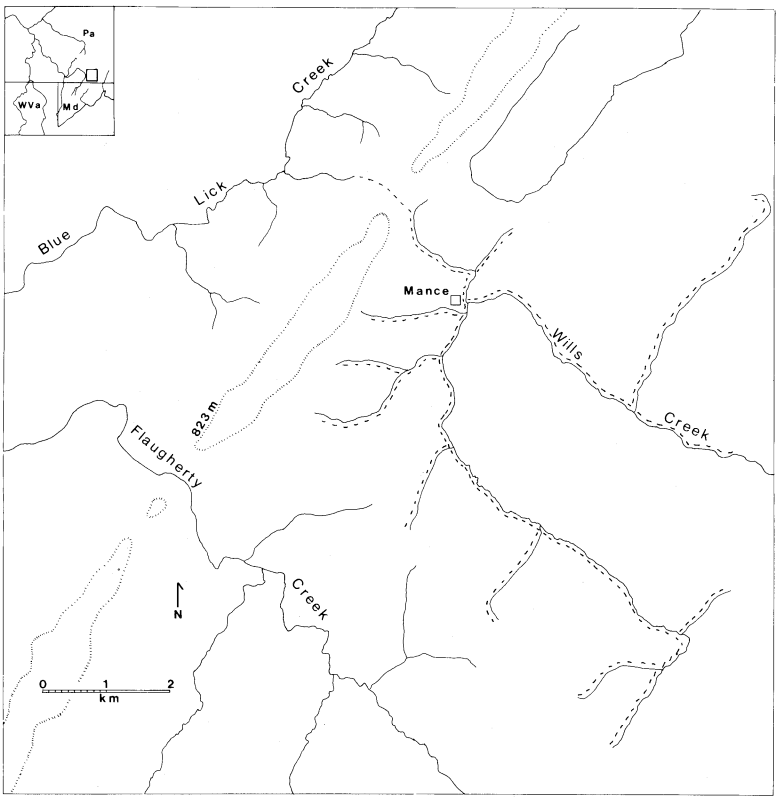

Fig. 4.—Present day (solid line) and hypothetical precapture (dotted line) Wills and Blue Lick creeks

above Ohiopyle Falls of several species (*e.g., Notropis photogenis, C. catostomus* and *Etheostoma nigrum*) indicates that the falls was not always a barrier. Additionally, those species hypothesized to have utilized the Youghiogheny-Potomac theater of stream capture as a route to the Atlantic slope must also have negotiated (or passed prior to establishment of) the falls. The absence of the above species in the upper portion of the Youghiogheny relates to lack of suitable habitat, recent extirpation or their acquisition after the falls became a barrier. These forms are characteristic of big river habitat and may not have been able to survive in unpolluted tributaries.

Acknowledgments.—We wish to acknowledge the following students who assisted in the field collections: Theresa Y. Barila, Daniel A. Cincotta, John E. Cooper, Kenneth D. Dull, William L. Goodfellow, Lenwood W. Hall, John G. Hockman, Daniel R. Lispi, Edward L. Melisky, Stephen A. Pistolas, Reinald E. Smith, W. Bruce Taliaferro and David K. Vann. Special thanks go to Steven L. Markham, who assisted in all the field collections.

We also acknowledge Dr. Edward L. Cooper, Pennsylvania State University, Dr. Frank J. Schwartz, University of North Carolina, and C. Blake Wierich, Pennsylvania Fish Commission, who made unpublished records available to us. Dr. Carter R. Gilbert, Florida State University, assisted in the identification of several specimens.

This research was financially supported by the Maryland Bureau of Mines.

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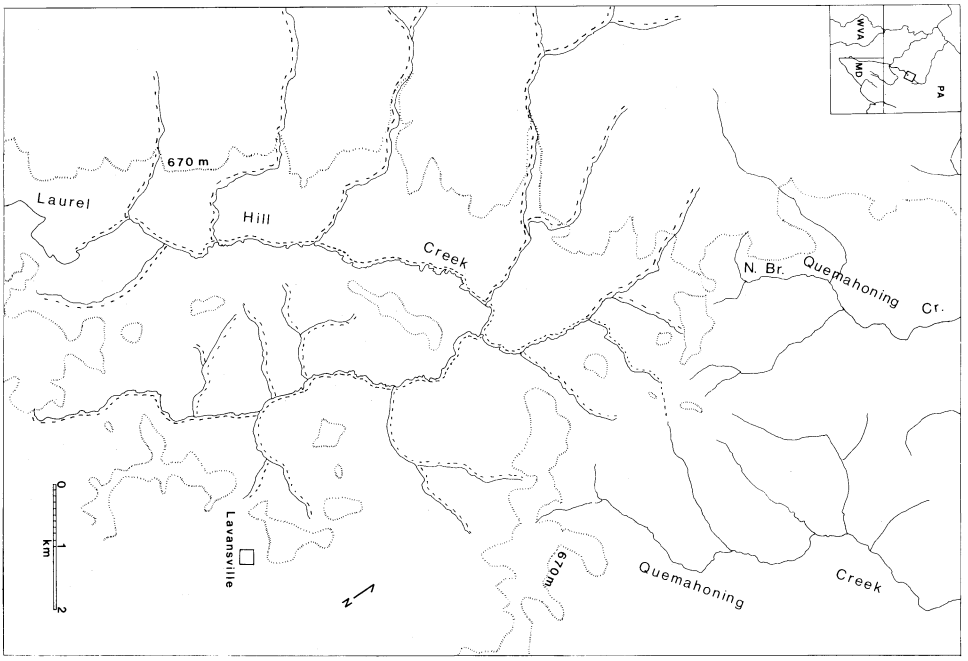

Fig. 5.—Present day (solid line) and hypothetical precapture (dotted line) Quemahoning and Laurel Hill creeks

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SUBMITTED 7 APRIL 1982 ACCEPTED 3 NOVEMBER 1982