This work made possible by funding from the Sport Fish Restoration Act Project F-57-R Fisheries Management.

PENNSYLVANIA FISH AND BOAT COMMISSION
BUREAU OF FISHERIES
FISHERIES MANAGEMENT DIVISION

Monongahela River, Sections 02, 03, and 06 (819A, C, G)
Management Report

Monongahela River Mine Pool Study 2003

Prepared by
Rick Lorson and Gary Smith
Fisheries Management Area 8

Fisheries Management Database Name: Monongahela R
Lat/Lon: 402627/800051

Date Sampled: May, Sept. 2003 Date Prepared: July 2004

Introduction

The headwaters of the Monongahela River are in northern West Virginia and the mainstem traverses north for 206 km to Pittsburgh, PA. The PA portion enters at Point Marion, PA, and is 147 km long, ranges in width from 183 to 274 m, and entails about 36% of the basin (Putnam et al. 1984). There are six US Army Corps of Engineers Locks and Dams maintained for commercial navigation within the PA stretch of the Monongahela River. These dams serve as sectioning limits for Pennsylvania Fish and Boat Commission (PFBC) fish management purposes (Table 1).

Historically, the Monongahela River has been the most heavily polluted of the Three Rivers system. The three major pollutants have been mine drainage, sewage, and industrial effluents. The peak of the pollution load was in the 1960s, with the recovery phase in the 1970s and 1980s. The recovery came at the hands of sewage treatment facility construction and upgrades, regulation, removal, and reduction of industrial effluents, and regulation, reclamation, and most notably treatment of acid mine drainage discharges (Weller et al. 1991). The Federal Clean Water Act of 1972 served as a landmark in cleanup efforts in the Mon Basin (Pittsburgh Federal Executive Board 1972).

The Ohio River Valley Water Sanitation Commission (ORSANCO) has maintained a long-term data set of Monongahela River lock and

dam rotenone fish sampling dating to 1968. Fish species occurrence and fish biomass measures are the primary means to monitor time-series changes from this type of sampling. Lock chambers at Maxwell Dam and Braddock Dam each had about 5 species collected in 1968 and increased to about 20 species by 1988 (ORSANCO data, unpublished). The fish biomass at the same two locks was approximately 5 kg in 1968 and registered at about 150 kg in 1988. These data provided insight that the Monongahela River fish resource was changing in a positive direction.

Subsequently, initial night electrofishing efforts by the PFBC toward sampling fish populations of the river in the 1990s also served to document a dramatic recovery in this fish resource (Miko and Lorson 1994). Sampling by night electrofishing in Sections 04, 05, and 06 at Lock and Dam 4 at Charleroi (RM 41.5) Lock and Dam 3 at Elizabeth (RM 23.8), and Lock and Dam 2 at Braddock (RM 11.2) in 1992 to 1994 had high quantity and quality populations of smallmouth bass *Micropterus dolomieui*, sauger *Sander canadense*, white bass *Morone chrysops*, and channel catfish *Ictalurus punctatus*. Fish populations in the Monongahela River had switched from a recovery phase to a fishable stage by the mid-1990s.

A serious threat to the water quality and fish resource of the Monongahela River has entered in the new millennium. Deep mining operations for coal in the Mon Basin over the last 100 years have left massive voids currently filled, or filling, with acid water. The improved water quality in the Mon Basin has mainly been a result of pumping and treating this water by operating mining companies within the Basin. The devastating potential enters from what have been termed "orphan mines", or bankrupt coal mining operations that discontinue their mine acid abatement systems (Western Pennsylvania Coalition for Abandoned Mine Reclamation 2003). The existing Monongahela River Mine Pool has been described as a giant football shape stretching from Fairmont, WV, to the south; Pittsburgh, PA, on the north; Wheeling, WV, to the west; and Uniontown, PA, on the east. The West Virginia University Center for Coal Mining Research conducted an extensive study to map the underground mining and water quality of this mine pool (Ziemkiewicz and Vandivort 2004). They have documented extremely acidic water with heavy metal loads within the mine pool. The mine pool has several points that are at a level where they may discharge their acid load to the Monongahela River in the near future.

The purpose of the work in 2003 was to document changes in the fish populations of the Monongahela River over the last 35 years since 1968 through the time-series rotenone surveys and night electrofishing data. These fish data will be used to demonstrate the importance of protecting the Monongahela River from the potential impacts of orphan mine discharges and to emphasize the

need for continued efforts toward prevention and remediation of point source and non-point source pollution in the Monongahela River Basin.

Methods

Historic sampling data were reviewed for the PA portion of the Monongahela River in January 2003. This review and the Ziemkiewicz and Vandivort (2004) study data were utilized to select the sampling strategy that would be conducted in 2003 and 2006. Tailwater night electrofishing and lock chamber rotenone sampling were selected for their value to compare with historical fish data. The West Virginia Department of Natural Resources (WVDNR) also was involved in a similar venue in their upstream portion of the Monongahela River.

Sampling in May 2003 consisted of tailwater night electrofishing at three dams: Grays Landing Lock and Dam in Section 02 (RM 82.0), Maxwell Lock and Dam in Section 03 (RM 61.2), and Braddock Lock and Dam in Section 06 (RM 11.2). Agency participation in this phase included the PFBC, ORSANCO, Pennsylvania Department of Environmental Protection (PADEP), United States Environmental Protection Agency (USEPA). Surveys consisted of 10 10-minute transects at each tailwater using pulsed DC boat mounted electrofishing equipment. Transects for each tailwater were split with five on each of the right descending and left descending banks. Two electrofishing crews were utilized to sample each tailwater on one sample night. All fish were collected during the electrofishing operation.

Fish occurrence, relative abundance, and age and growth were collected in accordance to methods prescribed for river sampling (Marcinko et al. 1986). Descriptive statistics for fish population data were generated, in part, through the Pennsylvania Fish and Boat Commission Electronic Data Processing system. All reported fish lengths are total length (TL). Lateral scales, viewed under a microprojector at 31X or 52X magnification, were used for age and growth determination. Otoliths were not used to verify age data from scales. The 2003 data were then compared to PFBC night electrofishing data collected from 1992, 1995, and 1996 at each tailwater.

Sampling in September 2003 consisted of lock chamber rotenone sampling. The three lock chambers adjacent to the May 2003 electrofishing sites were used which included Grays Landing, Maxwell, and Braddock. All fish were collected from the chamber through the aid of the fish toxicant rotenone. The species, numbers, lengths, and weights of all fish were then determined for comparison to previous years data starting from 1968. This survey was a multiple agency and multi-state effort that

included PFBC, PADEP, WVDNR, USEPA, ORSANCO, United States Army Corps of Engineers, and California University of Pennsylvania. Historical data from rotenone surveys conducted by ORSANCO from 1968 on were used for comparison.

Results

Basic surface water quality parameters were collected at each of our night electrofishing sites in May of 2003 and at one site in May 1992 (Table 2). The 2003 sampling of three sites had a pH range from 7.1 to 7.6. Alkalinity in 2003 was lowest at the Grays Landing site at 19 mg/l and increased to 40 mg/l at Maxwell and 36 mg/l at Braddock. Braddock pH and alkalinity were lower in 1992 than in 2003 at 7.1 and 23 mg/l, respectively.

Fish species occurrence from night electrofishing and rotenone in 2003 resulted in 40 species total collected at Grays Landing (Table 3). Of the 40 species, 14 were collected with both gears, 11 by electrofishing only, and 15 by rotenone only. There were four PA endangered, threatened, or candidate species collected in 2003 at Grays Landing. The Maxwell total species collected from electrofishing and rotenone in 2003 was 43 (Table 4). Nineteen species were collected with both gears at Maxwell, with 15 species collected with electrofishing only and 9 species collected with rotenone only. Pennsylvania endangered, threatened, or candidate species collected in 2003 at Maxwell included 8 species. The 2003 fish species occurrence for Braddock from both gear types had a total of 33 species (Table 5). Species found with both gears at Braddock was 19, 7 species were collected with electrofishing only, and 7 species with rotenone only. There were 6 total PA endangered, threatened, or candidate species collected in 2003 at Braddock.

Catch and catch per unit effort (CPUE) data were compiled for Grays Landing selected species from the spring tailwater night electrofishing sampling of 1996 and 2003. Catches were low for all species with the exception of smallmouth bass in 1996 (Table 6). Mean total CPUE was highest for smallmouth bass in 1996 at 24.85/hr. Sauger and smallmouth bass had the highest catches of the selected species in 2003 sampling at Grays Landing. Flathead catfish *Pylodictis olivaris* were not collected by night electrofishing in either 1996 or 2003. All mean total CPUE's were higher in 2003 than 1996 at Grays Landing, with the exception of channel catfish. Catch per unit effort (CPUE) $\geq$ 300 mm for sauger, smallmouth bass, and walleye *S. vitreus* were higher in 2003 than in 1996. Actually, CPUE $\geq$ 300 mm for sauger and walleye was 0/hr in 1996. The catch of sauger, smallmouth bass, and walleye $\geq$ 375 mm was 0 for Grays Landing in 1996, whereas, which of these three species $\geq$ 375 mm was greater than year 2003.

Fish catch and CPUE data for Maxwell were available for comparison from 1995 and 2003 sampling for night electrofishing. Total catch and mean total CPUE were higher in 2003 versus 1995 for all species with the exception of white bass (Table 7). Smallmouth bass and white bass had the highest Mean Total CPUE of the selected species in 1995, while sauger and smallmouth bass were highest in 2003. Catch per unit effort (CPUE) $\geq$ 300 mm was considerably higher for sauger, smallmouth bass, and walleye in 2003 compared to 1995. There were no sauger, smallmouth bass, or walleye $\geq$ 375 mm collected in 1995 from Maxwell; whereas, smallmouth bass and walleye $\geq$ 375 mm were sampled in 2003.

Night electrofishing at Braddock took place in 1992 and 2003. Sauger and smallmouth bass had the highest mean total CPUE of the selected species in both 2003 and 1992 (Table 8). Mean total CPUE was lower in 2003 than in 1992 for rock bass *Ambloplites rupestris*, sauger, smallmouth bass, and white bass. Mean total CPUE was higher in 2003 than 1992 for channel catfish, flathead catfish, freshwater drum *Aplodinotus grunniens*, and walleye. However, Catch per unit effort (CPUE) $\geq$300 mm was higher in 2003 than in 1992 for all of the selected species. Rock bass CPUE $\geq$ 175 mm was lower in 2003 compared to 1992. Catch per unit effort (CPUE) $\geq$ 375 mm was higher in 2003 than 1992 for channel catfish, flathead catfish, smallmouth bass and walleye, while freshwater drum, and sauger had lower CPUE $\geq$ 375 mm in 2003 versus 1992.

Sampling period means were computed from tailrace night electrofishing fish catch and CPUE data for selected species by combining sites at Grays Landing, Maxwell, and Braddock (Sections 02, 03, and 06) across years (1996, 1995, and 1992 as one; and 2003 the other). Annual combined site mean total CPUE was higher in 2003 versus the 1990s for channel catfish, flathead catfish, freshwater drum, smallmouth bass, rock bass, sauger, and walleye and was lower for white bass (Tables 9, 10, 11, and 12). All of the selected species CPUE > 300 mm (rock bass > 175 mm) combined means were higher in 2003 compared to the 1990s. Annual combined means for CPUE > 375 mm were higher in 2003 for channel catfish, flathead catfish, smallmouth bass, and walleye; whereas, CPUE > 375 mm was lower for freshwater drum, white bass, and sauger.

Night electrofishing data for smallmouth bass, sauger, and walleye from the PFBC Fish Management Database were queried for comparison to our two Monongahela River sampling periods 1990s and 2003. Overall mean total CPUE, CPUE $\geq$ 300 mm, and CPUE $\geq$ 375 mm data were computed for the Area 8 portions of the Monongahela River overall 1992 to 2003, Allegheny River overall (1986 to 2000), and the Ohio River overall 1990 to 2002. The smallmouth

bass 2003 Monongahela River sampling period mean total CPUE was highest, followed by the Allegheny River overall mean (Figure 1). The CPUE > 300 mm and CPUE > 375 mm showed the Monongahela River 2003 sampling period as the highest, followed by the Monongahela River Overall (Figures 2 and 3).

The sauger mean total CPUE and CPUE > 300 mm were highest for the Monongahela River in 2003 of the five measures compared (Figures 4 and 5). The next to highest sauger mean total CPUE was from the Monongahela River 1990s and Monongahela River overall. The next to highest sauger CPUE > 300 mm was for Monongahela River overall and Allegheny River overall. Catch per unit effort (CPUE) > 375 mm for sauger was highest for the Monongahela River 1990s, followed again by the Monongahela River overall and Allegheny River overall (Figure 6). Walleye mean total CPUE, CPUE > 300 mm, and CPUE > 375 mm were all highest for the Allegheny River overall, followed by the Monongahela River in 2003 (Figures 7, 8, and 9).

Mean back calculated lengths at age data were assembled from Monongahela River night electrofishing for white bass, smallmouth bass, rock bass, sauger and walleye. Means were then computed for Grays Landing and Maxwell in 1995 and 1996, Grays Landing and Maxwell in 2003, and Braddock in 2003. Age 4 white bass were not collected from Grays Landing and Maxwell in the 1990s (Table 13). Age 2 white bass from Grays Landing and Maxwell for 2003 had the highest mean back calculated length, and Braddock white bass at Ages 3 and 4 had the highest mean back calculated length. Four age classes of white bass were collected from the Grays Landing and Maxwell 2003 work, while two age classes were represented from Grays Landing and Maxwell in 1995 and 1996.

Smallmouth bass, rock bass, sauger, and walleye mean back-calculated lengths were, for most age classes, higher for Grays Landing and Maxwell 2003 and Braddock 2003 samples compared to Grays Landing and Maxwell 1990s samples (Tables 14 and 15). Smallmouth bass mean back calculated length for Grays Landing and Maxwell 1990s was similar to the Grays Landing and Maxwell 2003 for Age classes 1 to 5, and Grays Landing and Maxwell 2003 Ages 6 and 7 were higher. The mean back calculated length for rock bass and sauger showed 3 of 4 age classes were higher for the Grays Landing and Maxwell 2003 versus the Grays Landing and Maxwell 1990s. Walleye mean back calculated length was higher for all Age classes of the Grays Landing and Maxwell 2003 period compared to the Grays Landing and Maxwell 1990s period.

The 2003 Grays Landing rotenone sampling had 28 total species in the collection (Table 3). This was the first time for rotenone sampling at Grays Landing. The 2003 rotenone survey total fish

weight collected was 81.72 Kg, and total fish count was 13,823 (Table 16). The biomass total for Grays Landing was 145.41 kg/ha. The species with the highest total weight at Grays Landing was carp *Cyprinus carpio* at 21.15 kg (26% of total), and the highest in total numbers was emerald shiner *Notropis atherinoides* at 12,986 (94% of total).

The 2003 rotenone sampling at Maxwell was the eleventh time for this survey type since 1968. The 2003 Maxwell rotenone sampling had 26 total species in the collection (Table 4). The 2003 rotenone survey total fish weight collected was 77.41 Kg; total fish count was 7,310 (Table 16). Of the 11 rotenone samples at Maxwell, 2003 had the highest total fish count (7,310) and total species (26). The Maxwell rotenone sampling number of species and total weight collected increased steadily from 1968 to 2003 (Figures 10 and 11). The species with the highest total weight at Maxwell was carp at 38.07 kg (49% of total), and the highest in total numbers was emerald shiner at 6,099 (83% of total). The Maxwell biomass for rotenone sampling in 2003 was 137.75 kg/ha.

The 2003 rotenone sampling at Braddock was the sixteenth time for this survey type since 1968. The 2003 Braddock rotenone sampling had 25 total species in the collection (Table 5). The 2003 rotenone survey total fish weight collected was 275.47 Kg; total fish count was 1,127 (Table 17). Of the 16 rotenone samples at Braddock, 2003 had the highest total weight (275.47 Kg) and total species (25). The Braddock rotenone sampling number of species and total weight collected increased steadily from 1969 to 2003 (Figures 12 and 13). The species with the highest total weight at Braddock was carp at 151.21 kg (55% of total), and the highest in total numbers was emerald shiner at 344 (30% of total). The total fish biomass from Braddock in 2003 was 1473.09 kg/ha.

Discussion

The basis of the 2003 Monongahela River fish sampling lies in research conducted as part of the EPA Region 3 funded Mine Pool Project (Ziemkiewicz and Vandivort 2004). This research was conducted by West Virginia University's National Mine Lands Reclamation Center. The study included mapping underground mine pools from over fifty mines, monitoring mine levels and water chemistry. Abandoned and orphaned mines near the PA-WV border in the vicinity of Dunkard Creek and Tenmile Creek have gone from being largely dry to being largely flooded. The mines in this area pose some long-term threats of surface discharge of a large volume of highly acidic water, or leakage into adjacent mines posing similar threats. The most imminent danger was predicted from the Shannopin Mine on Dunkard Creek with a continuing mine

pool rise that could result in a surface discharge by the end of 2004. The Gateway Mine on Tenmile Creek has a more complicated scenario due to leakage and spillage to adjacent mines, but its discharge location could likely be at or downstream of Clarksville, PA. Mine drainage discharges from the Monongahela River Mine Pool have the potential for serious negative impact to aquatic life in the Monongahela River. The PFBC was part of a multi-Agency team to gather aquatic resource data in an effort to focus attention and avoid a potential catastrophe from the mine drainage problem. The PFBC charge was to document the current status of fish populations in the Monongahela River downstream of these problem areas from 1968 to 2003.

The Monongahela River pH at Grays Landing (RM 81.42) in May 2003 was registered at 7.1. Data from the same area for June 1975 from the USACOE ranged in pH from 4.2 to 5.5 (U.S. Army Engineer District, Pittsburgh Corps of Engineers 1976). The potential for flow differences between samples is recognized, however, a shift toward better water quality was noted. Alkalinity ranged from 19 mg/l at Grays Landing (RM 81.42) to 36 mg/l at Braddock (RM 10.59) in 2003. Alkalinity at Braddock in May of 1992 was 23 mg/l. Thus, evidence is provided for water quality improvement from 1975 to 2003 in the Monongahela River with conditions improving as you move downriver. The 1975 USACOE report also noted improved water quality as one progressed downriver from the mine drainage impacted Cheat River (Monongahela River RM 89.59).

There were 55 total species collected from the Monongahela River in 2003 using night electrofishing and rotenone sampling from all sampling locations. This demonstrates the diverse fish species assemblage in the Monongahela River. The total number of species collected from night electrofishing and rotenone was 40 at Grays Landing, 43 at Maxwell, and 33 at Braddock. Several species on the Pennsylvania endangered (E), threatened (T), or candidate(C) species lists were captured in 2003 sampling. Pennsylvania endangered species included ghost shiner *N. buchanani* at all three sites, and silver chub *Macrhybopsis storeriana* at Maxwell. Threatened Species sampled included mooneye *Hiodon tergisus* and skipjack herring *Alosa chrysochloris* at all three sites, smallmouth buffalo *Ictiobus bubalus* at Maxwell and Braddock, and channel darter *Percina copelandi* at Maxwell. Pennsylvania candidate species were longnose gar *Lepisosteus osseus* at all three sites; brook silverside *Labidesthes sicculus* at Maxwell, and river redhorse *Moxostoma carinatum* at Braddock. This also provides the importance of the Monongahela River as habitat for at least nine Pennsylvania species of special concern. Additionally, the PFBC 2003 sampling was the first occurrence for silver chub, ghost shiner, channel darter, and paddlefish *Polyodon spathula* in the Monongahela

River in Pennsylvania. The silver chub had been collected by the PFBC previously from the Ohio River. The 2003 collections from the Monongahela River for channel shiner *N. wickliffi*, ghost shiner, and paddlefish were the first recorded by the PFBC. The ORSANCO lock and dam rotenone sampling had historically collected channel shiner and ghost shiner in Pennsylvania. The USACOE collected one other paddlefish in Pennsylvania in Loyalhanna Creek at the base of Loyalhanna Dam in Westmoreland County in 1992. The PFBC has recorded numerous angler and public accounts of paddlefish in PA since restoration stocking began in 1991.

Several big river species collected in the 2003 sampling in the Monongahela River have been described as intolerant to pollution as determined for the Ohio River Fish Index (Emery et al. 2003). Intolerant to pollution species at Grays Landing were seven in total including black redhorse *M. duquesnei*, mimic shiner *N. volucellus*, mooneye, northern hog sucker *Hypentelium nigricans*, sand shiner *N. stramineus*, shorthead redhorse *M. macrolepidotum*, and smallmouth bass. At Maxwell there were also seven species collected considered intolerant to pollution to include channel darter, logperch *P. caprodes*, mimic shiner, mooneye, paddlefish, shorthead redhorse, and smallmouth bass. Braddock yielded five species as intolerant to pollution including greenside darter *Etheostoma blennioides*, mimic shiner, mooneye, river redhorse, and smallmouth bass.

Combining the sample methods of night electrofishing and rotenone, although labor intensive, proved useful in substantially increasing the total number of species collected at each of the three sampling sites. The total species collected was increased from 7 to 15 species at each sampling location (Grays Landing, Maxwell, and Braddock) by combining the two gear types. Differences in number of species collected came as a result of three features: habitat (tailwater vs. lock chamber), time of year (May vs. September), and gear selectivity (night electrofishing vs. rotenone). There were also comparisons to historical data that could be made from each sampling method as described below.

Eight gamefish and panfish species were selected to compare night electrofishing data for each tailrace site sampled in May 2003. The eight species considered most important to the Monongahela River fishery were channel catfish, flathead catfish, freshwater drum, rock bass, sauger, smallmouth bass, walleye, and white bass. The Grays Landing tailrace had 6 of 8 of these species that increased in mean total CPUE from 1996 to 2003, with the most dramatic increases from sauger and walleye at over 20 times greater. Quality sizes in the catch (CPUE > 300 mm and CPUE > 375 mm) of sauger, smallmouth bass and walleye

were low in 1996 and were much higher at Grays Landing in 2003. The Maxwell tailrace gamefish and panfish species mean total CPUE was higher for 7 of the 8 species, with freshwater drum, rock bass, sauger, and walleye showing the greatest increases of 4 times higher in 2003 versus 1995. Again, quality sizes (CPUE > 300 mm and CPUE > 375 mm) of sauger, smallmouth bass and walleye were low in 1995 and were much higher at Maxwell in 2003. Differences in mean total CPUE at Braddock tailrace had 4 species with an increase and 4 species with a decrease between 1992 and 2003. Quality sizes (CPUE > 300 mm and CPUE > 375 mm) of sauger, smallmouth bass and walleye were low in 1992 at Braddock and were higher in 2003. Overall, fish of interest to anglers were more abundant in the Monongahela River in 2003 and showed a considerable improvement in opportunities to catch fish. Also, the improvements were greater at Grays Landing and Maxwell, compared to Braddock. The greater relative increases at Grays Landing and Maxwell were most likely a result of more marked water quality improvements over that time period.

Annual mean CPUE comparison for Monongahela River night electrofishing data for eight gamefish and panfish species was accomplished by computing annual means (1996, 1995, and 1992 to 2003) for the three tailraces combined (Grays Landing, Maxwell, and Braddock). Mean total CPUE and CPUE > 300 mm were higher for 7 of the 8 species in 2003 versus the 1990s to include channel catfish, flathead catfish, freshwater drum, smallmouth bass, rock bass, sauger, and walleye. The quality size (CPUE > 300 mm) rates for sauger and walleye had the most substantial increases of at least 8 times higher. The 2003 abundance of larger size (CPUE > 375 mm) channel catfish, flathead catfish, smallmouth bass and walleye were higher compared to the 1990s. These figures also pointed toward a higher quantity and quality of fish available to anglers in the Monongahela River in 2003.

Age and growth data for night electrofishing sampling from white bass, rock bass, smallmouth bass, sauger, and walleye were also reviewed by determining means across years (1996, 1995, and 1992 to 2003) for the three tailraces (Grays Landing, Maxwell, and Braddock). Older and larger individuals were sampled in 2003 for four of five species (white bass, rock bass, smallmouth bass, and walleye). Overall, mean back calculated lengths at age for all five species were higher from 2003 sampling. Improved water quality likely influenced growth and survival of these species in 2003.

Smallmouth bass, sauger, and walleye comprised 79% of the total directed fishing effort from a creel survey in 2000 on the lock and dam portion of the Allegheny River (Lorson and Miko 2001). We assume a similar response in directed fishing effort in the Monongahela River and looked at additional abundance comparisons

for these three species with a focus on the 2003 Monongahela River data. Pennsylvania Fish and Boat Commission database night electrofishing CPUE means were computed for the lock and dam portions of the Three Rivers (Monongahela River combined, Allegheny River combined (from Lock and Dam 6 at Clinton to the mouth at Pittsburgh), and Ohio River combined) from 1986 to 2003. Smallmouth bass catch rates (mean total CPUE, CPUE > 300 mm, and CPUE > 375 mm) from the Monongahela River in 2003 were all higher than Three Rivers catch rates (Figures 1, 2, and 3). The Monongahela River 2003 sauger mean total CPUE and CPUE > 300 mm were also higher than any of those in the Three Rivers system (Figures 4, 5 and 6). Walleye abundance rates for the Monongahela River in 2003 (mean total CPUE, CPUE > 300 mm, and CPUE > 375 mm) were all second highest behind the Allegheny River combined (Figures 7, 8 and 9). The Monongahela River has historically been considered below the Ohio and Allegheny Rivers in gamefish abundance, however, that picture has changed over the last ten years.

A longer data set back to 1968 was available for rotenone sampling at Maxwell and at Braddock primarily through the monitoring efforts of ORSANCO. Although rotenone sampling is limited in scope for gamefish and panfish populations, it can be used to reflect long-term trends since other gear types were simply not employed in the Monongahela River until the mid-1980s. The total species count was the most descriptive information for our purposes. The highest number of species collected in years from 1968 to 2003 at both Maxwell and Braddock occurred in 2003 at 26 and 25 species, respectively. The total species mean for Maxwell was 16, with the lowest total species in 1968 at 1. The total species mean for Braddock was 15, with lowest total species of 8 occurring in 1968, 1978, and 1990. The 2003 rotenone data at Maxwell yielded the highest total fish count, while at Braddock the highest total fish weight was registered in 2003. Trend lines for Maxwell and Braddock for total species and total weight were both positive for data spanning 1968 to 2003. Interestingly, 2003 was the first year of rotenone sampling at Grays Landing and it had the highest total fish count (13,823) and total species count (28) of the three chambers sampled in 2003. Grays Landing is situated in the area of the greatest historical water quality degradation of the three lock chambers. The rotenone data provides another bioindicator of much improved conditions for fish survival and reproduction available in the Monongahela River in 2003.

A portion of this study not reported here involved sampling with night electrofishing gear in May 2003 near the mouth of Dunkard Creek (RM 87.20) and Tenmile Creek (RM 65.60). Sites were sampled directly above and below the mouths of these two tributaries. Ziemkievicz and Vandivort (2004) sited Dunkard

Creek and Tenmile Creek as having the earliest and highest likelihood of a mine drainage breakout from the mine pool. These data can be drawn upon if water quality changes in either of these tributaries.

The treatment and control of acid mine drainage in the Pennsylvania portion of the Monongahela River basin really began around 1970. An EPA study of the fish populations from rotenone sampling at Maxwell and Braddock from 1967 to 1973 noted dramatic changes over their short-term (Preston 1974). They had 0 and 20 fish collected from the Maxwell and Braddock lock chambers in 1967. Over the thirty-five years from 1968 to 2003 there was an average number of fish collected of 1,715 at Maxwell and 9,441 at Braddock during lock chamber rotenone sampling. The PFBC sampled fish populations from 1992 to 1994 with night electrofishing, gill nets and seining from the tailwaters of Lock and Dam 4 at Charleroi (RM 41.5), Lock and Dam 3 at Elizabeth (RM 23.8), and Lock and Dam 2 at Braddock (RM 11.2). Results from this work included findings of good populations of gamefish and panfish populations discussed in this report and lead to a fishery management plan for these sections of the Monongahela River which was a change from simply monitoring this River's recovery from pollution (Miko and Lorson 1994).

The 2003 night electrofishing and rotenone sampling of the Monongahela River provided a healthy fish population picture. Fishing opportunities are currently considered abundant and varied for this river for many species. A forage fish base of numerous species is also now available in the river to sustain these populations. Fish populations will continue to vary annually based on environmental conditions, but still are being targeted by anglers at increasing levels. Efforts must continue toward pollution abatement in the watershed. This work provides an emphasis to also work toward avoidance of the impact that could occur from the acid-laden mine pool waters reaching the Monongahela River.

Management Recommendations

1. This multi-Agency Monongahela River Mine Pool study will be repeated in 2006.

2. Cooperating Agencies should work toward acquiring funds for creel survey work on the Monongahela River. This would provide angler use and fish harvest data, and an economic assessment of the value of this fishery.

3. A copy of this report should be provided to PFBC Steve Kepler; PFBC John Arway; PFBC Emil Svetahor; Frank Borsuk, Ph.D., Freshwater Biology Team Leader, USEPA-Region 3 Wheeling Office, 1060 Chapline Street, Suite 303, Wheeling, WV 26003-2995; Erich Emery, Ohio River Valley Water Sanitation Commission, 5735 Kellogg Avenue, Cincinnati, OH 45228; Tom Proch, Aquatic Biologist, Pennsylvania Department of Environmental Protection, 400 Water Front Drive, Pittsburgh, PA 15222; Rick Spear, Aquatic Biologist, Pennsylvania Department of Environmental Protection, 400 Water Front Drive, Pittsburgh, PA 15222; Frank Jernejcic, West Virginia Division of Natural Resources, PO Box 99 1110 Railroad Street, Farmington, WV 26571; Chris O'Bara, West Virginia Division of Natural Resources, 2311 Ohio Avenue, Parkersburg, WV 26101; Bob Hoskin, U.S. Army Corps of Engineers Pittsburgh District, 1205 Kinzua Road, Warren, PA 16365-5599; Mike Fowles, U.S. Army Corps of Engineers Pittsburgh District, RD 2 Box 131, Saltsburg, PA 15681; Rosemary Reilly, U.S. Army Corps of Engineers Pittsburgh District, 2032 William S. Moorhead Federal Building, 1000 Liberty Avenue, Pittsburgh, PA 15222-4186; and Paul Ziemkavicz Ph.D, Director, National Mine Land Reclamation Center, West Virginia University, PO Box 6064, Morgantown, WV 26506-6064.

Literature Cited

Emery, E.B., T.P. Simpson, F.H. McCormick, P.L. Angermeier, J.E. Deshon, C.O.Yoder, R.E. Sanders, W.D. Pearson, G.D. Hickman, R.J. Reash, and J.A. Thomas. 2003. Development of a multimetric index for assessing the biological condition of the Ohio River. North American Journal of Fisheries Management 132: 791-808.

Lorson, R.D. and G.A. Smith. 2001. Allegheny River (818 A,F), Sections 19 and 20: Big Bass regulation evaluation. Pennsylvania Fish and Boat Commission, Fisheries Management Area 8. Somerset, Pennsylvania.

Marcinko, M., R.D. Lorson and R.L. Hoopes. 1986. Procedures for stream and river inventory information input. Pennsylvania Fish and Boat Commission, Fisheries Management Division. Bellefonte, Pennsylvania.

Miko, D. and R. Lorson. 1994. Monongahela River (819A&C) management report, Sections 04-06. Pennsylvania Fish and Boat Commission, Fisheries Management Area 8. Somerset, Pennsylvania.

Pittsburgh Federal Executive Board. 1972. Proceedings of the Tri-State Environmental Symposium. Three Rivers Improvement and Development Corporation. Pittsburgh, PA.

Preston, H.R. 1974. Monongahela River Basin aquatic biology, Part 1: Fish population studies of the Monongahela River. EPA 903/9-75-016. U.S. Environmental Protection Agency, Region 3, S&A Division. Wheeling Field Office. Wheeling, West Virginia.

Putnam, D.J., D.F Brown and F.R. Plewa. 1984. Planning aid report-Fish and wildlife resources of the lower Monongahela River locks and dams 2, 3, and 4. U.S. Department of the Interior Fish and Wildlife Service, Region 5. State College, Pennsylvania. 44 pages.

U.S. Army Engineer District, Pittsburgh. 1976. Monongahela River navigation projects annual water quality report: An evaluation of the effect of mainstem navigation dams on the water quality of the Monongahela River. U.S. Army Engineer District, Pittsburgh Corps of Engineers. Pittsburgh, Pennsylvania.

Weller, R., W.B. Perry, F. Jernejcic, and S.A Perry. 1991. Improvements in fish populations of the Monongahela River, West Virginia, after reduction of acid mine drainage.

Proceedings of the Annual Conference of the Southeast Association of Fish and Wildlife Agencies. 45:407-414.

Western Pennsylvania Coalition for Abandoned Mine Reclamation. 2003. PA's orphan mines: Grave threat or new opportunities. Western Pennsylvania Coalition for Abandoned Mine Reclamation, Coalition News, November 2003. Greensburg, Pennsylvania.

Ziemkievicz, P. and T. Vandivort. 2004. WV173 Phase 3: EPA Region 3 Mine Pool Project final report. National Mine Land Reclamation Center, West Virginia University. Morgantown, West Virginia.

Table 1. Monongahela River (819A, B, C, and G) fisheries management sectioning strategy.

Section	Length (Km)	Mean Width (m)	Limits
01	14.9	189.6	From the PA-WV State Line at Point Marion downstream to Grays Landing Lock and Dam at Grays Landing (RM: 91.3 to 82.0)
02	33.5	200.9	From Grays Landing Lock and Dam at Grays Landing downstream to Maxwell Lock and Dam at Maxwell (RM: 82.0 to 61.2)
03	31.5	198.15	From Maxwell Lock and Dam at Maxwell downstream to Lock and Dam 4 at Charleroi (RM: 61.2 to 41.5)
04	28.5	221.5	From Lock and Dam 4 at Charleroi downstream to Lock and Dam 3 at Elizabeth (RM: 41.5 to 23.8)
05	20.3	225.96	From Lock and Dam 3 at Elizabeth downstream to Lock and Dam 2 at Braddock (RM: 23.8 to 11.2)
06	18.0	255.1	From Lock and Dam 2 at Braddock downstream to The Point at Pittsburgh (RM: 11.2 to 0.0)

Table 2. Surface water chemistries collected from Monongahela River, Sections 02, 03, and 06 (819A, C, and G) for 2003 and 1992.

Section Number (River Mile)	Date	Water Temp. (°C)	Diss. Oxygen (ml/g)	Alk. (mg/l)	Hard. (mg/l)	Spec. Cond. (umhos)	pH (SU)
2 (81.42)	5/21/03	15.1	10.7	19	82	152	7.1
3 (60.77)	5/22/03	15.8	10.5	40	85	176	7.1
6 (10.59)	5/27/03	17.7	9.2	36	97	230	7.6
6 (10.59)	5/20/92	23.0	--	23	90	288	7.1

Table 3. Fish species occurrence for the Monongahela River, Section 2 (819G) from night electrofishing and lock chamber rotenone sampling in 2003. An E denotes a PA Endangered species, a T for a PA Threatened species, and a C for a PA Candidate species.

Common Name	*Scientific Name*	*Night EF May 2003*	*Rotenone Sept. 2003*
Black Redhorse	*Moxostoma duquesnei*	X	X
Bluegill	*Lepomis macrochirus*	X	X
Bluntnose Minnow	*Pimephales notatus*		X
Channel Catfish	*Ictalurus punctatus*	X	X
Channel Shiner	*Notropis wickliffi*		X
Common Carp	*Cyprinus carpio*	X	X
Emerald Shiner	*Notropis atherinoides*	X	X
Flathead Catfish	*Pylodictis olivaris*		X
Freshwater Drum	*Aplodinotus grunniens*	X	X
Ghost Shiner[E]	*Notropis buchanani*		X
Gizzard Shad	*Dorosoma cepedianum*	X	X
Golden Redhorse	*Moxostoma erythrurum*	X	X
Golden Shiner	*Notemigonus crysoleucas*		X
Largemouth Bass	*Micropterus salmoides*	X	
Logperch	*Percina caprodes*	X	
Longnose Gar[C]	*Lepisosteus osseus*	X	
Mimic Shiner	*Notropis volucellus*		X
Mooneye[T]	*Hiodon tergisus*		X
Muskellunge	*Esox masquinongy*		X
N. Hog Sucker	*Hypentelium nigricans*	X	
Pumpkinseed	*Lepomis gibbosus*	X	
Quillback	*Carpiodes cyprinus*	X	X
Rainbow Darter	*Etheostoma caeruleum*		X
River Carpsucker	*Carpiodes carpio*		X
Rock Bass	*Ambloplites rupestris*	X	X
Sand Shiner	*Notropis stramineus*	X	
Sauger	*Sander canadense*	X	X
Saugeye	*Sander vitreus x s. canadense*	X	
Shorthead Redhorse	*Moxostoma macrolepidotum*	X	
Silver Redhorse	*Moxostoma anisurum*	X	
Skipjack Herring[T]	*Alosa chrysochloris*		X
Smallmouth Bass	*Micropterus dolomieui*	X	X
Spotfin Shiner	*Cyprinella spiloptera*	X	
Spottail Shiner	*Notropis hudsonius*	X	
T. Muskellunge	*Esox lucius x E. masquinongy*		X
Walleye	*Sander vitreus*	X	X
White Bass	*Morone chrysops*	X	X
White Crappie	*Pomoxis annularis*		X
Yellow Bullhead	*Ameiurus natalis*		X
Yellow Perch	*Perca flavescens*		X
Totals: 40 Species		25	29

Table 4. Fish species occurrence for the Monongahela River, Section 3 (819C) from night electrofishing and lock chamber rotenone sampling in 2003. An E denotes a PA Endangered species, a T for a PA Threatened species, and a C for a PA Candidate species.

Common Name	*Scientific Name*	*Night EF May 2003*	*Rotenone Sept. 2003*
Black Crappie	*Pomoxis nigromaculatus*	X	X
Bluegill	*Lepomis macrochirus*	X	X
Bluntnose Minnow	*Pimephales notatus*	X	
Brook Silverside[C]	*Labidesthes sicculus*		X
Channel Catfish	*Ictalurus punctatus*	X	X
Channel Darter[T]	*Percina copelandi*	X	
Channel Shiner	*Notropis wickliffi*		X
Common Carp	*Cyprinus carpio*	X	X
Emerald Shiner	*Notropis atherinoides*	X	X
Flathead Catfish	*Pylodictis olivaris*	X	X
Freshwater Drum	*Aplodinotus grunniens*	X	X
Ghost Shiner[E]	*Notropis buchanani*		X
Gizzard Shad	*Dorosoma cepedianum*	X	X
Golden Redhorse	*Moxostoma erythrurum*	X	
Green Sunfish	*Lepomis cyanellus*	X	X
Johnny Darter	*Etheostoma nigrum*		
Largemouth Bass	*Micropterus salmoides*	X	
Logperch	*Percina caprodes*	X	
Longnose Gar[C]	*Lepisosteus osseus*	X	
Mimic Shiner	*Notropis volucellus*	X	X
Mooneye[T]	*Hiodon tergisus*		X
Paddlefish	*Polyodon spathula*		
Pumpkinseed	*Lepomis gibbosus*	X	
Quillback	*Carpiodes cyprinus*	X	X
Rainbow Darter	*Etheostoma caeruleum*	X	
River Carpsucker	*Carpiodes carpio*	X	X
River Chub	*Nocomis micropogon*	X	
Rock Bass	*Ambloplites rupestris*	X	X
Sauger	*Sander canadense*	X	X
Saugeye	*Sander vitreus x s. canadense*	X	
Shorthead Redhorse	*Moxostoma macrolepidotum*	X	
Silver Chub[E]	*Macrhybopsis storeriana*	X	X
Silver Redhorse	*Moxostoma anisurum*	X	
Skipjack Herring[T]	*Alosa chrysochloris*		X
Smallmouth Bass	*Micropterus dolomieui*	X	X
Smallmouth Buffalo[T]	*Ictiobus bubalus*	X	
Spotfin Shiner	*Cyprinella spiloptera*	X	
Spottail Shiner	*Notropis hudsonius*	X	
Walleye	*Sander vitreus*	X	X
White Bass	*Morone chrysops*	X	X
White Perch	*Morone americana*		X
White X Striped Bass	*White x striped bass*	X	X
Yellow Bullhead	*Ameiurus natalis*		X
Totals: 43 Species		34	26

Table 5. Fish species occurrence for the Monongahela River, Section 6 (819A) from night electrofishing and lock chamber rotenone sampling in 2003. An E denotes a PA Endangered species, a T for a PA Threatened species, and a C for a PA Candidate species.

Common Name	*Scientific Name*	*Night EF May 2003*	*Rotenone Sept. 2003*
Bluegill	*Lepomis macrochirus*	X	X
Channel Catfish	*Ictalurus punctatus*	X	X
Channel Shiner	*Notropis wickliffi*		X
Common Carp	*Cyprinus carpio*	X	X
Emerald Shiner	*Notropis atherinoides*	X	X
Flathead Catfish	*Pylodictis olivaris*	X	X
Freshwater Drum	*Aplodinotus grunniens*	X	X
Ghost Shiner[E]	*Notropis buchanani*		X
Gizzard Shad	*Dorosoma cepedianum*	X	X
Golden Redhorse	*Moxostoma erythrurum*	X	
Greenside Darter	*Etheostoma blennioides*	X	
Largemouth Bass	*Micropterus salmoides*	X	
Longnose Gar[C]	*Lepisosteus osseus*	X	
Mimic Shiner	*Notropis volucellus*		X
Mooneye[T]	*Hiodon tergisus*		X
Quillback	*Carpiodes cyprinus*	X	
Redear Sunfish	*Lepomis microlophus*		X
River Carpsucker	*Carpiodes carpio*		X
River Redhorse[C]	*Moxostoma carinatum*	X	
Rock Bass	*Ambloplites rupestris*	X	X
Sauger	*Sander canadense*	X	X
Saugeye	*Sander vitreus x s. canadense*	X	X
Shorthead Redhorse	*Moxostoma macrolepidotum*	X	X
Silver Redhorse	*Moxostoma anisurum*	X	X
Skipjack Herring[T]	*Alosa chrysochloris*		X
Smallmouth Bass	*Micropterus dolomieui*	X	X
Smallmouth Buffalo[T]	*Ictiobus bubalus*	X	X
Spotfin Shiner	*Cyprinella spiloptera*	X	X
Spottail Shiner	*Notropis hudsonius*	X	
Walleye	*Sander vitreus*	X	X
White Bass	*Morone chrysops*	X	X
White Perch	*Morone americana*	X	X
White X Striped Bass	*White x striped bass*	X	X
Totals: 33 Species		26	26

Table 6. Summary of night electrofishing fish catch and CPUE data for selected species from the Monongahela River, Section 02 (819G) at the Grays Landing Dam tailrace.

Species	Year	Total Effort	Total Catch	Mean Total CPUE (No/Hr)	Standard Error	Catch >300 mm	CPUE ≥300 mm (No/Hr)	Standard Error	Catch >375 mm	CPUE ≥375 mm (No/Hr)	Standard Error
Channel Catfish	1996	1.92	3	1.5	0.87	3	1.5	0.87	1	0.50	0.50
	2003	1.7	2	1.18	0.78	2	1.18	0.78	2	1.18	0.78
Flathead Catfish	1996	1.92	0	0	0	0	0	0	0	0	0
	2003	1.7	0	0	0	0	0	0	0	0	0
Freshwater Drum	1996	1.92	3	1.72	1.72	1111	--	--	1111	--	--
	2003	1.7	4	2.35	0.96	4	2.35	0.96	1	0.59	0.59
Rock Bass	1996	1.92	14	7.36	0.75	*5	2.64	1.36	0	0	0
	2003	1.7	17	10	4.21	*6	3.53	2.35	0	0	0
						(* ≥175 mm for Rock Bass)					
Sauger	1996	1.92	6	3.22	1.06	0	0	0	0	0	0
	2003	1.7	125	73.53	18.04	24	14.12	5.7	1	0.59	0.59
Smallmouth Bass	1996	1.92	49	24.85	14.59	4	2.14	1.08	0	0	0
	2003	1.7	67	39.41	12.59	15	8.82	3.95	4	2.35	1.3
Walleye	1996	1.92	1	0.5	0.5	0	0	0	0	0	0
	2003	1.7	22	12.94	4.37	8	4.7	1.71	1	0.59	0.59
White Bass	1996	1.92	3	1.57	0.87	0	0	0	0	0	0
	2003	1.7	8	4.7	2.6	2	1.18	0.78	0	0	0

(Note: 1111= Individual Fish Not Measured)

Table 7. Summary of night electrofishing fish catch and CPUE data for selected species from the Monongahela River, Section 03 (819C) at the Maxwell Dam tailrace.

Species	Year	Total Effort	Total Catch	Mean Total CPUE (No/Hr)	Standard Error	Catch >300 mm	CPUE ≥300 mm (No/Hr)	Standard Error	Catch >375 mm	CPUE ≥375 mm (No/Hr)	Standard Error
Channel Catfish	1995	2.72	8	3.65	1.30	5	2.55	1.40	2	1.54	1.54
	2003	1.7	10	5.88	2.32	1111	--	--	1111	--	--
Flathead Catfish	1995	2.72	0	0	0	0	0	0	0	0	0
	2003	1.7	1	0.59	0.59	0	0	0	0	0	0
Freshwater Drum	1995	2.72	4	1.60	1.60	4	1.60	1.60	1	0.40	0.40
	2003	1.7	12	7.06	2.29	1111	--	--	1111	--	--
Rock Bass	1995	2.72	9	3.33	1.04	*4	1.67	0.83	0	0	0
	2003	1.7	20	11.76	2.91	*5	2.94	1.31	0	0	0
						(* ≥175 mm for Rock Bass)					
Sauger	1995	2.72	28	13.38	6.16	6	3.40	2.13	0	0	0
	2003	1.7	87	51.18	8.94	41	24.12	5.07	0	0	0
Smallmouth Bass	1995	2.72	69	23.88	9.17	12	4.27	2.19	0	0	0
	2003	1.7	85	50.00	11.10	26	15.29	5.05	2	1.18	0.78
Walleye	1995	2.72	6	1.96	0.89	1	0.38	0.38	0	0	0
	2003	1.7	17	10.00	2.78	15	8.82	2.36	4	2.35	0.96
White Bass	1995	2.72	37	16.44	7.93	5	1.97	1.29	1	0.59	0.59
	2003	1.7	20	11.76	2.48	4	2.35	1.30	0	0	0

(Note: 1111= Individual Fish Not Measured)

Table 8. Summary of night electrofishing fish catch and CPUE data for selected species from the Monongahela River, Section 06 (819A) at the Braddock Dam tailrace.

Species	Year	Total Effort	Total Catch	Mean Total CPUE (No/Hr)	Standard Error	Catch >300 mm	CPUE ≥300 mm (No/Hr)	Standard Error	Catch >375 mm	CPUE ≥375 mm (No/Hr)	Standard Error
Channel Catfish	1992	1.88	7	3.92	1.86	7	3.92	1.86	4	2.29	1.22
	2003	1.7	10	5.88	2.15	10	5.88	2.15	6	3.53	1.30
Flathead Catfish	1992	1.88	1	0.67	0.67	1	0.67	0.67	0	0	0
	2003	1.7	2	1.18	0.78	2	1.18	0.78	2	1.18	0.78
Freshwater Drum	1992	1.88	6	3.24	1.52	4	2.28	1.75	2	1.20	1.20
	2003	1.7	25	14.71	2.94	6	3.53	1.30	1	0.59	0.59
Rock Bass	1992	1.88	9	4.68	1.61	*5	2.64	1.23	0	0	0
	2003	1.7	5	2.94	1.31	*3	1.76	1.26	0	0	0
						(* ≥175 mm for Rock Bass)					
Sauger	1992	1.88	172	97.67	27.91	6	3.62	1.82	5	3.02	1.43
	2003	1.7	50	29.41	6.32	34	20.00	5.96	1	0.59	0.59
Smallmouth Bass	1992	1.88	120	65.63	16.63	22	11.05	3.87	1	0.67	0.67
	2003	1.7	89	52.35	10.93	33	19.41	5.69	4	2.35	1.30
Walleye	1992	1.88	2	0.96	0.96	0	0	0	0	0	0
	2003	1.7	10	5.88	1.96	5	2.94	1.31	3	1.76	0.90
White Bass	1992	1.88	64	35.00	8.02	0	0	0	0	0	0
	2003	1.7	22	12.94	4.79	3	1.76	0.90	0	0	0

Table 9. Sampling period means of tailrace night electrofishing fish catch and CPUE data for channel and flathead catf the Monongahela River, Sections 2, 3, and 6 for 1992, 1995, 1996, and 2003.

Species	Year	Section	Total Catch	Mean Total CPUE (No/Hr)	Standard Error	Catch ≥300 mm	CPUE ≥300 mm (No/Hr)	Standard Error	Cat >375
Channel Catfish	1996	2	3	1.5	0.87	3	1.5	0.87	1
	1995	3	8	3.65	1.3	5	2.55	1.4	2
	1992	6	7	3.92	1.86	7	3.92	1.86	4
Sampling Period Means>>			6	3.02		5	2.66		2
	2003	2	2	1.18	0.78	2	1.18	0.78	2
	2003	3	10	5.88	2.32	1111	1111	1111	111
	2003	6	10	5.88	2.15	10	5.88	2.15	6
Sampling Period Means>>			7	4.31		6	3.53		4
Flathead Catfish	1996	2	0	0	0	0	0	0	0
	1995	3	0	0	0	0	0	0	0
	1992	6	1	0.67	0.67	1	0.67	0.67	0
Sampling Period Means>>			<1	0.22		<1	0.22		0
	2003	2	0	0	0	0	0	0	0
	2003	3	1	0.59	0.59	0	0	0	0
	2003	6	2	1.18	0.78	2	1.18	0.78	2
Sampling Period Means>>			1	0.59		1	0.39		1

(Note: 1111= Individual Fish Not Measured)

Table 10. Sampling period means of tailrace night electrofishing fish catch and CPUE data for freshwater drum and white bass from the Monongahela River, Sections 2, 3, and 6 for 1992, 1995, 1996, and 2003.

Species	Year	Section	Total Catch	Mean Total CPUE (No/Hr)	Standard Error	Catch ≥300 mm	CPUE ≥300 mm (No/Hr)	Standard Error	Catch ≥375 mm	CPUE ≥375 mm (No/Hr)	Sta Er
Freshwater Drum	1996	2	3	1.72	1.72	1111	1111	1111	1111	1111	1
	1995	3	4	1.6	1.6	4	1.6	1.6	1	0.4	(
	1992	6	6	3.24	1.52	4	2.28	1.75	2	1.2	1
Sampling Period Means>>			4	2.19		4	1.94		2	0.8	
	2003	2	4	2.35	0.96	4	2.35	0.96	1	0.59	0
	2003	3	12	1.06	2.29	1111	1111	1111	1111	1111	1
	2003	6	25	14.71	2.94	6	3.53	1.3	1	0.59	0
Sampling Period Means>>			14	6.04		5	2.94		1	0.59	
White Bass	1996	2	3	1.57	0.87	0	0	0	0	0	
	1995	3	37	16.44	7.93	5	1.97	1.29	1	0.59	0
	1992	6	64	35	8.02	0	0	0	0	0	
Sampling Period Means>>			35	17.67		2	0.66		<1	0.20	
	2003	2	8	4.7	2.6	2	1.18	0.78	0	0	
	2003	3	20	11.76	2.48	4	2.35	1.3	0	0	
	2003	6	22	12.94	4.79	3	1.76	0.9	0	0	
Sampling Period Means>>			17	9.80		3	1.76		0	0	

(Note: 1111= Individual Fish Not Measured)

Table 11. Sampling period means of tailrace night electrofishing fish catch and CPUE data for smallmouth bass and rock bass from the Monongahela River, Sections 2, 3, and 6 for 1992, 1995, 1996, and 2003.

Species	Year	Section	Total Catch	Mean Total CPUE (No/Hr)	Standard Error	Catch ≥300 mm	CPUE ≥300 mm (No/Hr)	Standard Error	Catch ≥375 mm	CP ≥375 (No/
Smallmouth Bass	1996	2	49	24.85	14.59	4	2.14	1.08	0	C
	1995	3	69	23.88	9.17	12	4.27	2.19	0	C
	1992	6	120	65.63	16.63	22	11.05	3.87	1	0.
Sampling Period Means>>			79	38.12		13	5.82		<1	0.
	2003	2	67	39.41	12.59	15	8.82	3.95	4	2.
	2003	3	85	50	11.1	26	15.29	5.05	2	1.
	2003	6	89	52.35	10.93	33	19.41	5.69	4	2.
Sampling Period Means>>			80	47.25		25	14.51		3	1.
Rock Bass	1996	2	14	7.36	0.75	*5	2.64	1.36	0	C
	1995	3	9	3.33	1.04	*4	1.67	0.83	0	C
	1992	6	9	4.68	1.61	*5	2.64	1.23	0	C
Sampling Period Means>>			11	5.12		5	2.32		0	C
	2003	2	17	10	4.21	*6	3.53	2.35	0	C
	2003	3	20	11.76	2.91	*5	2.94	1.31	0	C
	2003	6	5	2.94	1.31	*3	1.76	1.26	0	C
Sampling Period Means>>			14	8.23		5	2.74		0	C

(* ≥175 mm for Rock Bass)

Table 12. Sampling period means of tailrace night electrofishing fish catch and CPUE data for sauger and walleye from the Monongahela River, Sections 2, 3, and 6 for 1992, 1995, 1996, and 2003.

Species	Year	Section	Total Catch	Mean Total CPUE (No/Hr)	Standard Error	Catch ≥300 mm	CPUE ≥300 mm (No/Hr)	Standard Error	Catch ≥375 mm	CPUE ≥375 mm (No/Hr)	Standard Error
Sauger	1996	2	6	3.22	1.06	0	0	0	0	0	0
	1995	3	28	13.38	6.16	6	3.4	2.13	0	0	0
	1992	6	172	97.67	27.91	6	3.62	1.82	5	3.02	1.43
Sampling Period Means>>			69	38.09		4	2.34		2	1.01	
	2003	2	125	73.53	18.04	24	14.12	5.7	1	0.59	0.59
	2003	3	87	51.18	8.94	41	24.12	5.07	0	0	0
	2003	6	50	29.41	6.32	34	20	5.96	1	0.59	0.59
Sampling Period Means>>			87	51.37		33	19.41		1	0.39	
Walleye	1996	2	1	0.5	0.5	0	0	0	0	0	0
	1995	3	6	1.96	0.89	1	0.38	0.38	0	0	0
	1992	6	2	0.96	0.96	0	0	0	0	0	0
Sampling Period Means>>			3	1.14		<1	0.13		0	0	
	2003	2	22	12.94	4.37	8	4.7	1.71	1	0.59	0.59
	2003	3	17	10	2.78	15	8.82	2.36	4	2.35	0.96
	2003	6	10	5.88	1.96	5	2.94	1.31	3	1.76	0.9
Sampling Period Means>>			16	9.61		9	5.49		3	1.57	

Table 13. Mean back calculated lengths at age (mm) for white bass sampled by night electrofishing from the Monongahela River, Sections 2, 3, and 6 for 1992, 1995, 1996, and 2003.

			Mean Back Calculated Lengths (mm) at Age							
Species	Section	Year	1	2	3	4	5	6	7	8
White Bass	2	1996		246	286					
	3	1995		263	316					
		Means>>		255	301					
	2	2003		290	297	267				
	3	2003	167	263	297	384				
		Means>>	167	277	297	326				
	6	2003	167	192	368	358				

Table 14. Mean back calculated lengths at age (mm) for smallmouth bass and rock bass sampled by night electrofishing from the Monongahela River, Sections 2, 3, and 6 for 1992, 1995, 1996, and 2003.

			Mean Back Calculated Lengths (mm) at Age							
Species	Section	Year	1	2	3	4	5	6	7	8
Smallmouth Bass	2	1996	95	162	241	277	300	299	335	
	3	1995	70	193	265	285	336			
	Means>>		83	178	253	281	318	299	335	
	2	2003	113	182	231	280	298	375	440	477
	3	2003	103	175	239	288	330	372		502
	Means>>		108	179	235	284	314	374	440	490
	6	2003	136	215	247	293	336	373	395	434
Rock Bass	2	1996		110	141	169	179			
	3	1995				168				
	Means>>			110	141	168	179			
	2	2003		93	162	159	192			
	3	2003		137	163	165	187			
	Means>>			115	163	162	190			
	6	2003				171	205	209		

Table 15. Mean back calculated lengths at age (mm) for sauger and walleye sampled by night electrofishing from the Monongahela River, Sections 2, 3, and 6 for 1992, 1995, 1996, and 2003.

Species	Section	Year	Mean Back Calculated Lengths (mm) at Age							
			1	2	3	4	5	6	7	8
Sauger	2	1996	196	251	331	360				
	3	1995	133	271	362					
		Means>>	165	261	347	360				
	2	2003	213	285	274	383				
	3	2003	214	300	328					
		Means>>	213	291	300	383				
	6	2003	231	313	341	399				
Walleye	2	1996		290	256					
	3	1995	190	339	399					
		Means>>	190	315	328					
	2	2003	277	336	393	470	501			
	3	2003	240	329	353	414				
		Means>>	259	333	373	442	501			
	6	2003	230	319	373		518			

Table 16. Fish collection summary data for rotenone sampling at Maxwell Lock Chamber (Monongahela River, Section 03) from 1968 to 2003 and from Grays Landing Lock Chamber (Monongahela River, Section 02) for 2003.

Year of Survey	Total Weight (Kg)	Total Fish Count	Total Species
MAXWELL			
1968	0.02	1	1
1970	3.04	46	5
1973	34.00	860	12
1976	49.68	1664	19
1977	44.53	1158	20
1978	82.48	387	18
1985	53.56	4107	19
1987	130.62	1290	13
1988	149.66	1434	21
1989	328.37	611	19
2003	**77.41**	**7310**	**26**
Means	86.67	1715	16
GRAYS LANDING			
2003	**81.72**	**13823**	**28**

Table 17. Fish collection summary data for rotenone sampling at Braddock Lock Chamber (Monongahela River, Section 06) from 1968 to 2003.

Year of Survey	Total Weight (Kg)	Total Fish Count	Total Species
BRADDOCK			
1968	12.69	207	8
1970	20.73	261	11
1973	39.66	867	13
1976	3.94	754	14
1977	116.06	6363	19
1978	44.54	288	8
1980	233.463	1158	20
1981	36.15	4426	15
1983	131.91	1310	16
1985	23.531	418	13
1987	111.703	3556	19
1988	147.586	123443	20
1989	32.655	6581	10
1990	60.2	102	8
1992	55.829	194	13
2003	**275.467**	**1127**	**25**
Means	84.13	9441	15

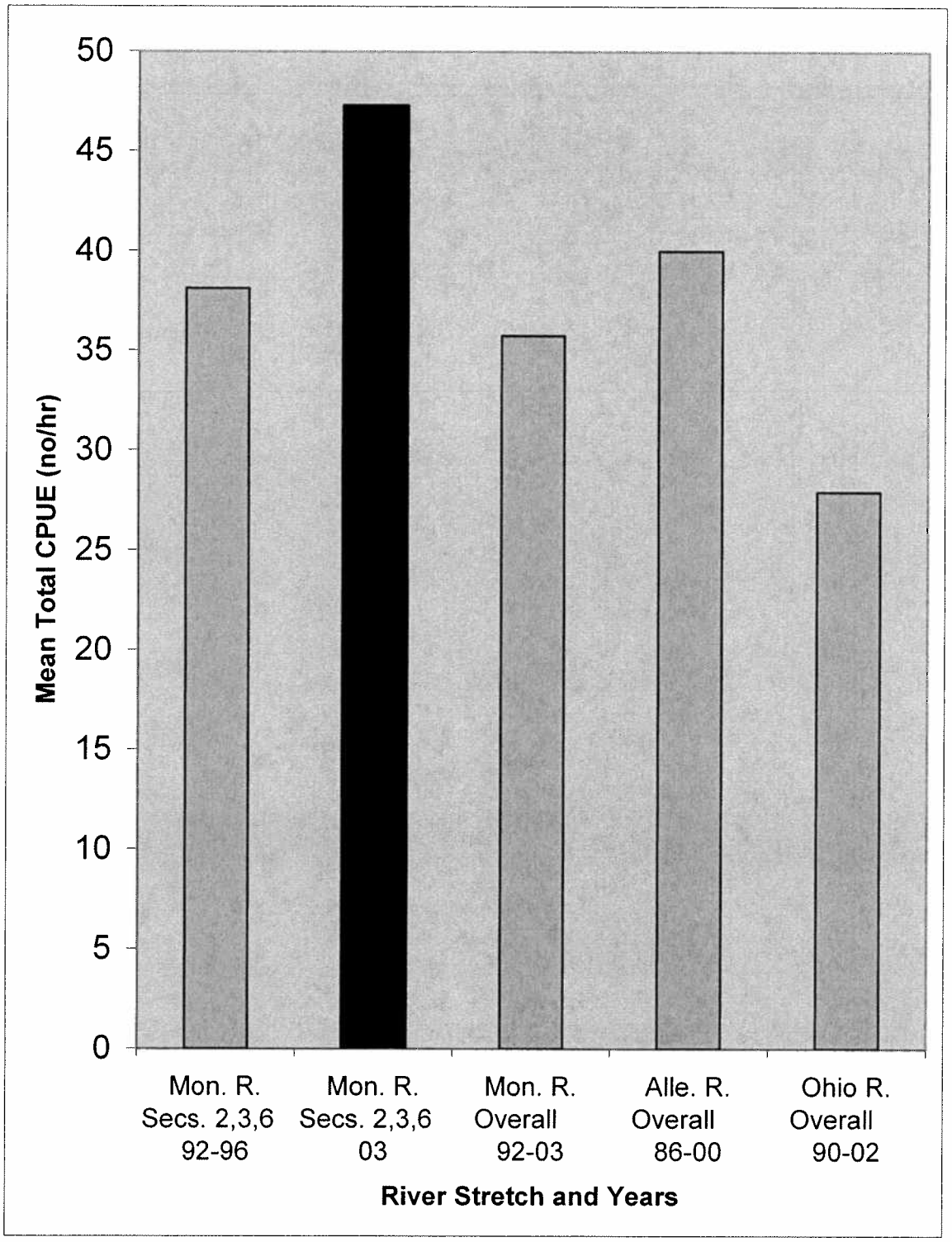

Figure 1. Comparison of mean total CPUE from night electrofishing for smallmouth bass from various stretches of the Three Rivers system.

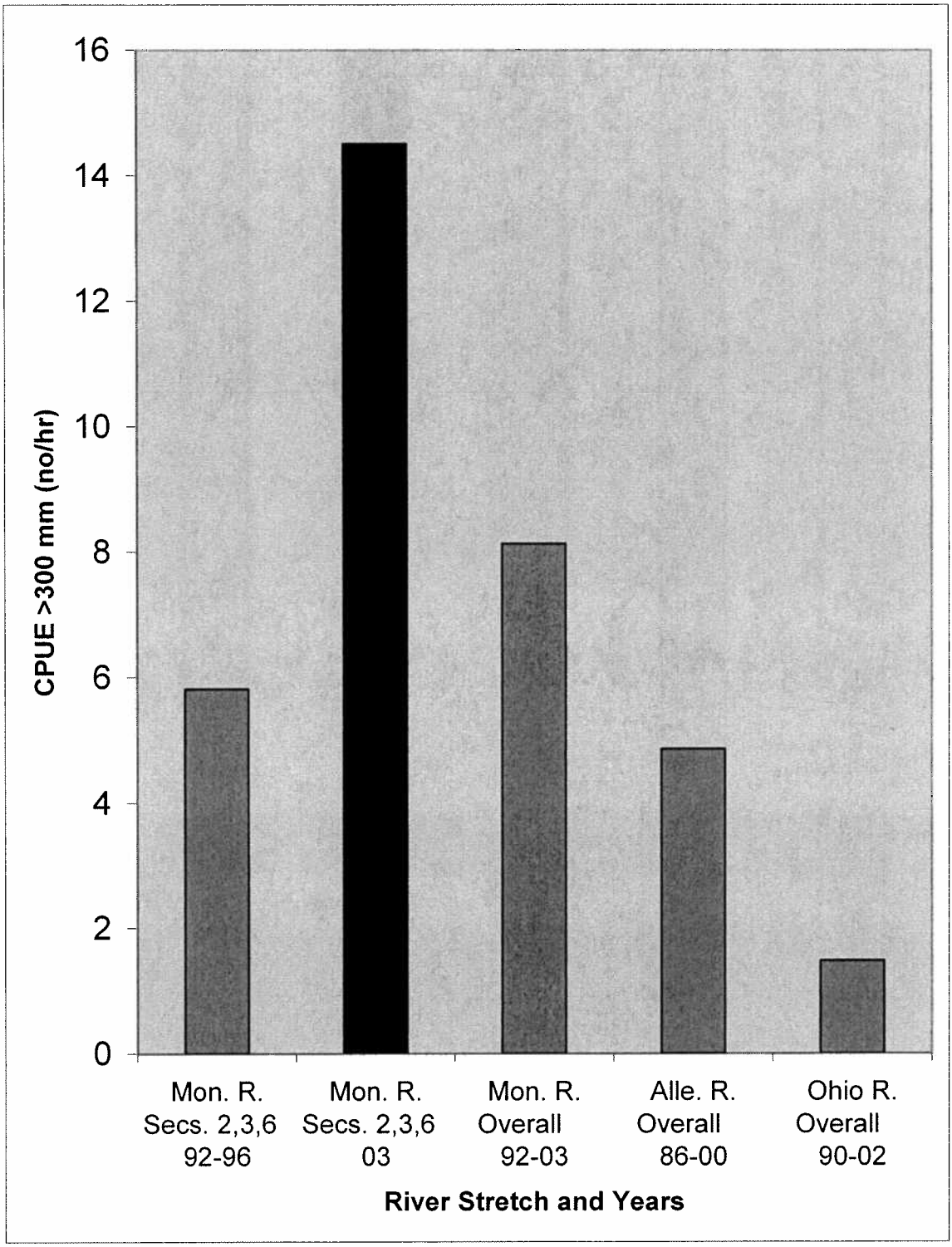

Figure 2. Comparison of CPUE >300 mm from night electrofishing for smallmouth bass from various stretches of the Three Rivers system.

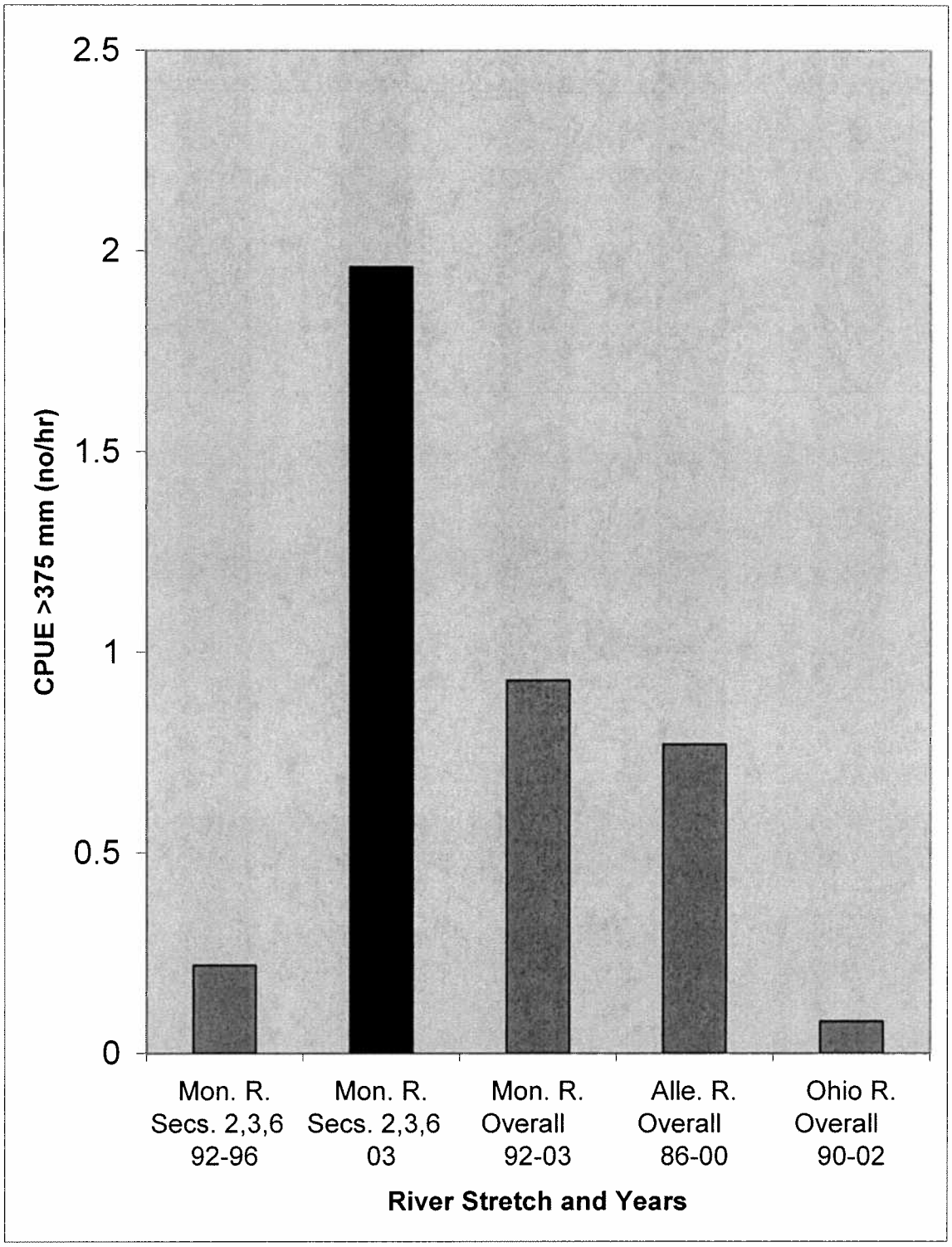

Figure 3. Comparison of CPUE >375 mm from night electrofishing for smallmouth bass from various stretches of the Three Rivers system.

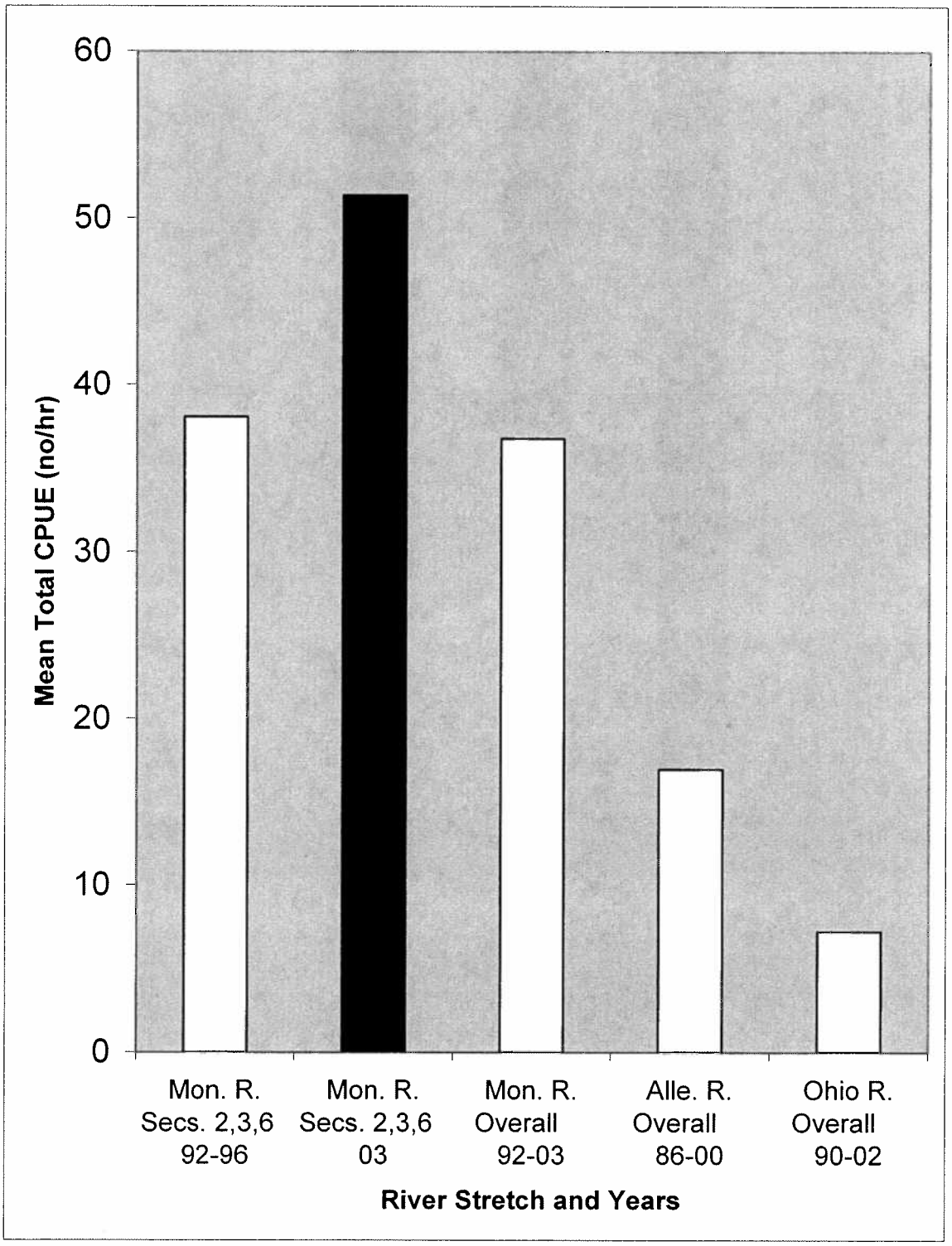

Figure 4. Comparison of Mean Total CPUE from night electrofishing for sauger from various stretches of the Three Rivers system.

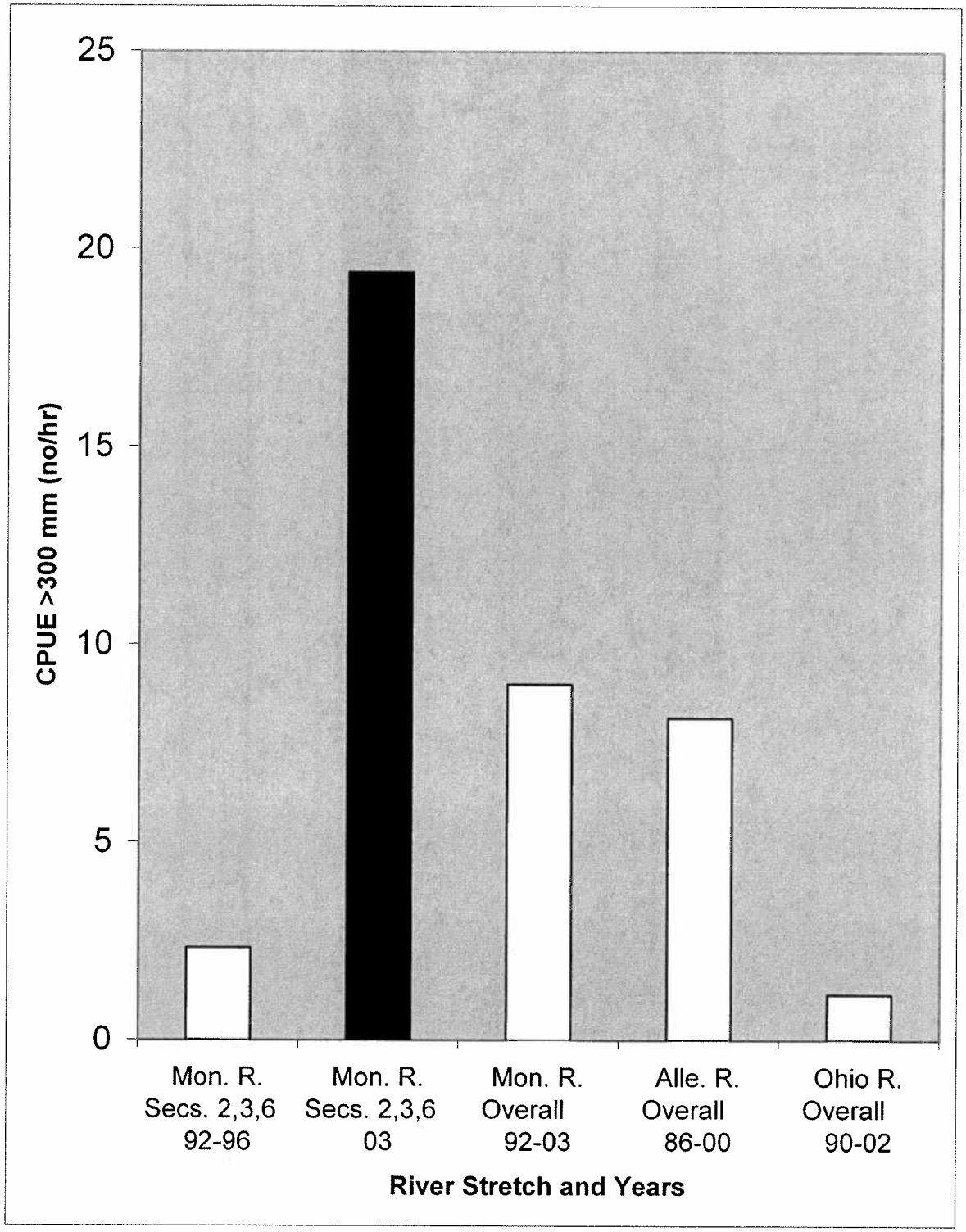

Figure 5. Comparison of CPUE ≥300 mm from night electrofishing for sauger from various stretches of the Three Rivers system.

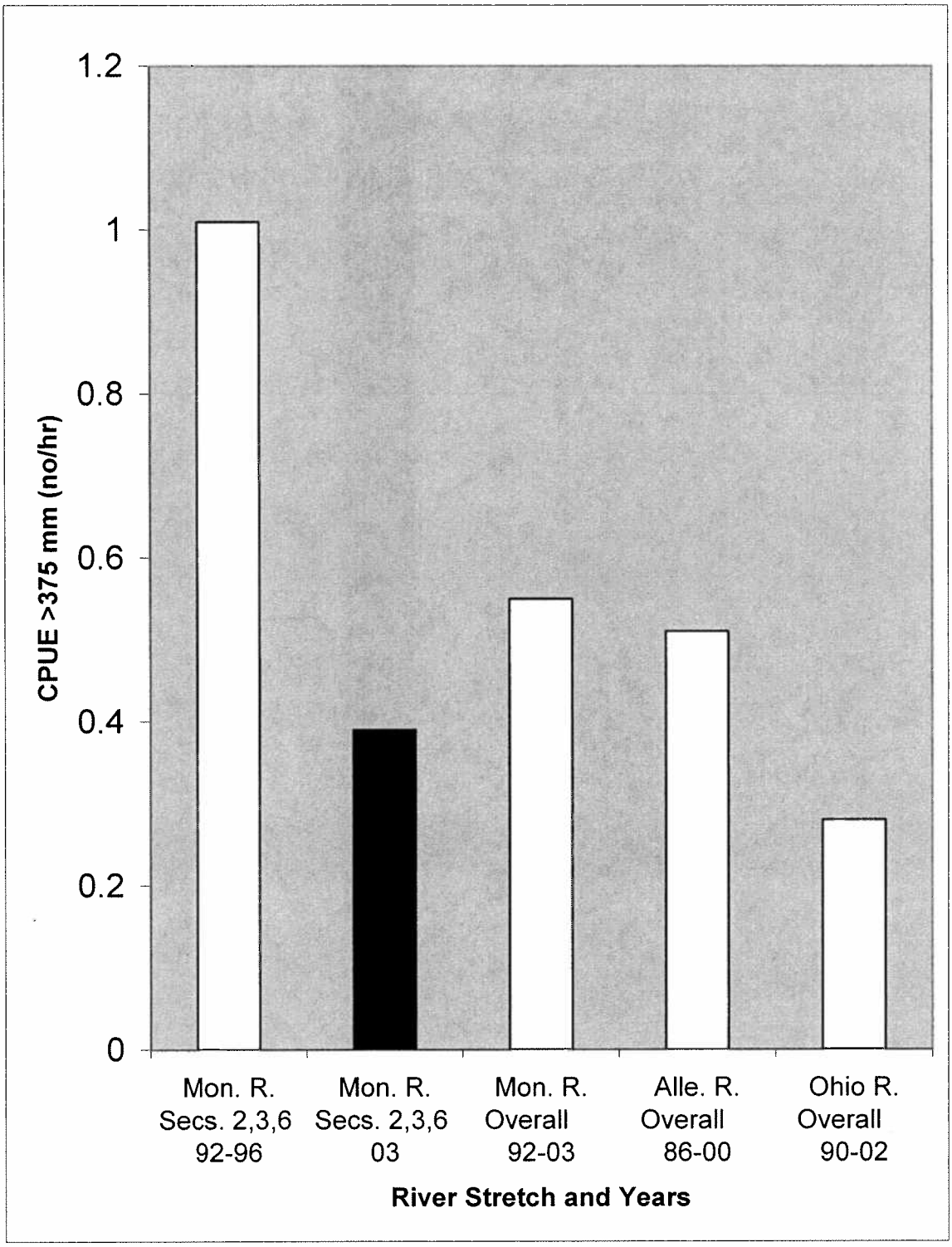

Figure 6. Comparison of CPUE ≥375 mm from night electrofishing for sauger from various stretches of the Three Rivers system.

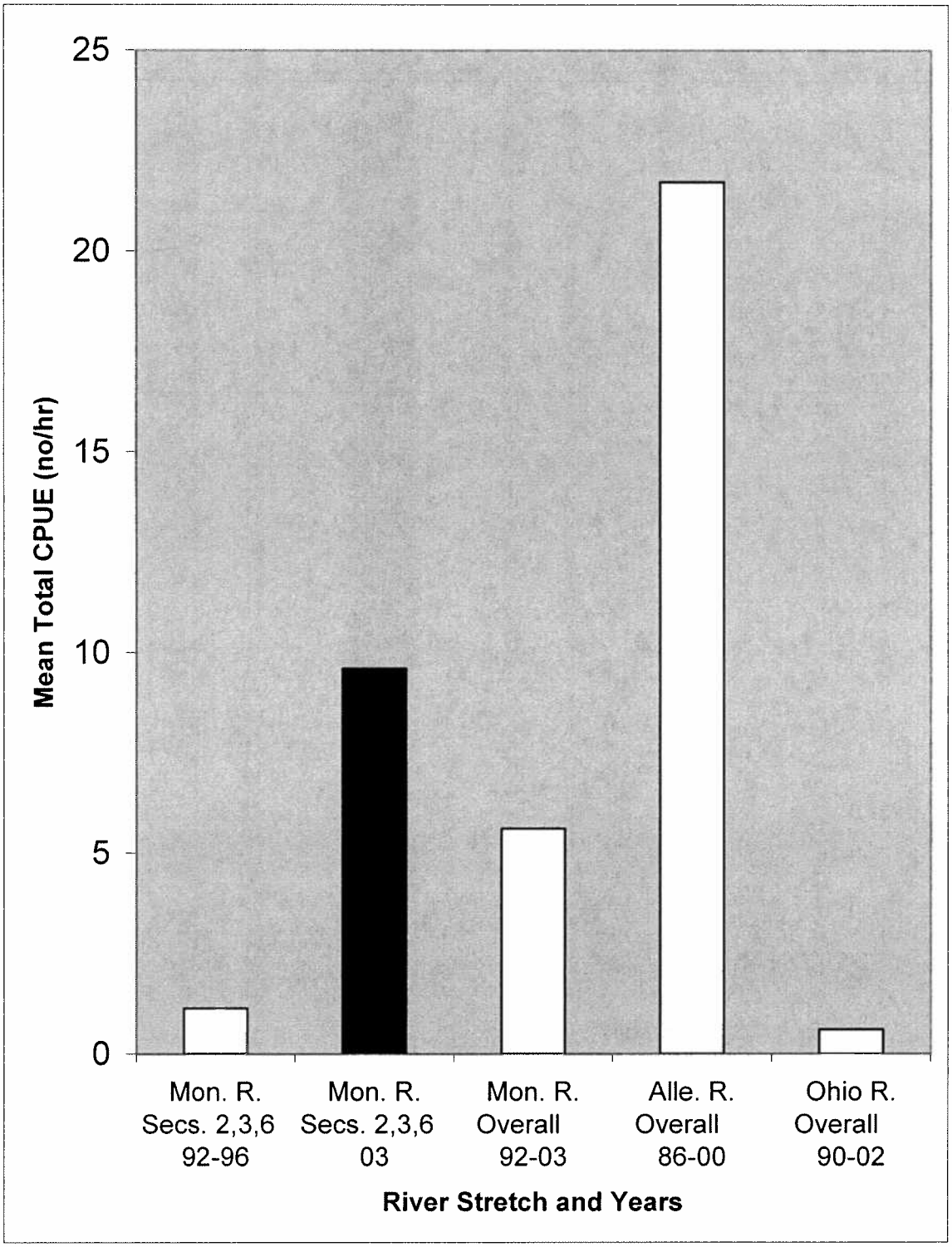

Figure 7. Comparison of Mean Total CPUE from night electrofishing for walleye from various stretches of the Three Rivers system.

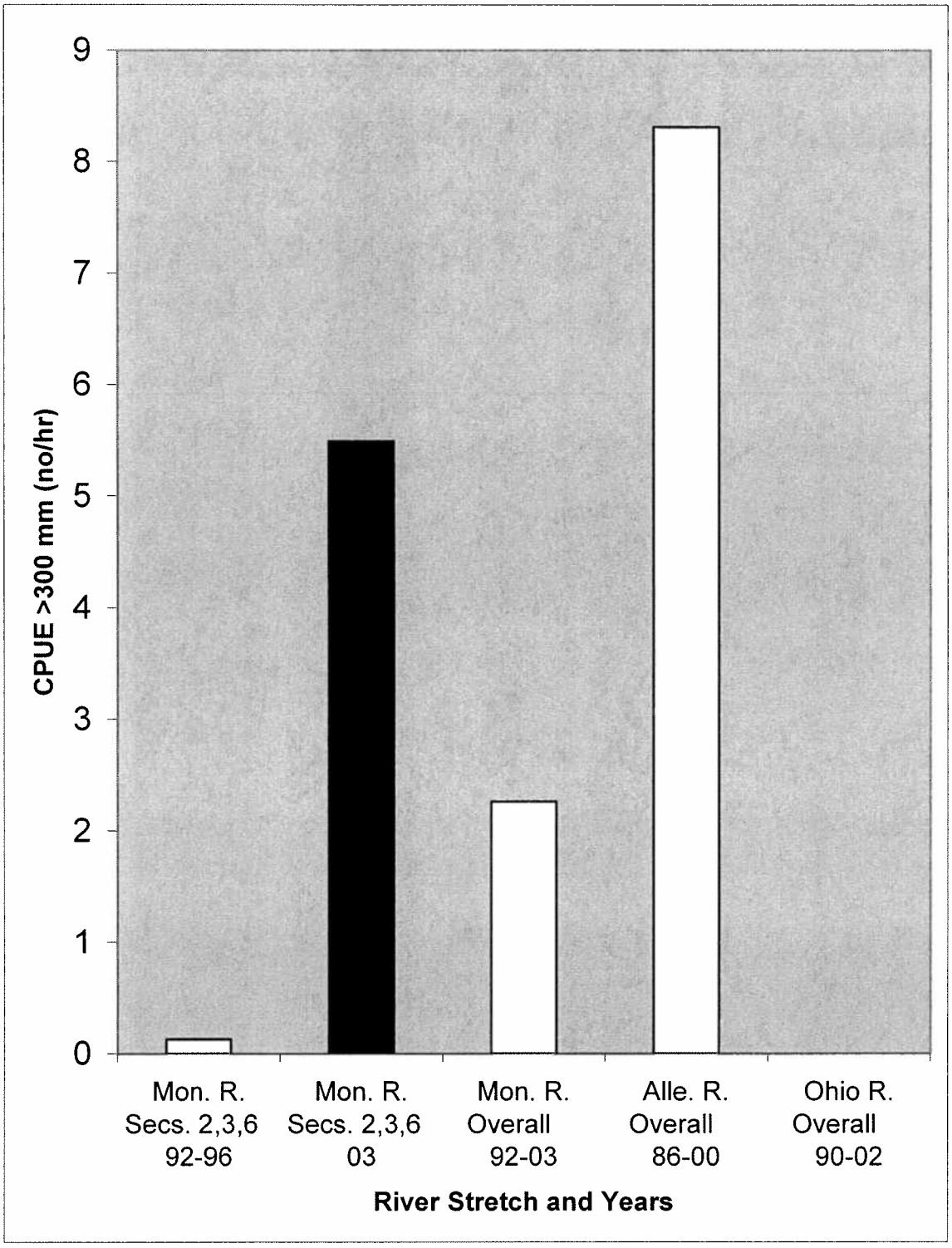

Figure 8. Comparison of CPUE ≥300 mm from night electrofishing for walleye from various stretches of the Three Rivers system.

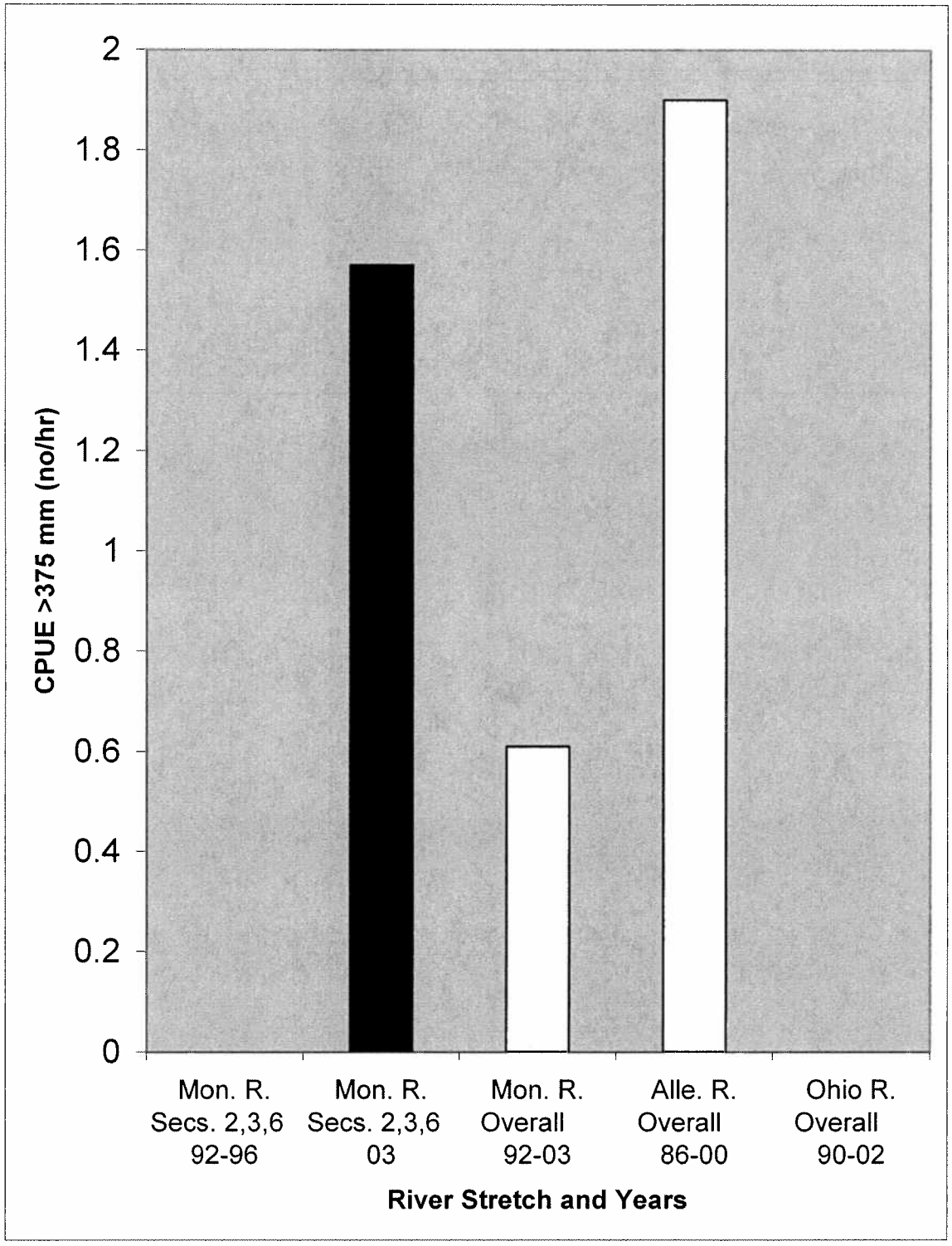

Figure 9. Comparison of CPUE ≥375 mm from night electrofishing for walleye from various stretches of the Three Rivers system.

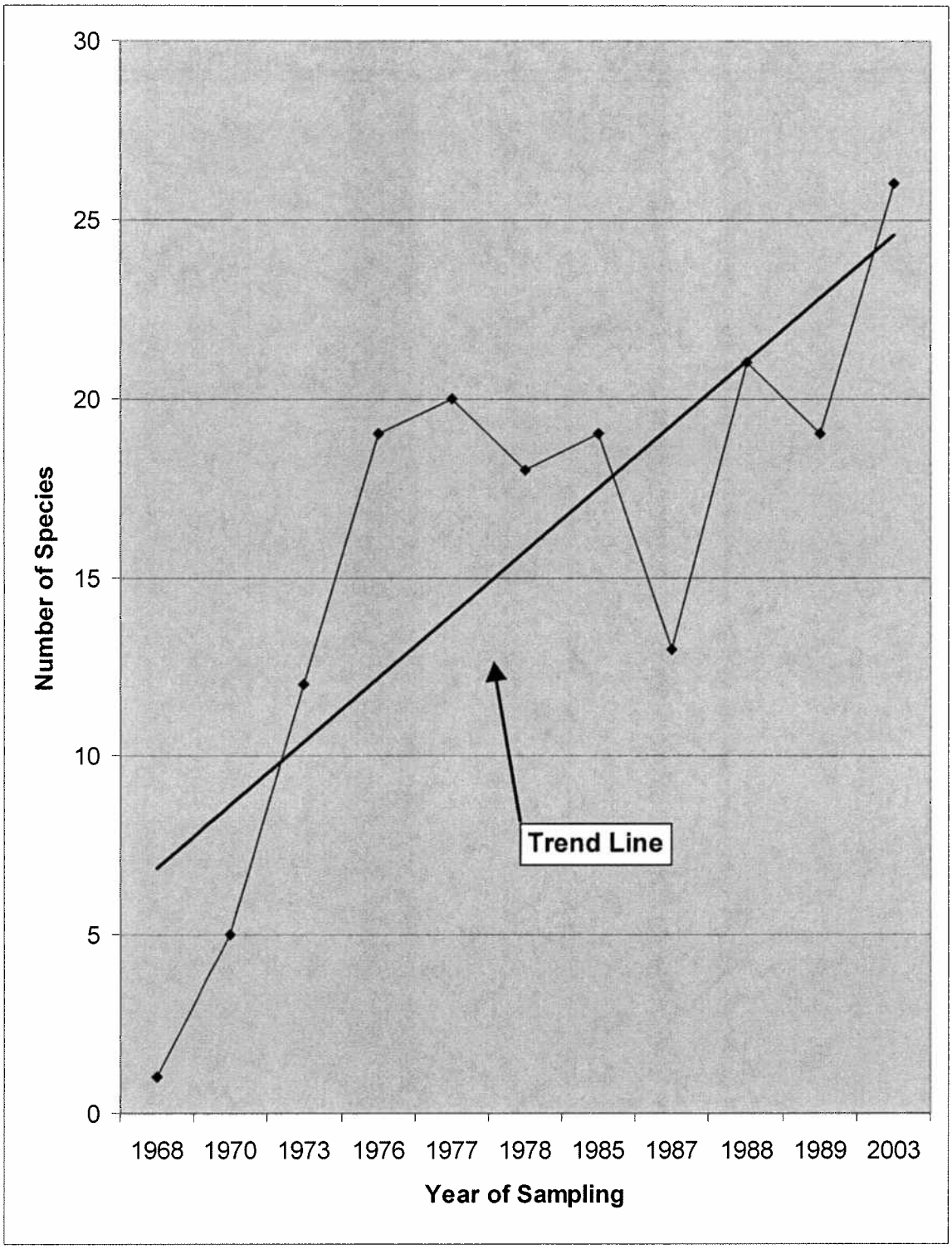

Figure 10. Number of species collected at the Maxwell Lock Chamber (Monongahela River, Section 03) during rotenone surveys from 1968 to 2003.

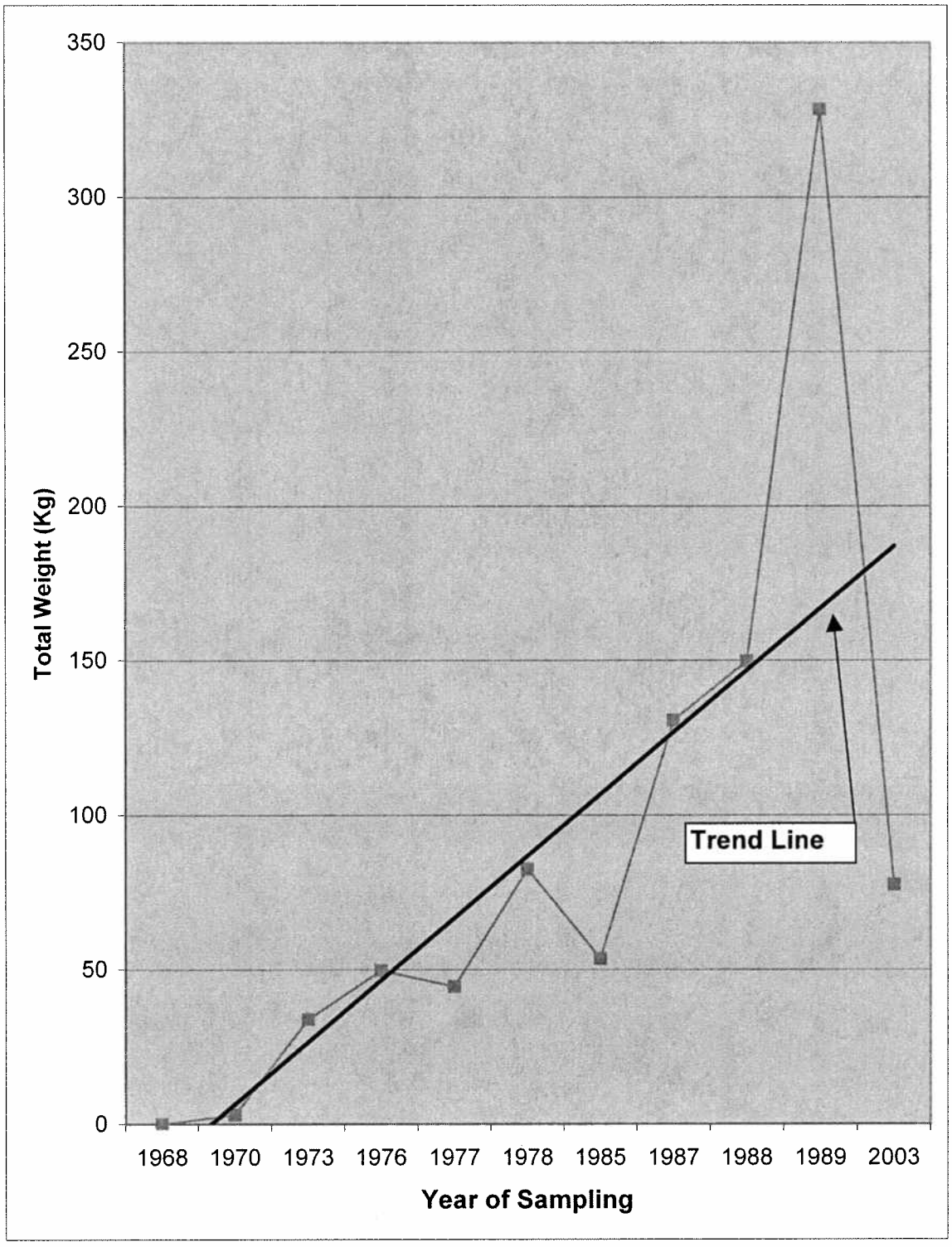

Figure 11. Fish weight totals collected at the Maxwell Lock Chamber (Monongahela River, Section 03) during rotenone surveys from 1968 to 2003.

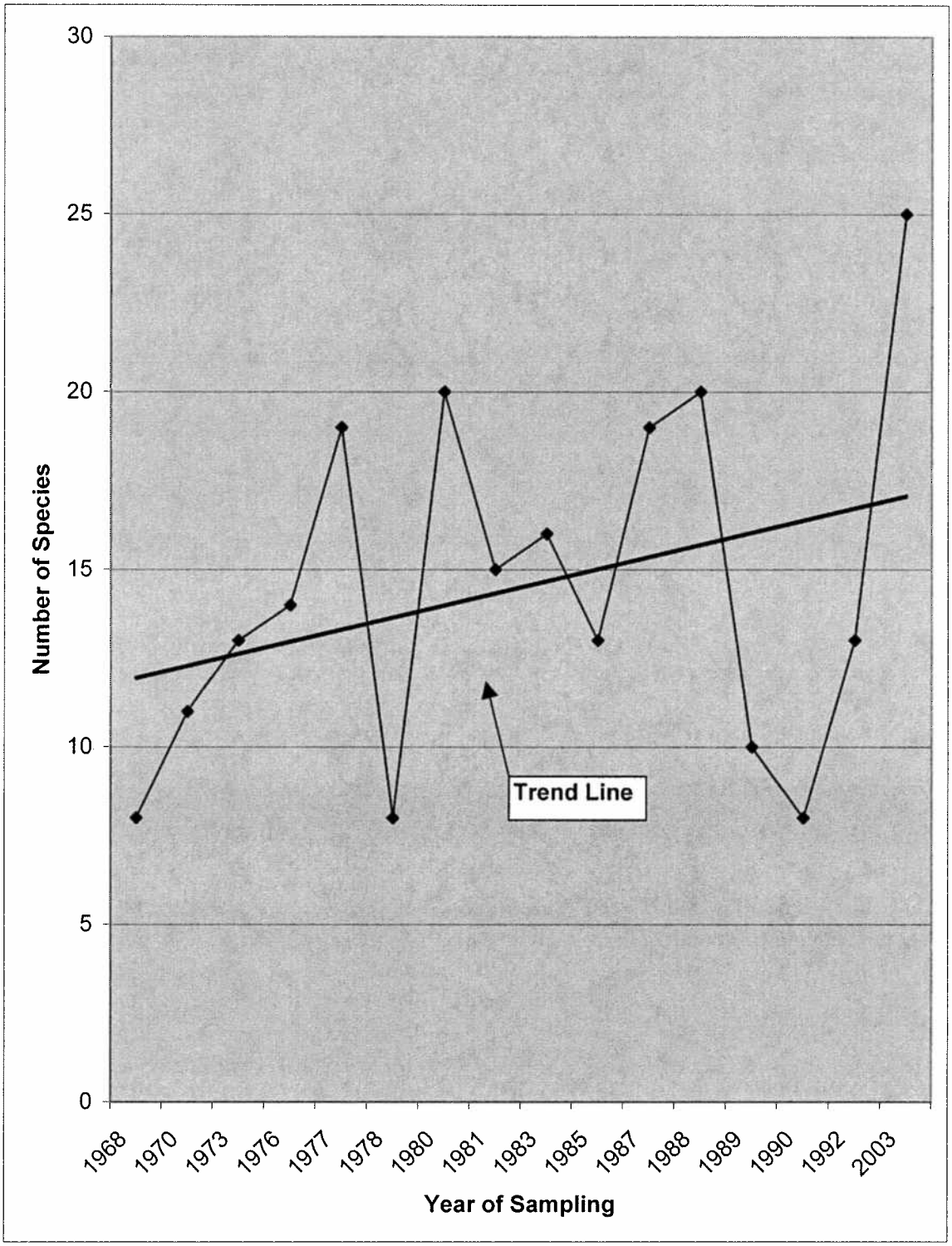

Figure 12. Number of species collected at the Braddock Lock Chamber (Monongahela River, Section 06) during rotenone surveys from 1968 to 2003.

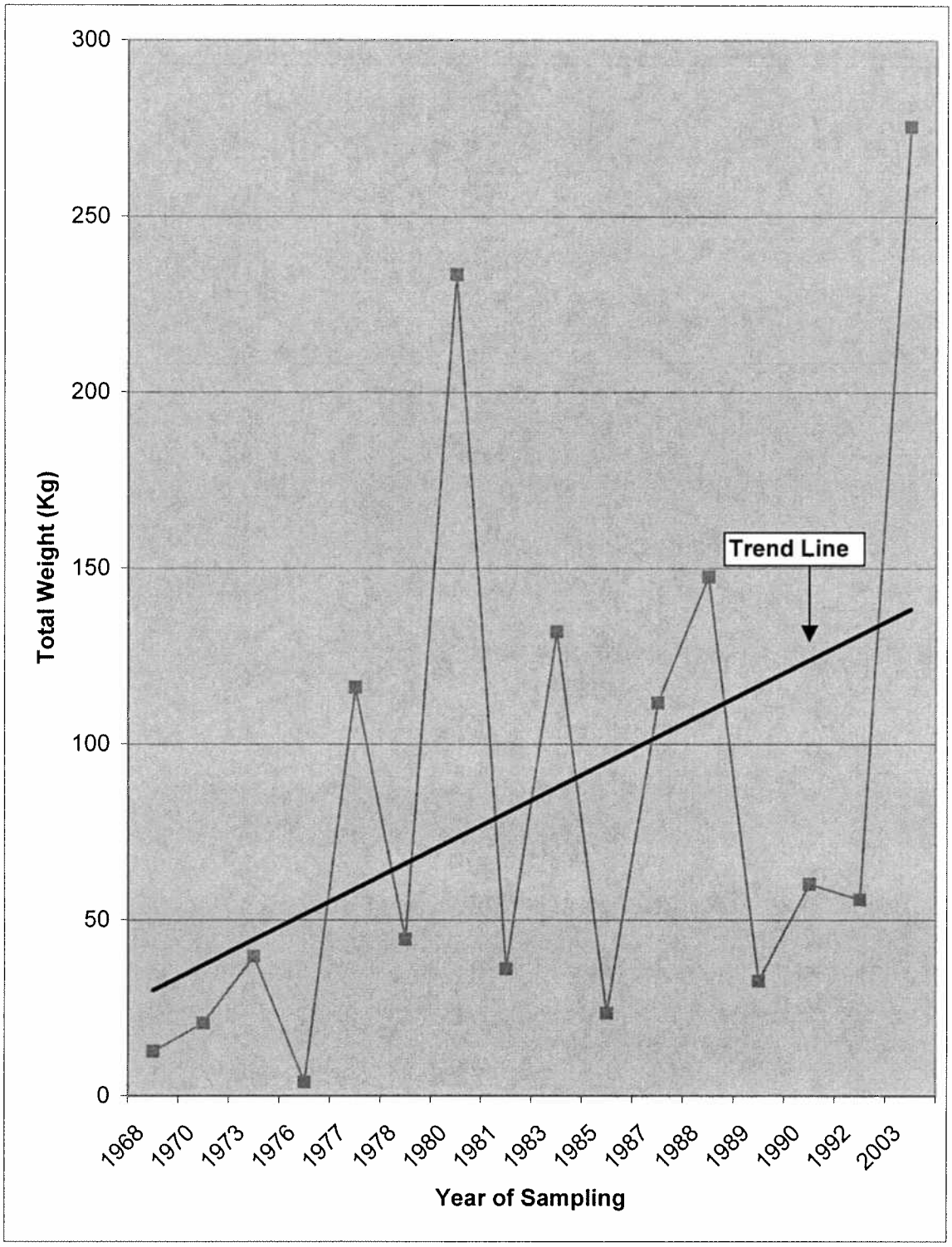

Figure 13. Fish weight totals collected at the Braddock Lock Chamber (Monongahela River, Section 06) during rotenone surveys from 1968 to 2003.

Appendix A. Warmwater and coolwater stocking for the Monongahela River, Section 02 (River Mile 71.6) from 1975 to 2003.

Year	Species	Life Stage	Number Stocked	Stocking Rate (No/Acre)
1983	CHANNEL CATFISH	FING	1000	1
2000	MUSKELLUNGE	FING	1650	1
1998	MUSKELLUNGE	FING	1900	1
1995	MUSKELLUNGE	FING	1900	1
1993	MUSKELLUNGE	FING	1900	1
2002	TIGER MUSKELLUNGE	FING	1650	1
2001	TIGER MUSKELLUNGE	FING	1648	1
1999	TIGER MUSKELLUNGE	FING	1650	1
1997	TIGER MUSKELLUNGE	FING	1900	1
1996	TIGER MUSKELLUNGE	FING	3200	2
1995	TIGER MUSKELLUNGE	FING	1900	1
1993	TIGER MUSKELLUNGE	FING	3250	2
1991	TIGER MUSKELLUNGE	FING	1900	1
1989	TIGER MUSKELLUNGE	FING	3800	2
1986	TIGER MUSKELLUNGE	FING	2000	1
1985	TIGER MUSKELLUNGE	FING	2000	1
1984	TIGER MUSKELLUNGE	FING	1900	1
1981	TIGER MUSKELLUNGE	FING	3100	2
1979	TIGER MUSKELLUNGE	FING	750	<1
1977	TIGER MUSKELLUNGE	FING	1000	<1
1975	TIGER MUSKELLUNGE	FING	1900	1
2003	WALLEYE	FRY	1247250	750
2002	WALLEYE	FRY	1663000	1000
2001	WALLEYE	FRY	1663000	1000
2000	WALLEYE	FRY	1247250	750
1996	WALLEYE	FRY	1426500	858
1995	WALLEYE	FRY	1902000	1144
1994	WALLEYE	FRY	1426500	858
1993	WALLEYE	FRY	1902000	1144
1992	WALLEYE	FRY	1426500	858
1991	WALLEYE	FRY	1902000	1144
1990	WALLEYE	FRY	1426500	858
1983	WALLEYE	FRY	2000000	1202
1978	WALLEYE	FRY	2500000	1502
1976	WALLEYE	FRY	60000	36
1975	WALLEYE	FRY	100000	602

Appendix A cont'd.

Year	Species	Life Stage	Number Stocked	Stocking Rate (No./Acre)
2003	WALLEYE	PH1	4150	3
2000	WALLEYE	PH1	4150	3
1998	WALLEYE	PH1	4750	3
1996	WALLEYE	PH1	4750	3
1994	WALLEYE	PH1	4750	3
1992	WALLEYE	PH1	4750	3
1990	WALLEYE	PH1	4750	3
1989	WALLEYE	PH1	3800	2
1987	WALLEYE	PH1	1000	1
1986	WALLEYE	PH1	4000	2
1982	WALLEYE	PH1	13500	8
1981	WALLEYE	PH1	11000	7
1979	WALLEYE	PH1	2500	2
1976	WALLEYE	PH1	68000	41
1983	WALLEYE	PH2	2200	1
1990	WHITE X STRIPED BASS	FING	7600	5
1988	WHITE X STRIPED BASS	FING	5700	3
1983	WHITE X STRIPED BASS	FING	6300	4

Appendix B. Warmwater and coolwater stocking for the Monongahela River, Section 03 (River Mile 51.35) for 1975 to 2003.

Year	Species	Life Stage	Number Stocked	Stocking Rate (No/Acre)
1983	LARGEMOUTH BASS	FING	9024	6
2002	MUSKELLUNGE	FING	4950	3
2001	MUSKELLUNGE	FING	4950	3
1999	MUSKELLUNGE	FING	4950	3
1998	MUSKELLUNGE	FING	4950	3
1997	MUSKELLUNGE	FING	4950	3
1995	MUSKELLUNGE	FING	4950	3
1993	MUSKELLUNGE	FING	4950	3
2003	TIGER MUSKELLUNGE	FING	4950	3
2000	TIGER MUSKELLUNGE	FING	4950	3
1995	TIGER MUSKELLUNGE	FING	4950	3
1993	TIGER MUSKELLUNGE	FING	4950	3
1991	TIGER MUSKELLUNGE	FING	4950	3
1989	TIGER MUSKELLUNGE	FING	9900	6
1987	TIGER MUSKELLUNGE	FING	9900	6
1986	TIGER MUSKELLUNGE	FING	9900	6
1985	TIGER MUSKELLUNGE	FING	9900	6
1984	TIGER MUSKELLUNGE	FING	3984	3
1981	TIGER MUSKELLUNGE	FING	5700	4
1979	TIGER MUSKELLUNGE	FING	3750	2
1977	TIGER MUSKELLUNGE	FING	2700	2
1975	TIGER MUSKELLUNGE	FING	4800	3
2003	WALLEYE	FRY	3728250	2418
2002	WALLEYE	FRY	4971000	3224
2001	WALLEYE	FRY	4971000	3224
2000	WALLEYE	FRY	3728250	2418
1999	WALLEYE	FRY	4971000	3224
1998	WALLEYE	FRY	3728250	2418
1997	WALLEYE	FRY	4971000	3224
1996	WALLEYE	FRY	3728250	2418
1995	WALLEYE	FRY	4971000	3224
1994	WALLEYE	FRY	3728250	2418
1993	WALLEYE	FRY	4971000	3224
1992	WALLEYE	FRY	3728250	2418
1991	WALLEYE	FRY	4971000	3224
1990	WALLEYE	FRY	3728250	2418
1983	WALLEYE	FRY	6000000	3892
1978	WALLEYE	FRY	6600000	4281
1976	WALLEYE	FRY	336000	218
1975	WALLEYE	FRY	3000000	1946

Appendix B. Cont'd.

Year	Species	Life Stage	Number Stocked	Stocking Rate (No/Acre)
2003	WALLEYE	PH1	12450	8
2000	WALLEYE	PH1	12450	8
1998	WALLEYE	PH1	12450	8
1996	WALLEYE	PH1	12450	8
1994	WALLEYE	PH1	12450	8
1992	WALLEYE	PH1	12450	8
1990	WALLEYE	PH1	12450	8
1986	WALLEYE	PH1	30000	19
1984	WALLEYE	PH1	30000	19
1982	WALLEYE	PH1	19500	13
1981	WALLEYE	PH1	30000	19
1979	WALLEYE	PH1	12900	8
1990	WHITE X STRIPED BASS	FING	14955	10
1988	WHITE X STRIPED BASS	FING	15000	10
1984	WHITE X STRIPED BASS	FING	24000	16
1983	WHITE X STRIPED BASS	FING	12000	8

Appendix C. Warmwater and Coolwater stocking data for the Monongahela River, Section 06 (River Mile 5.6) for 1975 to 2003.

Year	Species	Life Stage	Number Stocked	Stocking Rate (No/Acre)
2000	MUSKELLUNGE	FING	1150	1
1998	MUSKELLUNGE	FING	1150	1
1995	MUSKELLUNGE	FING	1150	1
1993	MUSKELLUNGE	FING	1150	1
2002	TIGER MUSKELLUNGE	FING	1148	1
2001	TIGER MUSKELLUNGE	FING	1150	1
1999	TIGER MUSKELLUNGE	FING	1150	1
1998	TIGER MUSKELLUNGE	FING	5650	5
1997	TIGER MUSKELLUNGE	FING	1150	1
1995	TIGER MUSKELLUNGE	FING	1150	1
1993	TIGER MUSKELLUNGE	FING	1150	1
1991	TIGER MUSKELLUNGE	FING	1150	1
1989	TIGER MUSKELLUNGE	FING	2250	2
1987	TIGER MUSKELLUNGE	FING	2250	2
1986	TIGER MUSKELLUNGE	FING	2250	2
1985	TIGER MUSKELLUNGE	FING	2250	2
1984	TIGER MUSKELLUNGE	FING	1150	1
2003	WALLEYE	FRY	850500	750
2002	WALLEYE	FRY	1134000	1000
2001	WALLEYE	FRY	1134000	1000
2000	WALLEYE	FRY	850500	750
1999	WALLEYE	FRY	1134000	1000
1998	WALLEYE	FRY	850500	750
1997	WALLEYE	FRY	1134000	1000
1996	WALLEYE	FRY	850500	750
1995	WALLEYE	FRY	1134000	1000
1994	WALLEYE	FRY	850500	750
1993	WALLEYE	FRY	1134000	1000
1992	WALLEYE	FRY	850500	750
1991	WALLEYE	FRY	1134000	1000
1990	WALLEYE	FRY	850500	750
2003	WALLEYE	PH1	2850	3
2000	WALLEYE	PH1	2850	3
1999	WALLEYE	PH1	1750	2
1998	WALLEYE	PH1	2850	3
1996	WALLEYE	PH1	2850	3
1994	WALLEYE	PH1	2850	3
1992	WALLEYE	PH1	2850	3
1990	WALLEYE	PH1	2850	3
1989	WALLEYE	PH1	5650	5
1986	WALLEYE	PH1	6000	5
1984	WALLEYE	PH1	6000	5