ORBES

PENNSYLVANIA BASELINE

Part 2 - Impact Assessment Data Base

Chapter 1 - Characteristics and Human Utilization of Natural Ecosystems

Section 7 - Aquatic Ecology

PHASE II

OHIO RIVER BASIN ENERGY STUDY

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PENNSYLVANIA BASELINE

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Chapter 1 - Characteristics and Human Utilization of Natural Ecosystems

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2.1.7. AQUATIC ECOLOGY

2.1.7.1. GENERAL OVERVIEW

A. Historical Background

Any retrospective characterization of the aquatic ecology of the Pennsylvania ORBES region to colonial times must rely heavily upon scattered historical documents that make reference to fish fauna. A review of such documents has led Lachner (1) to conclude that "...the fish heritage in the Upper Ohio Basin was extremely rich. Dense schools of fish existed in these waters. Early explorers and pioneers traversing the Alleghenies found the streams teeming with life and these provided them with a ready source of excellent food." The seventeen species listed by Lachner (Table 2.1.7.-1), although not all suitable as table fare, were reported as occurring in the Upper Ohio Basin prior to 1900. Many of these species probably never were exceedingly numerous in the basin. Others were reported as being common to abundant in colonial times. About one-third of these seventeen species still inhabit that portion of the basin in Pennsylvania. Nonetheless, Lachner notes of this list that "...the general data warrant the thesis that there has been a great reduction in numbers and the extirpation of many forms." Indeed, many of the species currently categorized by the Pennsylvania Fish Commission as "endangered," "threatened," or "status indeterminate" (see Table 2.T.7.-2) were once inhabitants of the Ohio River Basin. Habitat preferences for most basin fishes are outlined in Appendix A.

B. Past Impacts

Relatively little eighteen and nineteenth century information exists that would help characterize the plankton, periphyton, and macrobenthos of western Pennsylvania waterways. It has been reported (4, 5) that several mussel beds containing various species occurred in the Allegheny, Monongahela, and Ohio Rivers in 1805. However, such interesting tidbits of historical information are too scarce to provide a complete description of past conditions. A more broadly based historical characterization can be arrived at by considering the probable ecological impacts of channelization, the first major man-induced alteration of the river system. Prior to the construction of locks and dams, the "Three Rivers" consisted of alternating reaches of sluggish, deep pools and extremely shallow riffles (see Section 2.1.5.-Surface Hydrology). It can be hypothesized that the aquatic biota of that time was essentially composed of species typical of free-flowing, temperate zone rivers. Conversely, due to the present navigation system, the Ohio, Monongahela, and lower Allegheny Rivers ecologically behave much as a series of narrow connected impoundments. The navigable rivers are currently inhabited by lentic (lake-like) biota; moreover, they are essentially devoid of forms adapted exclusively to riffles. The following trends are at least partially due to the consequences of lock and dam construction, dredging, and snag-cleaning:

a.) Increased plankton biomass
b.) Increased zooplankton diversity
c.) Decreased aquatic macrophyte abundance
d.) Decreased benthos diversity
e.) Decreased fish diversity

Diversity decreased in benthos and fish are largely due to the fact that the aforementioned activities create rather uniform physical conditions throughout the rivers, thereby eliminating habitats such as riffles and shoals.

The many categories of water pollutants in the Pennsylvania ORBES region have further reduced the species diversity of aquatic organisms inhabiting the major rivers. Many pollution sensitive, lentic species which could conceivably exist with the constraints of the navigation system are nonetheless absent from the degraded reaches of the navigable rivers. Many free-flowing polluted tributary streams are likewise inhabited exclusively by pollution-tolerant organisms. The original aquatic biota of the basin were adapted to clear streams with gravel or sand substrates (1). However, in the late 1800's and early 1900's intensive lumbering resulted in dramatically increased erosion rates with an accompanying siltation of many streams (see Section 2.1.4.-Terrestrial Ecology). During the twentieth century acid mine drainage has been the big problem, rendering receiving waters acidic and blanketing their benthic communities with iron hydroxide precipitate (see Section 2.1.6.-Water Quality). Oxygen-demanding domestic wastewaters, toxic industrial wastewaters, and thermal effluents from power plants have also contributed to past impacts on the aquatic life of the Pennsylvania ORBES region.

Various miscellaneous factors have also altered the ecology of western Pennsylvania waterways. An often overlooked factor is the introduction of non-indigenous fish species. Thousands of hatchery reared rainbow trout (Salmo gairdneri) (a species native to the Pacific Coast), and brown trout (Salmo trutta) (a species native to Europe) are released in the Pennsylvania ORBES region every year. Competition and predation by such stocked trout doubtlessly alters the ecology of many small, cold water tributaries of the major rivers. Such streams are often stocked in numbers which are orders of magnitude beyond their natural carrying capacity. Moreover, preordained times and locations for trout stocking are published events in area newspapers, thereby producing a large crowd of fishermen which often cause additional adverse impacts (6). Carp (Cyprinus carpio), goldfish (Carassius auratus), eastern banded killifish (Fundulus d. diaphanus) and mummichog (F. heteroclitus macrolepidotus) were all introduced into the basin in the past. Carp are especially significant in that they are often the dominant fish species in polluted reaches of western Pennsylvania waterways, out-competing native benthophages.

C. Present Status

Biologists currently responsible for assessing the water quality of western Pennsylvania's rivers are acutely aware of the paucity of detailed information regarding the composition, diversity, and productivity of aquatic communities in the Upper Ohio River System. Furthermore, short-term studies which are undertaken often produce raw data that defies extensive interpretation due to the poor quality of the historical data base. Nonetheless, one trend seems obvious---the major rivers of the Pennsylvania ORBES region are currently undergoing a biotic recovery from the pollutional insults incurred during the past century. Only a few technical reports (7, 8, 9), mention or allude to this recovery. (More extensive documentation of this phenomenon can be witnessed in the bait shops and taverns of southwestern Pennsylvania, where the conversation often concerns catches of warm water game fishes from river reaches that were formerly devoid of fish or inhabited chiefly by pollution-tolerant rough species.) Indeed, as far as the general public is concerned, fish species composition and abundance are perhaps the most frequently used criteria for gauging the water quality of a river (10). The Youghiogheny, lower Allegheny, and upper Monongahela Rivers are good examples of recovery areas.

The reasons for the return of desirable aquatic life forms to the region are manifold. Past mine drainage abatement projects of the Pennsylvania Department of Environmental Resources have reclaimed a significant number of streams. The Federal Water Pollution Control Act Amendments (PL 92-500) have had profound ramifications in improving the quality of municipal and industrial effluents. Furthermore, several Corps of Engineers reservoirs are now operated with water quality considerations incorporated into their release schedules.

2.1.7.2. THE MONONGAHELA RIVER

A. Phytoplankton

Two water quality surveys of the Monongahela River were conducted by the U.S. Army Corps of Engineers (8) in the summer of 1975. The initial survey was performed in June during an intermediate flow regime (5,000-12,000 cfs*) at which time the phytoplankton concentrations of the various reaches were found to range between 64 and 1,439 cells/ml at a depth of one meter. The mean concentration at all of the sampling stations was calculated to be 515 cells/ml. A follow-up survey initiated in July during low flow conditions (650-1,800 cfs*) measured total phytoplankton concentrations ranging between 31 and 6,571 cells/ml along the length of the river with an average of 2,173 cells/ml for all stations (see Fig. 2.1.7.-1).

Microscopic examination of the samples collected during both 1975 water quality surveys disclosed the presence of 108 different phytoplankton taxa in the Monongahela River. This figure undoubtedly represents a somewhat conservative estimate of all Monongahela River algae species since several individuals were only keyed to the generic level and additional species probably went undetected because of their bionomy (e.g. deep water forms and species atypical of the summer community) or simply because of sampling error. The observed phytoplankton community was found to contain representative species from each of the five major taxonomic divisions; however, the euglenophytes and pyrrophytes were few in numbers of individuals and species. The green algae *Ankistrodesmus falcatus* and *Ankistrodesmus convolutus* and the blue-green alga *Schizothrix calcicola* were found to be numerically dominant

*extremes of mean daily flow along the entire length of the river.

in most reaches of the river. During the low flow survey diatom populations peaked at the headwaters and mouth of the Monongahela. The headwater peak was dominated by pennate forms such as Synedra acus and Nitzschia acicularis. The diatom peak observed at the river's mouth consisted largely of centric forms such as Melosira granulata and Cyclotella menenghiniana.

Other numerically important phytoplankters of the Monongahela River are Actinastrum hantzschii, Scenedesmus quadricauda, and Merismopedia glauca. A list of phytoplankton genera recently identified from the "Three Rivers" is provided in Table 2.1.7.-3.

Algological analyses performed during the low flow survey are deemed to be especially valuable since the "biological zones" of the Monongahela River tend to manifest themselves during the critical water quality situation attendant to such flows. Williams (11) has noted that algological field studies performed during low flow are more meaningful, since phytoplankton populations can develop without the devastating influence of high velocity. During the 1975 Corps of Engineers (8) low flow survey abrupt decreases in total phytoplankton concentration were noted between river miles 35 and 24 (see Fig. 2.1.7.-1), a reach in which the Monongahela River water is used and warmed by the Mitchell and Elrama fossil fueled power plants.

The chemical analyses performed concurrently with the phytoplankton studies of the July low flow survey revealed the presence of acid mine drainage in the reach between river mile 90 and 60. The chemistry of this reach at low flow is governed largely by acid contributions from the Cheat River (see Section 2.1.6.-Water Quality). The reach was characterized by low total phytoplankton concentrations (see Fig. 2.1.7.-1) with a community dominated by Ankistrodesmus (see Fig. 2.1.7.-2). Populations of acid sensitive blue-green algae were noticeably small in this reach.

B. Periphyton

Attached growths were collected by the U.S. EPA from a station 0.8 miles upstream of the Monongahela's mouth in the spring of 1970 (12). This reach of the river receives substantial industrial wastewater discharges from the steel industry and such effluents influence the water quality of the reach (see Section 2.1.7.6-Water Quality). The periphyton of this reach was found to consist primarily of pollution tolerant species of blue-green algae. Relative to other concurrently sampled stations in the Upper Ohio River Basin, the periphyton of the lower Monongahela River station appeared to have an average cellular density, a low generic diversity and a low biomass (see Figs. 2.1.7.-3, 4, and 5).

C. Zooplankton

Limited zooplankton sampling was conducted by the Army Corps of Engineers (13) at three Monongahela River stations in April of 1975. Nine different zooplankton taxa were identified, five of these were rotifers (see Table 2.1.7.-4). These grab samples probably represent a conservative estimate of total zooplankton species since copepod nauplii and calanoid copepodites were not even keyed to the generic level. Moreover, the cool water temperatures and high turbidities typical of April undoubtedly serve to limit rotifer populations, which are generally the principal component of river zooplankton (14, 15).

D. Aquatic Macrophytes

Clarkson and Moore (16) identified twelve species of aquatic macrophytes in the Tygart Valley River, West Fork River, and West Virginia portion of the Monongahela River during the summers of 1965 and 1966. Their statistical correlations of physico-chemical and biological data demonstrated that the distribution of aquatic macrophytes within the upper basin was regulated by substrate type, phosphate content of the substrate, and the degree of water-level fluctuation. Moreover, the environmental perturbations caused by acid mine drainage did not exhibit any statistically significant effect on the distribution of these plants.

A superficial survey of aquatic macrophytes along the entire length of the Monongahela River was conducted by the Corps of Engineers in the summer of 1975 (8). Eleven of Clarkson and Moore's original twelve species were observed; furthermore, eight additional species were detected at this time (see Table 2.1.7.-5). Burweed (Sparganium sp.), arrowhead (Sagittaria latifolia), great bulrush (Scirpus validus), soft rush (Juncus effusus), and spikerushes (Eleocharis sp.) were the most commonly observed species. Emergent macrophyte communities were found to be abundant on the exposed mud flats of the L/D 3 and L/D 7 Pools. Both of these pools are impounded by fixed crest dams which permit fluctuation of the pool elevations. In pools behind gated dams the water levels are better controlled; consequently, submersed and floating leaved macrophytes are more common than emergent forms which under such conditions are essentially restricted to the mouths of tributary streams. The 1975 survey disclosed that submersed macrophytes were most common in the Maxwell Pool, a relatively transparent pool impounded by a gated dam.

E. Macrobenthos

Relative to the other benthic communities of the Upper Ohio River System, the macrobenthos of the lower Monongahela River may be characterized by a low species diversity (see Fig. 2.1.7.-6). Several field studies (12, 17, 18, 19) performed between 1960 and 1970 inclusive have noted this situation and have described a community that is generally dominated by pollution-tolerant midges such as Cricotopus bicinctus gr., C. exilis gr., C. trifasciatus gr., C. junus, Polypedilum ophiodes and Chironomus riparius have also been reported as typical benthos of lower Monongahela River. Benthological samples collected in 1975 at three stations along the entire length of the Monongahela River were likewise numerically dominated by pollution-tolerant oligochaetes and chironomids (13). The samples revealed a downstream trend of decreasing species diversity and organism density (see Table 2.1.7.-6).

The substrate of the lower Monongahela consists of soft mud and sand with certain areas downstream of McKeesport blanketed by oily sludges originating from steel mills. This situation is not deemed to be conducive to the development of a diverse benthic fauna.

F. Fish

The Monongahela River was originally inhabited by a diverse assemblage of freshwater fishes, including many pollution-sensitive species. Fish sampling performed in 1886 by Evermann and Bollman (20) near Pennsylvania-West Virginia border detected some forty different species. However, water pollution derived from intensive coal mining during the first half of the twentieth century contributed heavily to the ruination of this fishery (1). Moreover, industrial wastewater effluents in the lower Monongahela have further intensified the trend toward a decreased biotic diversity. Many reaches of the river, therefore, became either devoid of fish life or populated exclusively by pollution-tolerant species.

The fish populations of the upper Monongahela River are still subjected to environmental stress from acid mine drainage. Since 1967, the EPA and its predecessor agencies have conducted five fish population surveys at the Maxwell Locks and Dams (river mile 61.2), using rotenone in the lock chambers. Interpretation of this data is tenuous due to the few collections made and the questionable representativeness of the sampling technique. Nonetheless, the data do suggest a biotic recovery in this reach of the river. In 1967 no fish were captured and in 1968 only one small bluegill sunfish (Lepomis macrochirus) was taken. In 1969 and 1970 the standing crop increased slightly. However, pollution-tolerant species such as brown bullhead (Ictalurus nebulosus) and sunfishes (Lepomis sp.) were dominant. The sampling program at Maxwell Lock and Dam in 1973 produced results that Preston (7) believes are indicative of such biotic recovery. Total number of fishes, their standing crop, and species diversity were all found to have increased substantially. More importantly, many of the fishes captured at this time were pollution-sensitive species such as largemouth bass (Micropterus salmoides), channel catfish (Ictalurus punctatus), and emerald shiners (Notropis atherinoides). Table 2.1.7.-7 presents the changes in abundance and diversity detected during each of the five surveys. Table 2.1.7.-8 lists the various fish species captured.

The favorable results of the 1973 Maxwell fish sampling, in addition to existing physico-chemical water quality data, prompted the Pennsylvania Fish Commission to implement a warm water fish stocking program in the upper portion of the Monongahela River. At the present time, a respectable warm water fishery exists between the Pennsylvania-West Virginia border and the town of Monongahela in Washington County, Pennsylvania (21).

Pollutional loads added to the lower Monongahela River consist of industrial wastewaters, domestic wastewaters, and urban runoff. Acid mine drainage does enter the river in this reach, but not with the same severity as in the upper reaches. Fish surveys comparable to those conducted at Maxwell Lock and Dam were also performed at Lock No. 2 in the lower Monongahela River (river mile 11.2). The results of the surveys (1967-1973) at this station, although exhibiting an increase in standing crop, demonstrated very little improvement in the quality of the fishery (see Table 2.1.7.-7). Collections were dominated by pollution-tolerant species such as carp and brown bullhead (see Table 2.1.7.-8).

G. Ecologically Important Basin Streams

The Tenmile Creek Basin, Dunkard Creek Basin, and the lower Youghiogheny River support significant populations of warm water game and pan fishes (21). Smallmouth bass (Micropterus dolomieu) constitute the main warm water angling attraction in these streams. The most important cold water fisheries are located in the Youghiogheny River Basin in Fayette County, Somerset County, and a small corner of Westmoreland County. Big Sandy Creek, Little Sandy Creek, White's Creek, Laurel Hill Creek, Indian Creek, Dunbar Creek and the Upper Youghiogheny main stem are among the most significant cold water streams (22).

2.1.7.3. THE ALLEGHENY RIVER

A. Phytoplankton

Algological surveys were performed by the Corps of Engineers (23) in the navigable reach* of the Allegheny River during an intermediate flow regime in August 1976, an intermediate flow regime in June 1977, and a high flow regime in July 1977. The average total phytoplankton concentration for the entire navigable reach was determined to be in excess of 6,500 cells/ml.

The Allegheny River phytoplankton community is considerably more diverse than that of the Monongahela River. A total of 217 algal taxa were identified in the navigable reach of the Allegheny during 1976 and 1977. The greatest algal diversity (118 taxa) for any single navigation pool was detected at the L/D 9 Pool. Centric diatoms and chlorophytes were found to dominate the Allegheny River phytoplankton community. The most common genera were Cyclotella, Melosira, Asterionella, Scenedesmus, Dictyosphaerium, and a small unidentified coccoid chlorophyte resembling Palmella.

The significant biological zonation noted by the Corps of Engineers (8) in the Monongahela River was not observed in the Allegheny River (23). However, a trend toward decreased chlorophytes in relation to centric diatoms was observed near the middle of the navigable reach. Moreover, acid-sensitive, blue-green algae were observed to paradoxically increase in a reach polluted by acid mine drainage derived from the Kiskiminetas River; it was hypothesized that this phenomenon may be a response to increased nutrient levels.

B. Periphyton

Studies conducted between 1975 and 1977 revealed that the lower Allegheny River periphyton community at New Kensington, Clinton, and Kittanning is comprised almost entirely of diatoms; however, a few chlorophytes (Oedogonium, Scenedesmus, and Pediastrum) were also noted as occurring at these locales (24). In contrast, a study conducted by EPA (12) in 1970 near the mouth of the Allegheny described the periphyton community as consisting primarily of blue-green algae with several chlorophytes and very few diatoms (see Figs. 2.1.7.-3, 4, and 5).

*lower 72 miles

C. Zooplankton

Zooplankton collected in September of 1975 near New Kensington, Clinton, and Kittanning consisted of eight taxa of Cladocera, three taxa of copepods, twelve taxa of rotifers, and two taxa of protozoans (24). The total zooplankton concentrations at these three stations ranged between 409 and 1,190 individuals/M^3. The most common cladocerons were Pleuroxus sp. and Bosmina longirostris. Most of the copepods detected were in the larval stage of development (nauplii). Kellicottia bostoniensis and Kellicottia sp. accounted for a high numerical percentage of the rotifers.

D. Aquatic Macrophytes

In 1977 twelve taxa of vascular aquatic plants were identified in the L/D 3 and L/D 6 Pools of the Allegheny River (25) (see Table 2.1.7.-9). Sagittaria-Eleocharis communities were found to be common in backwater areas with silt and soft mud bottoms. An especially extensive Sagittaria-Eleocharis community was noted in the L/D 3 Pool near Tarentum. Justicia was cited as the most common aquatic vascular in the lower Allegheny; it was typically found growing on lightly silted, gravel shoals and around islands. Justicia was noted as being abundant in areas where the river channel was braided, especially in the L/D 6 Pool near Ford City. Koryak (25) notes that Justicia is absent from the Monongahela River; he speculates that this situation is due to the fact that the Monongahela, unlike the Allegheny, "has a generally undiversified ditch-like channel and no islands."

E. Macrobenthos

The Federal Water Pollution Control Administration sampled the Allegheny River for benthic macroinvertebrates in 1966 and 1967 (18, 26). Samples collected upstream of the confluence of the main stem with the Kiskiminetas River generally contained numerous benthic organisms from many invertebrate taxa, a situation indicative of a relatively unpolluted waterway. Hydropsychid caddisflies were numerically dominant in many of the samples. In contrast, samples collected downstream of the confluence with the acid mine drainage-degraded Kiskiminetas River (see Section 2.1.6.-Water Quality) contained few organisms and were dominated by pollution-tolerant chironomids and oligochaetes. Samples collected near Pittsburgh in the spring of 1970 (12) likewise revealed a sparse, undiversified benthic community (see Fig. 2.1.7.-6).

Recent studies conducted by the Corps of Engineers (24) in 1975 and 1977 between river miles 18 and 51 revealed that chironomids are the most prevalent group of Allegheny River macrobenthos, with Procladius sp. being the most abundant individual. However, tubificid worms generally constituted the majority of the biomass. The mayflies Stenonema interpunctatum, S. nepotellum, and Hexagenia limbata were also often detected, as were the caddisflies Hydropsyche betteni, Neureclipsis sp., and Nyctiophylax sp.

F. Fish

Fish sampling conducted from 1975 to 1977 at six stations between river miles eighteen and fifty-one revealed the presence of thirty-two species of fish in the Allegheny River (24). Various species of game fish including largemouth bass, smallmouth bass, walleye, northern pike, and channel catfish were captured during this survey (see Table 2.1.7.-10). Over the past several years there has been a surge of angling interest along this reach. The authors are aware of significant catches of walleye and smallmouth bass from "fishing holes" near Kittanning (r.m. 45.5), Acmetonia (r.m. 14.5), and even as far downstream as Sharpsburg (r.m. 6.6).

G. Ecologically Important Basin Streams

The majority of ecologically important Allegheny River tributaries drain the northern-most Pennsylvania ORBES counties. Tionesta, Sugar, and East Hickory Creeks in Forest County, Dennison Run in Venango County, Mill Creek, Schoolhouse Run, and the North Fork in Jefferson County are just a few of the streams supporting populations of native brook trout. In the southern portion of the basin (Westmoreland County) Powdermill Run and Loyalhanna Creek are cold water streams of special importance. The ecology of Powdermill Run has been extensively studied by the staff and associates of the Carnegie Museum of Natural History; consequently, this stream represents a "natural laboratory" for which there already exists a large data base. Loyalhanna Creek is of particular importance because, as noted in Section 2.1.4.-Terrestrial Ecology, it contains one of the few remaining hellbender populations in southwestern Pennsylvania.

Valuable warm water fisheries of the Allegheny River Basin occur in French Creek, Buffalo Creek, and the Allegheny main stem. French Creek is biologically unique in that it harbors the most diverse assemblage of freshwater mussels in the Pennsylvania ORBES region.

2.1.7.4 THE UPPER OHIO RIVER (PA)

Ecological conditions in the first forty miles of the Ohio River will be dealt with briefly herein, since the "ORBES Preliminary Technology Assessment Report" (27) includes a biological overview of the entire river.

A. Phytoplankton

Field studies of the Upper Ohio River (28, 29) have described a phytoplankton community dominated by *Melosira*, *Scenedesmus*, *Ankistrodesmus*, *Chlamydomonas*, *Cyclotella*, and *Dictyosphaerium*. Surveys conducted by the Corps of Engineers (29) in the summer and fall of 1974 indicate that during intermediate flow regimes the total phytoplankton concentration ranges between two and four thousand cells per milliliter. During high flows the community may be reduced and/or diluted to a few hundred cells per milliliter or less. The available data indicate that phytoplankton concentrations tend to be greatest in the lower sections of navigation pools where velocities are low.

B. Periphyton

Attached growths collected by the EPA in the spring of 1970 (12) were dominated by blue-green algae which comprised 50-86% of the cell count at all but one of the sampling stations (see Fig. 2.1.7.-3). Diatoms were also significant community members, comprising 8-32% of the cell count at, likewise, all but one station. The station deviating from the normal blue-green algae/diatom phycoperiphyton assemblage is located immediately downstream of the Allegheny County Sanitary Authority's (ALCOSAN's) wastewater effluent. At this station green algae comprised fifty percent of the cell count, a chlorophyte density greater than those observed at all other stations. More importantly, the conspicuous presence of protozoans* downstream of ALCOSAN (13% of the cell count) suggests that this waste source induces observable changes in the composition of the periphyton community. Increases in cellular density and chlorophyll content further downstream of ALCOSAN (see Figs. 2.1.7.-3 and 2.1.7.-5) were attributed to nutrient enrichment from this point source. Approximately fifteen miles downstream of the outfall these effects begin to reverse themselves. It should be noted however, that these observations are somewhat dated and that ALCOSAN's conversion to secondary treatment in 1974 may have eliminated or lessened spatial differences in the composition of attached communities.

C. Zooplankton

The Beaver Valley Power Station's pre-operational environmental impact studies characterized the zooplankton community of the Upper Ohio River (river miles 31-40) as being dominated by rotifers. Although cladocerans and copepods were frequently detected, rotifers always comprised at least 33% (by numbers) of the zooplankton and usually constituted over 50% (30). Aperiodic plankton analyses performed by the authors over the past nine years confirms this rotifer dominance for the entire Upper Ohio River in Pennsylvania. Common rotifers include species of Brachionus, Keratella, Polyarthra, and Synchaeta. Cladocerans consist mainly of Bosmina, Diaphanosoma, Ceriodaphnia, and Moina while copepods are represented by Cyclops, Tropocyclops, Mesocyclops, and Diaptomus.

D. Aquatic Macrophytes

Heavy industrialization along the banks of the Upper Ohio River has greatly reduced the availability of sites for the growth of aquatic vasculars. Consequently, emergent macrophytes are relatively scarce. A survey conducted by the Corps of Engineers in 1975 identified only ten narrow bands of significant growth on the reach within the Pittsburgh Corps' District (31). These bands were generally located at sites on the back channel sides of islands. Sagittaria and Eleocharis were identified as the most common genera although Sparganium was frequently detected in deeper water.

E. Macrobenthos

The most recent studies (12, 30) indicate that the benthic fauna of the Upper Ohio River is composed primarily of oligochaetes with lesser numbers of the midges Psectrocladius sp., Cricotopus gr. bicinctus, and C. trifasciatus. Minor components include the amphipod Crangonyx sp., the crayfish Orconectes sanborni, the damselfly Enallagma exulans, and several other miscellaneous invertebrates. The EPA field study of 1970 (12) noted that oligochaetes were most abundant at three stations (see Fig. 2.1.7.-6) immediately downstream

*Protozoans thrive on bacteria and minute sewage particles.

of significant sources of iron-bearing wastewater; it was hypothesized that iron precipitates and filamentous iron-bacteria provide a more suitable substrate for these burrowing organisms than bare rocks.

F. Fish

Lock chamber studies conducted annually 1968-1970 and 1975-1976 at Dashields Lock and Dam (river mile 13.3) have disclosed the presence of thirty-four species of fish (see Table 2.1.7.-8) for the entire period of examination; however, only sixteen to nineteen species have been captured in any given year. Data from each survey year reveals that the Dashields sampling station typically exhibits a lower fish species diversity than downstream stations. Along the entire length of the Ohio River, eighty-two species of fish have been captured during the history of these surveys. Several individual downstream stations have yielded more than forty species for the period of examination and in excess of thirty species for individual years (32). Moreover, fish biomass estimates for the period of record at Dashields shows that 76% of the biomass is composed of rough species, whereas at most downstream stations these pollution-tolerant species constituted less than 50% of the biomass.

G. Ecologically Important Sub-basin Streams

Most streams in the Upper Ohio River Basin would be incapable of supporting a naturally reproducing cold water fishery and much of its associated biota even if all pollutional insults were removed tomorrow (33). This seeming pecularity is due to the hydrologic, topographic, and geologic characteristics of the land area which favor low gradient, warm water streams. The notable exception to this generalization is the portion of Slippery Rock Creek and its tributaries located in McConnells Mill State Park (Lawrence County). Several warm water streams are, however, significant in that they support natural populations of smallmouth bass and stocked populations of walleye and tiger muskellunge. Areas of particular importance are:

a). Connoquenessing Creek in Butler, Lawrence, and Beaver Counties
b). The lower reaches of Slippery Rock Creek in Lawrence County
c). The Wheeling and Buffalo Creek Watersheds in Greene and Washington Counties
d). Portions of the Shenango River in Mercer and Lawrence Counties

2.1.7.4 EXECUTIVE SUMMARY

The "mishmash" of taxonomic names so typical of environmental impact statements, ecological baseline documents, and natural resource inventories provides lengthy lists of species, which generally defy analysis and therefore prove to be nonutilitarian. Conversely, detailed statistical analysis of aquatic ecological data for the entire Pennsylvania ORBES region is not only impractical, but dangerous, since field studies are aperiodic and often cursory. Perhaps the most logical method of simplifying this portion of the baseline document is to rank areas as to their relative diversity of aquatic life. For example, most western Pennsylvania fishermen are aware of the following trend:

QUALITY OF SPORT FISHERY

Upper Allegheny River > Lower Allegheny River > Upper Monongahela River > Ohio River in Pa. > Lower Monongahela River

Relative rankings become more difficult to assign as one considers other forms of aquatic biota and tributary streams. Nonetheless, in Figure 2.1.7.-7 we attempt to make some generalizations for entire counties based upon the diversity of fish, other fully aquatic vertebrates, freshwater mollusks, and aquatic insects in the flowing waters of western Pennsylvania. These relative rankings are based upon our field collections, and the field experience of friends and colleagues in the region, as well as species information provided in recent reports of state and federal environmental agencies.

As can be seen in Figure 2.1.7.-7, the most diverse aquatic communities are located in sparsely populated areas to the north and east of Pittsburgh.

TABLE 2.1.7.-1

IMPACTED* FISH SPECIES OF THE UPPER OHIO RIVER BASIN

paddlefish (*Polyodon spathula*)

lake sturgeon (*Acipenser fulvescens*)

shovelnose sturgeon (*Scaphirhynchus platorhynchus*)

shortnose gar (*Lepisosteus platostomus*)

highfin sucker (*Carpiodes velifer*)

river carpsucker (*Carpiodes carpio*)

Blue sucker (*Cycleptus elongatus*)

sturgeon sucker (*Catostomus catostomus*)

sauger (*Stizostedion canadense*)

bowfin (*Amia calva*)

goldeye (*Hiodon alosoides*)

smallmouth buffalo (*Ictiobus bubalus*)

river shiner (*Notropis blennius*)

silvery minnow (*Hybognathus nuchalis*)

blue catfish (*Ictalurus furcatus*)

American eel (*Anguilla rostrata*)

freshwater drum (*Aplodinotus grunniens*)

*Hostorical evidence suggests that these species have undergone population reductions or extirpations since colonial times.

SOURCE: Adapted from Lachner (1).

TABLE 2.1.7.-2

PENNSYLVANIA FISH COMMISSION
LIST OF ENDANGERED (1), THREATENED (2),
OR STATUS INDETERMINATE (3) FISHES

Common Name	Scientific Name	Status
*Shortnose sturgeon	Acipenser brevirostrum	1
Lake sturgeon	Acipenser fulvescens	1
Threespine stickleback	Gasterosteus aculeatus	1
*Blue pike	Stizostedion vitreum glaucum	1
Eastern sand darter	Ammocrypta pellucida	2
Northern brook lamprey	Ichthyomyzon fosser	3
Silver lamprey	Ichthyomyzon unicuspis	3
Sea lamprey	Petromyzon marinus	3
Atlantic sturgeon	Acipenser oxyrhynchus	3
Spotted gar	Lepisosteus oculatus	3
Cisco	Coregonus artedii	3
Lake whitefish	Coregonus clupeaformis	3
Southern redbelly dace	Phoxinus erythrogaster	3
Gravel chub	Hybopsis x-punctata	3
Hornyhead chub	Nocomis biguttatus	3
Silver chub	Hybopsis storeriana	3
River shiner	Notropis blennius	3
Blackchin shiner	Notropis heterodon	3
Blacknose shiner	Notropis heterolepis	3
Redfin shiner	Notropis umbratilis	3
Spotted sucker	Minytrema melanops	3
Black bullhead	Ictalurus melas	3
Mountain madtom	Noturus eleutherus	3
Tadpole madtom	Noturus gyrinus	3
Brindled madtom	Noturus miurus	3
Northern madtom	Noturus stigmosus	3
Burbot	Lota lota	3
Warmouth	Lepomis gulosus	3
Orangespotted sunfish	Lepomis humilis	3
Longear sunfish	Lepomis megalotis	3
Spotted bass	Micropterus punctulatus	3
Bluebreast darter	Etheostoma camurum	3
Spotted darter	Etheostoma maculatum	3
Tippecanoe darter	Etheostoma tippecanoe	3
Channel darter	Percina copelandi	3
Longhead darter	Percina macrocephala	3
Sauger	Stizostedion canadense	3

Status categories are defined as follows:

1. Endangered: Actively threatened with extinction in the state. Continued survival unlikely without special protective measures.

2. Threatened: Not under immediate threat of extinction in the state, but occurring in such small numbers and/or in such restricted habitat that it could quickly cease to be a part of the state fauna.

3. Indeterminate: Apparently threatened or uncommon to rare, but insufficient data currently available on which to base a reliable assessment of status.

*Also classified as U.S. endangered.

SOURCE: Adapted from Pa. Fish Commission (2), U.S. Fish and Wildlife Service (3).

TABLE 2.1.7.-3

MAJOR PHYTOPLANKTON GENERA OF
THE MONONGAHELA, LOWER* ALLEGHENY
AND UPPER** OHIO RIVERS

I. CYANOPHYTA (Blue-Green Algae)

Anabaena
Anacystis
Aphanizomenon
Aphanocapsa
Chroococcus
Coelosphaerium
Gomphosphaeria
Lyngbya
Merismopedia
+Microcystis
+Oscillatoria
+Schizothrix
Cyanophyta g. sp.

II. CHLOROPHYTA

+Actinastrum
+Ankistrodesmus
Carteria
Characiopsis
+Chlamydomonas
Closterium
Closteriopsis
Coelastrum
Cosmarium
Crucigenia
+Dictyosphaerium
Echinosphaerella
Elakatothrix
Eremosphaera
Franceia
Golenkinia
Gonium
Haematococcus
Kirchneriella
Lagerheimia
Micractinium
Mougeotia
Oocystis
Pandorina
Pediastrum
Phacotus
Planktosphaeria
Quadrigula
+Scenedesmus
Schroederia
Selenastrum
Sphaerocystis
Staurastrum
Tetraedron
Treubaria
+Chlorophyta g. sp.

III. CHRYSOPHYTA

Achnanthes
Amphiprora
+Asterionella
Cocconeis
Coscinodiscus
+Cyclotella
Cymatopleura
Cymbella
Diatoma
Dinobryon
Diploneis
Epithemia
Eunotia
+Fragilaria
Frustulia
Gomphonema
Gyrosigma
Hantzschia
Mallomonas
Mastogloia
+Melosira
Meridion
Navicula
+Nitzschia
Pinnularia
Pleurosigma
Rhoicosphenia
Stauroneis
+Stephanodiscus
Surirella
Synedra
Tabellaria
Chrysophyta g. sp.

IV. PYRROPHYTA

Ceratium
Glenodinium
Peridinium

V. EUGLENOPHYTA

Chroomonas
+Cryptomonas
Euglena
Lepocinclis
Phacus
Rhodomonas
Trachelomonas

*Navigable Reach
**Within the State of Pennsylvania

+Indicates that species of this genera are often numerically dominant

TABLE 2.1.7 - 4

ZOOPLANKTON TAXA OF THE MONONGAHELA RIVER

APRIL 1975

Name of Organism	River Mileage of Sampling Stations 7.0	63.0	89.0
Rotifera			
Brachionus sp.	X	X	X
Euchlanis sp.		X	
Filinia longiseta	X		
Keratella cochlearis	X	X	X
Rotaria sp.			X
Cladocera			
Bosmina sp.		X	
Chydorus sp.	X	X	
Copepoda			
Nauplius	X	X	X
Calanoid copepodite	X		

SOURCE: U.S. Army Corps of Engineers (13).

TABLE 2.1.7. - 5

AQUATIC MACROPHYTES OF THE MONONGAHELA RIVER
SUMMER 1975

Scientific Name	Common Name
Equisetum fluviatile L.	Water Horsetail
Typha latifolia L.*	Common Cattail
Sparganium sp.*	Bur Weed
Potamogeton pusillus L.	Slender pondweed
Potamogeton ephydrus Raf.*	Floating pondweed
Potamogeton nodosus Poir.*	Longleaf pondweed
Alisma subcordatum Raf.	Broadleaf water plantain
Sagittaria graminea Michx.*	Slender arrowhead
Sagittaria latifolia Willd.*	Broadleaf arrowhead
Elodea canadensis Michx.	Waterweed
Cyperus ferruginescens Boeckl.	An umbrella sedge
Eleocharis acicularis L. R+S*	Slender spikerush
Eleocharis obtusa (Willd.) Schuttes	Blunt spikerush
Scirpus validus Vahl.*	Great bulrush
Juncus effusus L.*	Soft rush
Iris pseudacorus L.	Yellow iris
Polygonum lapathifolium L.	Nodding smartweed
Callitriche palustris L.	Water starwort
Ludwegia palustris (L.) Ell.*	Water purslane
Myriophyllum heterophyllum Michx.*	Variable watermilfoil

* Also collected by Clarkson and Moore (16) on the upper Monongahela, West Fork, and Tygart Valley Rivers. Additionally, they collected Potamogeton diversifolius, not listed above

SOURCE: U.S. Army Corps of Engineers (8).

TABLE 2.1.7 - 6

DENSITY OF BENTHIC MACROINVERTEBRATES COLLECTED AT MONONGAHELA RIVER STATIONS DURING APRIL, 1975

Organisms	River Mileage 7.0	63.0	89.0
	Density (no./m^2)		
Oligochaeta			
Tubificidae			
Limnodrilus claparedeanus			19.0
Limnodrilus hoffmeisteri			76.2
Limnodrilus (immature)	28.6	57.1	142.9
Diptera			
Chironomidae			
Cricotopus sp. (unidentified)			9.5
Chaetocladius sp.			19.0
Endochironomus dimorphus			409.5
Polypedilum sp.			47.6
Procladius (*Procladius*) sp.			152.4
Procladius (*Psilotanypus*) *adumbratus*		19.0	38.1
Tipulidae			
Tipula sp.			9.5
Collembola			
Isotomurus palustris	19.0		
Pelecypoda			
Sphaeriidae			
Pisidium (*Cyclocalyx*) *adamsi*		9.5	
Total Density	47.6	95.1	923.8

SOURCE: U.S. Army Corps of Engineers (13).

TABLE 2.1.7.-7

SUMMARY OF FISH SAMPLING DATA
FROM THE MONONGAHELA RIVER
1967-1973

		1967	1968	1969	1970	1973
MAXWELL LOCK (1.4 surface acres)	Total number fish	0	1	204	54	8,071
	Total weight fish (lbs.)	0	0.04	6.43	6.76	91.50
	Standing crop (lbs./acre)	0	0.03	4.59	4.83	65.36
	Number of species	0	1	8	6	16
	Percentage sensitive species (by total weight)	-	-	18	23	65
LOCK NO. 2 (0.5 surface acres)	Total number fish	20	207	1,626	261	869
	Total weight fish (lbs.)	2.58	27.33	58.33	45.70	74.48
	Standing crop (lbs./acre)	5.16	54.66	116.66	91.40	148.96
	Number of species	4	8	12	12	16
	Percentage sensitive species (by total weight)	26	9	6	12	31

SOURCE: Adapted from Preston (7).

TABLE 2.1.7.-8

FISHERY SURVEY RESULTS FOR REACHES
OF THE MONONGAHELA AND OHIO RIVERS IN PENNSYLVANIA

		Upper Ohio River (Pa.)		Monongahela River (Pa.)	
Family Species	Common Name	Dashields Lock[a]	Montgomery Lock[b]	Maxwell Lock[c]	Lock No. 2[c]
Clupeidae					
Dorosoma cepedianum	Gizzard shad	X	X	X	X
Cyprinidae					
Carassius auratus	Goldfish	X		X	X
Cyprinus carpio	Carp	X	X	X	X
Notemigonus crysoleucas	Golden shiner				X
Notropis atherinoides	Emerald shiner	X	X	X	X
Notropis spilopterus	Spotfin shiner	X	X		X
Notropis stramineus	Sand shiner	X	X	X	X
Notropis volucellus	Mimic shiner	X	X		X
Notropis boops	Bigeye shiner	X			
Notropis blennius	River shiner	X			
Pimephales notatus	Bluntnose minnow	X	X		X
Pimephales promelas	Fathead minnow				X
Catostomidae					
Catostomus commersoni	White sucker	X			X
Moxostoma erythrurum	Golden redhorse			X	
Moxostoma duquesnei	Black redhorse	X			
Ictaluridae					
Ictalurus catus	White catfish	X	X	X	
Ictalurus natalis	Yellow bullhead	X	X		X
Ictalusus nebulosus	Brown bullhead	X	X	X	X
Ictalurus melas	Black bullhead		X		
Ictalurus punctatus	Channel catfish	X	X	X	X
Pylodictus divarius	Flathead catfish	X			
Cyprinodontidae					
Fundulus diaphanus	Banded killifish	X	X		X
Percichthyidae					
Morone chrysops	White bass	X			

Family Species	Common Name	Upper Ohio River (Pa.) Dashields Lock[a]	Upper Ohio River (Pa.) Montgomery Lock[b]	Monongahela River (Pa.) Maxwell Lock[c]	Monongahela River (Pa.) Lock No. 2[c]
Centrarchidae					
Ambloplites rupestris	Rock bass	X	X	X	X
Lepomis cyanellus	Green sunfish		X	X	X
Lepomis gibbosus	Pumpkinseed	X	X	X	X
Lepomis humilis	Orangespotted sunfish			X	
Lepomis macrochirus	Bluegill	X	X	X	X
Lepomis microlophus	Redear sunfish	X			
Micropterus dolomieu	Smallmouth bass			X	
Micropterus salmoides	Largemouth bass	X	X	X	X
Micropterus punctulatus	Spotted bass	X			
Pomoxis annularis	White crappie	X			
Pomoxis nigromaculatus	Black crappie	X	X	X	
Percidae					
Percina caprodes	Logperch	X			
Perca flavescens	Yellow perch	X			
Stizostedion vitreum	Walleye	X	X		
Stizostedion canadense	Sauger	X			
Anguillidae					
Anguilla rostrata	American eel	X			
Sciaenidae					
Aplodinotus grunniens	Freshwater drum	X			
Esocidae					
Esox masquinongy	Muskellunge	X			

a. Lock chamber sampling conducted in 1968-1970; 1975-1976
b. Lock chamber sampling conducted in 1968-1970
c. Lock chamber sampling conducted in 1967-1973

Adapted from Preston (7) and Preston and White (32).

TABLE 2.1.7.-9

AQUATIC MACROPHYTES OF THE ALLEGHENY RIVER 1977

Scientific Name	Common Name
Sparganium americanum Nutt.	Burr Weed
Potamogeton crispus L.	Curly pondweed
Potamogeton nodosus Poir.	Longleaf pondweed
Potamogeton sp.	Pondweed
Sagittaria latifolia Willd.	Broadleaf - arrowhead
Sagittaria graminea Michx.	Slender arrowhead
Eleocharis acicularis (L.) R + S	Slender Spikerush
Scirpus validus Vahl	Great bulrush
Scirpus americanus Pers.	Three-square rush
Polygonium coccineum Muhl.	Smartweed
Myriophyllum sp.	Watermilfoil
Justicia americana (L.) Vahl	Water willow

SOURCE: Koryak (25).

TABLE 2.1.7.-10

SPECIES OF FISH COLLECTED*
FROM POOLS 3, 5, and 7 OF THE ALLEGHENY RIVER
1975 - 1977

Family Cyprinidae

Carp (3, 5, 7)
Goldfish (3, 7)
Streamline Chub (7)
Creek Chub (3, 7)
Golden Shiner (5, 7)
Stoneroller (5)
Emerald Shiner (3, 5, 7)
Spotfin Shiner (3, 5, 7)
Mimic Shiner (3, 5, 7)
Rosyface Shiner (3, 5, 7)
Sand Shiner (3)
River Shiner (3, 5, 7)
Common Shiner (7)
Silver Shiner (7)
Striped Shiner (7)
Bluntnose Minnow (3, 5, 7)

Family Catostomidae

Northern Hogsucker (3, 5, 7)
White Sucker (3, 7)
Smallmouth Buffalo (3)
Quillback (3, 7)
Golden Redhorse (3, 5, 7)
Silver Redhorse (3, 7)
Black Redhorse (3, 7)
Shorthead Redhorse (3, 5, 7)
River Redhorse (5)

Family Centrarchidae

Rock Bass (3, 5, 7)
Bluegill (5, 7)
Pumpkinseed (3, 7)
Largemouth Bass (3, 7)
Smallmouth Bass (3, 5, 7)
White Crappie (5, 7)

Family Percidae

Logperch (3, 5, 7)
Yellow Perch (3, 5, 7)
Walleye (3, 5, 7)
Fantail Darter (7)
Banded Darter (3, 5)
Johnny Darter (3, 5, 7)

Family Percopsidae

Trout - Perch (3, 5, 7)

Family Cyprinodontidae

Banded Killifish (5)

Family Ictaluridae

Channel Catfish (3, 5, 7)
Flathead Catfish (3, 7)
Brown Bullhead (3, 5)

Family Esocidae

Northern Pike (3, 7)

Family Clupeidae

Gizzard Shad (3, 5)

Family Cottidae

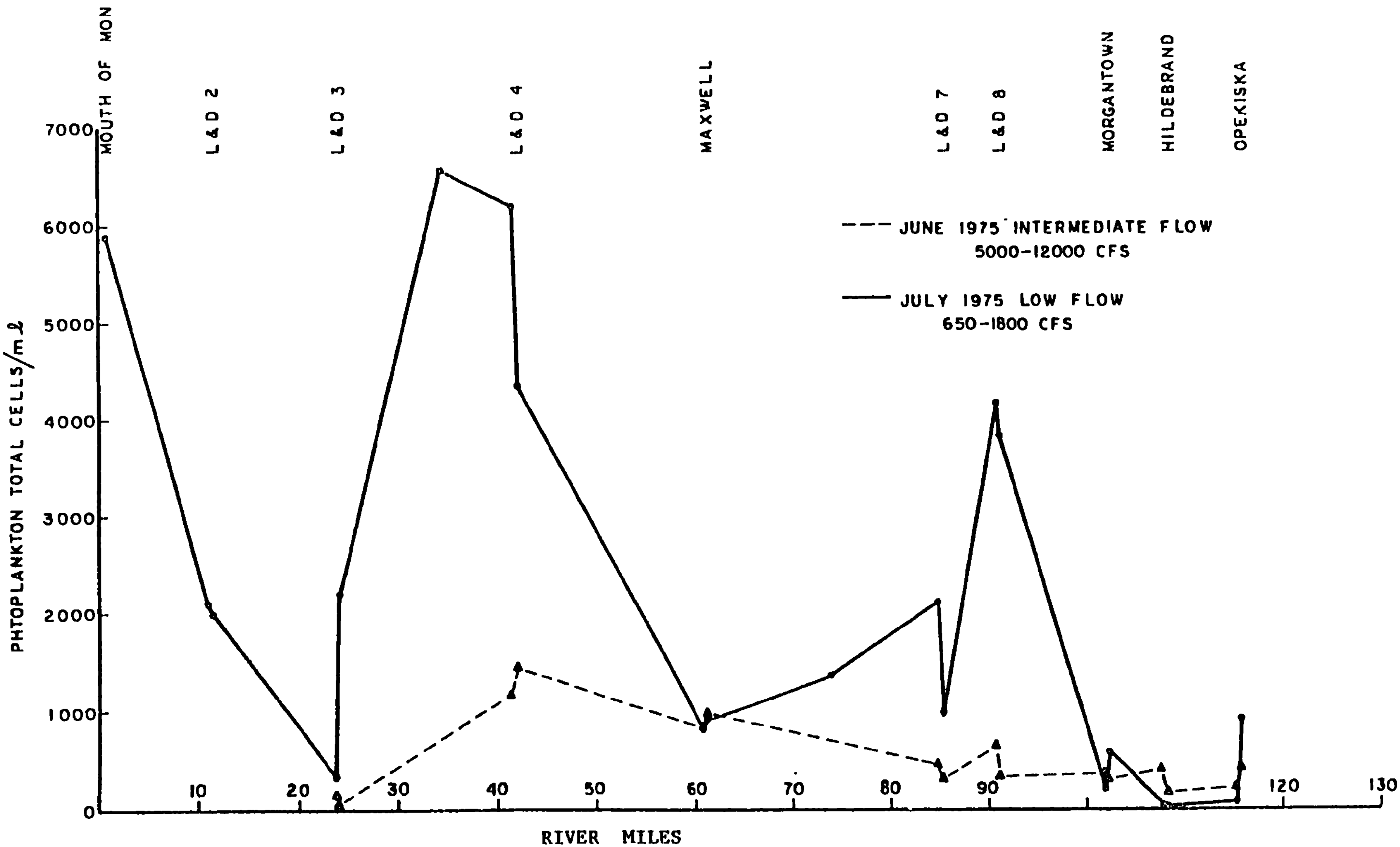
Mottled Sculpin (7)

*Collections made by electrofishing, experimental gill netting, bag seining, and towing half-meter larval fish nets. Numbers in parentheses indicate Navigation Pools where that particular species was detected.

SOURCE: Adapted from U.S. Army Corps of Engineers (24).

FIGURE 2.1.7 - 1

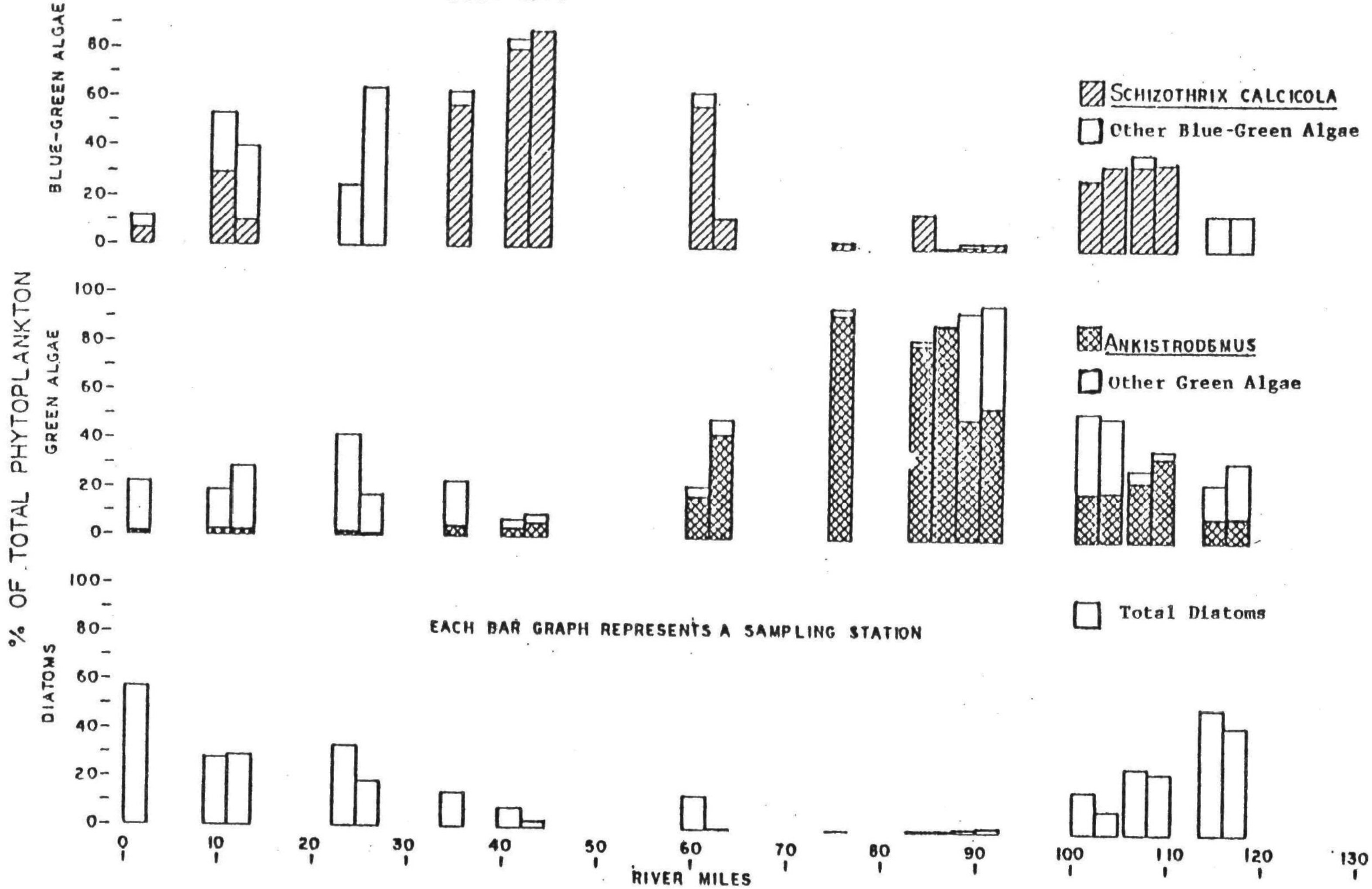
MONONGAHELA RIVER TOTAL PHYTOPLANKTON
(midstream at one meter depth)



SOURCE: U.S. Army Corps of Engineers (8)

FIGURE 2.1.7 - 2

COMPOSITION OF MONONGAHELA RIVER
PHYTOPLANKTON COMMUNITY
JULY 1975

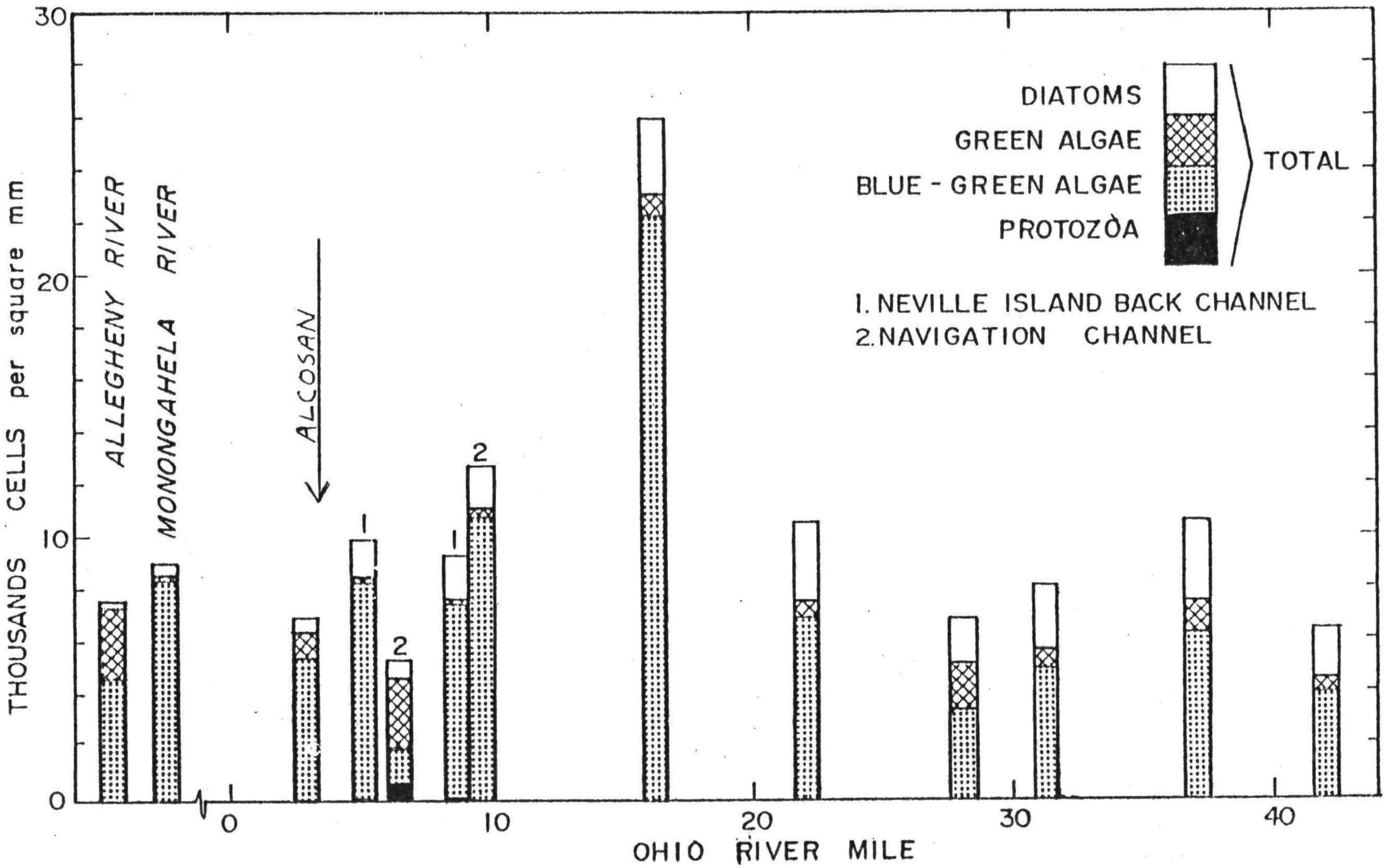


SOURCE: U.S. Army Corps of Engineers (8)

FIGURE 2.1.7 - 3

NUMBERS AND COMPOSITION OF ATTACHED GROWTHS

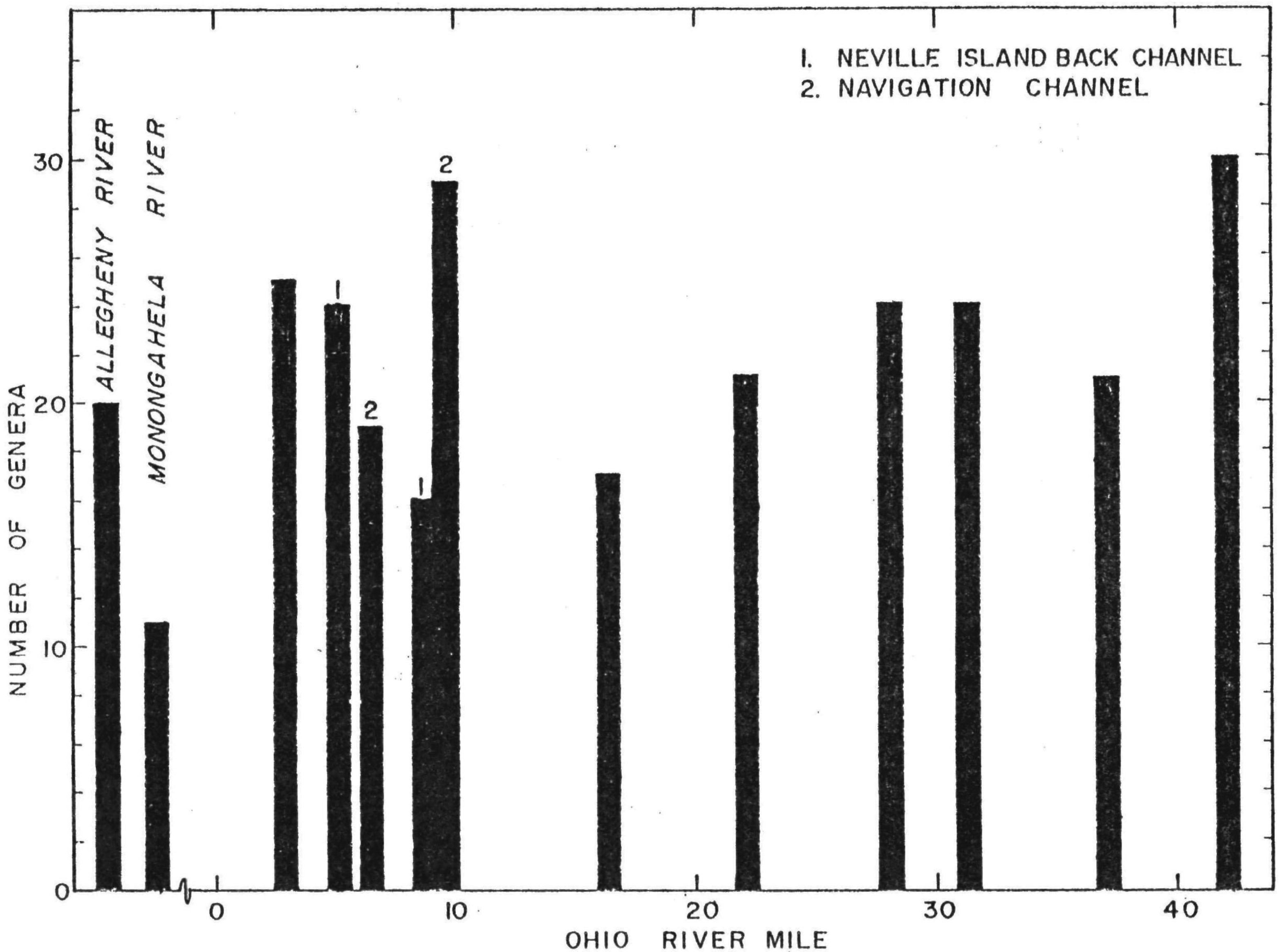
UPPER OHIO RIVER SYSTEM, MAY - JUNE 1970



SOURCE: U.S. EPA (12).

FIGURE 2.1.7 - 4

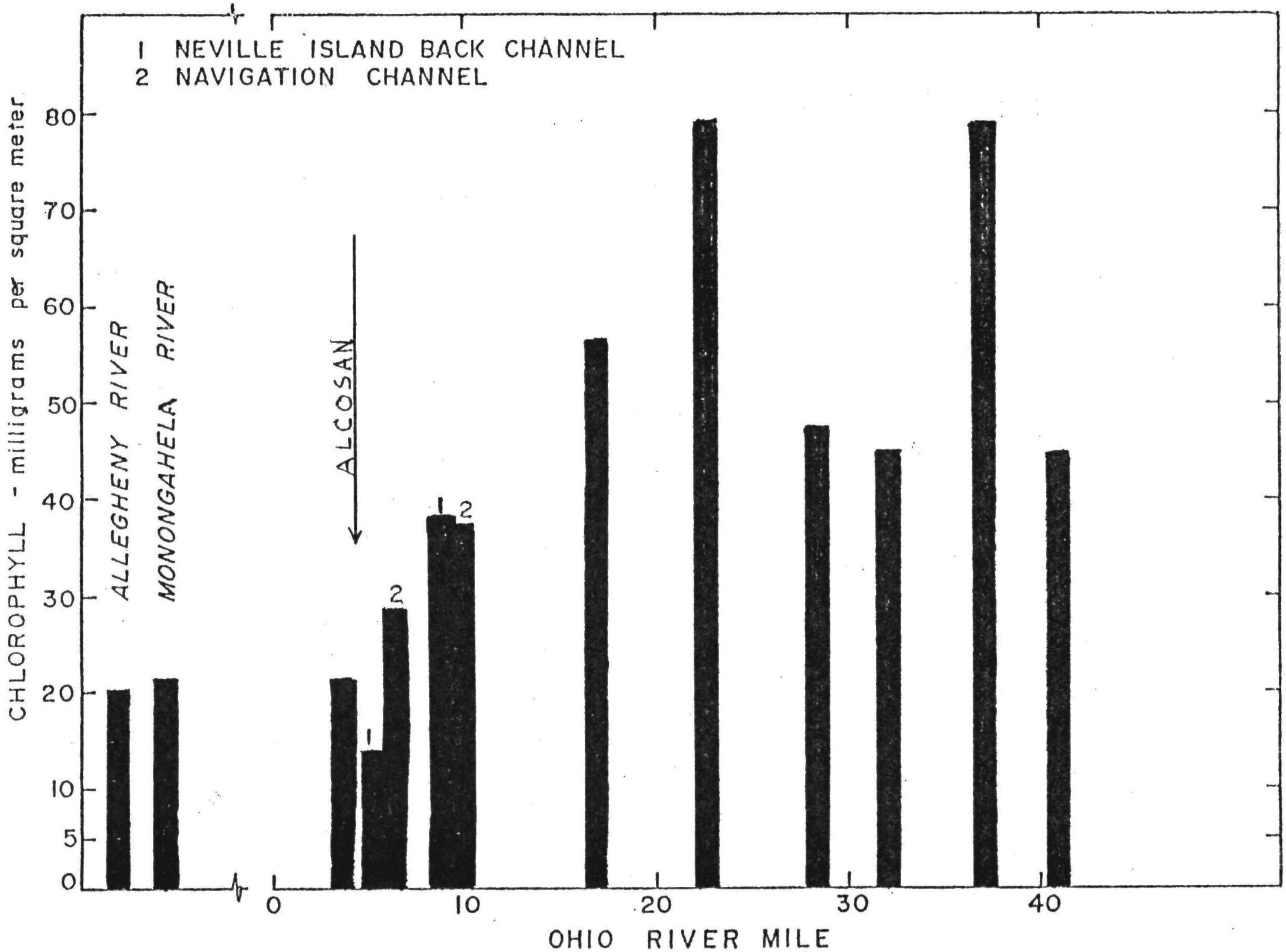
NUMBER OF PERIPHYTON GENERA IN THE ATTACHED GROWTH COMMUNITIES IN THE UPPER OHIO RIVER SYSTEM, MAY - JUNE 1970.



SOURCE: U.S. EPA (12).

FIGURE 2.1.7 - 5

QUANTITY OF CHLOROPHYLL IN THE ATTACHED GROWTH COMMUNITIES OF THE UPPER OHIO RIVER SYSTEM, MAY - JUNE 1970

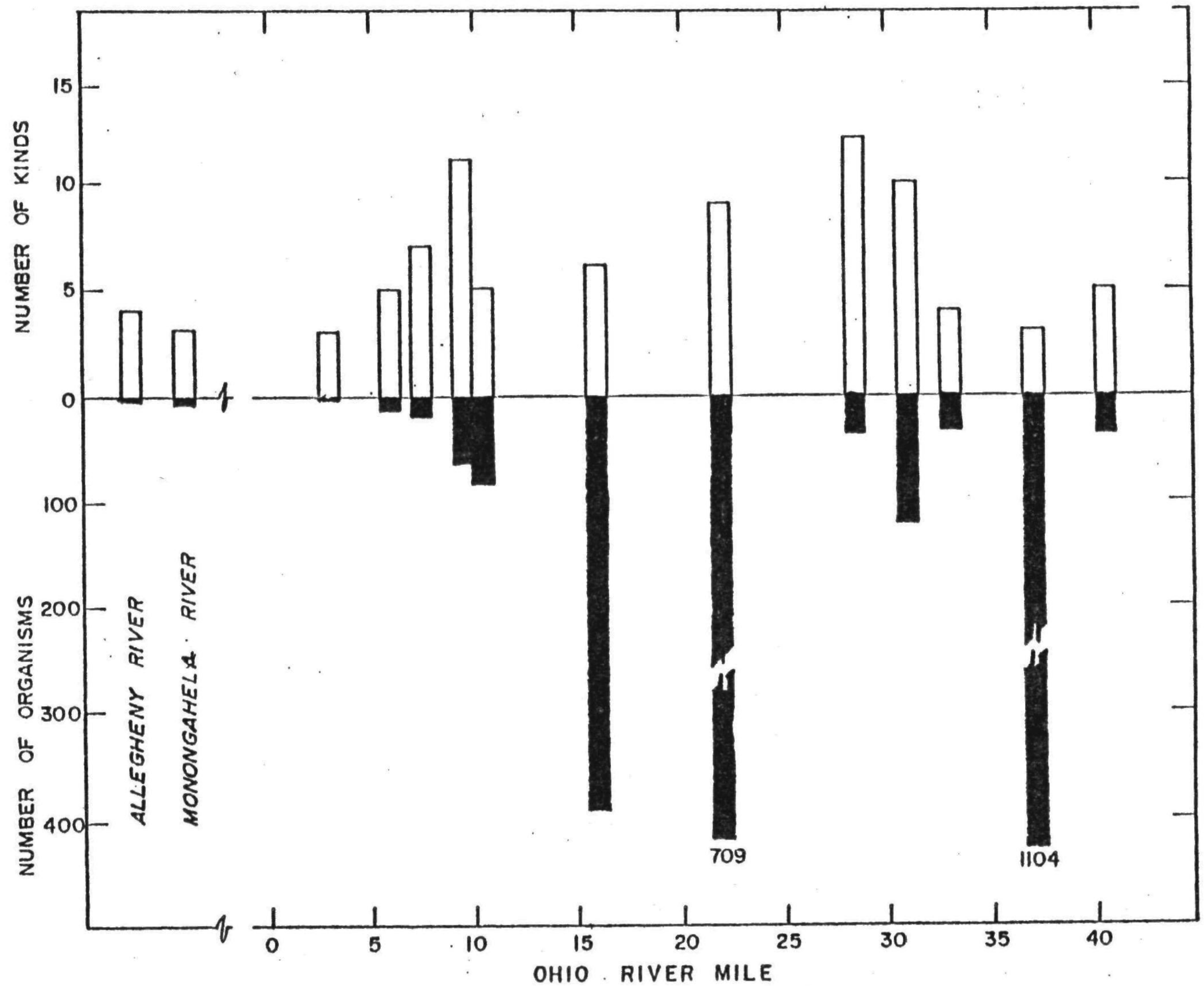


SOURCE: U.S. EPA (12).

FIGURE 2.1.7 - 6

BENTHIC FAUNA COLLECTED IN ROCK BASKET SAMPLERS, UPPER OHIO RIVER BASIN

MAY - JUNE 1970

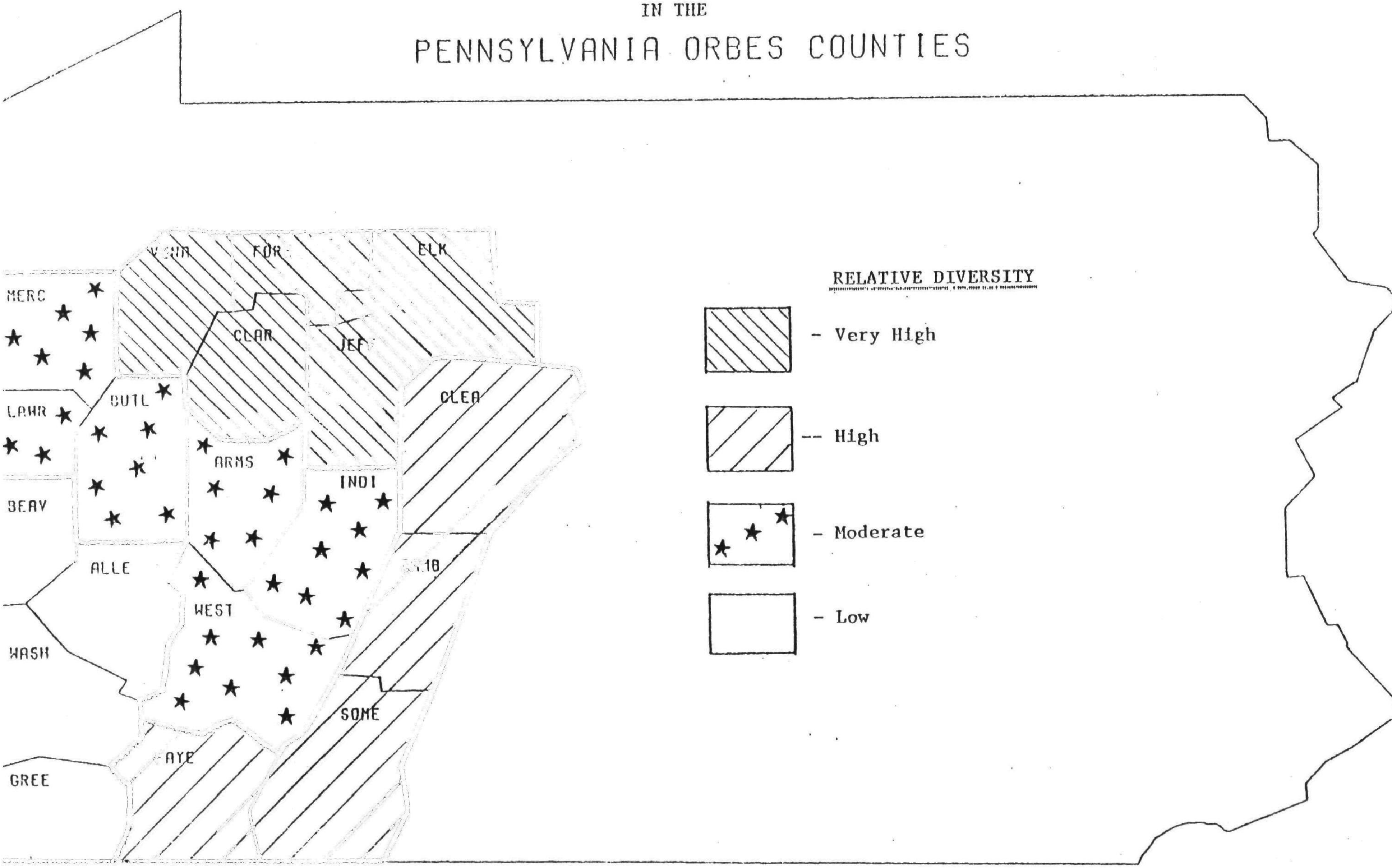


F I G U R E 2.1.7.-7

RELATIVE DIVERSITY OF AQUATIC FAUNA

IN THE

PENNSYLVANIA ORBES COUNTIES



REFERENCES

1. E.A. Lachner. "The Changing Fish Fauna of the Upper Ohio Basin". In: Man and the Waters of the Upper Ohio Basin. C.A. Tryon, and M.A. Shapiro (eds). Spec. Publ. No. 1, Pymatuning Laboratory of Field Biology, University of Pittsburgh, Linesville, Pa., 1956.

2. Pennsylvania Fish Commission. "A New List of Endangered Threatened or Status Indeterminate Fishes, Amphibians and Reptiles." Bellefonte, Pa., 1977.

3. U.S. Fish and Wildlife Service. "A Checklist of the Fishes of Pennsylvania." State College, Pa., 1977.

4. F.A. Michaux. "Travels to the West of the Allegheny Mountains." In: Early Western Travels 1748-1846, Vol. 3, R.G. Thwaites (ed.) A.H. Clar Publishing Co., 1805.

5. Ohio River Sanitation Commission. "Aquatic-life Resources of the Ohio River". Cincinnati, Ohio 1962.

6. Pennsylvania Game Commission and the National Audubon Society. "Proceedings of the Symposium on Nongame Species, October 1, 1977." T. Williams (ed.), Harrisburg, Pa. 1978.

7. H.R. Preston. "Monongahela River Basin Aquatic Biology - Part I Fish Populations." U.S. EPA Region III, Wheeling, West Virginia, 1974.

8. U.S. Army Corps of Engineers, Pittsburgh District. "Monongahela River Navigation Projects Annual Water Quality Report 1976". Pittsburgh, 1976.

9. Pennsylvania Department of Environmental Resources, Bureau of Water Quality Management. "Pennsylvania 1976 Water Quality Inventory". Publ. No. 42, Harrisburg, Pa., 1976.

10. U.S. Environmental Protection Agency, Office of Research and Development. "Biological Field and Laboratory Methods for Measuring the Quality of Surface Waters and Effluents". C.I. Weber (ed.) EPA 670/4-73-001, Cincinnati, Ohio 1973.

11. L.G. Williams, "Possible relationships between plankton-diatom species numbers and water quality estimates". Ecology 45:809-823 1964.

12. U.S. Environmental Protection Agency Region III. "A Report on Pollution of the Ohio River and its Tributaries in the Pittsburgh Pennsylvania Area." Philadelphia, P , 1971.

13. U.S. Army Corps of Engineers, Pittsburgh District. Monongahela River - Draft Environmental Statement on the Operation and Maintenance of the Navigation System." Pittsburgh, PA,1975.

14. L.G. Williams. "Dominant planktonic rotifers of major waterways of the United States." Limnol. Oceanogr. 11 (1) (1966): 83-91.

15. H.B.N. Hynes. The Ecology of Running Waters. Toronto: University of Tobonto Press, 1972.

16. R.B. Clarkson and J.A. Moore. "Vascular Aquatic Plants in Acid Mine Water of the Monongahela River, West Virginia." Bulletin No.2 Water Research Institute, West Virginia University. Morgantown, West Virginia, 1971.

17. University of Pittsburgh, Graduate School of Public Health and Department of Biology. "A Limnological Study of the Upper Ohio River." Progress Report AT (30-1) 2411 to the Atomic Energy Commission for Period of June 1, 1960 - February 28, 1961. Pittsburgh, PA, 1961.

18. W.T. Mason Jr., P.A. Lewis, and J.B. Anderson. "Macroinvertebrate Collections and Water Quality Monitoring in the Ohio River Basin 1963-67." Analytical Quality Control Laboratory, U.S. EPA, Cincinnati, Ohio, 1971.

19. Federal Water Pollution Control Administration. "Benthic Biology of the Monongahela River Basin - Pennsylvania, West Virginia, Maryland". Work Document No. 16. Ohio River Basin Project, Wheeling, West VA, 1968.

20. B.W. Everman and C.H. Bollman. "Notes on a Collection of Fishes from the Monongahela River." Ann. N.Y. Acad. Sci., 3:335-350, 1886.

21. Pennsylvania Department of Environmental Resources. "State Water Plan -Sub-basin #19 (draft copy)." Harrisburg, PA, 1977.

22. Pennsylvania Department of Environmental Resources, Bureau of Water Quality Management. "Proposals for Recommended Revisions to Water Quality Criteria Wastewater Treatment Regulations, and Industrial Wastes." Pennsylvania Bulletin, 8(9), Harrisburg, PA, 1978.

23. U.S. Army Corps of Engineers, Pittsburgh District. "Allegheny River Navigation Projects Water Quality Report - 1978" (draft material). Pittsburgh, 1978.

24. U.S. Army Corps of Engineers Pittsburgh District. "Commercial Sand and Gravel Dreding in the Allegheny River (mile 0 to Mile 72) Final Environmental Statement". Pittsburgh, PA, 1977.

25. M. Koryak, "Emergent Aquatic Plants in the Upper Ohio River and Major Navigable Tributaries, West Virginia and Pennsylvania" Castanea (in print), 1978.

26. Federal Water Pollution Control Administration. "Benthic Biology Allegheny River Basin. New York, Pennsylvania." Work Document No. 27, Aquatic Biology Unit, Wheeling, West Virginia, 1969.

27. Indiana University, Ohio State University, and Purdue University "Preliminary Technology Assessment Report for the Ohio River Basin Energy Study" Vol. II-A Part I. Prepared for US EPA Office

Energy, Minerals and Industry, Washington, D.C., 1977.

28. R.T. Hartman. "Composition and Distribution of Phytoplankton Communities in the Upper Ohio River." In: Studies on the Aquatic Ecology of the Upper River System. C.A. Tryon Jr., R.T. Hartman, and K.W. Cummins (eds.), Spec. Publ. No. 3, Pymatuning Laboratory of Ecology,Linesville PA, 1965.

29. U.S. Army Corps of Engineers Pittsburgh District. "An Evaluation of the Effects of Mainstem Navigation Dams on the Water Quality of the Upper Ohio River". Pittsburgh, PA, 1975.

30. Duquesne Light Company, Ohio Edison Company, and Pennsylvania Power and Light Company. "Final Environmental Statement Related to the Beaver Valley Power Station Unit 1." U.S. Atomic Energy Commission, Directorate of Licensing. Docket No. 50-334. Washington, D.C. 1973.

31. U.S. Army Corps of Engineers Pittsburgh District Office, Private Communication, October 18, 1978.

32. H.R. Preston and G.E. White. "Summary of Ohio River Fishery Surveys, 1960-76." EPA 903/9-78-009. U.S. Environmental Protection Agency, Region III, Philadelphia, PA, 1978.

33. Pennsylvania Department of Environmental Resources. "State Water Plan Sub-Basin #20 (draft copy)". Harrisburg, PA, 1977.

34. Green International Inc. "Comprehensive Water Quality Management Plan, Study Area #9, Chapter IV, Appendix A" (Prelim. draft copy). Report prepared for Commonwealth of Pennsylvania, Dept. Environ. Resources. Sewickley, Pa., 1976.

35. Green International, Inc. "Comprehensive Water Quality Management Plan, Study Area #8, Chapter IV, Appendix A" (Prelim. draft copy). Report prepared for Commonwealth of Pennsylvania, Dept. Environ. Resources. Sewickley, Pa., 1976.

APPENDIX

Habitat Preferences of the Fishes of Western Pennsylvania

Species Common Name	Low Gradient to Ponded, Turbid	Low Gradient Clear	Moderate Gradient Clear	High Gradient Clear and Cold	Comments
Goldfish	X	X	X		
Goldenshiner		X			
River Chub		X	X		
Silver Chub		X	X		
Northern Bigeye Chub		X	X		
Western Blackmore Dace			X	X	
Longnose Dace			X	X	
Northern Creek Chub	X	X	X	X	
Eastern Tonguetied Chub		X	X		Local Distribution Upper Allegheny River
Southern Redbelly Dace				X	
Redside Dace					
Common Emerald Shiner	X	X			
Silver Shiner		X	X		
Rosyface Shiner			X	X	
Central Common Shiner			X	X	
Northern Common Shiner				X	
Spotfin Shiner	X	X			Tolerates turbidity and pollution.
Northeastern Sand Shiner			X	X	Tolerates mine waste.

Species Common Name	Low Gradient to Ponded, Turbid	Low Gradient Clear	Moderate Gradient Clear	High Gradient Clear and Cold	Comments
Northern Mimic Shiner		X	X		
Silverjaw Minnow			X	X	Tolerates mine waste.
Northern Flathead Minnow	X	X			
Bluntnose Minnow	X	X	X	X	
Ohio Stoneroller Minnow			X	X	
Channel Catfish	X	X			
Yellow Bullhead		X	X		
Brown Bullhead		X	X		
Black Bullhead	X	X			
Flathead Catfish		X	X		
Stonecat Madtom		X	X		
Brindled Madtom	X	X			
Eastern Banded Killifish					
Troutperch		X			
Brook Silverside		X			May be extinct because of turbidity and pollution.
White Coppil	X	X	X		
Black Crappie	X	X	X		
Northern Rockbass			X		Requires clean water with rock or gravel bottom. Much of former habitat destroyed.

Species Common Name	Low Gradient to Ponded, Turbid	Low Gradient Clear	Moderate Gradient Clear	High Gradient Clear and Cold	Comments
Northern Smallmouth Blackbass		X	X		Originally abundant, much habitat destroyed by siltation.
Northern Largemouth Blackbass					
Green Sunfish	X	X			
Northern Bluegrass Sunfish		X	X		
Central Longear Sunfish		X			Intolerant to high turbidity.
Pumpkinseed Sunfish		X	X		
Yellow Walleye		X			Intolerant to turbidity and silt bottoms.
Yellow Perch	X	X	X		
Blackside Darter		X	X		Sensitive to pollution.
Longhead Darter			X	X	Original habitat destroyed by mine drainage.
Gilt Darter		X	X		
Ohio Logperch Darter		X	X		Intolerant to pollution.
Greenside Darter		X	X		
Eastern Banded Darter		X	X	X	

Species Common Name	Low Gradient to Ponded, Turbid	Low Gradient Clear	Moderate Gradient Clear	High Gradient Clear and Cold	Comments
Ohio Lamprey		X			
Allegheny Brook Lamprey				X	
Ohio Brook Lamprey				X	
Longnose Gar		X			
Eastern Gizzardshad	X	X			
Brown Trout			X	X	Cold Water less than 65° F.
Rainbow Trout			X	X	
Brook Trout				X	Coldest headwater tribs.
Central Mudminnow			X		
Central Redfin Pickerel		X			
Ohio Muskellunge			X		
Central Quillback Carpsucker	X	X			
Silver Redhorse		X			
Golden Redhorse			X		
Ohio Redhorse			X		
Hog Sucker			X	X	
Common White Sucker	X	X	X		
Carp	X	X	X		

Species Common Name	Low Gradient to Ponded, Turbid	Low Gradient Clear	Moderate Gradient Clear	High Gradient Clear and Cold	Comments
Variegated Darter		X	X		
Spotted Darter		X			
Bluebreast Darter		X	X		
Rainbow Darter		X	X	X	Intolerant to pollution.
Barred Fantail Darter		X	X		
Freshwater Drum	X	X			Rare or absent because of commercial fishing.
Central Redfin Sculpin				X	
Brook Stickleback		X			
Bigmouth Buffalo	X				
Black Redhorse			X		
River Redhorse		X			

SOURCE: Green International, Inc. (34,35).