273

# 8 Influence of the Family Catostomidae on the Metrics Developed for a Great River Index of Biotic Integrity

*Erich B. Emery, Thomas P. Simon, and Robert Ovies*

## CONTENTS



## 8.1 INTRODUCTION

The 15 sucker species composing the genera *Carpiodes, Catostomus, Cycleptus, Hypentelium, Ictiobus, Minytrema*, and *Moxostoma* are common inhabitants of the Ohio River (Pearson and Krumholz, 1984). Catostomids are primarily insectivores that utilize their subterminal mouth for

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suction feeding (Etnier and Starnes, 1993; see Goldstein and Simon, Chapter 6). Most species are simple lithophilous spawners, scattering eggs among the gravel substrates without parental care, and frequently utilize smaller tributary streams for spawning (Trautman, 1981; Etnier and Starnes, 1993). Species intolerance to pollution varies widely; however, the round-bodied suckers are generally considered responsive to changes in water quality and habitat composition.

Catostomids are a major component of the Ohio River community and, because of their importance, they are considered reliable environmental indicators (Ohio EPA, 1989a; Simon and Emery, 1995). Suckers compose 12% of the total number and 14% of all the species collected. The family is a significant component of a Great River fish community index being developed for the Ohio River (Ohio EPA, 1989a; Simon and Emery, 1995). The sucker family will be a single metric; however, it will ultimately influence several of the other metrics. Sucker abundance will influence several of the species composition metrics (e.g., total number of species, number of sucker species, and number of round-bodied sucker species), and several of the proportional metrics (e.g., percent round-bodied suckers, percent omnivores, percent insectivores, and percent simple lithophils).

Historical information for the Catostomidae enables long-term temporal trend assessment; and the overall knowledge for each of the species defines community function (Pearson and Krumholz, 1984; Pearson and Pearson, 1989). Reproductive and feeding patterns, tolerances to impairment, and other ecological parameters have been adequately described for each of the species occurring in the Ohio River (Kay et al., 1996).

The purpose of this study is to evaluate longitudinal and ecological patterns, and the influence of the family on individual Index of Biotic Integrity (IBI) metrics. Although the Catostomidae are well studied in streams, little is known of the community structure and function in the Ohio River. The intention here is to explore the influence of suckers on the structure and function of a Great River fish community.

## 8.2 MATERIALS AND METHODS

### 8.2.1 Study Area

The Ohio River begins at the confluence of the Monongahela and Allegheny Rivers, flowing southwesterly to the Mississippi River near Cairo, Illinois (Figure 8.1). The Ohio River is 981 linear miles and is impounded by 20 navigation dams that provide a 9-foot minimum depth for river commerce and navigation. The study area crosses four ecoregions: Western Allegheny Plateau, Interior Plateau, Interior River Lowland, and the Mississippi Alluvial Plain (Omernik, 1987; Omernik and Gallant, 1989).

The Ohio River fish community was sampled using boat electrofishing methods at 339 locations along the mainstem between 1990 and 1996. Intensive surveys of five pools that provide spatial coverage of a location every two river miles were conducted.

### 8.2.2 Sample Methods

Fish community surveys were conducted using night, nearshore boat electrofishing methods and by introducing rotenone into lock chambers of the navigation dams. Lock chambers were sampled by opening the downstream gates for 8 h prior to sampling the previous night. The following morning, the chamber gate was closed and a concentration of 2.5% rotenone was introduced into the lock chamber. The rotenone caused the fish to rise to the surface where they were netted, placed into containers, and returned to the shoreline for processing. Fish were sorted according to species into 3-cm size classes, and total batch weights were measured for each size class. Lock chambers were sampled on a rotating basis so that all navigation lock chambers were covered every two or three years. Four lock chambers were selected for temporal analysis for this chapter because of the longitudinal position along the river: Pike Island, Gallipolis, McAlpine, and Uniontown Lock

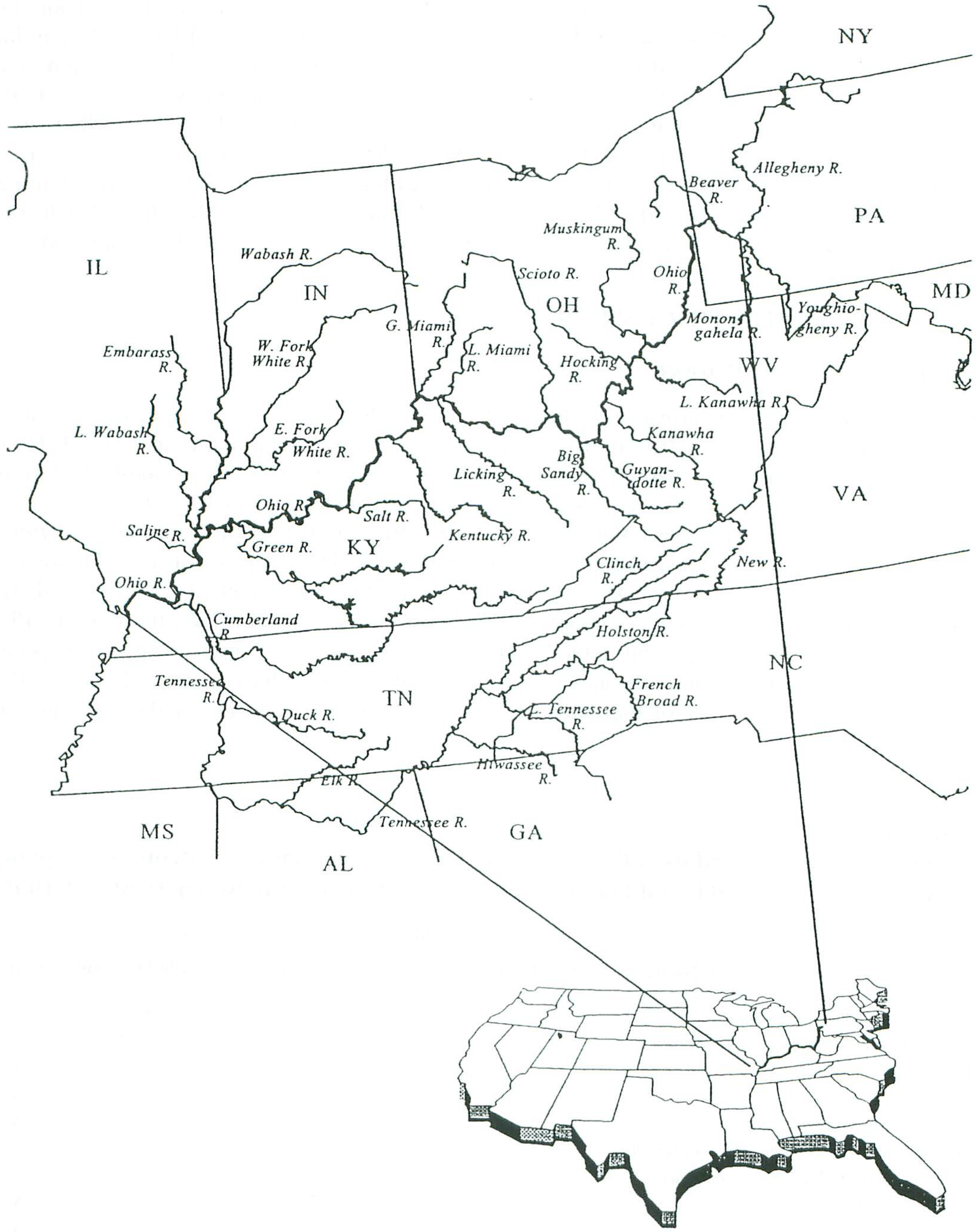


**FIGURE 8.1** Map of the Ohio River showing the study area and four lock chambers sampled between 1978 and 1993.

chambers were selected to represent upper, upper-mid, mid-lower, and lower sections of the river and were sampled between 1978 to 1995.

Night electrofishing boat samples were collected between July and October 1991 to 1996. A total of 339 stations were collected using standardized field, laboratory, and data processing methods (Ohio EPA, 1989 a,b). Fish were collected using conventional Great River methods (Sanders, 1988;

Simon and Sanders, Chapter 17). A two- or three-person crew operated an 18-ft aluminum jon boat equipped with a 5000-watt generator and a Smith Root VI-A pulsed DC electrofishing unit. Sampling at each zone began no sooner than 30 minutes after sunset. The gear had an effective depth of 10 to 15 ft, which was most effective in the shallow nearshore zone within 75 m of shore. Each 500-m zone was sampled for 2000 to 3000 s, depending on the complexity of the habitat. All observed fish were netted, placed into an aerated holding tank, weighed, measured, and returned to the river. Batch weights based on 3-cm size classes were measured for each species. All fish were identified to species using Gerking (1955), Pflieger (1973), and Trautman (1981). All collected fish were identified for deformities, eroded fins, lesions, and tumors (DELT; Sanders et al., Chapter 8).

## 8.3 RESULTS AND DISCUSSION

### 8.3.1 Species Composition

Fifteen species of sucker have been collected from the Ohio River (Table 8.1). Suckers can be categorized into two groups based on body morphology: deep-bodied and round-bodied. Deep-bodied suckers include members of the genera *Ictiobus* and *Carpiodes*. The round-bodied group includes the genera *Catostomus, Cycleptus, Hypentelium, Minytrema,* and *Moxostoma.*

The most frequently collected sucker in the Ohio River is the smallmouth buffalo *Ictiobus bubalus*, while the white sucker *Catostomus commersoni* is the least collected species (Figure 8.2). Both the white sucker and blue sucker *Cycleptus elongatus* distribution patterns have changed. The blue sucker has rarely been collected since 1978; however, lock chamber data from before 1978 shows that the species was present in the lower Ohio River. The white sucker is a tolerant species and was once more prevalent in the upper Ohio River, but appears to have been displaced by other species as the water quality of the Ohio River improved with the closing of the steel mills in Pittsburgh (Figure 8.3).

**TABLE 8.1**
**Sucker Species Collected from the Ohio River During Lock Chamber Rotentone Sampling Between 1978 and 1993, and During Nightboat Electrofishing Between 1990 and 1995**

| | Trophic Guild | | Reproductive Guild | | |
|---|---|---|---|---|---|
| Common Name/Scientific Name | Insectivore | Omnivore | Tolerance | Simple Lithophil | Other |
| Blue sucker, *Cycleptus elongatus* | X | | Sensitive | X | |
| White sucker, *Catostomus commersoni* | | X | Tolerant | X | |
| River carpsucker, *Carpiodes carpio* | | X | Tolerant | | X |
| Quillback, *C. cyprinus* | | X | Tolerant | | X |
| Highfin carpsucker, *C. velifer* | X | | Tolerant | | X |
| Northern hogsucker, *Hypentelium nigricans* | X | | Sensitive | X | |
| Smallmouth buffalo, *Ictiobus bubalus* | | X | Tolerant | | X |
| Bigmouth buffalo, *I. cyprinellus* | | X | Tolerant | | X |
| Black buffalo, *I. niger* | | X | Tolerant | | X |
| Spotted sucker, *Minytrema melanops* | X | | — | X | |
| Silver redhorse, *Moxostoma anisurum* | X | | Sensitive | X | |
| River redhorse, *M. carinatum* | X | | Sensitive | X | |
| Black redhorse, *M. duquesnei* | X | | Sensitive | X | |
| Golden redhorse, *M. erythrurum* | X | | Sensitive | X | |
| Shorthead redhorse, *M. macrolepidotum* | X | | Sensitive | X | |

*Note:* Characteristics of sucker species include trophic guild, tolerance, and reproductive guild classification based on Kay et al. (1994).

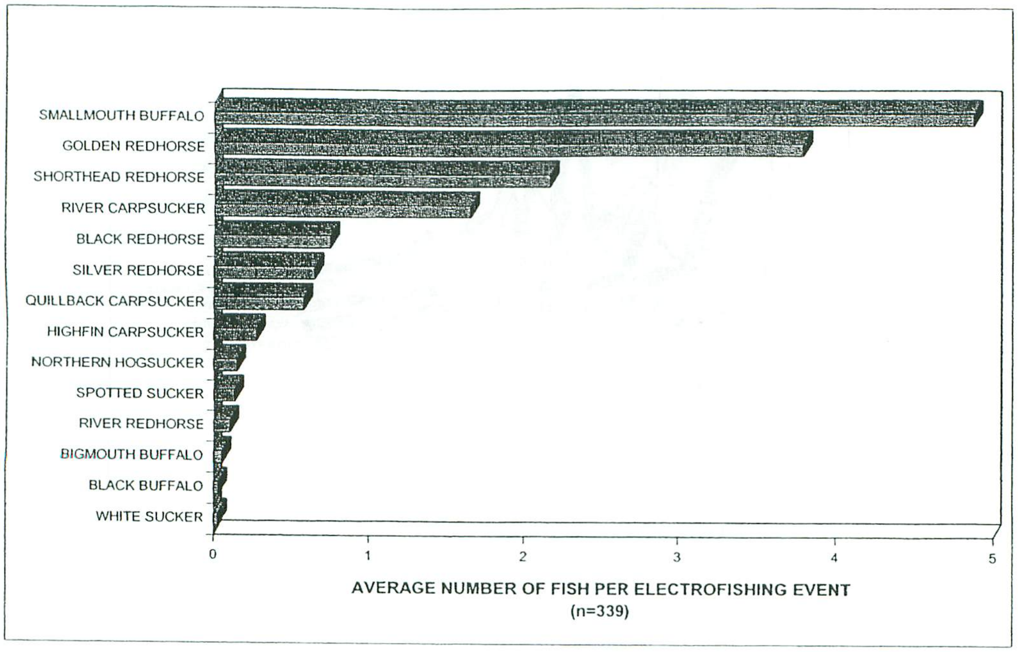


**FIGURE 8.2** Average number of sucker species collected per night electrofishing sample event. The number of collection attempts is based on 339 sample events.

### 8.3.2 Longitudinal Trends

Longitudinal patterns of Ohio River suckers show that specific species are more prevalent along certain stretches of the Ohio River (Figure 8.3). Pearson and Krumholz (1984) graphed distribution patterns for all Ohio River species based on historical data. The distribution of sucker species along longitudinal gradients is important for showing patterns for accurate portrayal of calibrated metric expectations. For example, various species are often limited to specific reaches of the Ohio River.

The round-bodied suckers (Figure 8.3) are most frequently collected in the upper 600 miles of the Ohio River, while deep-bodied suckers are more typical in the lower 300 miles but are found riverwide because of characteristics of the lacustrine zone of navigation pools. Specific species patterns show that the redhorse species reaches its highest abundance in the upper 450 miles of the Ohio River, rarely occurring below the McAlpine Dam (Ohio River Mile 605.0) and former Falls of the Ohio River.

Five species of redhorse occur in the Ohio River (Figure 8.3A). The golden redhorse *Moxostoma erythrurum* is most dominant in the middle Ohio River, while population numbers decline in the lower and upper portions of the river. The shorthead redhorse *M. macrolepidotum* occurs in the upper Ohio River and maintains a high relative abundance until the McAlpine Pool. Black redhorse *M. duquesnei* is most common in the upper 300 miles of the Ohio River, a decline in the population density occurring below the Meldahl Pool. Silver redhorse *M. anisurum* is found in the upper Ohio River pools; population densities decline rapidly with distance downstream from the Allegheny, Monongahela, and Ohio River confluence. The river redhorse *M. carinatum* is so rarely collected that distribution patterns cannot be discerned.

Three additional round-bodied suckers — spotted sucker *Minytrema melanops*, white sucker, and northern hogsucker *Hypentelium nigricans* — occur in the Ohio River (Figure 8.3B). The spotted sucker is frequently collected from the middle Ohio River, while the northern hogsucker and white sucker are commonly collected in the upper third of the river.

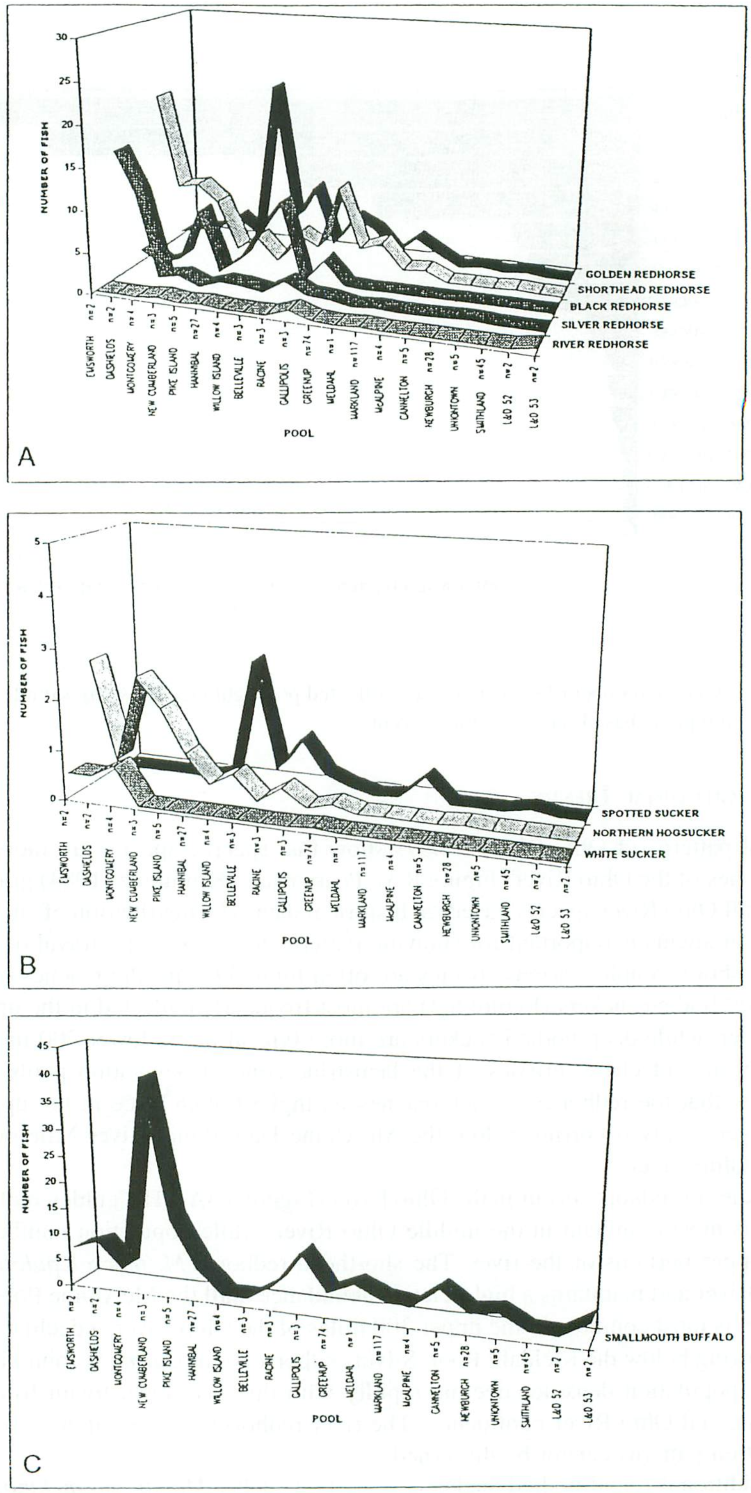


**FIGURE 8.3** Average number of sucker species collected along the length of the Ohio River per electrofishing event. (A) redhorse species; (B) other round-bodied suckers; (C) smallmouth buffalo; (D) buffalo species; and (E) carpsucker species.

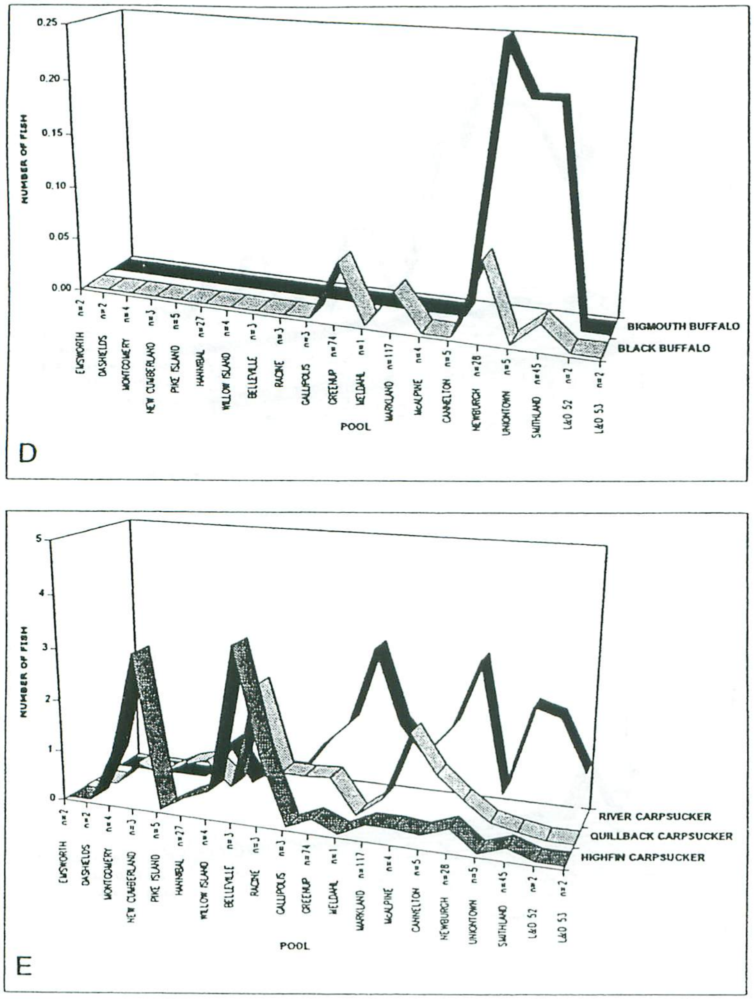


**FIGURE 8.3** *Continued.*

The deep-bodied suckers are typically associated with the lower half of the Ohio River (Figures 8.3C, D, E). The three species of *Ictiobus* are generally associated with ultra-fine particulate organic matter. The smallmouth buffalo occurs predominantly in the upper 300 miles of the Ohio River, but is frequently collected riverwide. The black buffalo *I. niger* and bigmouth buffalo *I. cyprinellus* are generally limited to the lower half of the Ohio River, reaching their highest population densities in the lower 300 miles (Figure 8.3D). The quillback *Carpiodes cyprinus* is limited to the middle Ohio River (Figure 8.3E); this distribution pattern was also observed by Pearson and Krumholz (1984).

The distribution patterns of suckers are a function of a variety of factors, including habitat requirements, feeding guild trophic dynamics, and reproductive requirements. The changing nature of the Ohio River from the upper river above "The Falls of the Ohio" to downstream reflects a natural break in river gradient. The influence of the navigation pools also contributes to the decline in gradient within each individual navigation pool. The round-bodied sucker populations are most dominant in the upper half of the Ohio River above the falls. Increased flow causes the sorting of substrate particle sizes, enabling coarse, silt-free substrates to accumulate in the upper portion of the river and below each navigation dam in the tailwater or riverine zones. The transition in the lower portions of a pool to a lacustrine zone causes ultra-fine particulate organic matter, the preferred

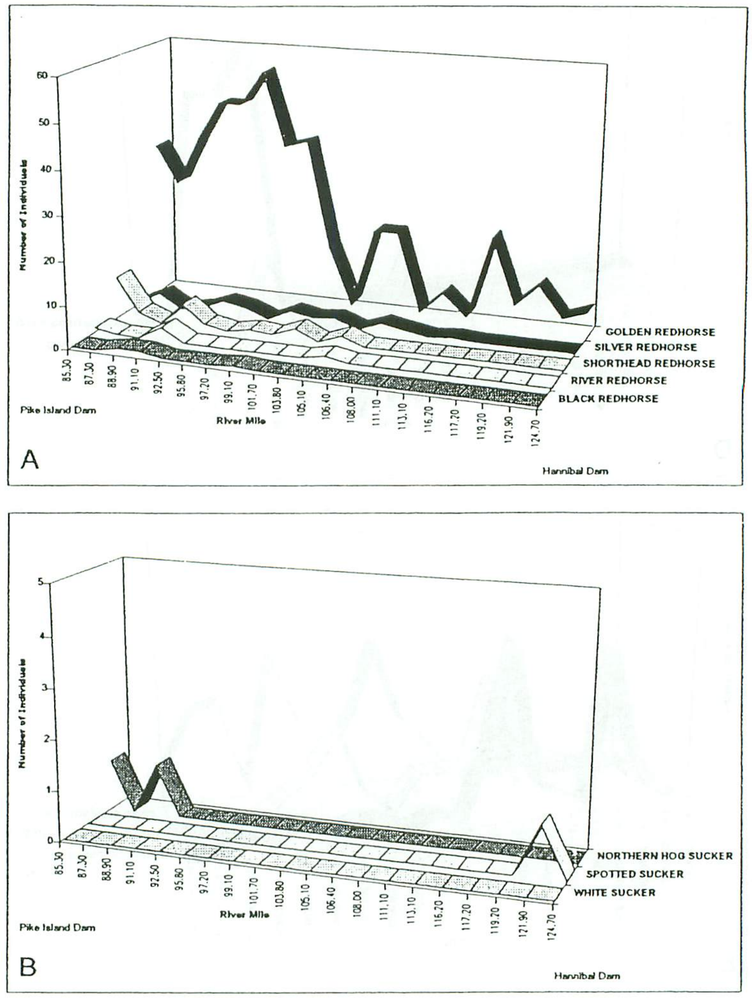


FIGURE 8.4 Average number of sucker individuals collected at 2-mile intervals in the Hannibal Pool per electrofishing event. (A) redhorse species; (B) other round-bodied suckers; (C) carpsucker species; and (D) buffalo species.

food of the deep-bodied suckers, to accumulate. The trophic dynamics of the deep-bodied suckers are mostly detrital and, morphologically, the species possesses a black peritoneum and longer coiled gut (Becker, 1983; Etnier and Starnes, 1993). Goldstein and Simon (Chapter 6) have classified these deep-bodied suckers as detrital feeders.

The deep-bodied suckers are generally found in the transition and lacustrine zones of a navigation pool (Figures 8.4C, D). River carpsucker and quillback are the most abundant in the lacustrine zones of a navigation pool, while highfin carpsucker *Carpiodes velifer* is common in the transition zone of the navigation pool. The presence of smallmouth buffalo throughout the navigation pool shows that the species may be a habitat generalist and not influenced by habitat changes. In Hannibal Pool, the round-bodied suckers, including species of redhorses, hogsucker, spotted sucker, and white sucker, are typically found in the upper riverine zone of the navigation pool (Figures 8.4A, B).

Longitudinal patterns of sucker distribution may be a result of the geomorphology of the Ohio River. As the gradient declines from upstream to downstream in the Ohio River, substrate changes occur from coarse substrates in the upper reaches to sand-clay substrates in the lower reaches.

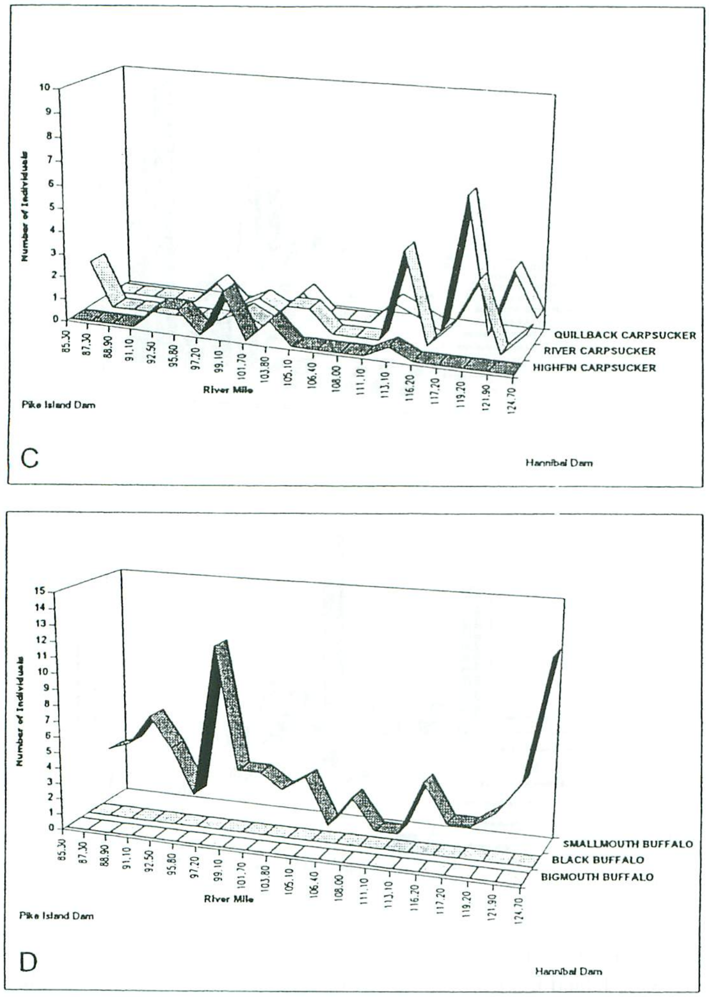


FIGURE 8.4 *Continued.*

These changes affect the reproductive and feeding habitat available to round-bodied suckers. Kay et al. (1994) report that most species of redhorse require coarse, silt-free substrates at the head of riffles for reproduction. Often, these species are known to return to smaller tributaries for spawning (Curry and Spacie, 1984; Moss et al., 1983; Page and Johnston, 199?; Matheny and Rabeni, 1995). Since it is not known whether round-bodied suckers utilize the mainstem Ohio River for reproduction, the reduced number of tributary streams in the lower river may preclude the occurrence of some round-bodied species (E. Emery, unpublished data).

Feeding requirements of suckers are adapted for specialized feeding (Goldstein and Simon, Chapter 6). Round-bodied suckers utilize coarse sand and gravel areas where they search for benthic invertebrates. All species root around in the substrate, using the papillose lips and subterminal mouth for removing macroinvertebrates from the substrate (Kay et al., 1994). Substrate composition changes from gravel to clay in the lower river; thus, a change in substrate composition may not support an adequate macroinvertebrate food base. The presence of round-bodied suckers in the lower river may be limited to the areas beneath the navigation dams where the riverine zones of the navigation pools are most similar to preimpoundment conditions.

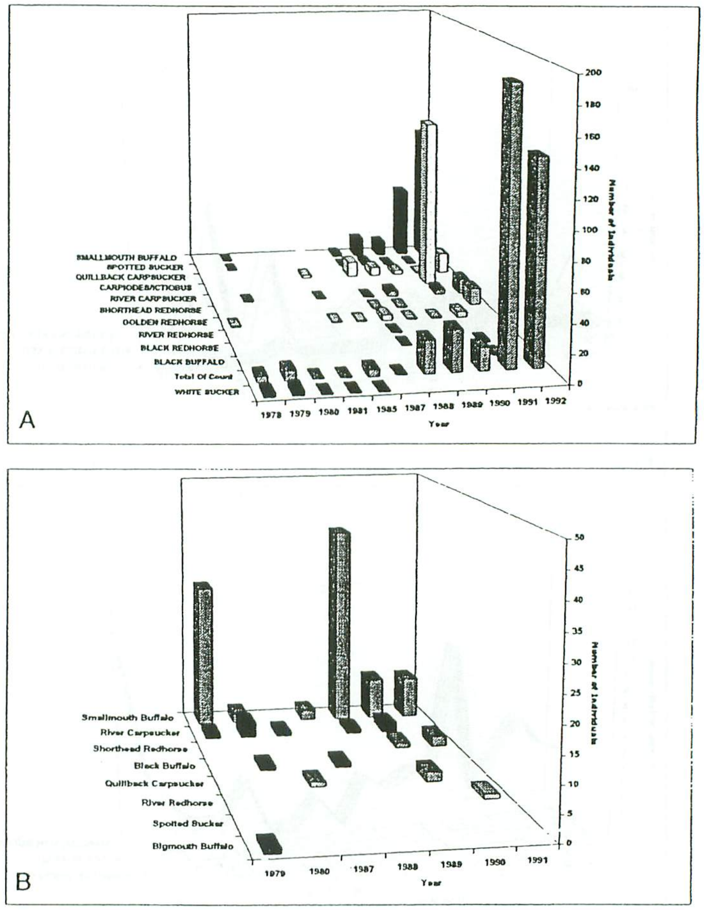


**FIGURE 8.5** Species abundance of suckers collected in the Ohio River at various lock chambers between 1978 and 1993. (A) Pike Island Lock and Dam; (B) Gallipolis Lock and Dam; (C) McAlpine Lock and Dam; and (D) Uniontown Lock and Dam.

### 8.3.3 Temporal Trends

The biological integrity of the fish community of the Ohio River has shown improvement based on correlated water quality improvements (Reash and Van Hassel, 1988). Krumholz and Minckley (1964) reported that, during the steel mill strike of 1959 that reduced pollution loadings to the Ohio River, white sucker invaded the mainstem from tributaries and backwater areas. Lock chamber collections conducted between 1978 and 1993 have shown an increased species richness, a lower number of tolerant and omnivorous species, and increased percentages of insectivores and carnivores, and few DELT anomalies.

Temporal trends of catostomids in four representative lock chambers sampled between 1978 and 1993 were examined (Figure 8.5). These four lock chambers show trends in sucker abundance and species richness during the recovery of the Ohio River after the industrialized city of Pittsburgh began to close steel mills.

#### 8.3.3.1 Pike Island Lock Chamber

The Pike Island lock chamber occurs in the upper Ohio River at ORM 84.2. This section of the river was heavily polluted during the period when the steel mills and numerous other related

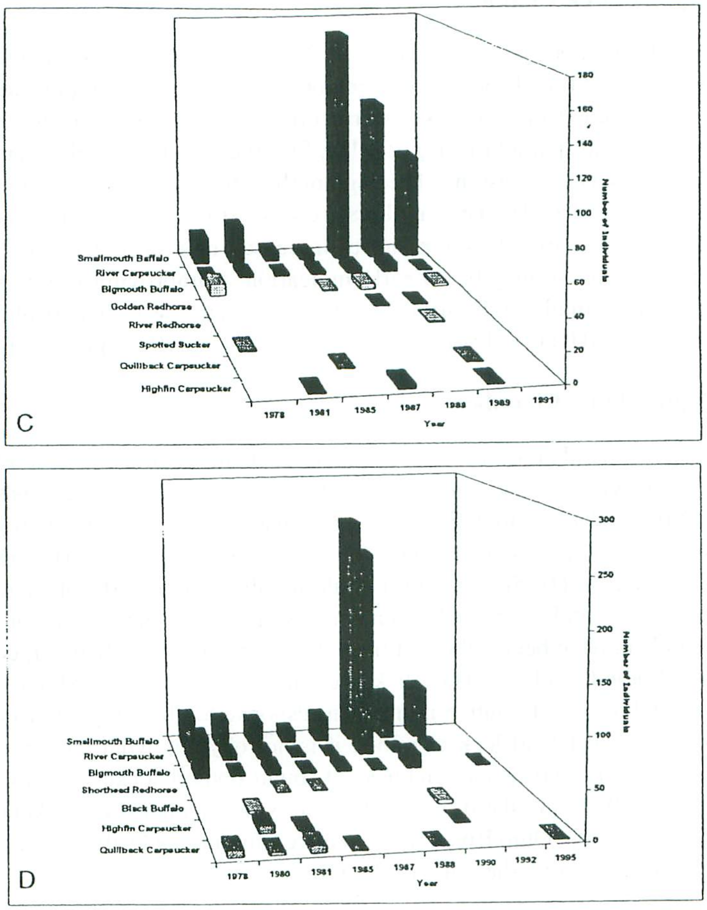


**FIGURE 8.5** *Continued.*

industries thrived in the upper Ohio Valley (Figure 8.5A). Increases in species richness and relative abundance of round- and deep-bodied suckers increased with reductions in pollutant loadings. The only species showing a decline with increased water quality improvements was the white sucker (paired *t*-test, $p < 0.01$). Prior to 1987, white sucker was the most abundant species and occurred at nearly all sampling events. This species is considered tolerant of a wide range of water quality conditions and can be found in highly degraded areas. We observed a decline in the relative abundance of white sucker as other sucker species returned to the Pike Island Pool. Since 1988, not a single white sucker has been collected; but eight other sucker species have recolonized the area. Between 1988 and 1992, sucker species increased in relative abundance and tolerant sucker species declined. Recolonization of the Pike Island Pool by eight sucker species considered sensitive suggests that improvements in the water quality of the Ohio River during this time have been a result of anthropogenic influences. Smallmouth buffalo relative abundance increased significantly (paired *t*-test, $p < 0.05$) during 1991 and 1992. The increase in smallmouth buffalo is likely a result of the species' sustained reproductive period between May and September (Kay et al., 1994). Spawning success for this species is improved when water levels inundate adjacent fields and low areas (Becker, 1983). Increased water levels during the spring would have also benefited river carpsucker; however, the sustained water levels throughout the year increased smallmouth buffalo abundance (U.S. Geological Survey, unpublished Ohio River stage data).

#### 8.3.3.2 Gallipolis Lock Chamber

The Gallipolis lock chamber is located at ORM 279.2. The dramatic changes in species richness and relative abundance at Pike Island Pool were not observed at the Gallipolis lock chamber (Figure 8.5B). Black buffalo and river carpsucker were collected throughout the study period and did not reveal any temporal trend (paired *t*-test, $p < 0.10$). Shorthead redhorse, black buffalo, and quillback were collected on only two occasions. The bigmouth buffalo was collected only during 1979 and has not been collected since. The river redhorse, collected in 1991, is a mollusk sight feeder. The presence of river redhorse may be the result of increased mussel populations. The appearance of shorthead and river redhorse may be an early indication of improving water quality conditions in the upper Ohio River. Smallmouth buffalo relative abundance was statistically significant during 1988 (paired *t*-test, $p < 0.01$), and was also significant during 1979 (paired *t*-test, $p < 0.01$).

#### 8.3.3.3 McAlpine Lock Chamber

The McAlpine lock chamber is located at ORM 604.0 near Louisville, Kentucky. The relative abundance of the sucker community near the McAlpine lock chamber suggests that the community was possibly suppressed prior to 1987. Few individuals of any species were typically collected during any sample event, and six species ($\bar{x} = 3.5$ species per sample event) were collected between 1978 and 1987 (Figure 8.5D). Smallmouth buffalo numbers increased statistically (pairwise *t*-test, $p > 0.05$) between 1987 and 1988, and seven species of suckers have been collected. Five species of deep-bodied suckers have been collected from the McAlpine lock chamber, compared with three species of round-bodied suckers. The sucker community in the McAlpine lock chamber has increased species richness and relative number in response to changing environmental conditions. However, unlike the Pike Island lock chamber, it is not obvious what the stresses were that have been moderated. An increased species richness of round-bodied suckers during 1989 could be the result of reduced runoff during the drought of 1988. Another plausible explanation could be that, in the lower 300 miles of the Ohio River, the sucker community lacks the species richness of round-bodied suckers observed above the Falls of the Ohio.

#### 8.3.3.4 Uniontown Lock Chamber

The Uniontown lock and dam is located near Uniontown, Indiana, at ORM 846.0. No temporal trend in species richness was observed before 1992 (paired *t*-test, $p < 0.10$); however, a reduction in species richness since 1992 (paired *t*-test, $p < 0.01$) has been a result of declining round-bodied suckers (Figure 8.5D). Species collected from the Uniontown lock and dam are dominated by deep-bodied suckers. No significant community changes occurred for most species, with the exception of smallmouth buffalo and river carpsucker. During the drought of 1988, these two species increased dramatically in relative abundance (paired *t*-test, $p < 0.01$). A possible reason for increased relative abundance of these two species may be the result of improved spawning success in years when water levels rise in the spring to flood marshes or low-lying areas (Walburg, 1976; Becker, 1983). Such was the case in the spring of 1988. In subsequent years, the relative abundance of smallmouth buffalo and river carpsucker returned to expected ranges.

### 8.3.4 Multimetric Applications

Ecologically significant species groups are typically included in a multimetric index for assessing ecosystem integrity (Karr, 1981; Ohio EPA, 1989a; Simon and Emery, 1995). Karr (1981) suggested that the family Catostomidae is an important measure of flowing rivers in the midwest; suckers as a component of a freshwater stream and small river community were used when developing the Index of Biotic Integrity (IBI). The Ohio EPA (1989a) modified the IBI for large inland rivers of Ohio and used the proportion of round-bodied suckers and number of sucker species in the boat method IBI. Sanders (1991) applied the inland large river metrics to an evaluation of the Ohio River along the Ohio shoreline. Simon and Emery (1995) modified the IBI for use in Great Rivers. They evaluated several species richness metrics, number and proportion of round-bodied sucker species and individuals for evaluating the Western Allegheny Plateau, which is the upper 300 miles of the Ohio River.

The suckers are capable of influencing several of the IBI metrics currently being evaluated for consideration in an index for Great Rivers. Suckers influence species richness metrics, trophic and proportional metrics, catch and relative abundance measures, and DELT anomaly metrics.

#### 8.3.4.1 Species Richness Metrics

Metrics typically considered for development of the IBI include: total number of species, total number of sucker species, number of round-bodied sucker species, and number of deep-bodied sucker species (Figure 8.6). The riverwide expectations for the total number of sucker species show a decreasing trend in species richness with increasing drainage area (Figure 8.6A). A lower total number of sucker species richness for the lower river is expected.

The decline in total number of sucker species is a result of the declining number of round-bodied sucker species. The number of round-bodied sucker species along the Ohio River shows declining trends with increasing drainage area (Figure 6B). The occurrence of round-bodied suckers below ORM 600 is erratic. Use of the total number of round-bodied suckers as a metric in the Ohio River fish index is likely, although it may not be excluded for use below ORM 600. Round-bodied suckers are important indicators of a high quality resource, and increasing number of species would reflect increasing biological integrity.

Deep-bodied suckers are uniformly distributed in the Ohio River (Figure 8.6C). No drainage area relationship was observed; however, the increase of deep-bodied suckers may be a reflection of declining biological integrity. The deep-bodied suckers are detritivores and are tolerant of thermal increase (Gammon, 1983; Simon, 1992). The deep-bodied suckers become more important in the lower river because they typically are the only representatives. This group may replace the round-bodied suckers as a metric for the lower portion of the river, but would reflect declining biological integrity.

#### 8.3.4.2 Proportional Metrics

As sucker species increase and dominate the relative catch, they influence various community function characteristics. These functional characteristics of Great River fish communities are often utilized as proportion metrics (Karr et al., 1986; Simon and Emery, 1995). Metrics considered for a Great River index included: percent round-bodied sucker individuals, percent deep-bodied sucker individuals, percent round-bodied sucker biomass, and percent deep-bodied sucker biomass.

In the Ohio River the percent of round-bodied sucker individuals declines with increasing drainage area (Figure 8.7A). Although the round-bodied suckers are an important community member in the upper 500 river miles, in the lower 400 river miles round-bodied sucker individuals rarely contribute more than 5% of the community. Thus, the use of round-bodied suckers should be considered an indicator of high biological integrity for the upper Ohio River (above ORM 520). Deep-bodied suckers attain their highest relative abundance in the middle Ohio River (between ORM 400 and 500), but the variance in relative abundance is not statistically different (MANOVA, $p < 0.10$) for the entire Ohio River (Figure 8.7B). If one considers an increase in percent of deep-bodied sucker individuals to reflect a decline in biological integrity, this metric should reflect lower integrity characteristics when increasing.

Percent community composition expressed as biomass has not been routinely used for development of an IBI (Goldstein et al. 1994; Niemela et al., Chapter 12). In the Red River of the North drainage systems of northwestern Minnesota and northeastern North Dakota, few species are

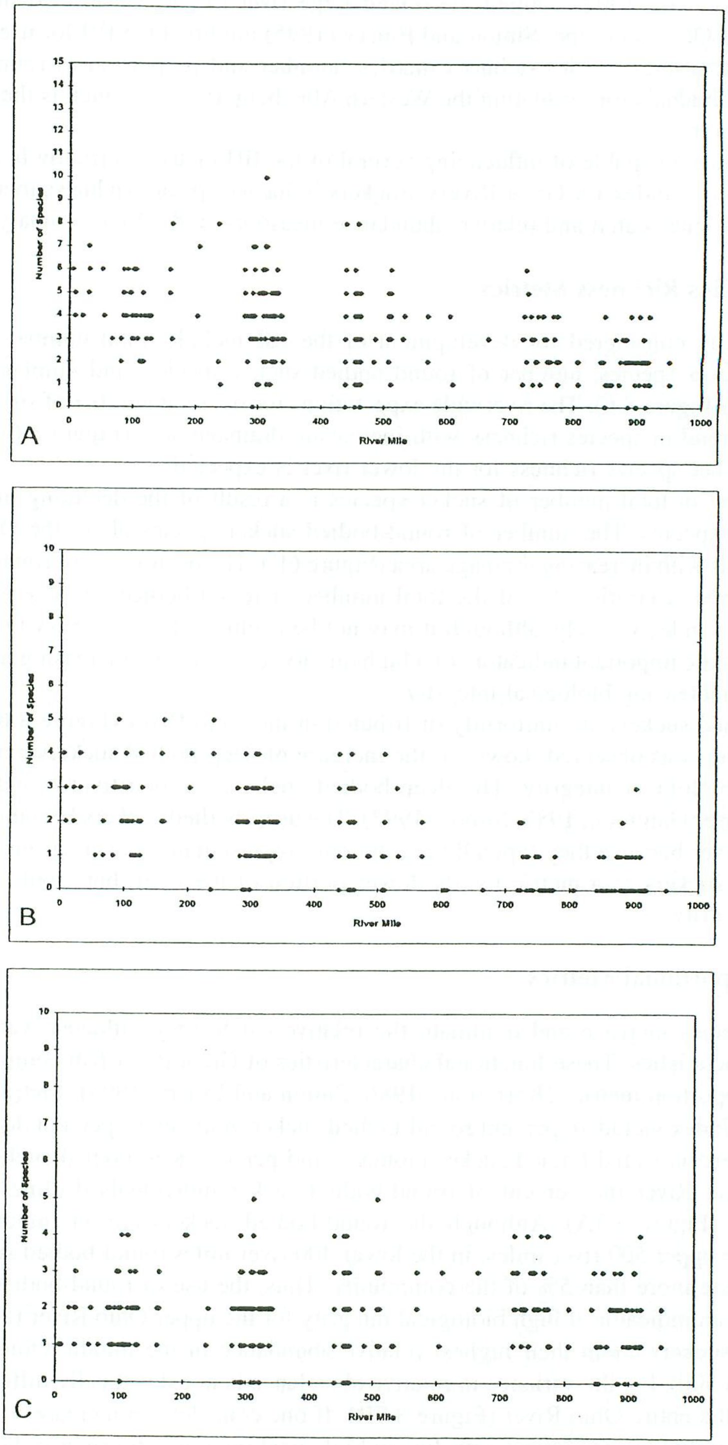


**FIGURE 8.6** Influence of the number of suckers species individuals on various species composition metrics considered for use in an index of biotic integrity. (A) total number of sucker species; (B) round-bodied sucker species; and (C) deep-bodied sucker species.

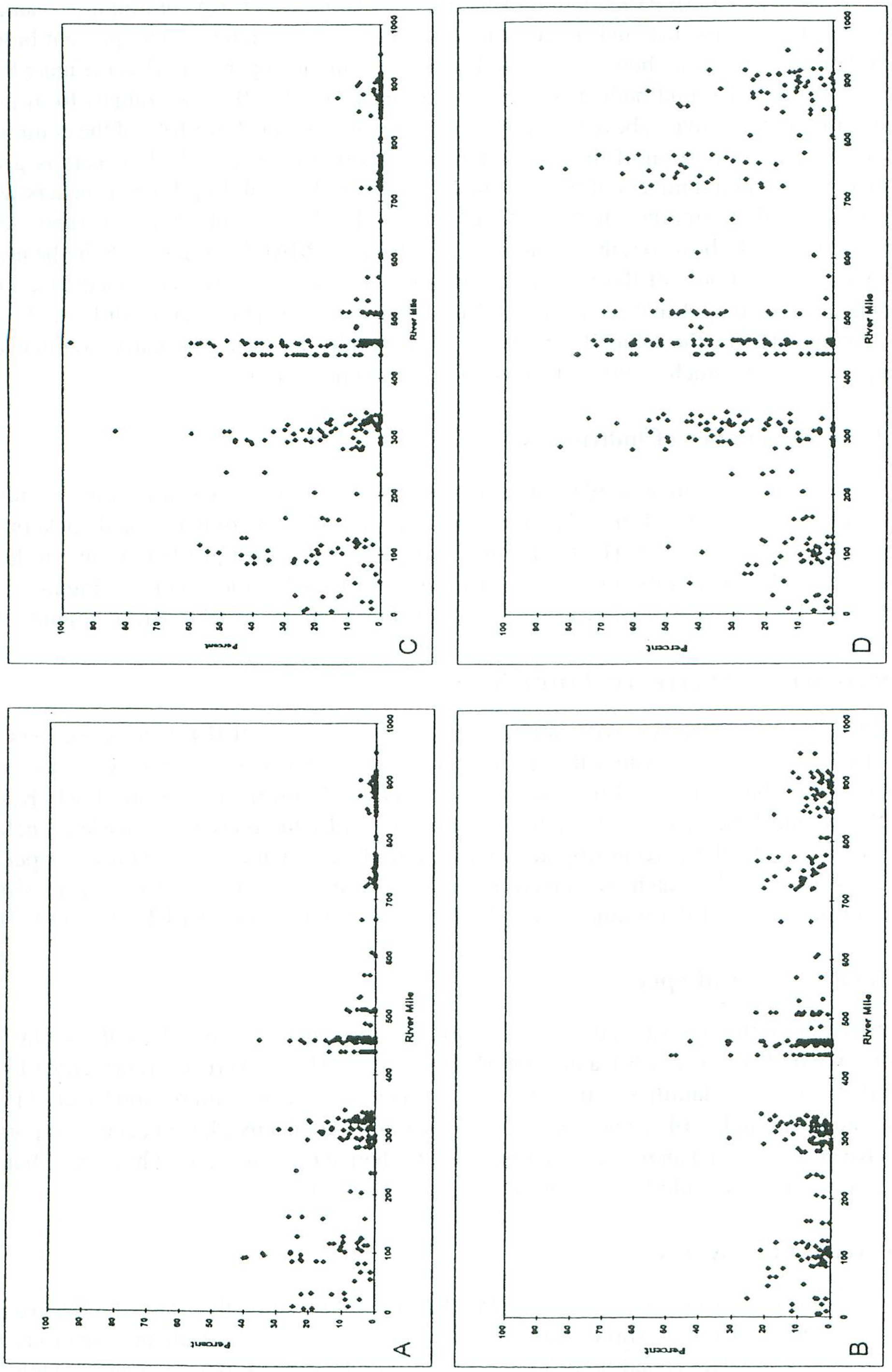


FIGURE 8.7 Influence of sucker individuals on proportion metrics. (A) percent round-bodied sucker individuals; (B) percent deep-bodied sucker individuals; (C) percent round-bodied sucker biomass; and (D) percent deep-bodied sucker biomass.

naturally present. For the Red River, trophic dynamics are better measured using biomass than percentage of individuals. Generally, reasons that many indices have not used biomass are simply because either the information does not exist or the information is used in another index (Index of Well-Being, Gammon, 1973). Examination of biomass for Great River fish communities can more adequately depict the roles that suckers contribute to the entire community. The percent biomass of round-bodied suckers shows how significant this family is in the upper Ohio River (Figure 8.7C). The dramatic decline of round-bodied sucker biomass near ORM 520 shows ranges from nearly 98% of the community biomass above the Falls of the Ohio, to seldom above 10% of the community below the Falls. The proportion of the total catch biomass that is deep-bodied suckers is greater than proportions based on numbers of fish caught. Typically, individual deep-bodied suckers weigh 2.0 kg and thus contribute significantly to the total biomass. The biomass of the deep-bodied suckers is variable (Figure 8.7D); however, they contribute significantly (MANOVA, $p < 0.05$) in the middle and lower Ohio River. Pools of the middle and lower Ohio River possess large lacustrine zones that may enhance the competitive advantage of deep-bodied suckers. However, regardless of where sampling is conducted in the Ohio River, the fish community biomass is clearly dominated by suckers, representing as much as 90% of the total catch biomass at any site.

#### 8.3.4.3 Relative Number of Individuals

Sanders (1991) used the relative number of round-bodied suckers in the catch as a metric for the upper Ohio River. We evaluated the relative number of total suckers, round-bodied suckers, and deep-bodied suckers (Figure 8.8). The total number of suckers declined just below river mile 500 (Figure 8.8A), which is certainly a reflection of the loss of round-bodied suckers (Figure 8.8B), since the deep-bodied suckers are more evenly distributed throughout the Ohio River (Figure 8.8C).

### 8.3.5 Influences of Suckers on Other Metrics

The dominant presence of suckers will indirectly affect other aspects of IBI metrics. Suckers will indirectly affect select metrics within the species composition and richness, trophic composition, reproductive guild, abundance, and individual health and condition metrics (Karr, 1981; Karr et al., 1986; Simon and Emery, 1995). Specific metrics affected by the presence of suckers include: total number of species, the percent trophic composition of the catch as insectivores, the percent trophic composition of the catch as omnivores, catch per unit effort (CPUE), percent simple lithophils, and frequency of deformities, eroded fins, lesions, and tumors (DELT) (Figure 8.9).

#### 8.3.5.1 Total Number of Species

Our collections show that catostomids represent 14% of all species collected by the night boat electrofishing method between 1991 and 1996 (Figure 8.9A). The suckers are represented by 14 species, while the other 15 families of the Ohio River contain 88 species. Simon and Emery (1995) showed that the total number of species metric for the Western Allegheny Plateau ecoregion portion of the Ohio River would need an increase of 10 species to change integrity scores; however, changes in as few as three species could be enough to change integrity classes.

#### 8.3.5.2 Percent Insectivores

The trophic composition of insectivores in the Ohio River would be directly affected by the round-bodied suckers. Our collections show that suckers compose over 32% of all insectivorous fish collected (Figure 8.9B). The round-bodied suckers are all categorized as insectivores, while the deep-bodied suckers are omnivores (Ohio EPA, 1989a; Simon and Emery, 1995). Simon and Emery (1995) show that differences between integrity scores for insectivores are separated by 20% total

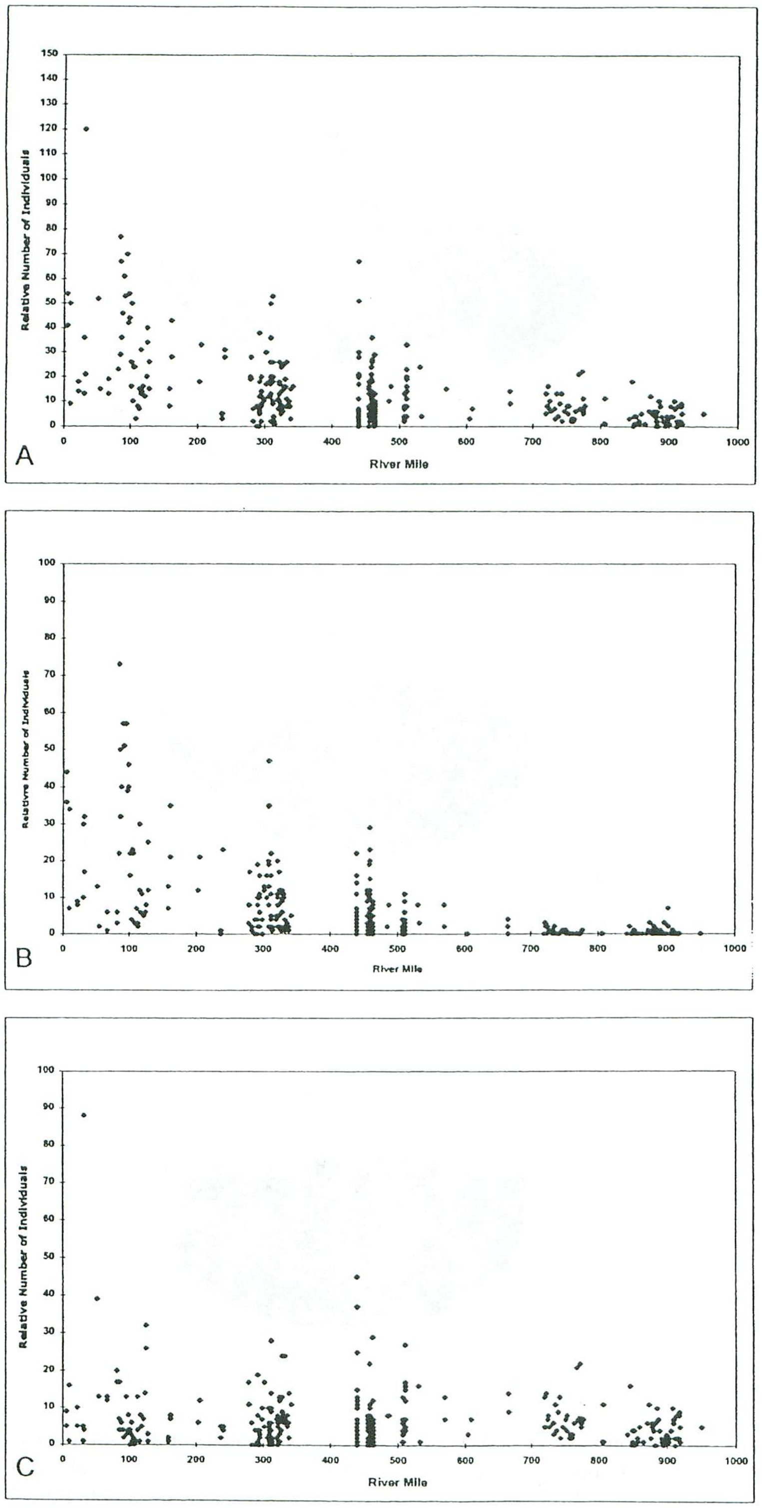


**FIGURE 8.8** Relative number of suckers on various metrics considered for use in an index of biotic integrity. (A) total number of suckers; (B) round-bodied suckers; and (C) deep-bodied suckers.

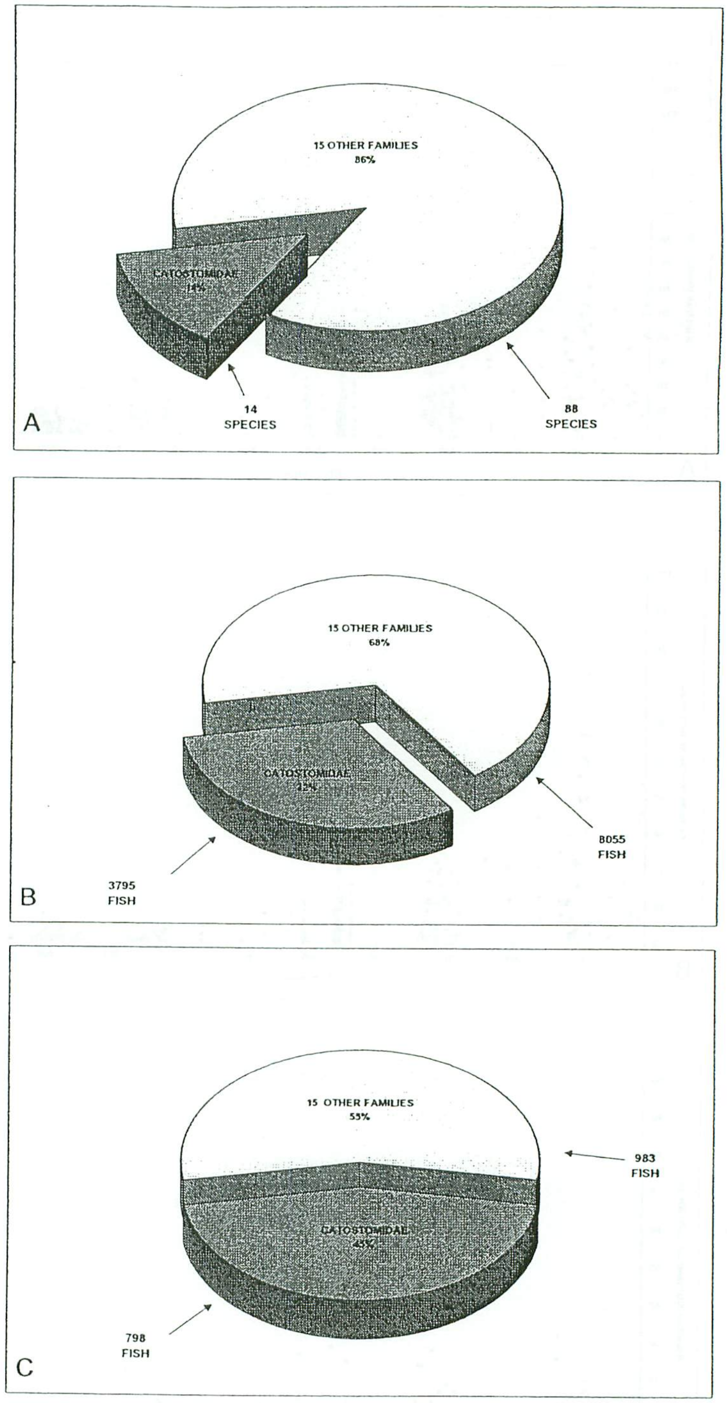


**FIGURE 8.9** Contributions of the sucker family to the total catch for specific characteristics of the Ohio River. (A) total number of species; (B) percent of catch as insectivore individuals; (C) percent of catch as omnivore individuals; (D) catch per unit of effort; (E) percent of catch as simple lithophils; and (F) percent of DELT anomalies.

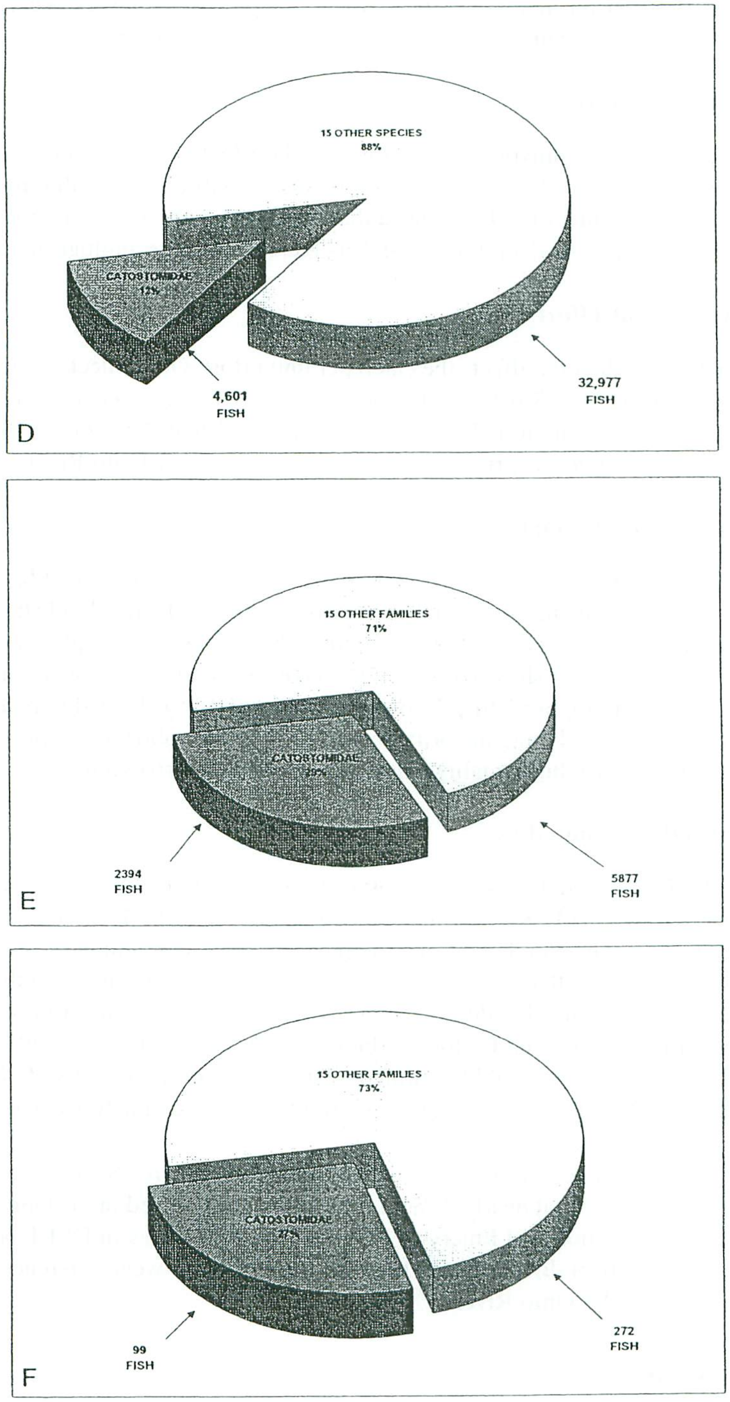


**FIGURE 8.9** *Continued.*

catch proportions. If either an increase or decrease in deep-bodied suckers occurred, a reduction in percent insectivores would cause a decline in site biological integrity.

#### 8.3.5.3 Percent Omnivores

The trophic composition of omnivores would be directly affected by an increase in deep-bodied sucker individuals. The deep-bodied suckers compose nearly half (45%) of all omnivores collected (Figure 8.9C). Simon and Emery (1995) showed that a change in about 7% of omnivore abundance could change integrity scores. As deep-bodied suckers increase at a site, biological integrity declines.

#### 8.3.5.4 Catch per Unit Effort

High sucker abundance indirectly affects the catch per unit effort. Our collections in the Ohio River resulted in a total catch of 37,578 fish. Of the total catch, 4601 were suckers — contributing 12% of the catch (Figure 8.9D). Simon and Emery (1995) showed that the total catch would need to increase by 250 fish to change integrity scores at a site in the upper Ohio River.

#### 8.3.5.5 Percent Simple Lithophils

The proportion of simple lithophilous spawning fish are considered a measure of habitat disturbance since these species spawn in the interstitial spaces of cobble and gravel substrates (Ohio EPA, 1989a). Simon and Emery (1995) classified all round-bodied suckers as simple lithophilous spawning species. Author collections show catostomids make up nearly 30% of all simple lithophils sampled in the Ohio River (Figure 8.9E). Simon and Emery (1995) showed that changes of about 20% simple lithophils would change integrity scores. Simple lithophils are important components of the Ohio River and require high-quality, silt-free substrates for spawning.

#### 8.3.5.6 Percent DELT Anomalies

The occurrence of DELT anomalies is an indicator of community health at the lowest extremes of biological integrity (Karr, 1981; Karr et al., 1986). Increases in DELT anomalies are a result of increased contaminant levels (Sanders et al., Chapter 8). Since contaminants are often found in the sediments, benthic species that either feed, reproduce, or are in proximity to the sediments are the most vulnerable to exposure. In addition, long-lived species are the most important indicators since they will generally be exposed for longer durations. Simon and Emery (1995) suggested that proportions of DELT anomalies should be limited to species attaining lengths of 200 mm TL. The occurrence of specific DELT anomalies are important response signatures that can categorize impact type.

As DELT anomalies increase, stresses on individual fish are reflected especially in sucker species. Our collections show that nearly 27% of all anomalies observed in the Ohio River occurred in suckers (Figure 8.9F). Simon and Emery (1995) show that increases in DELT between 1 to 3% of the total catch would reflect differences in biological integrity between reference conditions and the most degraded site in the Ohio River.

## 8.4 CONCLUSION

The family Catostomidae composes a significant amount of the fish fauna biomass of the Ohio River. The species of this family are important environmental indicators of river health and are used as an important attribute of Great River fish communities in a multimetric index. The fish community of the Ohio River was sampled by electrofishing at 339 locations and 4 navigation lock and dams. Spatial distribution patterns associating community structure with drainage area riverwide show that, within each navigation pool, community structure is related to distance downstream from the navigation dam. The Catostomidae of the Ohio River has demonstrated an increase in community diversity and complexity spatially as the water quality of the system has improved. However, the displacement of redhorses by buffalo and carpsuckers in the lower 300 miles of the Ohio River might be a result of differing habitat characteristics, food base alterations, and reproductive limitations imposed by fewer tributaries.

As water pollution control measures have been incorporated into the management scheme for the Ohio River, the quality of the water and the resources it supports have improved. The most significant improvement was observed at the Pike Island lock and dam. This dam is in the upper portion of the river where round-bodied suckers dominate the fish community and relative abundance is greatest. Suckers become a smaller component of the community in the middle and lower stretches of the Ohio River. Changes in sucker community structure and function as a result of water quality improvements are not as obvious. Since the sucker community of the upper Ohio River was the most impacted by pollution it was the most able to show improvement. The increase in round-bodied sucker species richness and relative abundance in the upper river is an important environmental indicator since this species is sensitive to water quality impact and is more likely to show response to improved conditions.

The deep-bodied suckers of the lower Ohio River may not have been as affected historically by the polluted conditions resulting from industrialization. Therefore, sucker community temporal trends observed at Gallipolis, McAlpine, and Uniontown Pools may not be a result of impact and recovery, but actually of a stable community with natural fluctuations from water levels. Improved species richness and relative abundance in the lower Ohio River would require extensive habitat restoration of backwater areas and inundated gravel bars.

Distribution trends of suckers longitudinally along the river and within navigational pools must be accounted for in the development of reference condition expectations. The influence of suckers on metrics in a Great River IBI must be evaluated to determine which component of this family best describes the structure and function of the Ohio River fish community. Sucker metrics could be developed to reflect species richness, proportion within the community, or simply relative numbers. The metric development described here highlights the round-bodied suckers or focuses on the deep-bodied group, or could include all suckers occurring in the Ohio River. The conclusion is that the round-bodied suckers should be featured as a metric to characterize the upper Ohio River above the Falls of the Ohio, while all sucker species should be used to evaluate the Great River community below the falls. If the deep-bodied suckers are used, they should reflect a loss of biological integrity. The proportion of total catch as biomass shows the importance of the suckers: round-bodied suckers in the upper river and deep-bodied suckers in the lower river. The influence of the round-bodied suckers should be an indication of high biological integrity, while the increase in deep-bodied suckers are a reflection of declining biological integrity.

The catostomids could greatly influence six other metrics being considered for inclusion in numeric biocriteria for the Ohio River. Sucker influence must be considered in the development of the fish index component of biocriteria. The development of biological criteria must take sucker presence into consideration so as not to allow the catostomids to determine the integrity scores of too many of the metrics.

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