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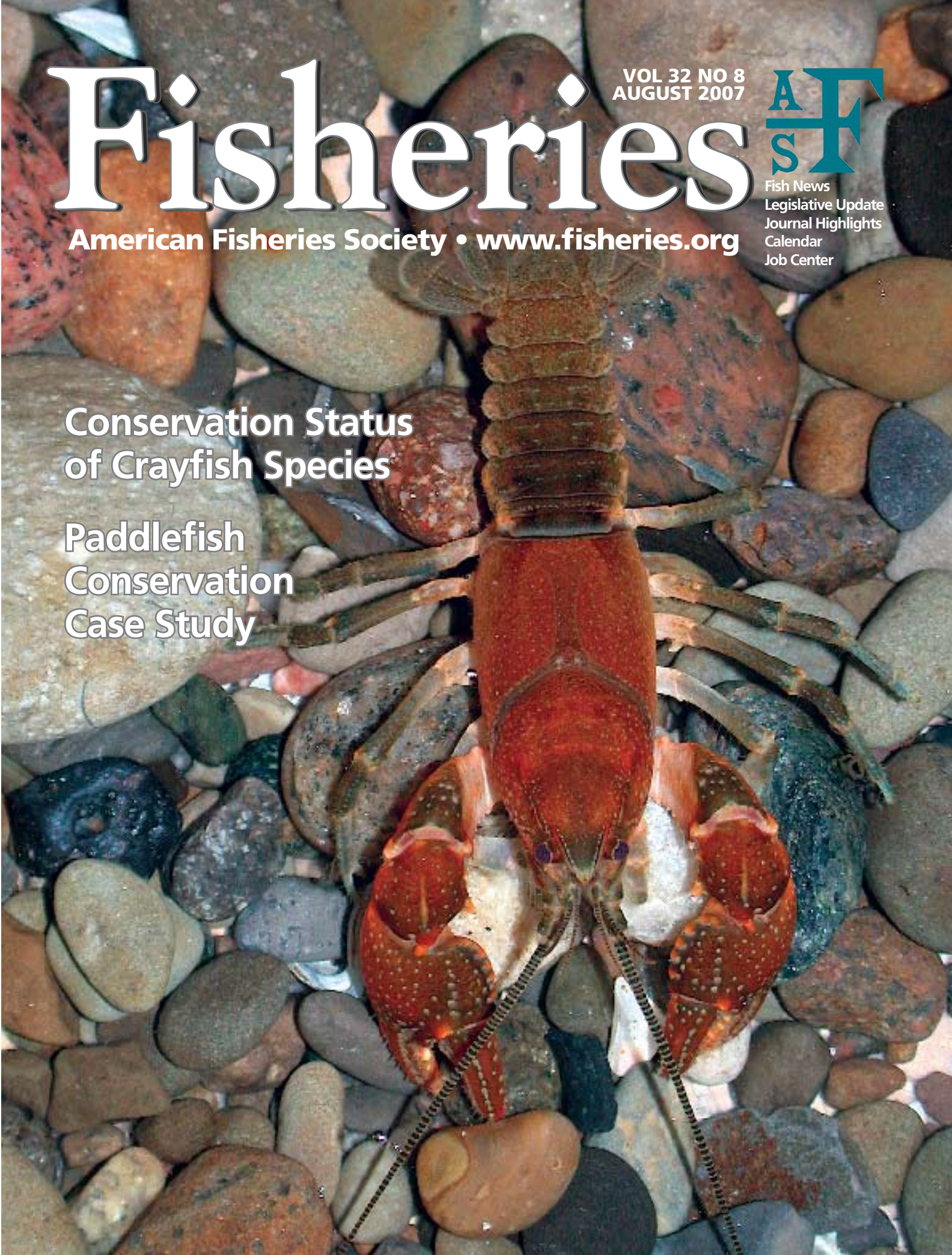

Conservation Status of Crayfish Species

Paddlefish Conservation Case Study

A Reassessment of the Conservation Status of Crayfishes of the United States and Canada after 10+ Years of Increased Awareness

Christopher A. Taylor, Guenter A. Schuster, John E. Cooper, Robert J. DiStefano, Arnold G. Eversole, Premek Hamr, Horton H. Hobbs III, Henry W. Robison, Christopher E. Skelton, and Roger F. Thoma

ABSTRACT: The American Fisheries Society Endangered Species Committee herein provides a list of all crayfishes (families Astacidae and Cambaridae) in the United States and Canada that includes common names; state and provincial distributions; a comprehensive review of the conservation status of all taxa; and references on biology, conservation, and distribution. The list includes 363 native crayfishes, of which 2 (< 1%) taxa are listed as Endangered, Possibly Extinct, 66 (18.2%) are Endangered, 52 (14.3%) are Threatened, 54 (14.9%) are Vulnerable, and 189 (52.1%) are Currently Stable. Limited natural range continues to be the primary factor responsible for the noted imperilment of crayfishes; other threats include the introduction of nonindigenous crayfishes and habitat alteration. While progress has been made in recognizing the plight of crayfishes, much work is still needed.

Una revaluación del estado de conservación de langostinos en los Estados Unidos y Canadá después de más de 10 años de conciencia creciente

RESUMEN:. En el presente trabajo, El Comité para el Estudio de Especies Amenazadas de la Sociedad Americana de Pesquerías presenta una lista de todos los langostinos (familias Astacidae y Cambaridae) presentes en los Estados Unidos y Canadá, que incluye nombres comunes, distribución estatal y municipal, una revisión del estado de conservación de todos los taxa y referencias sobre su biología, conservación y distribución. La lista incluye 363 langostinos autóctonos, de los cuales dos taxa (< 1%) se catalogan como amenazados, posiblemente extintos; 66 (18.2%) se consideran en peligro; 52 (14.3%) están amenazados; 54 (14.9%) son vulnerables; y 189 (52.1%) se encuentran actualmente en condición estable. El principal factor responsable de la vulnerabilidad de los langostinos es su limitado rango natural de distribución; otras amenazas incluyen la introducción de especies foráneas de langostinos y la alteración del hábitat. Si bien se ha progresado en cuanto al reconocimiento de las amenazas hacia los langostinos, aún existe mucho trabajo por hacer.

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The Short Mountain crayfish (*Cambarus clivosus*) a narrowly endemic species found only in central Tennessee and ranked as Threatened.
Photo by R. Thoma.

Cambarus cymatilis, a burrowing species ranked as Endangered by the AFS Endangered Species Crayfish Subcommittee.
Photo by C. Lukhaup.

The greensaddle crayfish (*Cambarus manningi*) is a Currently Stable species found in rocky creeks of the Coosa River drainage.
Photo by C. Lukhaup.

INTRODUCTION

The term biodiversity has become intimately intertwined with the conservation movement of the last quarter-century, and in North America no serious discussion of biodiversity and conservation can neglect the status of that continent's freshwater fauna. The presence of a highly diverse aquatic fauna in a densely populated, economically developed country such as the United States demands the continued attention of scholars, resource managers and biologists, politicians, and private conservation groups. Current biological information for species and species groups at risk is crucial to making sound decisions on all conservation fronts.

The plight of North American aquatic biodiversity, particularly invertebrate biodiversity, was brought to the forefront with the compilation of Natural Heritage / The Nature Conservancy Global (G) conservation status ranks for that continent's fauna by Master (1990). Master (1990) found a disproportionate number of aquatic organisms in need of conservation attention when compared to their terrestrial counterparts. Since then a steady stream of literature has highlighted the need for action and identified threats to the aquatic fauna (e.g., Allan and Flecker 1993; Richter et al. 1997; DeWalt et al. 2005). Through the American Fisheries Society (AFS) Endangered Species Committee and others, the conservation status of North America's freshwater fish fauna has been assessed at regular intervals (Deacon et al. 1979; Williams et al. 1989; Warren et al. 2000) while that of other aquatic taxa such as freshwater mussels (Williams et al. 1993) and crayfishes (Taylor et al. 1996) have only recently received their first conservation reviews. With the passing of a decade since the first, and last, conservation review of North American crayfishes, the purposes of this article are to (1) reassess the conservation status and threats to native crayfishes in the United States and Canada using the best information available, (2) provide updated state/provincial distributions, (3) update the list of references on the biology, conservation, and distribution of crayfishes in the United States and Canada provided in Taylor et al. (1996), and (4) assign standardized common names to those species lacking them.

Crayfishes are placed in the order Decapoda, which also includes crabs, lobsters, and shrimps. They are most closely related to marine lobsters (Crandall et al. 2000) and differ from those organisms by possessing direct juvenile development rather than dimorphic larval stages. Also known regionally as crawfish, mudbugs, or crawdads, crayfishes are assigned to three families and are native inhabitants of freshwater ecosystems on every continent except Africa and Antarctica. Two families, Astacidae and Cambaridae, occur natively in North America and it is here that crayfishes reach their highest level of diversity. Approximately 77% (405 species and subspecies) of the world's 500+ species occur in North America (Taylor 2002), with the overwhelming majority of that continent's fauna (99%) assigned to the family Cambaridae. With over two-thirds of its species endemic to the southeastern United States, the distribution of crayfish diversity in North America closely follows those observed in other freshwater aquatic taxa such as fishes (Warren and Burr 1994 and mussels (Williams et al. 1993).

Crayfishes are important ecologically as predators, bioprocessors of vegetation and carrion, and as a critical food resource for fishes and numerous other terrestrial and aquatic organisms (Hobbs III 1993; DiStefano 2005). In some aquatic habitats they can comprise greater than 50% of macroinvertebrate biomass (Momot 1995). They are equally important from an economic standpoint, supporting bait fisheries and a multi-million dollar human food fishery (Huner 2002). Finally, crayfishes in the family Cambaridae also possess unique life-history traits such as reproductive form alteration and burrowing abilities that allow numerous species to colonize seasonally wet and terrestrial habitats (Hobbs 1981; Welch and Eversole 2006). Because the purpose of this article is to report on the conservation status of the North American fauna north of Mexico, we refer readers interested in the economic and ecological aspects of crayfish to previously published syntheses (Huner 1994; Taylor et al. 1996; Holdich 2002).

RATIONALE AND THREATS

Taylor et al. (1996) pointed to the broad disparity in the recognition of actual or potential imperilment of crayfishes between governmental agencies charged with protecting natural resources and non-profit conservation organizations as a rationale for their conservation assessment. At that time, only four crayfish species (*Pacifastacus fortis*, *Cambarus aculabrum*, *Cambarus zophonastes*, and *Orconectes shoupi*) received protection under the federal Endangered Species Act of 1973 (ESA) and 47 species received varying levels of protection at the state level. This was in stark contrast to the 197 species listed by Master (1990) as in need of conservation attention. Taylor et al. (1996) surmised that 48% of the U.S. and Canadian crayfish fauna was imperiled. While some changes have been made at the state level (see below), the number

Cambarus carolinus is a burrowing species found along the margins of Appalachian streams in North Carolina, South Carolina, and Tennessee.
Photo by A. Braswell.

The bottlebrush crayfish (*Barbicambarus cornutus*) is currently stable and found in the Green River drainage of Kentucky and Tennessee.
Photo by G. Schuster.

Crayfishes have historically been classified as opportunistic omnivores; however, our expanding knowledge of crayfish ecology indicates that they may be primary carnivores in some streams.
Photo by C. Lukhaup.

and identity of species listed under the ESA remains unchanged. This continuing disparity serves as the underlying justification for the current reassessment.

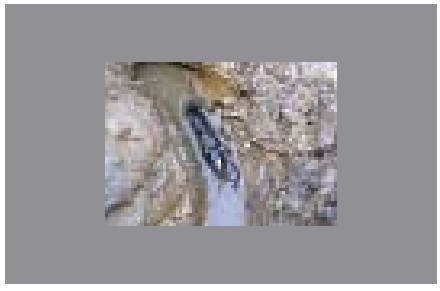
The causes of aquatic species losses and population declines have been thoroughly discussed in the literature and are usually ascribed to four major categories: (1) loss, degradation, or alteration of habitat; (2) chemical pollution; (3) introduction of nonindigenous organisms; and (4) overexploitation (Allan and Flecker 1993; Richter et al. 1997; Wilcove et al. 2000). For crayfishes, most of these threats are applicable. As benthic invertebrates susceptible to fish predation, the impoundment of lotic habitat can affect crayfishes by increasing concentrations of major crayfish predators such as centrarchid bass and sunfish and altering both the physical and chemical structure of streams (Williams et al. 1993). Crayfish depend on gravel and boulder substrates, woody debris, and vegetation for refuge from predators (Stein 1977). Loss of such habitat components through dredging and channelization can drastically affect crayfish populations by making them more susceptible to predation. Finally, draining wetlands and dewatering of springs can have obvious impacts on crayfishes dependent on those types of habitats. The possible extinction of *Cambarellus alvarezi* after the removal of spring water from its only known location in northern Mexico (Contreras-Balderas and Lozano-Vilano 1996) serves as a prime example of the negative consequences of the latter type of habitat alteration.

Crustacea are known to be among the most sensitive aquatic organisms when exposed to pesticides and metals (Mayer and Ellersieck 1986, Jarvinen and Ankley 1999). While acute toxicity tests (usually expressed as LC50 values) have been performed using many crayfish species and toxicants (Eversole and Seller 1996), field studies examining the effects of chemical or heavy metal pollutants on crayfishes are lacking. The available data suggest significant variability among genera, species, and life stages (Berrill et al. 1985; NCDENR 2003, Peake et al. 2004, Wigginton and Birge 2007). Recently Wigginton and Birge (2007) reported higher mortality rates for juvenile than adult crayfishes exposed to cadmium, which they attributed to increased cadmium uptake and calcium metabolic disruption in the more rapidly molting juveniles. Besser et al. (2006) found evidence for heavy metal accumulation, including cadmium, in crayfishes found near mining sites while Allert et al. (in press) noted increased sensitivity in at least one species to these same metals. These observations indicate that crayfish may prove to be indicators of habitat degradation from pollutants and that future research is warranted.

The introduction of nonindigenous organisms may represent the gravest of all threats to this planet's biodiversity (Clavero and García-Berthou 2005) and crayfish could represent the proverbial posterchild of the damage wrought by these species (Lodge et al. 2000). In North America crayfishes are transported easily over land and inadvertently introduced into aquatic habitats when they are discarded as unused bait. Such bait-bucket introductions have led to dramatic range extensions of several species, most notably the rusty crayfish (*Orconectes rusticus*). The rusty crayfish is native to the lower Ohio River drainage in Ohio, Indiana, and Kentucky and the Maumee River drainage in extreme southeastern Michigan. Over the past 50 years the species has been introduced across the upper midwestern United States and Canada (Page 1985; Lodge et al. 2000). Once introduced, *O. rusticus* rapidly expands its range and displaces native crayfishes (Taylor and Redmer 1996). This behavior has led to the complete elimination of local populations and reductions in total ranges of native species in at least three midwestern states and one Canadian province (Lodge et al. 2000; C. A. Taylor, unpub. data). Possible displacement mechanisms include faster individual growth rates (Hill et al. 1993), differential susceptibility to fish predation (DiDonato and Lodge 1993), and hybridization (Perry et al. 2001). Imperiled crayfishes also have been affected by nonindigenous species. The federally endangered Shasta crayfish, (*Pacifastacus fortis*) has been displaced in large portions of its native range by the nonindigenous signal crayfish (*P. leniusculus*; Erman et al. 1993). Nonindigenous crayfishes can also serve as disease vectors. The introduction of three North American species, *Procambarus clarkii*, *O. limosus*, and *Pacifastacus leniusculus*, into western Europe has contributed to massive die-offs of native crayfishes in that region. A fungus-like protist, *Aphanomyces astaci* (Class Oomycetes), causes a lethal disease known as the "crayfish plague" in native European species while North American species are immune to its effects. By carrying spores of *A. astaci*, North American species act as a plague vector between water bodies. Outbreaks of the crayfish plague have been occurring in Europe since the introduction of the North American species in the late 1880s (Ackefors 1999; Holdich 1999) and have led to 85% or greater reductions in native crayfish populations in several countries (Fjälling and Fürst 1988; Ackefors 1999; Holdich 1999).

While the introduction of nonindigenous crayfishes through their use as bait continues to represent a significant threat to crayfish biodiversity, the Internet revo-

Procambarus escambiensis is an endemic species found in narrow region of the Gulf Coastal Plain of Alabama and Florida.
Photo by G. Schuster.



Numerous species of crayfishes spend all or a significant portion of their lives in subterranean burrows. Basic ecological information can be very hard to collect for these species.
Photo by C. Lukhaup.

The eastern red swamp crayfish, *Procambarus troglodytes,* is a Currently Stable species found on the Atlantic Slope of Georgia and South Carolina.
Photo by C. Lukhaup.

lution of the past 10 years has spawned an equally disconcerting vector. Conservation biologists have for years warned of the risk posed from the release/escape of pets. From monk parakeets in Chicago (Kleen et al. 2004) to burmese pythons in the Florida Everglades (McGrath 2005), established populations of organisms kept as pets have become an unwelcome component of the North American fauna. Currently over a half-dozen Internet businesses (www.google.com search conducted 03/23/07) and numerous individuals on the Internet auction site eBay® (www.ebay.com) offer for sale dozens of live crayfish species from North America and around the world. While the aquarium pet trade has been around for more than half a century, crayfishes are a recent arrival to the aquarium marketplace. The ease of 24-hour shopping and overnight delivery to anywhere in the world facilitated by the Internet has dramatically increased the potential for accidental introductions of crayfishes.

While no known cases of overexploitation of crayfish have been documented in North America, it has been cited as a contributing factor in the decline of at least one Australian crayfish species. The Tasmanian crayfish (*Astacopsis gouldi*) can reach sizes in excess of 0.8 meters in length (> 5 kg in weight), and its meat is valued by local inhabitants. The species has experienced local extirpations and population declines throughout a significant portion of its range, and over-harvesting has been implicated as a contributing factor (Horwitz 1994). We acknowledge that overexploitation is not an imminent threat to United States and Canadian crayfish populations; however, we believe that it is prudent to acknowledge this potential threat and be proactive in future crayfish fishery decisions.

The above-listed threats are not unique to crayfishes; however, they are compounded by a single overarching factor—limited natural ranges (Taylor et al. 1996). Crayfishes show a level of endemism not seen in other aquatic groups. Approximately 43% of the U.S. crayfish fauna is distributed entirely within one state's political boundaries, compared to 16% for freshwater fishes and 15% for unionid mussels (Lodge et al. 2000). In their first conservation assessment, Taylor et al. (1996) documented 11 crayfish species known from single localities and another 20 known from 5 or fewer localities. While taxa with restricted natural ranges are particularly vulnerable to habitat destruction or degradation, the known displacement abilities of nonindigenous crayfishes when coupled with a high level of endemism represent a threat of unequalled severity.

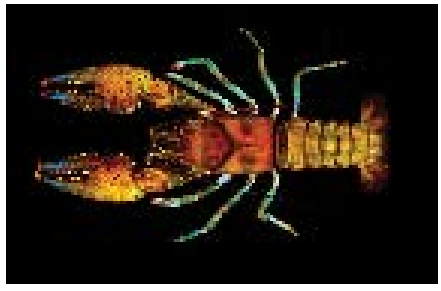
PROGRESS AND CHANGES

The conservation status of 30 taxa has changed since the previous assessment (Taylor et al. 1996). These changes have been facilitated by an increased awareness of crayfishes (Butler et al. 2003) and a subsequent increase in field efforts undertaken by federal (e.g.; Simon and Thoma 2003), state (e.g.; Thoma and Jezerinac 2000; Westhoff et al. 2006), and academic (e.g.; Ratcliffe and DeVries 2004; Taylor and Schuster 2004) personnel. These efforts have provided new distributional records that led to downgrading 25 taxa by at least one conservation category. Simultaneously, these efforts documented the introduction of nonindigenous species into the ranges of narrow endemics (Flinders and Magoulick 2005) and the subsequent reductions in range sizes, leading to the upgrading of four taxa. Promising signs of increased awareness are the proposed changes in bait regulations by several states in an attempt to thwart the spread of nonindigenous crayfishes, as well as an increase in the number of crayfishes listed by state agencies as endangered, threatened, or vulnerable/special concern. Virginia now bans the sale of crayfish as bait while Missouri has followed the lead of other states and recently created a prohibited species list for use by bait dealers which includes several nonindigenous crayfishes (B. Watson, VA Dept. Game and Inland Fisheries, pers. com.; B. DiStefano, pers. com.). Since 1996 at least two new states, Pennsylvania and North Carolina, have added the rusty crayfish to their lists of banned species (www.fish.state.pa.us/news-releases/2005/rusty_cray.htm; NCWRC 2006). North Carolina also banned the transport, purchase, and possession of the nonindigenous virile crayfish (*O. virilis*). While the level of protection afforded to species listed at the state level ranges from bans on taking to token lists for future research efforts, it is noteworthy that the number of species listed at some level has increased from 47 to 66 since 1996. Finally, seven states (Arkansas, Missouri, New Mexico, North Carolina, South Carolina, Tennessee, Virginia) now have at least one field biologist in their respective natural resource agencies whose position requires them, at least on a part time basis, to monitor and assess crayfish populations. Taken together, these regulatory actions and field efforts can be interpreted as nothing less than progress in the domain of crayfish conservation. However, the majority of states with highly diverse crayfish faunas and high levels of endemism lack any protective measures and adequate funding structures to ascertain the statuses of their respective faunas.

While little research is being conducted in Canada at present, its crayfish fauna was

Members of the genus *Fallicambarus*, such as the burrowing bog crayfish (*F. burrisi*) here, are all burrowing species.
Photo by G. Schuster.

Due to their restricted ranges, specialized habitats, and the development of groundwater recharge areas, many obligate cave dwelling crayfish species such as the Orlando cave crayfish (*Procambarus acherontis*) are listed as Endangered.
Photo by D. McShaffrey.



Meek's crayfish (*Orconectes meeki meeki*) is a common inhabitant of Ozark streams in Missouri and Arkansas.
Photo by C. Taylor.

reviewed by Hamr (1998, 2003). This work resulted in new provincial records for several species. Most recently, the Framework for Conservation of Species at Risk in Canada (a federal and provincial initiative) has classified the status of Canadian crayfish species based on existing information (www.wildspecies.ca).

Taxonomic efforts since Taylor et al. (1996) have resulted in the description of 27 new crayfish species in the United States. At slightly more than two new species per year, these efforts clearly demonstrate that undiscovered biodiversity continues to exist in North America. Using the best available information, 21 of these 27 species are recognized as requiring conservation attention in the following analysis. Clearly, more field efforts will yield new discoveries and improve the basis for future conservation assessments.

METHODS AND DEFINITIONS

Our review of the conservation status of crayfishes includes all species and subspecies from the United States and Canada as recognized by Taylor et al. (1996) with minor exceptions. *Cambarus laevis* and *C. ornatus* are not recognized following Taylor (1997), *Procambarus ferrugineus* is not recognized following Robison and Crandall (2005), and *Cambarus bartonii carinirostris* is recognized as *C. carinirostris* following Thoma and Jezerinac (1999). Twenty-seven taxa are also included that were described subsequent to Taylor et al. (1996). Both scientific and common names are given for each taxon (Appendix 1). Common names were taken from McLaughlin et al. (2005) and other peer-reviewed literature, including original species descriptions, and were available for approximately 50% of crayfish taxa; those taxa that lacked common names were assigned one after soliciting input from all authors and active species authorities. In most cases, we looked at the original descriptions to try to find a name that fit the spirit of what the author was trying to convey with the specific epithet. In other cases we simply used the English translation of the specific epithet. In determining conservation status and distribution, a variety of sources was used including state and federal endangered species lists, government agency reports and websites, research publications, and books. In addition, the observations and field experiences of the authors, reviewers, and other biologists working with crayfishes were actively solicited and incorporated.

The American Fisheries Society Endangered Species Committee, Subcommittee on Crayfishes has reviewed the best available distributional and status information and is responsible for the resulting conclusions. The assigned conservation category is based on the status of the taxon throughout its range without consideration of political boundaries (Appendix 1). Restricted range was the primary criterion for assignment of endangered or threatened status. Other threats, such as introductions of nonindigenous crayfishes, unique habitat requirements, and proximity to metropolitan areas, were taken into account in category assignments, but known range and consequent rarity were uppermost in applying category definitions. Conservation status categories generally follow Williams et al. (1993) and are defined as: Endangered (**E**)—a species or subspecies in danger of extinction throughout all or a significant portion of its range—an asterisk (*) following the letter "**E**" indicates the taxon is possibly extinct; Threatened (**T**)—a species or subspecies likely to become endangered throughout all or a significant portion of its range; Vulnerable (**V**)—a species or subspecies that may become endangered or threatened by relatively minor disturbances to its habitat and deserves careful monitoring of its abundance and distribution; Currently Stable (**CS**)—a species or subspecies whose distribution is widespread and stable and is not in need of immediate conservation management actions. Following Warren et al. (2000), the category of Vulnerable replaces the category of Special Concern used by Taylor et al. (1996) and Williams et al. (1993). In addition, criteria responsible for designating species as E, T, or V are noted (Appendix 1). These criteria have been formulated by the AFS Endangered Species Committee as: (1) existing or potential destruction, modification, or reduction of a species' habitat or range; (2) over-utilization for commercial, sporting, scientific, or educational purposes; (3) disease; (4) other natural or anthropogenic factors affecting a species' continued existence (e.g., hybridization, introduction of nonindigenous or transplanted species, predation, competition); and (5) restricted range (Deacon et al. 1979; Williams et al. 1989).

To allow state natural heritage programs across the United States to make comparisons between AFS Crayfish Subcommittee ranks and heritage ranks, we have also included the conservation ranks for each taxon following the system developed over the past 25 years by The Nature Conservancy/NatureServe and the Network of Natural Heritage Programs (Master 1991; Appendix 1). This system ranks taxa on a 1 to 5 (1 being the rarest) scale based on best available information and considers a variety of factors including abundance, distribution, population trends, and threats (www.natureserve.org/explorer/ranking.htm). Since our assessments are based on the statuses of crayfishes across their entire

The St. Francis River crayfish, *Orconectes quadruncus* is a species classified as Threatened due to its narrow range and the establishment of nonindigenous species near its range.
Photo by C. Lukhaup.

Over 50% of crayfish species are classified as Currently Stable. The golden crayfish, *Orconectes luteus* is one of those.
Photo by C. Lukhaup.

The Barren River crayfish, *Orconectes barrenensis,* is a species that occurs under gravel and cobble in creeks and rivers in the Barren River drainage of Kentucky and Tennessee.
Photo by C. Taylor.

native ranges, we use the G or Global scale for conservation status rankings. Categories follow Master (1991) and are defined as follows: G1 = critically imperiled, G2 = imperiled, G3 = vulnerable to extirpation or extinction, G4 = apparently secure, G5 = demonstrably widespread, abundant, and secure, GH = possibly extinct, known only from historical collections, and GX = presumed extinct.

LIST OF TAXA (APPENDIX 1)

The list of crayfish species and subspecies is arranged alphabetically by genus and by species and subspecies within the genus. Following the scientific name and author(s), the common name is followed by assigned conservation status using a letter code: **E** = Endangered; **E*** = Endangered, Possibly Extinct; **T** = Threatened; **V** = Vulnerable; **CS** = Currently Stable. Criteria used to determine conservation statuses are indicated by numerals 1 through 5 and correspond to those defined in Methods. Global Heritage ranks (see Methods) immediately follow listing criteria. A dagger denotes a species complex currently under taxonomic investigation. Finally, the distribution of each taxon is indicated by an alphabetical listing of U. S. states and Canadian provinces where that taxon occurs. Parentheses around states indicate known or suspected introductions. Standard two-letter abbreviations for states and provinces follow Williams et al. (1989).

SUMMARY AND CONCLUSIONS

The list of crayfishes of the United States and Canada includes 363 taxa. Possibly Extinct, Endangered, Threatened, or Vulnerable statuses are recognized for 174 taxa (47.9%). Of these, 2 (< 1%) are possibly Extinct, 66 (18.2%) are Endangered, 52 (14.3%) are Threatened, and 54 (14.9%) are Vulnerable. Taxa classified as currently stable total 189 (52.1%). The number of imperiled crayfishes (48%) parallels the high levels of imperilment of fishes and freshwater mussels, almost 33% and 72%, respectively (Williams et al. 1989; Williams et al. 1993; Warren and Burr 1994). These assessments support the contention that aquatic diversity in North America is in far worse condition than its terrestrial counterpart (Master 1990, Master et al. 2000).

For some crayfishes, limited natural range (e.g., one locality or one drainage system) precipitates recognition as Endangered or Threatened; but for many others, status assignments continue to be hampered by a paucity of recent distributional information. While progress has been made in this arena, basic ecological and current distributional information are lacking for 60% of the U.S. and Canadian fauna. In addition, threats highlighted by Taylor et al. (1996) such as habitat loss and the introduction of nonindigenous crayfishes continue to persist and are greatly magnified by the limited distributions of many species. The threat of nonindigenous species has even increased (Lodge et al. 2000; Flinders and Magoulick 2005) due to actual introductions and emerging conduits for potential introductions. As stated by Taylor et al. (1996), lack of recent species-specific information, whether distributional or biological, does not warrant neglect by resource agencies. Recognition of the potential for rapid decimation of crayfish species, especially those with limited ranges, should provide impetus for proactive efforts toward conservation as espoused by the American Fisheries Society (Angermeier and Williams 1994).

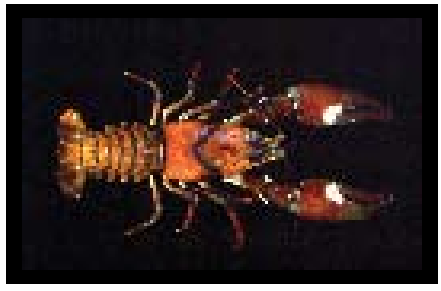
In publishing this list, the American Fisheries Society Endangered Species Committee summarizes for fisheries professionals, natural resource agencies, university researchers, conservation organizations, lawmakers, and citizens, the conservation status of crayfishes in the United States and Canada. The results of this reassessment provide some signs of improvement in the recognition of crayfish conservation. Because the number of crayfish taxa in need of conservation attention has changed little, suggested actions for natural resource personnel mirror those proposed by Taylor et al. (1996). These include, but are not limited to: (1) critically examine the findings of this reassessment and bring to our attention additional information; (2) use the list as a planning and prioritization tool for conducting recovery efforts, status surveys, and biological research on imperiled crayfishes; (3) support graduate research and training in the distribution, taxonomy, and ecology of crayfishes; (4) propagate education of citizens; and (5) recognize the plight of aquatic resources and act accordingly and proactively.

ADDITIONAL INFORMATION

We provide this section to aid the reader in accessing additional information on crayfishes of the United States and Canada. The papers and Internet resources, organized alphabetically by state, are primarily taxonomic or distributional in nature but also cover topics associated with a variety of aspects of the biology of crayfishes. Additional crayfish information can also be found by following links found on some of the websites listed below.

The digger crayfish (*Fallicambarus fodiens*) is one of the most widespread crayfish species in North America. It occurs from Ontario, Canada to Texas.
Photo by C. Taylor.

While generally inhabiting lentic habitats, a few members of the genus *Procambarus,* such as *P. lophotus* shown here, can occur in high gradient streams.
Photo by G. Schuster.



The signal crayfish (*Pacifastacus leniusculus leniusculus*) is a widespread species found in the Pacific Northwest and is harvested for human consumption in parts of its range.
Photo by C. Taylor.

ALABAMA

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Over 70, 000 metric tons of the red swamp crayfish (*Procambarus clarkii*) are harvested each year for human consumption.
Photo by C. Taylor.

Since 1996 several species such as the rusty gravedigger (*Cambarus miltus*) have had their conservation statuses downgraded due to intensive field surveys.
Photo by G. Schuster.

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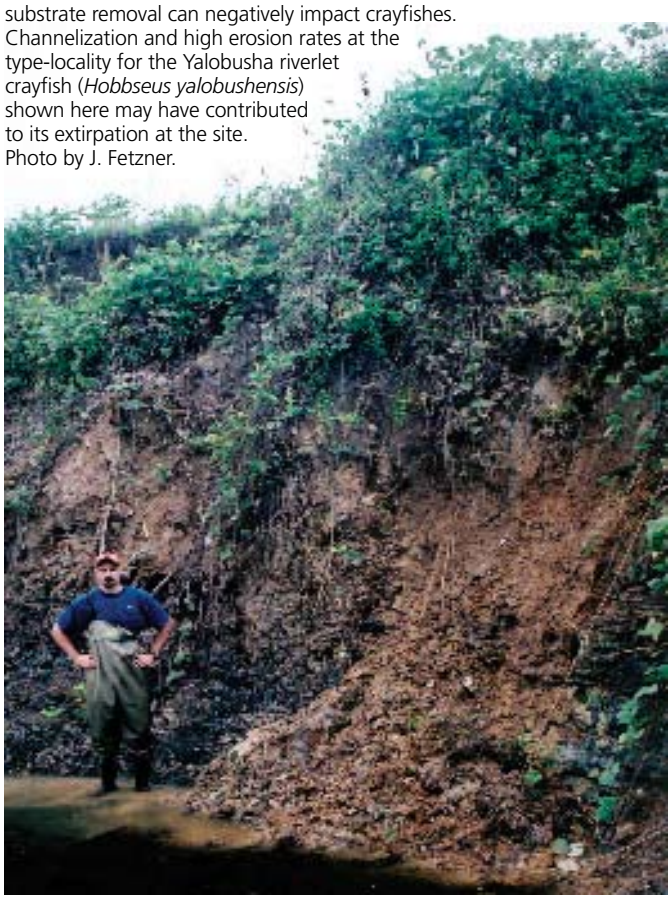
Habitat alteration, such as stream channelization and substrate removal can negatively impact crayfishes. Channelization and high erosion rates at the type-locality for the Yalobusha riverlet crayfish (*Hobbseus yalobushensis*) shown here may have contributed to its extirpation at the site. Photo by J. Fetzner.



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Appendix 1.

Species	Common name	AFS status	Listing criteria	Heritage rank	Known distribution
Family Astacidae					
Pacifastacus connectens (Faxon)	Snake River Pilose Crayfish	CS		G4	ID, OR
Pacifastacus fortis (Faxon)	Shasta Crayfish	E	4, 5	G1	CA
Pacifastacus gambelii (Girard)	Pilose Crayfish	CS		G4,G5	(CA), ID, MT, NV, OR, UT, WA, WY
Pacifastacus leniusculus klamathensis (Stimpson)	Klamath Signal Crayfish	CS		G5	CA, ID, OR, WA. BC
Pacifastacus leniusculus leniusculus (Dana)	Signal Crayfish	CS		G5	(CA), ID, (NV), OR, (UT), WA. BC
Pacifastacus leniusculus trowbridgii (Stimpson)	Columbia River Signal Crayfish	CS		G5	(CA), ID, (NV), OR, MT, WA. BC
Pacifastacus nigrescens (Stimpson)	Sooty Crayfish	E*		GX	CA
Family Cambaridae					
Barbicambarus cornutus (Faxon)	Bottlebrush Crayfish	CS		G4	KY, TN
Bouchardina robisoni Hobbs	Bayou Bodcau Crayfish	V	5	G2,G3	AR
Cambarellus blacki Hobbs	Cypress Crayfish	E	1, 5	G1	FL
Cambarellus diminutus Hobbs	Least Crayfish	T	5	G3	AL, MS
Cambarellus lesliei Fitzpatrick and Laning	Angular Dwarf Crawfish	T	5	G3	AL, MS
Cambarellus ninae Hobbs	Aransas Dwarf Crawfish	V	5	G3	TX
Cambarellus puer Hobbs	Swamp Dwarf Crayfish	CS		G5	AR, IL, KY, LA, MS, MO, OK, TN, TX
Cambarellus schmitti Hobbs	Fontal Dwarf Crawfish	CS		G3	FL
Cambarellus shufeldtii (Faxon)	Cajun Dwarf Crayfish	CS		G5	AL, AR, IL, KY, LA, MS, MO, TN, TX
Cambarellus texanus Albaugh and Black	Brazos Dwarf Crawfish	CS		G3,G4	TX
Cambarus acanthura Hobbs	Thornytail Crayfish	CS		G4,G5	AL, GA, NC, TN
Cambarus aculabrum Hobbs and Brown	Benton County Cave Crayfish	E	1, 5	G1	AR
Cambarus acuminatus Faxon	Acuminate Crayfish	†CS		G4	MD, NC, SC, VA
Cambarus angularis Hobbs and Bouchard	Angled Crayfish	CS		G3	TN, VA
Cambarus asperimanus Faxon	Mitten Crayfish	CS		G4	GA, NC,SC, TN
Cambarus bartonii bartonii (Fabricius)	Common Crayfish	CS		G5	AL, CT, DE, GA, ME, MD, MA, NJ, NY, NC, PA, RI, SC, TN, VT, VA, WV. NB, ON, QC
Cambarus bartonii cavatus Hay	Appalachian Brook Crayfish	CS		G5	AL, GA, KY, IN, OH, TN, VA, WV
Cambarus batchi Schuster	Bluegrass Crayfish	V	5	G3	KY
Cambarus bouchardi Hobbs	Big South Fork Crayfish	E	5	G2	KY, TN
Cambarus brachydactylus Hobbs	Shortfinger Crayfish	CS		G4	TN
Cambarus brimleyorum Cooper	Valley River Crayfish	V	5	G3	NC
Cambarus buntingi Bouchard	Longclaw Crayfish	†CS		G4	KY, TN
Cambarus carinirostris Hay	Rock Crawfish	CS		G5	OH, PA, VA, WV
Cambarus carolinus (Erichson)	Red Burrowing Crayfish	CS		G4	NC, SC, TN
Cambarus catagius Hobbs and Perkins	Greensboro Burrowing Crayfish	V	1, 5	G3	NC
Cambarus causeyi Reimer	Boston Mountains Crayfish	V	1, 5	G2	AR
Cambarus chasmodactylus James	New River Crayfish	CS		G4	NC, VA, WV
Cambarus chaugaensis Prins and Hobbs	Chauga Crayfish	T	5	G2	GA, NC, SC
Cambarus clivosus Taylor and Soucek	Short Mountain Crayfish	T	5	G2	TN
Cambarus conasaugaensis Hobbs and Hobbs	Mountain Crayfish	V	5	G3	GA, TN
Cambarus coosae Hobbs	Coosa Crayfish	CS		G5	AL, GA, TN
Cambarus coosawattae Hobbs	Coosawattee Crayfish	E	1, 5	G1	GA
Cambarus cracens Bouchard and Hobbs	Slenderclaw Crayfish	E	5	G1	AL
Cambarus crinipes Bouchard	Hairyfoot Crayfish	CS		G3	TN
Cambarus cryptodytes Hobbs	Dougherty Plain Cave Crayfish	T	5	G2,G3	FL, GA
Cambarus cumberlandensis Hobbs and Bouchard	Cumberland Crayfish	CS		G5	KY, TN
Cambarus cymatilis Hobbs	Conasauga Blue Burrower	E	5	G1	GA, TN
Cambarus davidi Cooper	Carolina Ladle Crayfish	CS		G4	NC
Cambarus deweesae Bouchard and Etnier	Valley Flame Crayfish	CS		G4	KY, TN
Cambarus diogenes Girard	Devil Crawfish	†CS		G5	AL, AR, CO, DE, FL, GA, IL, IN, IA, KS, KY, LA, MD, MI, MN, MS, MO, NE, NJ, NC, ND, OH, OK, PA, SC, SD, TN, TX VA, WI, WY. ON
Cambarus distans Rhoades	Boxclaw Crayfish	CS		G5	AL, GA, KY, TN
Cambarus doughertyensis Cooper and Skelton	Dougherty Burrowing Crayfish	E	5	G1	GA
Cambarus dubius Faxon	Upland Burrowing Crayfish	CS		G5	KY, MD, NC, PA, TN, VA, WV
Cambarus eeseeohensis Thoma	Grandfather Mountain Crayfish	T	5	G2	NC
Cambarus elkensis Jezerinac and Stocker	Elk River Crayfish	T	1, 5	G2	WV
Cambarus englishi Hobbs and Hall	Tallapoosa Crayfish	V	5	G3	AL, GA
Cambarus extraneus Hagen	Chickamauga Crayfish	T	5	G2	GA, TN
Cambarus fasciatus Hobbs	Etowah Crayfish	T	1, 5	G3	GA
Cambarus friaufi Hobbs	Hairy Crayfish	CS		G4	KY, TN
Cambarus gentryi Hobbs	Linear Cobalt Crayfish	CS		G4	TN
Cambarus georgiae Hobbs	Little Tennessee Crayfish	V	5	G2	GA, NC
Cambarus girardianus Faxon	Tanback Crayfish	CS		G5	AL, GA, TN
Cambarus graysoni Faxon	Twospot Crayfish	CS		G5	AL, KY, TN
Cambarus halli Hobbs	Slackwater Crayfish	V	5	G3,G4	AL, GA
Cambarus hamulatus (Cope)	Prickly Cave Crayfish	CS		G3,G4	AL, TN
Cambarus harti Hobbs	Piedmont Blue Burrower	E	5	G1	GA
Cambarus hiwasseensis Hobbs	Hiwassee Crayfish	V	5	G3,G4	GA, NC, TN
Cambarus hobbsorum Cooper	Rocky River Crayfish	CS		G3,G4	NC, SC
Cambarus howardi Hobbs and Hall	Chattahoochee Crayfish	CS		G3	AL, GA, NC
Cambarus hubbsi Creaser	Hubbs' Crayfish	CS		G5	AR, MO
Cambarus hubrichti Hobbs	Salem Cave Crayfish	CS		G4	MO

Cambarus hystricosus Cooper and Cooper	Sandhills Spiny Crayfish	V	5	G2	NC
Cambarus jezerinaci Thoma	Spiny Scale Crayfish	†CS		G3	TN, VA
Cambarus johni Cooper	Carolina Foothills Crayfish	V	5	G3	NC
Cambarus jonesi Hobbs and Barr	Alabama Cave Crayfish	CS		G3	AL
Cambarus latimanus (Le Conte)	Variable Crayfish	CS		G5	AL, FL, GA, NC, SC, TN
Cambarus lenati Cooper	Broad River Stream Crayfish	T	5	G2	NC
Cambarus longirostris Faxon	Longnose Crayfish	†CS		G5	AL, GA, NC, (SC), TN, VA
Cambarus longulus Girard	Atlantic Slope Crayfish	CS		G5	NC, VA, WV
Cambarus ludovicianus Faxon	Painted Devil Crayfish	CS		G5	AL, AR, KY, LA, MS, MO, OK, TN, TX
Cambarus maculatus Hobbs and Pflieger	Freckled Crayfish	CS		G4	MO
Cambarus manningi Hobbs	Greensaddle Crayfish	CS		G4	AL, GA, TN
Cambarus miltus Fitzpatrick	Rusty Grave Digger	T	5	G1,G2	AL, FL
Cambarus monongalensis Ortmann	Blue Crawfish	CS		G5	PA, VA, WV
Cambarus nerterius Hobbs	Greenbrier Cave Crayfish	E	5	G2	WV
Cambarus nodosus Bouchard and Hobbs	Knotty Burrowing Crayfish	CS		G4	GA, NC, SC, TN
Cambarus obeyensis Hobbs and Shoup	Obey Crayfish	E	5	G1	TN
Cambarus obstipus Hall	Sloped Crayfish	V	5	G4	AL
Cambarus ortmanni Williamson	Ortmann's Mudbug	CS		G5	IN, KY, OH
Cambarus parrishi Hobbs	Hiwassee Headwater Crayfish	E	5	G1	GA, NC
Cambarus parvoculus Hobbs and Shoup	Mountain Midget Crayfish	CS		G5	AL, GA, KY, TN, VA
Cambarus polychromatus Thoma et al.	Paintedhand Mudbug	CS		G5	AL, IL, IN, KY, MI, OH, TN
Cambarus pristinus Hobbs	Pristine Crayfish	E	5	G1	TN
Cambarus pyronotus Bouchard	Fireback Crayfish	E	5	G2	FL
Cambarus reburrus Prins	French Broad Crayfish	CS		G3	NC
Cambarus reduncus Hobbs	Sickle Crayfish	CS		G4,G5	NC, SC
Cambarus reflexus Hobbs	Pine Savannah Crayfish	CS		G4	GA, SC
Cambarus robustus Girard	Big Water Crayfish	CS		G5	CT, IL, IN, KY, MI, NY, NC, OH, PA, TN, VA, WV, ON, QC
Cambarus rusticiformis Rhoades	Depression Crayfish	CS		G5	(AL), IL, KY, TN
Cambarus sciotensis Rhoades	Teays River Crayfish	CS		G5	KY, OH, VA, WV
Cambarus scotti Hobbs	Chattooga River Crayfish	T	5	G3	AL, GA
Cambarus setosus Faxon	Bristly Cave Crayfish	CS		G4	AR, MO
Cambarus speciosus Hobbs	Beautiful Crayfish	E	1, 5	G2	GA
Cambarus sphenoides Hobbs	Triangleclaw Crayfish	CS		G4	KY, TN
Cambarus spicatus Hobbs	Broad River Spiny Crayfish	V	5	G2	NC, SC
Cambarus striatus Hay	Ambiguous Crayfish	CS		G5	AL, FL, GA, KY, MS, SC, TN
Cambarus strigosus Hobbs	Lean Crayfish	T	5	G2	GA
Cambarus subterraneus Hobbs	Delaware County Cave Crayfish	E	1, 5	G1	OK
Cambarus tartarus Hobbs and Cooper	Oklahoma Cave Crayfish	E	1, 5	G1	OK
Cambarus tenebrosus Hay	Cavespring Crayfish	†CS		G5	AL, IL, IN, KY, OH, TN
Cambarus thomai Jezerinac	Little Brown Mudbug	CS		G5	KY, OH, PA, TN, WV
Cambarus truncatus Hobbs	Oconee Burrowing Crayfish	T	5	G2	GA
Cambarus tuckasegee Cooper and Schofield	Tuckasegee Stream Crayfish	T	5	G2	NC
Cambarus unestami Hobbs and Hall	Blackbarred Crayfish	T	5	G2	AL, GA
Cambarus veitchorum Cooper and Cooper	White Spring Cave Crayfish	E	1, 5	G1	AL
Cambarus veteranus Faxon	Big Sandy Crayfish	T	1, 5	G3	KY, VA, WV
Cambarus williami Bouchard and Bouchard	Brawleys Fork Crayfish	E	5	G1	TN
Cambarus zophonastes Hobbs and Bedinger	Hell Creek Cave Crayfish	E	1, 5	G1	AR
Distocambarus carlsoni Hobbs	Mimic Crayfish	T	5	G2,G3	SC
Distocambarus crockeri Hobbs and Carlson	Piedmont Prairie Burrowing Crayfish	T	1, 5	G3	SC
Distocambarus devexus (Hobbs)	Broad River Burrowing Crayfish	T	5	G2	GA
Distocambarus hunteri Fitzpatrick and Eversole	Saluda Burrowing Crayfish	E	5	G1	SC
Distocambarus youngineri Hobbs and Carlson	Newberry Burrowing Crayfish	E	5	G1	SC
Fallicambarus burrisi Fitzpatrick	Burrowing Bog Crayfish	T	5	G3	AL, MS
Fallicambarus byersi (Hobbs)	Lavender Burrowing Crayfish	CS		G4	AL, FL, MS
Fallicambarus caesius Hobbs	Timberlands Burrowing Crayfish	CS		G4	AR
Fallicambarus danielae Hobbs	Speckled Burrowing Crayfish	T	5	G2	AL, MS
Fallicambarus devastator Hobbs and Whiteman	Texas Prairie Crayfish	V	5	G3	TX
Fallicambarus dissitus (Penn)	Pine Hills Digger	V	5	G4	AR, LA
Fallicambarus fodiens (Cottle)	Digger Crayfish	CS		G5	AL, AR, FL, GA, IL, IN, KY, LA, MD, MI, MS, MO, NC, OH, OK, SC, TN, TX, VA, WV. ON
Fallicambarus gilpini Hobbs and Robison	Jefferson County Crayfish	E	5	G1	AR
Fallicambarus gordoni Fitzpatrick	Camp Shelby Burrowing Crayfish	T	5	G1	MS
Fallicambarus harpi Hobbs and Robison	Ouachita Burrowing Crayfish	V	5	G3	AR
Fallicambarus hortoni Hobbs and Fitzpatrick	Hatchie Burrowing Crayfish	E	5	G1	TN
Fallicambarus jeanae Hobbs	Daisy Burrowing Crayfish	V	5	G2	AR
Fallicambarus macneesei (Black)	Old Prairie Digger	V	1, 5	G3	LA, TX
Fallicambarus oryktes (Penn and Marlow)	Flatwoods Digger	V	1, 4, 5	G4	AL, LA, MS
Fallicambarus petilicarpus Hobbs and Robison	Slenderwrist Burrowing Crayfish	E	5	G1	AR
Fallicambarus strawni (Reimer)	Saline Burrowing Crayfish	T	5	G1,G2	AR
Faxonella beyeri (Penn)	Sabine Fencing Crayfish	CS		G4	LA, TX
Faxonella blairi Hayes and Reimer	Blair's Fencing Crayfish	CS		G3	AR, OK
Faxonella clypeata (Hay)	Ditch Fencing Crayfish	CS		G5	AL, AR, FL, GA, LA, MS, MO, SC, TX
Faxonella creaseri Walls	Ouachita Fencing Crayfish	V	1, 5	G2	LA
Hobbseus attenuatus Black	Pearl Riverlet Crayfish	E	1, 5	G2	MS
Hobbseus cristatus (Hobbs)	Crested Riverlet Crayfish	T	1, 5	G3	MS
Hobbseus orconectoides Fitzpatrick and Payne	Oktibbeha Riverlet Crayfish	T	1, 5	G3	MS
Hobbseus petilus Fitzpatrick	Tombigbee Riverlet Crayfish	T	1, 5	G2	MS
Hobbseus prominens (Hobbs)	Prominence Riverlet Crayfish	CS		G4,G5	AL, MS

Hobbseus valleculus (Fitzpatrick)	Choctaw Riverlet Crayfish	T	1, 5	G1	MS
Hobbseus yalobushensis Fitzpatrick and Busack	Yalobusha Riverlet Crayfish	E	1, 5	G3	MS
Orconectes acares Fitzpatrick	Redspotted Stream Crayfish	CS		G4	AR
Orconectes alabamensis (Faxon)	Alabama Crayfish	V	5	G5	AL, MS, TN
Orconectes australis australis (Rhoades)	Southern Cave Crayfish	CS		G4	AL, TN
Orconectes australis packardi Rhoades	Appalachian Cave Crayfish	T	1, 5	G2	KY
Orconectes barrenensis Rhoades	Barren River Crayfish	CS		G4	KY, TN
Orconectes bisectus Rhoades	Crittenden Crayfish	E	5	G1	KY
Orconectes blacki Walls	Calcasieu Crayfish	T	1,5	G2	LA
Orconectes burri Taylor and Sabaj	Blood River Crayfish	E	1, 5	G1	KY, TN
Orconectes carolinensis Cooper and Cooper	North Carolina Spiny Crayfish	CS		G4	NC
Orconectes causeyi Jester	Western Plains Crayfish	CS		G5	CO, KS, (NM), OK, TX
Orconectes chickasawae Cooper and Hobbs	Chickasaw Crayfish	CS		G5	AL, MS
Orconectes compressus (Faxon)	Slender Crayfish	CS		G5	AL, KY, MS, TN
Orconectes cooperi Cooper and Hobbs	Flint River Crayfish	E	5	G1	AL, TN
Orconectes cristavarius Taylor	Spiny Stream Crayfish	CS		G5	KY, OH, NC, TN, WV, VA
Orconectes deanae Reimer and Jester	Conchas Crayfish	CS		G4	NM, OK
Orconectes difficilis (Faxon)	Painted Crayfish	CS		G3	OK
Orconectes durelli Bouchard and Bouchard	Saddle Crayfish	CS		G5	AL, KY, TN
Orconectes erichsonianus (Faxon)	Reticulate Crayfish	CS		G5	AL, GA, TN, VA
Orconectes etnieri Bouchard and Bouchard	Ets Crayfish	CS		G4	MS, TN
Orconectes eupunctus Williams	Coldwater Crayfish	T	1, 4, 5	G2	AR, MO
Orconectes forceps (Faxon)	Surgeon Crayfish	CS		G5	AL, GA, TN, VA
Orconectes harrisonii (Faxon)	Belted Crayfish	V	5	G3	MO
Orconectes hartfieldi Fitzpatrick and Suttkus	Yazoo Crayfish	T	1, 5	G2	MS
Orconectes hathawayi Penn	Teche Painted Crawfish	V	5	G3	LA
Orconectes hobbsi Penn	Pontchartrain Painted Crawfish	CS		G4	LA, MS
Orconectes holti Cooper and Hobbs	Bimaculate Crayfish	V	5	G3	AL
Orconectes hylas (Faxon)	Woodland Crayfish	CS		G4	MO
Orconectes illinoiensis Brown	Shawnee Crayfish	CS		G4	IL
Orconectes immunis (Hagen)	Calico Crayfish	CS		G5	CO, (CT), IL, IN, IA, KS, KY, (ME), (MA), MI, MN, MO, MT, NE, (NH), NY, ND, OH, (RI), SD, TN, (VT), WI, WY. MB, ON, PQ
Orconectes incomptus Hobbs and Barr	Tennessee Cave Crayfish	E	5	G1	TN
Orconectes indianensis (Hay)	Indiana Crayfish	CS		G4	IL, IN
Orconectes inermis inermis Cope	Ghost Crayfish	CS		G4	IN, KY
Orconectes inermis testii (Hay)	Unarmed Crayfish	T	1, 5	G2	IN
Orconectes jeffersoni Rhoades	Louisville Crayfish	E	1, 5	G1	KY
Orconectes jonesi Fitzpatrick	Sucarnoochee River Crayfish	†V	5	G3	AL, MS
Orconectes juvenilis (Hagen)	Kentucky River Crayfish	CS		G4	IN, KY
Orconectes kentuckiensis Rhoades	Kentucky Crayfish	CS		G4	IL, KY
Orconectes lancifer (Hagen)	Shrimp Crayfish	CS		G5	AL, AR, IL, KY, LA, MS, MO, OK, TN, TX
Orconectes leptogonopodus Hobbs	Little River Creek Crayfish	CS		G4	AR, OK
Orconectes limosus (Rafinesque)	Spinycheek Crayfish	CS		G5	CT, DE, ME, MD, MA, NH, NJ, NY, PA, RI, VT, VA, WV. QC, NB
Orconectes longidigitus (Faxon)	Longpincered Crayfish	CS		G4	AR, MO
Orconectes luteus (Creaser)	Golden Crayfish	CS		G5	IA, IL, KS, MN, MO
Orconectes macrus Williams	Neosho Midget Crayfish	CS		G4	AR, KS, MO, OK
Orconectes maletae Walls	Kisatchie Painted Crayfish	T	1, 5	G2	LA
Orconectes marchandi Hobbs	Mammoth Spring Crayfish	T	1, 5	G2	AR, MO
Orconectes margorectus Taylor	Livingston Crayfish	T	5	G2	KY
Orconectes medius (Faxon)	Saddlebacked Crayfish	CS		G4	MO
Orconectes meeki brevis Williams	Meek's Short Pointed Crayfish	T	5	G2	AR, OK
Orconectes meeki meeki (Faxon)	Meek's Crayfish	CS		G5	AR, MO
Orconectes menae (Creaser)	Mena Crayfish	T	5	G3	AR, OK
Orconectes mirus (Ortmann)	Wonderful Crayfish	CS		G4	AL, TN
Orconectes mississippiensis (Faxon)	Mississippi Crayfish	V	5	G3	MS
Orconectes nais (Faxon)	Water Nymph Crayfish	CS		G5	KS, MO, OK, TX
Orconectes nana Williams	Midget Crayfish	V	5	G3	AR, OK
Orconectes neglectus chaenodactylus Williams	Gap Ringed Crayfish	V	5	G3	AR, MO
Orconectes neglectus neglectus (Faxon)	Ringed Crayfish	CS		G5	AR, CO, KS, MO, NE, (NY), OK, (OR), WY
Orconectes obscurus (Hagen)	Allegheny Crayfish	CS		G5	ME, MD, NY, OH, PA, VA, WV. ON, QC,
Orconectes ozarkae Williams	Ozark Crayfish	CS		G5	AR, MO
Orconectes pagei Taylor and Sabaj	Mottled Crayfish	CS		G4	TN
Orconectes palmeri creolanus (Creaser)	Creole Painted Crayfish	CS		G4	(GA), LA, MS
Orconectes palmeri longimanus (Faxon)	Western Painted Crayfish	CS		G5	AR, KS, LA, OK, TX
Orconectes palmeri palmeri (Faxon)	Gray-speckled Crayfish	CS		G5	AR, KY, LA, MS, MO, TN
Orconectes pardalotus Wetzel et al.	Leopard Crayfish	E	1, 5	G1	IL, KY
Orconectes pellucidus (Tellkampf)	Mammoth Cave Crayfish	CS		G5	KY, TN
Orconectes perfectus Walls	Complete Crayfish	CS		G4,G5	AL, MS
Orconectes peruncus (Creaser)	Big Creek Crayfish	T	4, 5	G2	MO
Orconectes placidus (Hagen)	Bigclaw Crayfish	CS		G5	AL, IL, KY, TN
Orconectes propinquus (Girard)	Northern Clearwater Crayfish	CS		G5	IL, IN, IA, MA, MI, MN, NY, OH, PA, VT, WI. ON, QC
Orconectes punctimanus (Creaser)	Spothanded Crayfish	CS		G4,G5	AR, MO
Orconectes putnami (Faxon)	Phallic Crayfish	CS		G5	AL, IN, KY, TN
Orconectes quadruncus (Creaser)	St. Francis River Crayfish	T	4, 5	G2	MO

Orconectes rafinesquei Rhoades	Rough River Crayfish	V	1, 5	G3	KY
Orconectes rhoadesi Hobbs	Fishhook Crayfish	CS		G4	TN
Orconectes ronaldi Taylor	Mud River Crayfish	T	5	G3	KY
Orconectes rusticus (Girard)	Rusty Crayfish	CS		G5	(CT), (IL), IN, (IA), KY, (ME), (MA), MI, (MN), (NH), (NJ), (NM), (NC), (NY), OH, (PA), (TN), (VT), (VA), (WV), (WI). (ON), (QC)
Orconectes sanbornii (Faxon)	Sanborn's Crayfish	CS		G5	KY, OH, (WA), WV
Orconectes saxatilis Bouchard and Bouchard	Kiamichi Crayfish	E	5	G1	OK
Orconectes sheltae Cooper and Cooper	Shelta Cave Crayfish	E	1, 5	G1	AL
Orconectes shoupi Hobbs	Nashville Crayfish	E	1, 5	G1	TN
Orconectes sloanii (Bundy)	Sloan Crayfish	V	1, 4	G3	IN, OH
Orconectes spinosus (Bundy)	Coosa River Spiny Crayfish	CS		G4	AL, GA, TN
Orconectes stannardi Page	Little Wabash Crayfish	V	1, 5	G3	IL
Orconectes stygocaneyi Hobbs	Caney Mountain Cave Crayfish	T	5	G1	MO
Orconectes theaphionensis Simon et al.	Sinkhole Crayfish	CS		G4	IN
Orconectes tricuspis Rhoades	Western Highland Crayfish	CS		G4	KY
Orconectes validus (Faxon)	Powerful Crayfish	CS		G4,G5	AL, MS, TN
Orconectes virginiensis Hobbs	Chowanoke Crayfish	CS		G4	NC, VA
Orconectes virilis Hagen	Virile Crayfish	CS		G5	(AL), (AZ), AR, (CA), CO, (CT), IL, IN, IA, KS, (ME), (MD), (MA), MI, MN, MO, MT, NE, (NH), (NJ), (NM), (NC), NY, ND, OH, OK, (PA), (RI), SD, (TN), TX, UT, (VT), (VA), (WA), (WV), WI, WY. AB, MB, ON, PQ, SK
Orconectes willliamsi Fitzpatrick	Williams Crayfish	CS		G4	AR, MO
Orconectes wrighti Hobbs	Hardin Crayfish	E	5	G2	MS, TN
Procambarus ablusus Penn	Hatchie River Crayfish	CS		G4	MS, TN
Procambarus acherontis (Lonnberg)	Orlando Cave Crayfish	E	1, 5	G1	FL
Procambarus acutissimus (Girard)	Sharpnose Crayfish	CS		G5	AL, GA, MS
Procambarus acutus (Girard)	White River Crawfish	†CS		G5	AL, AR, (CA), (CT), DE, FL, GA, IL, IN, IA, KS, KY, LA, (ME), MD (MA), MI, MN, MS, MO, NJ, NY, NC, OH, OK, PA, (RI), SC, TN, TX, VA, WV, WI
Procambarus advena (Le Conte)	Vidalia Crayfish	CS		G3	GA
Procambarus alleni (Faxon)	Everglades Crayfish	CS		G4	FL
Procambarus ancylus Hobbs	Coastal Plain Crayfish	CS		G4,G5	NC, SC
Procambarus angustatus (Le Conte)	Sandhills Crayfish	E*		GX	GA
Procambarus apalachicolae Hobbs	Coastal Flatwoods Crayfish	T	1, 5	G2	FL
Procambarus attiguus Hobbs and Franz	Silver Glen Springs Crayfish	E	5	G1,G2	FL
Procambarus barbatus (Faxon)	Wandering Crayfish	CS		G5	GA, SC
Procambarus barbiger Fitzpatrick	Jackson Prairie Crayfish	V	5	G2	MS
Procambarus bivittatus Hobbs	Ribbon Crayfish	CS		G5	AL, FL, LA, MS
Procambarus blandingii (Harlan)	Santee Crayfish	CS		G4	NC, SC
Procambarus braswelli Cooper	Waccamaw Crayfish	V	5	G3	NC, SC
Procambarus brazoriensis Albaugh	Brazoria Crayfish	E	1, 5	G1	TX
Procambarus capillatus Hobbs	Capillaceous Crayfish	V	5	G3	AL, FL
Procambarus caritus Hobbs	Poor Crayfish	CS		G4	GA
Procambarus ceruleus Fitzpatrick and Wicksten	Blueclaw Chimney Crawfish	E	5	G1	TX
Procambarus chacei Hobbs	Cedar Creek Crayfish	CS		G4	GA, SC
Procambarus clarkii (Girard)	Red Swamp Crawfish	CS		G5	AL, (AZ), AR, (CA), FL, (GA), (HI), (ID), IL, IN, KY, LA, (MD), MS, MO, (NV), (NM), (NC), (OH), OK, (OR), (SC), TN, TX, (UT), (VA), (WA)
Procambarus clemmeri Hobbs	Cockscomb Crayfish	CS		G5	AL, LA, MS
Procambarus cometes Fitzpatrick	Mississippi Flatwoods Crayfish	E	5	G1	MS
Procambarus connus Fitzpatrick	Carrollton Crayfish	E	5	GH	MS
Procambarus curdi Reimer	Red River Burrowing Crayfish	CS		G5	AR, OK, TX
Procambarus delicatus Hobbs and Franz	Bigcheek Cave Crayfish	E	5	G1	FL
Procambarus dupratzi Penn	Southwestern Creek Crayfish	CS		G5	AR, LA, OK, TX
Procambarus echinatus Hobbs	Edisto Crayfish	V	5	G3	SC
Procambarus econfinae Hobbs	Panama City Crayfish	E	1, 5	G1	FL
Procambarus elegans Hobbs	Elegant Creek Crayfish	CS		G5	AR, LA, MS
Procambarus enoplosternum Hobbs	Black Mottled Crayfish	CS		G4,G5	GA, SC
Procambarus epicyrtus Hobbs	Humpback Crayfish	V	5	G3	GA
Procambarus erythrops Relyea and Sutton	Santa Fe Cave Crayfish	E	1, 5	G1,G2	FL
Procambarus escambiensis Hobbs	Escambia Crayfish	E	5	G2	AL, FL
Procambarus evermanni (Faxon)	Panhandle Crayfish	CS		G4	Al, FL, MS
Procambarus fallax (Hagen)	Slough Crayfish	CS		G5	FL, GA
Procambarus fitzpatricki Hobbs	Spinytail Crayfish	T	5	G2	MS
Procambarus franzi Hobbs and Lee	Orange Lake Cave Crayfish	E	1, 5	G1,G2	FL
Procambarus geminus Hobbs	Twin Crawfish	CS		G3,G4	AR, LA
Procambarus geodytes Hobbs	Muddiver Crayfish	CS		G4	FL
Procambarus gibbus Hobbs	Muckalee Crayfish	T	4, 5	G3	GA
Procambarus gracilis (Bundy)	Prairie Crayfish	CS		G5	IL, IN, IA, KS, MO, NE, OK, TX, WI
Procambarus hagenianus hagenianus (Faxon)	Southeastern Prairie Crayfish	CS		G4	AL, MS
Procambarus hagenianus vesticeps Fitzpatrick	Egyptian Crayfish	V	5	G3	MS
Procambarus hayi (Faxon)	Straightedge Crayfish	CS		G5	AL, MS, TN
Procambarus hinei (Ortmann)	Marsh Crayfish	CS		G5	LA, TX

Procambarus hirsutus Hobbs	Shaggy Crayfish	CS		G4	SC
Procambarus horsti Hobbs and Means	Big Blue Springs Cave Crayfish	E	1, 5	G2	FL
Procambarus howellae Hobbs	Ornate Crayfish	CS		G5	GA
Procambarus hubbelli (Hobbs)	Jackknife Crayfish	CS		G4	AL, FL
Procambarus hybus Hobbs and Walton	Smoothnose Crayfish	CS		G5	AL, MS
Procambarus incilis Penn	Cut Crayfish	CS		G4	TX
Procambarus jaculus Hobbs and Walton	Javelin Crayfish	CS		G4	LA, MS
Procambarus kensleyi Hobbs	Free State Chimney Crawfish	CS		G4	LA, TX
Procambarus kilbyi (Hobbs)	Hatchet Crayfish	CS		G4	FL
Procambarus lagniappe Black	Lagniappe Crayfish	T	5	G2	AL, MS
Procambarus latipleurum Hobbs	Wingtail Crayfish	V	5	G2	FL
Procambarus lecontei (Hagen)	Mobile Crayfish	V	5	G3,G4	AL, MS
Procambarus leitheuseri Franz and Hobbs	Coastal Lowland Cave Crayfish	E	1, 5	G1	FL
Procambarus leonensis Hobbs	Blacknose Crayfish	CS		G1,G2	FL
Procambarus lepidodactylus Hobbs	Pee Dee Lotic Crayfish	†CS		G4	SC
Procambarus lewisi Hobbs and Walton	Spur Crayfish	V	5	G4	AL
Procambarus liberorum Fitzpatrick	Osage Burrowing Crayfish	CS		G4	AR, OK
Procambarus litosternum Hobbs	Blackwater Crayfish	CS		G4	GA
Procambarus lophotus Hobbs and Walton	Mane Crayfish	CS		G5	AL, GA, TN
Procambarus lucifugus alachua (Hobbs)	Alachua Light Fleeing Cave Crayfish	T	1, 5	G2,G3	FL
Procambarus lucifugus lucifugus (Hobbs)	Florida Cave Crayfish	E	1, 5	G1	FL
Procambarus lunzi (Hobbs)	Hummock Crayfish	CS		G4	GA, SC
Procambarus lylei Fitzpatrick and Hobbs	Shutispear Crayfish	V	5	G2	MS
Procambarus machardyi Walls	Caddo Chimney Crawfish	E	5	G1,G2	LA
Procambarus mancus Hobbs and Walton	Lame Crayfish	CS		G4	MS
Procambarus marthae Hobbs	Crisscross Crayfish	V	5	G3	AL
Procambarus medialis Hobbs	Pamlico Crayfish	V	5	G2	NC
Procambarus milleri Hobbs	Miami Cave Crayfish	E	1, 5	G1	FL
Procambarus morrisi Hobbs and Franz	Putnam County Cave Crayfish	E	1, 5	G1	FL
Procambarus natchitochae Penn	Red River Crayfish	CS		G5	AR, LA, TX
Procambarus nechesae Hobbs	Neches Crayfish	T	5	G2	TX
Procambarus nigrocinctus Hobbs	Blackbelted Crayfish	E	5	G1,G2	TX
Procambarus nueces Hobbs and Hobbs	Nueces Crayfish	E	5	G1	TX
Procambarus okaloosae Hobbs	Okaloosa Crayfish	CS		G4	AL, FL
Procambarus orcinus Hobbs and Means	Woodville Karst Cave Crayfish	T	1, 5	G3	FL
Procambarus ouachitae Penn	Ouachita River Crayfish	CS		G5	AR, MS
Procambarus paeninsulanus (Faxon)	Peninsula Crayfish	CS		G5	AL, FL, GA
Procambarus pallidus (Hobbs)	Pallid Cave Crayfish	V	1, 5	G3,G4	FL
Procambarus parasimulans Hobbs and Robison	Bismark Burrowing Crayfish	CS		G4	AR
Procambarus pearsei (Creaser)	Carolina Sandhills Crayfish	CS		G4	NC, SC
Procambarus pecki Hobbs	Phantom Cave Crayfish	E	5	G1,G2	AL
Procambarus penni Hobbs	Pearl Blackwater Crayfish	V	5	G3	LA, MS
Procambarus petersi Hobbs	Ogeechee Crayfish	V	5	G3	GA
Procambarus pictus (Hobbs)	Black Creek Crayfish	T	1, 5	G2	FL
Procambarus planirostris Penn	Flatnose Crayfish	CS		G4	LA, MS
Procambarus plumimanus Hobbs and Walton	Croatan Crayfish	CS		G4	NC
Procambarus pogum Fitzpatrick	Bearded Red Crayfish	E	5	G1	MS
Procambarus pubescens (Faxon)	Brushnose Crayfish	CS		G4,G5	GA, SC
Procambarus pubischelae deficiens Hobbs	Hookless Crayfish	CS		G5	GA
Procambarus pubischelae pubischelae Hobbs	Brushpalm Crayfish	CS		G5	FL, GA
Procambarus pycnogonopodus Hobbs	Stud Crayfish	CS		G4,G5	FL
Procambarus pygmaeus Hobbs	Christmas Tree Crayfish	CS		G4	FL, GA
Procambarus raneyi Hobbs	Disjunct Crayfish	CS		G4	GA, SC
Procambarus rathbunae (Hobbs)	Combclaw Crayfish	T	5	G2	FL
Procambarus regalis Hobbs and Robison	Regal Burrowing Crayfish	V	5	G2,G3	AR
Procambarus reimeri Hobbs	Irons Fork Burrowing Crayfish	E	1, 5	G1	AR
Procambarus rogersi campestris Hobbs	Field Crayfish	V	1, 5	G3	FL
Procambarus rogersi expletus Hobbs and Hart	Perfect Crayfish	E	5	G1	FL
Procambarus rogersi ochlocknensis Hobbs	Ochlockonee Crayfish	V	5	G3	FL
Procambarus rogersi rogersi (Hobbs)	Seepage Crayfish	E	5	G1,G2	FL
Procambarus seminolae Hobbs	Seminole Crayfish	CS		G5	FL, GA
Procambarus shermani Hobbs	Gulf Crayfish	CS		G4	AL, FL, LA, MS
Procambarus simulans (Faxon)	Southern Plains Crayfish	CS		G5	AR, CO, KS, LA, NM, OK, TX
Procambarus spiculifer (Le Conte)	White Tubercled Crayfish	†CS		G5	AL, FL, GA, SC, TN
Procambarus steigmani Hobbs	Parkhill Prairie Crayfish	E	5	G1,G2	TX
Procambarus suttkusi Hobbs	Choctawhatchee Crayfish	V	5	G3,G4	AL, FL
Procambarus talpoides Hobbs	Mole Crayfish	CS		G5	FL, GA
Procambarus tenuis Hobbs	Ouachita Mountain Crayfish	V	5	G3	AR, OK
Procambarus texanus Hobbs	Bastrop Crayfish	E	5	G1	TX
Procambarus troglodytes (Le Conte)	Eastern Red Swamp Crawfish	CS		G5	GA, SC
Procambarus truculentus Hobbs	Bog Crayfish	CS		G4	GA
Procambarus tulanei Penn	Giant Bearded Crayfish	CS		G5	AR, LA
Procambarus verrucosus Hobbs	Grainy Crayfish	CS		G4	AL, GA
Procambarus versutus (Hagen)	Sly Crayfish	CS		G5	AL, FL, GA
Procambarus viaeviridis (Faxon)	Vernal Crayfish	CS		G5	AL, AR, IL, KY, LA, MS, MO, TN
Procambarus vioscai paynei Fitzpatrick	Payne's Creek Crayfish	CS		G4	AL, MS, TN
Procambarus vioscai vioscai Penn	Percy's Creek Crayfish	CS		G5	AR, LA
Procambarus youngi Hobbs	Florida Longbeak Crayfish	T	5	G2	FL
Procambarus zonangulus Hobbs and Hobbs	Southern White River Crawfish	CS		G5	AL, LA, (MD), MS, TX, (VA)
Troglocambarus maclanei Hobbs	Spider Cave Crayfish	V	5	G3,G4	FL

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