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A Review of the Interactions between Catfishes and Freshwater Mollusks in North America

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Abstract.—Catfishes are important in freshwater ecosystems not only as consumers, but also as essential partners in symbiotic relationships with other organisms. Freshwater mollusks are among the many organisms that have interactions with catfishes. For example, ictalurids are hosts for larvae of several native freshwater mussel species. The larvae, which attach briefly to gills or fins of fish to complete their development to the free-living juvenile stage, disperse via upstream and downstream movement of host fish. In turn, freshwater mussels serve as a food source for some catfish species while other catfish species may use spent mussel shells for habitat. Ictalurids also benefit from the conservation status of many freshwater mussel species. Federal and state laws protecting these invertebrates can preserve water quality and habitat and, at times, provide incentives and funding for conservation and restoration of stream and riparian habitats.

Introduction

North American native freshwater mollusks are among the most imperiled group of organisms in the world (Lydeard et al. 2004; Christian and Harris 2008). More than 70% of the 297 freshwater mussel taxa are extinct, listed federally as endangered or threatened, or in need of conservation, and more than 60% of the 842 freshwater snail taxa are imperiled, critically imperiled, or presumed extinct (Williams et al. 1993; Lysne et al. 2008). In his national strategy for the conservation of freshwater mussels, Neves (1997) pointed out that the public has a lack of understanding of the plight and value of freshwater mussels; the same is true for freshwater gastropods (Lysne et al. 2008). Because catfishes and aquatic mollusks cohabitate in many ecosystems, understanding interactions of these taxonomic groups can benefit managers and conservationists. In this review, we summarize importance of catfishes to freshwater mollusks and explain how catfishes can benefit from freshwater mollusks.

Predator–Prey Relationships between Catfishes and Freshwater Mollusks

Both freshwater mussels and snails are important components of aquatic ecosystems and fill several valuable ecological and economic roles. Freshwater mollusks and their feces and pseudofeces are valuable components in food webs (Vaughn and Hakenkamp 2001; Brown et al. 2008). Freshwater

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mollusks are a food source for some catfish species, including black bullhead *Ameiurus melas*, yellow bullhead *A. natalis*, brown bullhead *A. nebulosus*, blue catfish *Ictalurus furcatus*, channel catfish *I. punctatus*, and flathead catfish *Pylodictis olivaris* (Forbes 1888; Edds et al. 2002; Grist 2002). Several species of madtoms *Noturus* spp. also have been known to consume mollusks. Gastropods have been reported in stomachs of the slender madtom *N. exilis* (Curd 1960), Ouachita madtom *N. lachneri* (Robison and Harp 1985), and northern madtom *N. stigmosus* (Tzilkowski and Stauffer 2004). Forbes (1888) described mollusks as "a decidedly important element" in catfish diet, with bivalves (e.g., unionids and sphaeriids) and gastropods being nearly equally consumed. While some authors have reported catfish consuming whole mollusks, including shell (e.g., Graham 1999; Ledford and Kelly 2006), Forbes (1888) suggested that catfishes were able to separate mollusk bodies from their shells. He stated that a catfish "seizes the foot of the mollusk while the latter is extended from the shell, and tears the animal loose by vigorously jerking and rubbing it about." Forbes (1888) continued by speculating that a catfish might be able to crack shells in its jaws to consume the soft parts. He strengthened his argument by stating that "no fragment of a shell was ever found in <the> stomachs, but the bodies of the animals had invariably been torn from the shell while yet living – as shown both the fresh condition of the recently ingested specimens and likewise by the fact that the adductor muscles were scarcely ever present in the fragments." He also stated that 120 bodies and opercles of *Viviparus* spp. (as *Melanthos* and *Vivipara*), but no shells, were counted in one specimen. In describing catfishes, Forbes (1888) stated, "the capacious mouth, wide esophagus, and short broad stomach, admit objects of relatively large size and of nearly every shape; the jaws, each armed with a broad pad of fine sharp teeth, are well calculated to grasp and hold soft bodies as well as hard; the gill-rakers are of average number and development; and the pharyngeal jaws— broad, stout arches below and oval pads above, with thin opposed surfaces covered with minute, pointed denticles — serve fairly well to crush the crusts of insects and the shells of the smaller mollusks and to squeeze and grind the vegetable objects which appear in the food. The use made of the jaws in tearing mollusks from their shells <sic> is probably the most peculiar feeding practice of these animals."

Data are limited on when and how much catfishes consume native freshwater mollusks. Forbes (1888) reported that mollusks accounted for nearly 25% of the diet in black bullhead, 20% in brown bullhead, 15% in channel catfish, and 5% in yellow bullhead. We assume effects of catfish predation would vary seasonally and with mollusk density and fish size (e.g., gape size). Bailey and Harrison (1948) stated that few freshwater mussels were consumed by channel catfish in the Des Moines River because mussels were rare in the river, whereas Forbes (1888) stated that some channel catfish collected in September and October had nothing but mollusks in their stomach, and brown bullheads collected in September and October fed nearly exclusively on fingernail clams. Since the time of Forbes (1888), North American freshwater mollusks have experienced drastic reductions in terms of species richness and biomass as a result of habitat destruction, environmental contamination, overharvest, and invasion of nonindigenous species (Bogan 1993; Williams et al. 1993; Watters 2000). It is unknown what kind of effects, if any, this had on catfish predating on native mollusks.

Within the past 100 years, North America has witnessed invasion of several freshwater mollusks, including corbiculids (e.g., Asian clam *Corbicula fluminea*) in the 1930s and dreissenids (e.g., zebra mussel *Dreissena polymorpha*) in the 1980s (Watters et al. 2009). Asian clams and zebra mussels are usually smaller than native freshwater mussels, are often very abundant, and have low mobility (Watters et al. 2009). Blue catfish have been known to utilize these as a food source (Grist 2002; Eggleton and Schramm 2003; Eggleton and Schramm 2004). Ictalurid consumption of zebra mussels and Asian clams varies seasonally and can be dependent upon fish size and location of the fish (e.g., main channel versus floodplain lake) within a particular habitat (Eggleton and Schramm 2003; Bowers et al. 2005; Bowers and de Szalay 2007). Magoulick and Lewis (2002) noted that blue catfish selected against more energetically rich shad (*Dorosoma* spp.) during summer months, instead choosing more abundant and energetically poor zebra mussels. Effects this dietary shift may have on catfishes are unknown but has been implicated in declines in total length of other fishes. French and Bur (1996) found that total length of 6-year-old female freshwater drum *Aplodinotus grunniens* in Lake Erie significantly declined following invasion of dreissenids, presumably due to increased feeding on the nonindigenous mussels. While any effects have yet to be documented in catfish, they would counteract management goals of increasing size of blue catfish to increase angler satisfaction (e.g., Dames et al. 2003).

Catfishes may help to control these nonindigenous species (e.g., Robinson and Wellborn 1988; Bartsch et al. 2005), but sheer abundance and high fecundity of Asian clams and zebra mussels make it doubtful that fishes will ever eradicate them (Thorp et al. 1998; Magoulick and Lewis 2002). Rather, catfishes could become vectors in dispersal of these nonindigenous mollusks because both zebra mussels and Asian clams can pass through blue catfish undigested (D. Shoup, Oklahoma State University, personal communication). This potential for spreading nonindigenous mollusks needs to be considered when moving fishes between water bodies or into hatcheries.

Ictalurids are among the most frequently sought sport fishes in the United States, especially in Midwestern and Southern states (Burlingame and Guy 1999; Wilde and Ditton 1999). Often, freshwater mussel bodies will be used as bait when fishing for catfish (Forbes 1888; Howard 1914; Bailey and Harrison 1948). A recent article published in the fishing magazine *In-Fisherman* (Neumann 2008) described the connection between blue catfish diet and freshwater mussels. The article stated that even though some ictalurids consume freshwater mussels, legality of using mollusks as bait varied from state to state. For example, in Missouri, it is legal to possess up to five freshwater mussels (other than species of conservation concern) per day with a fishing license, and these may be used as bait (MDC 2010); however, in Ohio, it is illegal to possess any freshwater mussels, including invasive species (Watters et al. 2009). Promoting awareness of freshwater mollusk conservation among anglers could be a valuable tool for aquatic managers because improving freshwater mollusk populations and protecting their habitats would benefit not only mollusks themselves, but also could bolster catfish populations and improve these fisheries.

Freshwater Mussel Life History Interactions with Catfishes

Although catfishes consume freshwater mussels, they also aid mussels in reproduction (Coker et al. 1921; Hoggarth 1992). Freshwater mussels have a complex and unique life cycle (Figure 1). Males release sperm into the water column and females draw

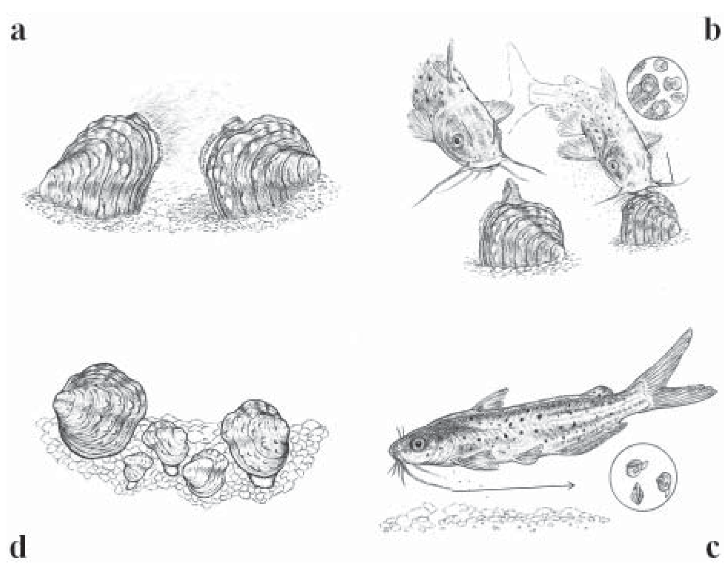

FIGURE 1. Generalized life cycle of freshwater mussels (shown here: winged mapleleaf with the channel catfish). The male mussel (left) releases sperm into the water and the female mussel (right) draws it in through her incurrent siphon (a). Eggs are internally fertilized and resulting larvae (called glochidia) develop inside modified gills (called marsupia). The female mussel then entices the host fish by displaying the mantle flap (b). When struck, the marsupia release glochidia. The glochidia then attach to gills of the host fish and begin metamorphosing. After a few weeks, juvenile mussels free from the cysts (c) and fall to the stream or lake bottom to begin an independent life (d). Drawing by Scott Faiman, Missouri Department of Conservation.

in sperm via the incurrent siphon. Eggs are fertilized internally and are brooded in the female's marsupium. Eggs then develop into an intermediate larval stage (termed glochidia). When mature, glochidia are released and attach to an appropriate host (usually a fish) by encysting on gills, fins, or skin of the host. While encysted, glochidia transform and begin to resemble adults, and after metamorphosis (1– 25 weeks depending upon species and environmental conditions), juveniles emerge from cysts and fall to the stream or lake bottom to begin an independent life (Cummings and Mayer 1992). Some freshwater mussel species simply expel their glochidia into the water column without adaptations to attract host fish to the female mussel, whereas others have evolved features and behaviors that function to lure host fish, thereby increasing chances of host encounters and reducing chances of infestation of unsuitable hosts (Haag and Warren 2003; Barnhart et al. 2008). These adaptations range from slight modifications of the mantle to more involved modifications that superficially resemble small prey items, including fishes, crayfishes, or insect larvae (Barnhart et al. 2008). Evolution of host specificity is linked with selective encounter of host taxa (Barnhart et al 2008). For example, unionids that display mantle lures to entice predatory fishes increase host contact and can target a particular feeding guild of host species. However, this intricate relationship can be easily disrupted by human disturbances, thus aiding imperilment of many freshwater mussel species (Barnhart et al. 2008). Although some mussel species (e.g., *Epioblasma* spp.) have been known to crush potential host fish (Barnhart et al. 2008), typically no harm is done to the fish. A host can carry more than 1,000 glochidia and can develop immunity to repeat infections (Wilson 1916; Watters 1997; Dodd et al. 2006). While some freshwater mussels can use several species of fishes as hosts, others require a particular species or family of fish. One example is the federally endangered winged mapleleaf *Quadrula fragosa*, which only uses blue catfish and channel catfish as its host (Steingraeber et al. 2004). Many ictalurid-dependent unionids use some form of lure and possibly a chemical attractant to entice their hosts (Pepi and Hove 1997; Barnhart et al. 2008). By being a food source to catfishes, freshwater mussels can attract host fishes and increase the likelihood newly transformed mussels will be deposited in suitable habitat, thus partially accounting for aggregations of mussels (Howard 1914).

Catfishes benefit freshwater mussels by facilitating development of larvae of several species (Coker et al. 1921; Hoggarth 1992) and can even host several species simultaneously (Weiss and Layzer 1995). Ictalurids are known to serve as hosts for at least 29 unionid species (Table 1), including several that are federally endangered (e.g., fat threeridge *Amblema neislerii*, catspaw *Epioblasma obliquata obliquata*, and winged mapleleaf) or are becoming rare and are state-listed as a species of concern in at least one state (Williams et al. 1993, NatureServe 2009). Some freshwater mussels are thought to only use catfishes as hosts, whereas other mussels can use catfishes as well as other groups of fishes as hosts (OSUM 2010).

The presumed host list (Table 1) is based on natural infestations (e.g., wild-caught fishes parasitized with glochidia) and laboratory infestations (e.g., fishes parasitized by artificial methods). In some cases, glochidia readily attach but never metamorphose on host fishes. These instances potentially could lead to erroneous reported host–mussel relationships (Hoggarth 1992; Haag and Warren 2003). Many host–mussel relationships are unknown, so this list is by no means complete. Some species (both fishes and freshwater mussels) that are easier to collect or maintain in the lab have a plethora of host–mussel relationship data. However, other species are rare (e.g., madtoms) or difficult to maintain in captivity and therefore might be understudied and underrepresented on the list. Identifying freshwater mussel hosts is paramount to restoring and conserving unionid populations. Because many freshwater mussels are protected, an avenue exists for preservation of catfishes via the need to maintain certain populations of host fishes.

Freshwater Mussel Habitats, Dispersal, and Potential Threats

Freshwater mussels vary considerably with respect to their habitat preferences, with some species being restricted to a specific habitat type (e.g., small creeks or large rivers), whereas others can live in almost any permanent body of water, including wetlands or lakes/reservoirs (Cummings and Mayer 1992; Parmalee and Bogan 1998; Watters et al. 2009). Host–mussel relationships can explain some patterns of unionid distribution and abundance (Haag and Warren 1998). Many ictalurid-hosted freshwater mussels are in the unionid subfamily Ambleminae and are found in similar habitats as catfishes. As with blue catfish, channel catfish, flathead catfish, and madtoms (Burr and Stoeckel 1999; Graham

TABLE 1. Ictalurids that are known host fishes for freshwater mussels (data taken from OSUM 2010). Asterisks (*) indicate those species that are federally endangered. Crosses (†) indicate those species that are believed to only use ictalurids as hosts. Evidence type of host/parasite associations are categorized by a two-letter code devised by Hoggarth (1992) and include NI (natural infestation; parasite found on wild-caught fish but metamorphosis not observed); LI (laboratory infestation; fish parasitized in experimental conditions but metamorphosis not observed); LT (as above but metamorphosis observed); and NS (not stated in original source).

Ictalurid host	Unionoid	Evidence type
Black bullhead *Ameiurus melas*	Purple wartyback *Cyclonaias tuberculata*†	LT
	Creek heelsplitter *Lasmigona compressa*	LT
	Washboard *Megalonaias nervosa*	LI, LT
	Pimpleback *Quadrula pustulosa*	NI, LT
	Creeper *Strophitus undulatus*	LT
Yellow bullhead *A. natalis*	Purple wartyback†	LT
	Creek heelsplitter	LT
	Carolina heelsplitter *Lasmigona decorata*	LT
	Washboard	LT
	Giant floater *Pyganodon grandis*	NI
	Alabama creekmussel *Strophitus connasaugaensis*	LT
	Creeper	LT
	Pistolgrip *Tritogonia verrucosa*†	LT
Brown bullhead *A. nebulosus*	Flutedshell *Lasmigona costata*	LT
	Washboard	LT
	Pimpleback	LT
	Pistolgrip†	LT
	Little spectaclecase *Villosa lienosa*	LT
Blue catfish *Ictalurus furcatus*	Louisiana fatmucket *Lampsilis hydiana*	LT
	Winged mapleleaf *Quadrula fragosa**†	LT
Channel catfish *I. punctatus*	Threeridge *Amblema plicata*	NI
	Flat floater *Anodonta suborbiculata*	LT
	Rock pocketbook *Arcidens confragosus*	LT
	Purple wartyback†	LT
	Louisiana fatmucket	LT
	Southern fatmucket *Lampsilis straminea claibornensis*	LT
	Washboard	LI, LT
	Alabama orb *Quadrula asperata*†	LT
	Winged mapleleaf*†	LT
	Gulf mapleleaf *Quadrula nobilis*†	LT
	Wartyback *Quadrula nodulata*	NI
	Pimpleback	NI, LT
	Mapleleaf *Quadrula quadrula*†	LT
	Creeper	LT
	Paper pondshell *Utterbackia imbecillis*	LT
	Little spectaclecase	LT
Stonecat *Noturus flavus*	Catspaw *Epioblasma obliquata obliquata**	LT
Tadpole madtom *N. gyrinus*	Mucket *Actinonaias ligamentina*	NI
	Fatmucket *Lampsilis siliquoidea*	NI
	Washboard	NI
Margined madtom *N. insignis*	Brook floater *Alasmidonta varicosa*	NS
Speckled madtom *N. leptacanthus*	Fat threeridge *Amblema neislerii**	LT
	Alabama orb†	LT

TABLE 1. Continued.

Ictalurid host	Unionoid	Evidence type
Flathead catfish *Pylodictis olivaris*	Threeridge	LT
	Purple wartyback[†]	LT
	Spike *Elliptio dilatata*	LT
	Creek heelsplitter	LT
	Washboard	NI, LT
	Gulf mapleleaf[†]	LT
	Wartyback	NI
	Pimpleback	NI, LT
	Mapleleaf[†]	NI
	Pistolgrip[†]	LT

1999; Hubert 1999; Jackson 1999), many freshwater mussels can be found in large reservoirs, backwaters, and embayments of large, flowing rivers where substrate varies from gravel-sand to silted-mud (Cummings and Mayer 1992; Parmalee and Bogan 1998; Watters et al. 2009). Catfishes have varying home ranges and seasonal movements (Graham 1999; Hubert 1999; Jackson 1999), and these host fish movements are critical for dispersal and genetic mixing of freshwater mussel populations (Elderkin et al. 2007). Freshwater mussel assemblages (often called "mussel beds") can support 25 or more species and reach densities of more than 100 individuals per square meter (Strayer 2008). These beds aid in stabilizing benthic substrates, and their shells offer microhabitats for other aquatic organisms, including madtoms and juvenile channel catfish (Vaughn et al. 2007; Zimmerman and de Szalay 2007).

Anthropogenic disturbances (e.g., sedimentation, channelization, and point and non-point source pollution) are major factors affecting ictalurid and freshwater mussel populations (Bogan 1993; Pflieger 1997; Watters 2000). One of the main disturbances is impoundments. Dams not only change physicochemical parameters (e.g., modified flow patterns and increased sedimentation), but also alter host fish assemblages and restrict host fish movement (Tiemann et al. 2004; Santucci et al. 2005; Tiemann et al. 2007). Resultant effects include restricted distributions, disruption of gene flow, declining populations, and altered community composition (Coker 1914; Watters 1996; Dean et al. 2002). These effects occur upstream and downstream of impoundments and are exacerbated by presence of multiple impoundments or impoundments on tributaries (McMurray et al. 1999; Vaughn and Taylor 1999; Combes and Edds 2005). In discussing freshwater mussels that utilize only a single group of fishes (e.g., pimpleback using only catfishes), Coker (1914) suggested that impoundments "may vitally affect the welfare of these important mussels." He stated that dams could hinder dispersal of several freshwater mussel species because dams impede movement of their host fishes. Watters (1996) and Tiemann et al. (2007) supported this claim by showing that dams, including low-head structures, impeded movement of ictalurids, which, in turn, limited dispersal of some species of unionids. Coker (1914) also suggested that because fish migration will be blocked, hosts could become rare in upper portions of a stream and therefore jeopardize future generations of freshwater mussels, possibly causing local extirpations.

There is the possibility of introducing freshwater mussels outside of their native range via fish stocking (see Chinese pond mussel *Sinanodonta woodiana* account in Watters 1997). There have been many instances in North America where private landowners have found live unionids or empty shells in farm ponds. Because they impound small, often intermittent streams, these reservoirs would not be expected to naturally have a resident freshwater mussel fauna (Watters 1992). Private impoundments are commonly stocked with channel catfish and other game fishes. Presumably, the freshwater mussels (e.g., giant floater, mapleleaf, or fatmucket) were either attached to host fishes or were otherwise in the water used to haul the fish. Even though circumstantial, this lends some evidence to the possibility of introducing freshwater mussels outside of their historic range via stocking of catfishes and other sport fishes into private and public waters.

Catfishes introduced outside of their native ranges also have potential to indirectly affect freshwater mussel assemblages. For example, flathead catfish has been introduced into many Atlantic Slope drainages (Thomas 1993; Brown et al. 2005) and, once established, can become the dominant predator and severely reduce native fish species richness and abundance (Thomas 1993; Brown et al. 2005). Neves (1993) pointed out that alterations in native fish assemblages could be detrimental to codependent freshwater mussel populations.

Data are lacking on how large-scale fish kills can affect freshwater mussel assemblages. However, instances where a certain group of fishes (e.g., catfishes) die for several stream miles during freshwater mussel reproductive periods could have dramatic and lasting effects on freshwater mussel recruitment. For example, by eliminating the host, glochidia will not be able to transform, possibly resulting in loss of an entire year-class or more, depending upon how quickly the fish assemblage recovers or is augmented. Although some freshwater mussel species have evolved to cope with fluctuating host numbers, threshold levels exist; if host abundances are reduced low enough, unionids could become extirpated (Watters 1997).

Artificial Culture and Propagation of Freshwater Mussels

Propagation is one way to bolster freshwater mussel populations. Unionids have been propagated for more than 100 years throughout the Mississippi River basin and elsewhere (Howard 1913; Coker 1916; Hubbs 2000). Ictalurids were used to propagate several unionids in the early 1900s as a way to bolster species used in the button industry or those with declining populations (Howard 1914; Coker 1916). In describing hosts for propagation, Howard (1914) stated "in the catfish we seem to have a fish almost ideal for the application of this method. It is abundant and hardy, thus meeting the conditions required by the method, i.e., the securing of many fish and the ability of the fish to withstand the handling and confinement incident to the process of infection with glochidia. <sic> The power of catfish to survive removal from water is remarkable and this hardihood is an important feature, since the breeding period for these mussels is July and August, when the mortality is highest among fish in captivity." The Tennessee Wildlife Resources Agency began artificially infesting fingerling channel catfish in 1994 as a means of propagating threeridge and washboard, both commercially important species (Hubbs 2000). The catfish were released into various Tennessee reservoirs following infestation, and juvenile freshwater mussels were collected after 3 years. Although evidence is circumstantial, this method might be a productive, cost-effective way to either maintain or augment natural populations of some unionid species (Hubbs 2000) and simultaneously improve catfish stocks for anglers. More recently, a propagation program for the federally endangered winged mapleleaf began in 2004 at the Genoa National Fish Hatchery in Wisconsin (Wege et al. 2007). As part of the winged mapleleaf recovery plan, closed propagation cages containing channel catfish inoculated with glochidia were placed in historical portions of the mussel's range. Juvenile mussels were documented in some cages and were left to develop to larger sizes. Propagation offers hope of rescuing some species but still faces several problems, including insufficient funds, yet to be developed technology, and unknown fish hosts (Coker et al. 1921; Neves 1997).

Other Benefits of Freshwater Mussels to Catfishes

Freshwater mussels are often credited with cleaning water by filtering algae and sediment (Vaughn and Hakenkamp 2001). However, their effect on water quality may be even more substantial. Availability of propagated freshwater mussels has spurred research in toxicology. This work has shown that freshwater mussels are the most sensitive group yet tested to ammonia, a common pollutant found in human and animal waste (Wang et al. 2008). As a result, in December 2009, the U.S. Environmental Protection Agency published a draft revision of criteria that will lower the allowable limits for ammonia by as much as two-thirds if mussels are present (USEPA 2009). These new criteria have potential to drive millions, if not billions, of dollars in sewage treatment improvements that will benefit aquatic ecosystems. Effects should be widespread because all continental states have mussels in at least some of their waters and states east of the 100th Meridian have freshwater mussels in most of their waters, or did until pollution and other anthropogenic disturbances took their toll (Williams et al. 1993). Also, streams with a population of a listed freshwater mussel species often have limits on riparian development or instream work. Such regulations can benefit other aquatic organisms, including catfishes. In many instances, landowner incentive programs for fish and wildlife conservation at the federal level and, in many states, are prioritized based on presence of endangered species.

Summary

In the relationships described herein, catfishes prey on freshwater mussels but, in turn, serve as hosts to freshwater mussel glochidia and aid in their dispersal. Many freshwater mussels are restricted to sites with a stable number of host fishes (Haag and Warren 1998). Coker et al. (1921) stated "the conservation of the fishes is as important to the preservation of the freshwater mussel resources and the industries dependent upon them as is the propagation and protection of mussels. The disappearance, or the radical diminution in number, of certain species of fish would result in the complete or virtual disappearance of corresponding species of mussels." There is a possibility that catfish populations could inadvertently benefit from future mollusk conservation efforts. Federal and state laws protecting freshwater mollusk species and their habitats provide incentive and funding for conservation actions that can benefit several aquatic species, including catfishes. Encouraging communication and cooperation among managers across aquatic taxa can only benefit conservation, particularly when taxa have obvious biological links to each other. Catfish managers should be aware of incentives and funding opportunities for conservation and restoration of threatened and endangered freshwater mussels, because these programs benefit freshwater mussels and help catfish fisheries.

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