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CONSERVATION STATUS OF NORTH AMERICAN FRESHWATER CRAYFISH (*DECAPODA: CAMBARIDAE*) FROM THE SOUTHERN UNITED STATES

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ABSTRACT. A list is provided of all crayfishes (family Cambaridae) in the southern United States, which includes common names, global conservation status, an alternative review of the conservation status based on the IUCN red list criteria, and state distribution. This list includes 357 native crayfishes, of which 12 (3.4%) are critically endangered, 37 (10.4%) are endangered, 126 (35.3%) are vulnerable, 181 (50.7%) are lower risk, and 1 (0.3%) is not evaluated. The leading factors causing imperilment are restricted ranges caused by anthropogenic impacts from changes in land use, contaminants, invasion by non-indigenous species, and habitat fragmentation. In order to conserve and manage diversity of native crayfish, consistency is needed in determining conservation status and more complete distribution and life history information are needed for about 60% of species.

Keywords: imperiled species, global vulnerability, International Union for Conservation of Nature, biodiversity, threatened species

INTRODUCTION

North American aquatic biodiversity has been disproportionately affected by anthropogenic influences. A major focus is to fill gaps in research on crayfish ecology and present new information on imperilment of aquatic species. This need has benefited from the focus produced by the Natural Heritage Global (G) compilation of conservation status ranks (Master 1991). As a result of the Global status ranks, other groups have increased their emphasis on assessing other freshwater faunal diversity. The American Fisheries Society (AFS) Endangered Species Committee evaluated the conservation status of North America's freshwater fish fauna (Deacon et al. 1979; Williams et al. 1989; Warren et al. 2000), freshwater mussels (Williams et al. 1993), and North American freshwater crayfishes (Taylor et al. 1996, 2007). Taylor et al. (2007) assessed the conservation status and threats to native crayfishes in the United States and Canada using the best information available, provided updated state/provincial distributions, updated the list of references on the biology, conservation, and distribution of crayfishes in the United States and Canada, and assigned standardized common names. All of the AFS conservation assessments used the best professional judgment of taxonomic group experts to determine imperilment.

Crayfishes are closely related to marine lobsters (Crandall et al. 2000) and are members of the order Decapoda, which includes crabs, lobsters, and shrimps. Crayfishes are included in three families, and native inhabitants occur in freshwater ecosystems on every continent except Africa and Antarctica. Two families, Astacidae and Cambaridae, are native to North America and include about 408 species and subspecies, representing about 77% of the global species diversity in North America (Taylor 2002). The majority of the North American fauna (99%) is assigned to the family Cambaridae with over two-thirds of its species endemic to the southeastern United States.

Crayfishes occur in every seasonally wet and terrestrial habitat including a variety of aquatic habitats. They possess unique life-history traits adapted for these habitats, including alteration of reproductive form and burrowing abilities that allow colonization (Hobbs 1981; Welch & Eversole 2006). Our purpose for this research is to report on the conservation status of the North American crayfish fauna distributed in the southeastern United States using the International Union for Conservation of Nature and Natural Resources (IUCN) red list

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criteria. The purpose is to report the status and effects that might cause future declines in relative abundance and loss of species richness (Huner 1994; Taylor et al. 1996; Holdich 2002).

METHODS

Our review of the conservation status of crayfishes includes all species and subspecies from the southern United States. We do not recognize *Cambarus ornatus* following Taylor (1997), we continue to recognize *Procambarus ferrugineus* until the work by Robison and Crandall is published in peer-reviewed literature, and *Cambarus bartonii carinirostris* is recognized as *C. carinirostris* Hay (Rock Crawfish) following Thoma & Jezerinac (1999). Additional southern taxa included in our work were described subsequent to Taylor et al. (1996, 2007).

Conservation status.—The current assessment of southern crayfish includes several rating systems that are used by the Heritage Database and the International Union for Conservation of Nature and Natural Resources (IUCN) red list criteria. Ranking categories for conservation status 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, T = threatened, and GX = presumed extinct. The conservation ranks for each taxon follow the system developed by The Nature Conservancy/ NatureServe and the Network of Natural Heritage Programs (Master 1991, www.natureserve.org/explorer/ranking.htm). The International Union for Conservation of Nature and Natural Resources (IUCN) includes the following six conservation categories: EXTINCT (EX) – when there is no reasonable doubt that the last individual has died. EXTINCT IN THE WILD (EW) – when it is known only to survive in cultivation, in captivity or as a naturalized population (or populations) well outside the past range. A taxon is presumed EW when exhaustive surveys in known and/or expected habitat, at appropriate times (diurnal, seasonal, annual), throughout its historic range have failed to record an individual. Surveys should be over a time frame appropriate to the taxon's life cycle and life form (Appendix 1). CRITICALLY ENDANGERED (CR) – A taxon is CR when it is facing an extremely high risk of extinction in the wild in the immediate future, as defined by any of the criteria (A to E) as described in Appendix 1. ENDANGERED (EN) – A taxon is EN when it is not CR, but is facing a very high risk of EW in the near future, as defined by any of the criteria (A to E) as described in Appendix 1. VULNERABLE (VU) – A taxon is VU when it is not CR or EN but is facing a high risk of extinction in the wild in the medium-term future, as defined by any of the criteria (A to E) as described in Appendix 1. LOWER RISK (LR) – A taxon is LR when it has been evaluated and does not satisfy the criteria for any of the categories CR, EN, or VU. Taxa included in the LR category can be separated into three subcategories: (1) Conservation Dependent (cd) – Taxa which are the focus of a continuing taxon-specific or habitat-specific conservation program targeted towards the taxon in question, the cessation of which would result in the taxon qualifying for one of the threatened categories above within a period of five years; (2) Near Threatened (nt) – Taxa which do not qualify for cd, but which are close to qualifying for VU; and (3) Least Concern (lc) – Taxa which do not qualify for cd or nt. DATA DEFICIENT (DD) – A taxon is DD when there is inadequate information to make a direct, or indirect, assessment of its risk of extinction based on its distribution and/or population status. A taxon in this category may be well studied, and its biology well known, but appropriate data on abundance and/or distribution are lacking. Data Deficient is therefore not a category of threat or Lower Risk. Listing of taxa in this category indicates that more information is required and acknowledges the possibility that future research will show that threatened classification is appropriate. It is important to make positive use of whatever data are available. In many cases great care should be exercised in choosing between DD and threatened status. If the range of a taxon is suspected to be relatively circumscribed, and if a considerable period of time has elapsed since the last record of the taxon, threatened status may well be justified. NOT EVALUATED (NE) – A taxon is NE when it is has not yet been assessed against the criteria (Appendix 1).

List of taxa.—The list of crayfish species and subspecies is arranged alphabetically by genus and by species and subspecies within genus (Table 1). Following scientific names, common

names are based primarily on those provided by two internet sites; the Crayfish Tree of Life – crayfish.byu.edu, and the Global Crayfish and Lobster taxonomy browser – iz.carnegiemnh.org/crayfish/NewAstacidea/index.aspwww.crayfish.byu.edu. However, we also used common names as reported in state lists, taxonomic descriptions, McLaughlin et al. (2005), and Taylor et al. (2007).

In determining conservation status and distribution, a variety of sources were used including state and federal endangered species lists, government agency reports and websites, research publications, and books. Global Heritage Rank criteria were based on numerals G1 through G5 and correspond to those defined in the Methods. Global Heritage ranks immediately follow common name. Following the Global Heritage ranks is the conservation status based on the IUCN conservation formula. Finally, the distribution of each taxon is indicated by an alphabetical listing of USA states within the Southern Division of the American Fisheries Society where it occurs.

Distribution.—The distribution reflected for each species is based only on its range within the Southern United States. This geographic state inclusion in based on the American Fisheries Society Southern Division membership (Fig. 1). Distribution information is based on reports for Alabama (Bouchard 1976; Harris 1990; McGregor et al. 1999; Ratcliffe & DeVries 2004; Schuster & Taylor 2004; Heath et al. 2010), Arkansas (Williams 1954; Bouchard & Robison 1980; Hobbs & Robison 1988; Hobbs 1989a), Florida (Hobbs 1942; Deyrup & Franz 1994; Franz & Franz 1990; Hobbs & Hobbs 1991), Georgia (Hobbs 1981; Skelton 2010), Kentucky (Rhoades 1944; Burr & Hobbs 1984; Taylor & Schuster 2004), Louisiana (Penn 1950, 1952, 1956, 1959; Penn & Marlow 1959; Walls & Black 1991; Walls and Shively 2003; Walls 2009), Maryland (Meredith & Schwartz 1959, 1960; Kilian et al. 2010; Loughman 2010), Mississippi (Adams 2008), North Carolina (Cooper & Braswell 1995; Cooper et al. 1998; Cooper 2002; LeGrand et al. 2006; Simmons and Fraley 2010), Oklahoma (Creaser & Ortenburger 1933; Dunlap 1951; Reimer 1969; Jones et al. 2005; Taylor et al. 2004), South Carolina (Hobbs et al. 1976; Eversole 1995; Eversole & Jones 2004), Tennessee (Bouchard 1972), Texas (Penn & Hobbs 1958; Albaugh & Black 1973; Hobbs 1990; Johnson & Johnson 2008), Washington District of Columbia (Loughman 2009), and West Virginia (Jezerinac et al. 1995; Loughman et al. 2009; Jones et al. 2010; Loughman & Welsh 2010). Each state is designated by the two-digit postal code. Parentheses around states indicate known or suspected introductions.

RESULTS AND DISCUSSION

The list of southern crayfishes includes 357 taxa (Table 1). This list includes 357 native crayfishes, of which 12 (3.4%) are critically endangered, 37 (10.4%) are endangered, 126 (35.3%) are vulnerable, 181 (50.7%) are lower risk, and 1 (0.3%) was not evaluated. Taxonomic efforts since Hobbs' (1989b) checklist of North American crayfishes have resulted in the description of many new crayfish species in the United States. New descriptions have averaged slightly less than two new species per year. This demonstrates the need to train taxonomists to further study biodiversity that continues to be undiscovered in North America. The number of imperiled crayfishes (49.0%) ranks intermediate between the high levels observed in fishes and freshwater mussels, almost 33% and 72%, respectively (Williams et al. 1989; Williams et al. 1993; Warren & Burr 1994; Warren et al. 2000). Our assessment is similar to the findings of Taylor et al. (2007), who assessed 48% of crayfish as imperiled. This assessment confirms the assertion that North American diversity in aquatic systems is in poorer condition than that in terrestrial systems (Master 1991; Master et al. 2000). The benefit of this assessment is the validation of the assessment of conservation status by Taylor et al. (2007) and the stabilization of the assessment process by removing best professional judgment from the analysis. Taylor et al. (1996) used as part of the American Fisheries Society's review process the recognition of either the actual or potential imperilment of crayfishes between governmental agencies charged with protecting natural resources and non-profit conservation organizations as a rationale for listing. Only four crayfish species (*Pacifastacus fortis*, *Cambarus aculabrum, Cambarus zophonastes,* and *Orconectes shoupi*) receive protection under the Federal Endangered Species Act of 1973 (ESA) and 66 species received varying levels of protection at the state level, which is lower than the 197 species listed

Table 1.—Checklist of crayfishes of the Southeastern United States including common name, Global Heritage rank, International Union for Conservation of Nature and Natural Resources (IUCN) red list, and distribution.

Species	Global Rank	Red List	Distribution
Barbicambarus cornutus (Faxon) (Bottle Brush Crayfish)	G4	LR lc	KY, TN
Barbicambarus simmonsi Taylor and Shuster (Tennessee Bottle Brush Crayfish)	G3	VU D2	TN
Bouchardina robisoni Hobbs (Bayou Bodcau Crayfish)	G2	VU B1+2c	AR
Cambarellus blacki Hobbs (Cypress Crayfish)	G1	EN B1+2c	FL
Cambarellus diminutus Hobbs (Least Crayfish)	G3	VU B1+2c	AL, MS
Cambarellus lesliei Fitzpatrick and Laning (Angular Dwarf Crayfish)	G3	VU B1+2c	AL, MS
Cambarellus ninae Hobbs (Aransas Dwarf Crawfish)	G3	VU B1+2c	TX
Cambarellus puer Hobbs (Swamp Dwarf Crayfish)	G5	LR lc	AR, KY, LA, MS, OK, TN, TX
Cambarellus schmitti Hobbs (Fontal Dwarf Crawfish)	G3	LR lc	FL
Cambarellus shufeldtii (Faxon) (Cajun Dwarf Crayfish)	G5	LR lc	AL, AR, KY, LA, MS, TN, TX
Cambarellus texanus Albaugh and Black (Brazos Dwarf Crawfish)	G3G4	LR lc	TX
Cambarus acanthura Hobbs (Thornytail Crayfish)	G4G5	LR lc	AL, GA, NC, TN
Cambarus aculabrum Hobbs and Brown (Benton County Cave Crayfish)	G1	EN B1+2c	AR
Cambarus acuminatus Faxon (Acuminate Crayfish)	G4	LR nt	MD, NC, SC, VA
Cambarus aldermanorum Cooper and Price (Carolina needlenose crayfish)	G3	VU B1, D1	SC
Cambarus angularis Hobbs and Bouchard (Angled Crayfish)	G3	LR lc	TN, VA
Cambarus asperimanus Faxon (Mitten Crayfish)	G4	LR lc	GA, NC, SC, TN
Cambarus bartonii bartonii (Fabricius) (Common Crayfish)	G5T5	LR lc	AL, GA, KY, MD, NC, SC, TN, VA, WV
Cambarus bartonii cavatus Hay (Appalachian Brook Crayfish)	G5T5	LR lc	AL, KY, WV
Cambarus batchi Schuster (Bluegrass Crayfish)	G3	VU B1+2c, D1	KY
Cambarus bouchardi Hobbs (Big South Fork Crayfish)	G2	VU B1+2c, D1	KY, TN
Cambarus brachydactylus Hobbs (Shortfinger Crayfish)	G4	LR lc	TN
Cambarus brimleyorum Cooper (Valley River Crayfish)	G3	VU B1+2c	NC

Table 1.—Continued.

Species	Global Rank	Red List	Distribution
Cambarus buntingi Bouchard (Bunting Crayfish)	G4	LR nt	KY, TN, VA
Cambarus carinirostris Hay (Rock Crawfish)	G5	LR lc	MD, VA, WV
Cambarus carolinus (Erichson) (Red Burrowing Crayfish)	G4	LR lc	NC, SC, TN
Cambarus catagius Hobbs and Perkins (Greensboro Burrowing Crayfish)	G3	VU B1+2c	NC
Cambarus causeyi Reimer (Boston Mountains Crayfish)	G2	VU A1,B1+2c	AR
Cambarus chasmodactylus James (New River Crayfish)	G4	LR lc	NC, VA, WV
Cambarus chaugaensis Prins and Hobbs (Chauga Crayfish)	G2	VU B1+2c, D1	GA, NC, SC
Cambarus clivosus Taylor, Soucek, and Organ (Short Mountain Crayfish)	G2	VU B1+2c, D1	TN
Cambarus conasaugaensis Hobbs and Hobbs (Mountain Crayfish)	G3	VU B1+2c	GA, TN
Cambarus coosae Hobbs (Coosa Crayfish)	G5	LR lc	AL, GA, TN
Cambarus coosawattae Hobbs (Coosawattae Crayfish)	G1	VU B1+2c, D1	GA
Cambarus cracens Bouchard and Hobbs (Slenderclaw Crayfish)	G1	EN B1+2c	AL
Cambarus crinipes Bouchard (Bouchard's Crayfish)	G3	LR lc	TN
Cambarus cryptodytes Hobbs (Dougherty Plain Cave Crayfish)	G2G3	VU B1+2c	FL, GA
Cambarus cumberlandensis Hobbs and Bouchard (Cumberland Crayfish)	G5	LR lc	KY, TN
Cambarus cymatilis Hobbs (Conasauga Blue Burrower Crayfish)	G1	VU B1+2c, D1	GA, TN
Cambarus davidi Cooper (Carolina Ladle Crayfish)	G3	LR lc	NC
Cambarus deweesae Bouchard and Etnier (Valley Flame Crayfish)	G4	EN B1+2c	KY, TN
Cambarus diogenes Girard (Devil Crawfish)	G5	LR lc	AL, AR, FL, GA, KY, LA, MD, MS, NC, OK, SC, TN, TX, VA
Cambarus distans Rhoades (Boxclaw Crawfish)	G5	LR lc	AL, GA, KY, TN
Cambarus doughertyensis Cooper and Skelton (Dougherty Burrowing Crayfish)	G1G2	EN B1+2c	GA
Cambarus dubius Faxon (Upland Burrowing Crayfish)	G5	LR lc	KY, MD, NC, TN, VA, WV
Cambarus eeseeohensis Thoma (Linville River Crayfish)	G1	EN B1+2c	NC
Cambarus elkensis Jezerinac and Stocker (Elk River Crayfish)	G2	VU B1+2c	WV

Table 1.—Continued.

Species	Global Rank	Red List	Distribution
Cambarus englishi Hobbs and Hall (Tallapoosa Crayfish)	G3	VU B1+2c	AL, GA
Cambarus erythrodactylus Simon and Morris (Warpaint Mudbug)	G5	LR lc	AL, GA, MS
Cambarus extraneus Hagen (Chickamauga Crayfish)	G2	VU B1+2c	GA, TN
Cambarus fasciatus Hobbs (Etowah Crayfish)	G3	VU B1+2c	GA
Cambarus friaufi Hobbs (Hairy Crayfish)	G4	LR lc	KY, TN
Cambarus gentryi Hobbs (Linear Cobalt Crayfish)	G4	LR lc	TN
Cambarus georgiae Hobbs (Little Tennessee Crayfish)	G2	VU B1+2c, D1	GA, NC
Cambarus girardianus Faxon (Tanback Crayfish)	G5	LR lc	AL, GA, MS, TN
Cambarus graysoni Faxon (Twospot Crayfish)	G5	LR lc	AL, KY, TN
Cambarus halli Hobbs (Slackwater Crayfish)	G3G4	LR lc	AL, GA
Cambarus hamulatus (Cope) (Prickly Cave Crayfish)	G3G4	LR lc	AL, TN
Cambarus harti Hobbs (Piedmont Blue Burrower)	G1	EN B1+2c	GA
Cambarus hiwasseensis Hobbs (Hiwassee Crayfish)	G3G4	VU B1+2c	GA, NC, TN
Cambarus hobbsorum Cooper (Rocky River Crayfish)	G3G4	LR lc	NC, SC
Cambarus howardi Hobbs and Hall (Chattahoochee Crayfish)	G3	VU B1+2c	AL, GA, NC
Cambarus hubbsi Creaser (Hubb's Crayfish)	G5	LR lc	AR
Cambarus hystricosus Cooper and Cooper (Sandhills Spiny Crayfish)	G2	VU B1+2c	NC
Cambarus jezerinaci Thoma (Powell River Crayfish)	G3	LR nt	TN, VA
Cambarus johni Cooper (Carolina Foothills Crayfish)	G3	VU B1+2C	NC
Cambarus jonesi Hobbs and Barr (Alabama Cave Crayfish)	G2	LR lc	AL
Cambarus laconensis Buhay and Crandall (Lacon Exit Cave Crayfish)	G1	VU B1+2C	AL
Cambarus latimanus (LeConte) (Variable Crayfish)	G5	LR lc	AL, FL, GA, NC, SC, TN
Cambarus lenati Cooper (Broad River Crayfish)	G2	VU B1+2c	NC
Cambarus longirostris Faxon (Longnose Crayfish)	G5	LR lc	AL, GA, NC, (SC), TN, VA
Cambarus longulus Girard (Atlantic Slope Crayfish)	G5	LR lc	NC, VA, WV
Cambarus ludovicianus Faxon (Painted Devil Crayfish)	G5	LR lc	AL, AR, KY, LA, MS, TN, TX

Table 1.—Continued.

Species	Global Rank	Red List	Distribution
Cambarus manningi Hobbs (Greensaddle Crayfish)	G4	LR lc	AL, GA, TN
Cambarus miltus Fitzpatrick (Rusty Gravedigger)	G2	VU B1+2c	AL, FL
Cambarus monongalensis Ortmann (Blue Crawfish)	G5	LR lc	VA, WV
Cambarus nerterius Hobbs (Greenbrier Cave Crayfish)	G2	VU B1+2c, D1	WV
Cambarus nodosus Bouchard and Hobbs (Knotty Burrowing Crayfish)	G4	LR lc	GA, NC, SC, TN
Cambarus obeyensis Hobbs and Shoup (Obey Crayfish)	G1	VU B1+2c	TN
Cambarus obstipus Hall (Sloped Crayfish)	G4	VU B1+2c	AL
Cambarus ortmanni Williamson (Ortmann's Mudbug)	G5	LR lc	KY
Cambarus parrishi Hobbs (Hiwassee Headwater Crayfish)	G1	VU B1+2c, D1	GA, NC
Cambarus parvoculus Hobbs and Shoup (Mountain Midget Crayfish)	G5	LR lc	AL, GA, KY, TN, VA
Cambarus pecki Hobbs (Phantom Cave Crayfish)	G1G2	VU B1+2c	AL
Cambarus polychromatus Thoma, Jezerinac, and Simon (Paintedhand Mudbug)	G5	LR lc	AL, KY, TN
Cambarus pristinus Hobbs (Pristine Crayfish)	G2	VU B1+2c, D1	TN
Cambarus pyronotus Bouchard (Fireback Crayfish)	G2	EN B1+2c	FL
Cambarus reburrus Prins (French Broad Crayfish)	G3	VU B1+2c	NC
Cambarus reduncus Hobbs (Sickle Crayfish)	G4G5	LR lc	NC, SC
Cambarus reflexus Hobbs (Pine Savannah Crayfish)	G4	LR lc	GA, SC
Cambarus robustus Girard (Big Water Crayfish)	G5	LR lc	KY, NC, TN, VA, WV
Cambarus rusticiformis Rhoades (Depression Crayfish)	G5	LR lc	(AL), KY, TN
Cambarus sciotensis Rhoades (Teays River Crayfish)	G5	LR lc	KY, VA, WV
Cambarus scotti Hobbs (Chatooga Crayfish)	G3	VU B1+2c	AL, GA
Cambarus setosus Faxon (Bristly Cave Crayfish)	G3	LR lc	AR, OK
Cambarus smilax Loughman, Simon, and Welch (Greenbrier Crayfish)	G4	LR lc	WV
Cambarus sp. 1 (Emory River Crayfish)	G1?	NE	TN
Cambarus speleocoopi Buhay and Crandall (Sweet Home Alabama Crayfish)	G1	VU B1+2C	AL

Table 1.—Continued.

Species	Global Rank	Red List	Distribution
Cambarus speciosus Hobbs (Beautiful Crayfish)	G2	VU B1+2c, D1	GA
Cambarus sphenoides Hobbs (Triangleclaw Crayfish)	G4	LR lc	KY, TN
Cambarus spicatus Hobbs (Broad River Spiny Crayfish)	G3	VU B1+2c	NC, SC
Cambarus striatus Hay (Hay Crayfish)	G5	LR lc	AL, FL, GA, KY, MS, SC, TN
Cambarus strigosus Hobbs (Lean Crayfish)	G2	EN B1+2c	GA
Cambarus subterraneus Hobbs (Delaware County Cave Crayfish)	G1	EN B1+2c	OK
Cambarus tartarus Hobbs and Cooper (Oklahoma Cave Crayfish)	G1	CR B1+2c	OK
Cambarus tenebrosus Hay (Cavespring Crayfish)	G5	LR lc	AL, GA, KY, TN
Cambarus thomai Jezerinac (Little Brown Mudbug)	G5	LR lc	KY, TN, WV
Cambarus trojanensis Simon and Morris (Spiny Collared Mudbug)	G5	LR lc	AL, FL, MS
Cambarus truncatus Hobbs (Oconee Burrowing Crayfish)	G2	EN B1+2c	GA
Cambarus tuckasegee Cooper and Schofield (Tuckasegee Stream Crayfish)	G1G2	VU B1+2c	NC
Cambarus unestami Hobbs and Hall (Blackbarred Crayfish)	G2	VU B1+2c	AL, GA
Cambarus veitchorum Cooper and Cooper (White Spring Cave Crayfish)	G1	EN A1, B1+2c	AL
Cambarus veteranus Faxon (Big Sandy Crayfish)	G2G3	VU B1+2c	KY, VA, WV
Cambarus williami Bouchard and Bouchard (Brawleys Fork Crayfish)	G2	EN B1+2c	TN
Cambarus zophonastes Hobbs and Bedinger (Hell Creek Cave Crayfish)	G1	CR B1+2c	AR
Distocambarus carlsoni Hobbs (Mimic Crayfish)	G2G3	VU B1+2c	SC
Distocambarus crockeri Hobbs and Carlson (Piedmont Prairie Burrowing Crayfish)	G3	VU B1+2c, D1	SC
Distocambarus devexus (Hobbs) (Broad River Burrowing Crayfish)	G1	VU B1+2c, D1	GA
Distocambarus hunteri Fitzpatrick and Eversole (Saluda Burrowing Crayfish)	G1	EN B1+2c	SC
Distocambarus youngineri Hobbs and Carlson (Newberry Burrowing Crayfish)	G1	VU B1+2c, D1	SC

Table 1.—Continued.

Species	Global Rank	Red List	Distribution
Fallicambarus burrisi Fitzpatrick (Burrowing Bog Crayfish)	G3	VU B1+2c	AL, MS
Fallicambarus byersi (Hobbs) (Lavender Burrowing Crayfish)	G4	LR lc	AL, FL, MS
Fallicambarus caesius Hobbs (Timberlands Burrowing Crayfish)	G4	LR lc	AR
Fallicambarus danielae Hobbs (Speckled Burrowing Crayfish)	G2	VU B1+2c	AL, MS
Fallicambarus devastator Hobbs and Whiteman (Texas Prairie Crayfish)	G3	VU B1+2c	TX
Fallicambarus dissitus (Penn) (Pine Hills Digger Crayfish)	G4	VU B1+2c	AR, LA
Fallicambarus fodiens (Cottle) (Digger Crayfish)	G5	LR lc	AL, AR, FL, GA, KY, LA, MD, MS, NC, OK, SC, TN, TX, VA, WV
Fallicambarus gilpini Hobbs and Robison (Jefferson County Crayfish)	G1	VU B1+2c, D1	AR
Fallicambarus gordoni Fitzpatrick (Camp Shelby Burrowing Crayfish)	G1	VU B1+2c, D1	MS
Fallicambarus harpi Hobbs and Robison (Ouachita Burrowing Crayfish)	G1	EN B1+2c	AR
Fallicambarus hortoni Hobbs and Fitzpatrick (Hatchie Burrowing Crayfish)	G1	EN B1+2c	TN
Fallicambarus houstonensis Johnson (Houston Burrowing Crayfish)	G3	VU B1+2c, D1	TX
Fallicambarus jeanae Hobbs (Daisy Burowing Crayfish)	G2	EN B1+2c	AR
Fallicambarus kountzeae Johnson (Big Thicket Burrowing Crayfish)	G3	VU B1+2c, D1	TX
Fallicambarus macneesei (Black) (Old Prairie Digger Crayfish)	G3	VU B1+2c, D1	LA, TX
Fallicambarus oryktes (Penn and Marlow) (Flatwoods Digger Crayfish)	G4	EN B1+2c, B2	AL, LA, MS
Fallicambarus petilicarpus Hobbs and Robison (Slenderwrist Burrowing Crayfish)	G1	CR B1+2c	AR
Fallicambarus strawni (Reimer) (Saline Burrowing Crayfish)	G1G2	VU B1+2c	AR
Faxonella beyeri (Penn) (Sabine Fencing Crayfish)	G4	LR lc	LA, TX
Faxonella blairi Hayes and Reimer (Blair's Fencing Crayfish)	G2	LR lc	AR, OK
Faxonella clypeata (Hay) (Ditch Fencing Crayfish)	G5	LR lc	AL, AR, FL, GA, LA, MS, OK, SC, TX

Table 1.—Continued.

Species	Global Rank	Red List	Distribution
Faxonella creaseri Walls (Ouachita Fencing Crayfish)	G2	VU B1+2c, D1	LA
Hobbseus attenuatus Black (Pearl Riverlet Crayfish)	G2	VU B1+2c, D1	MS
Hobbseus cristatus (Hobbs) (Crested Rivulet Crayfish)	G3	VU B1+2c	MS
Hobbseus orconectoides Fitzpatrick and Payne (Oktibbeha Riverlet Crayfish)	G3	VU B1+2c	MS
Hobbseus petilus Fitzpatrick (Tombigbee Riverlet Crayfish)	G2	VU B1+2c	MS
Hobbseus prominens (Hobbs) (Prominence Riverlet Crayfish)	G4G5	LR lc	AL, MS
Hobbseus valleculus (Fitzpatrick) (Choctaw Riverlet Crayfish)	G1	VU B1+2c	MS
Hobbseus yalobushensis Fitzpatrick and Busack (Yalobusha Riverlet Crayfish)	G3	VU B1+2c, D1	MS
Orconectes acares Fitzpatrick (Redspotted Stream Crayfish)	G4	LR lc	AR, OK
Orconectes alabamensis (Faxon) (Alabama Crayfish)	G5	LR lc	AL, MS, TN
Orconectes australis australis (Rhoades) (Southern Cave Crayfish)	G5T4	LR lc	AL, TN
Orconectes australis packardi Rhoades (Appalachian Cave Crayfish)	G2	EN B1+2c	KY
Orconectes barrenensis Rhoades (Barren River Crayfish)	G4	LR lc	KY, TN
Orconectes barri Buhay and Crandall (Cumberland Plateau Cave Crayfish)	G2	VU B1+2C	KY, TN
Orconectes bisectus Rhoades (Crittenden Crayfish)	G1	VU B1+2c, D1	KY
Orconectes blacki Walls (Calcasieu Crayfish)	G2	VU B1+2c, D1	LA
Orconectes burri Taylor and Sabaj (Burr Crayfish)	G1	EN B1+2c, D1	KY, TN
Orconectes carolinensis Cooper and Cooper (North Carolina Crayfish)	G3	LR lc	NC
Orconectes causeyi Jester (Western Plains Crayfish)	G4	LR lc	OK, TX
Orconectes chickasawae Cooper and Hobbs (Chickasaw Crayfish)	G5	LR lc	AL, MS
Orconectes compressus (Faxon) (Slender Crayfish)	G5	LR lc	AL, KY, MS, TN
Orconectes cooperi Cooper and Hobbs (Flint River Crayfish)	G1	VU B1+2c, D1	AL, TN
Orconectes cristavarius Taylor (Spiny Stream Crayfish)	G5	LR lc	KY, NC, TN, VA, WV
Orconectes deanae Reimer and Jester (Conchas Crayfish)	G4	VU B1+2c, D1	OK

Table 1.—Continued.

Species	Global Rank	Red List	Distribution
Orconectes difficilis (Faxon) (Painted Crayfish)	G3	LR lc	AR, OK
Orconectes durelli Bouchard and Bouchard (Saddle Crayfish)	G5	LR lc	AL, KY, TN
Orconectes erichsonianus (Faxon) (Reticulate Crayfish)	G5	LR lc	AL, GA, TN, VA
Orconectes etnieri Bouchard and Bouchard (Etnier's Crayfish)	G4	LR lc	MS, TN
Orconectes eupunctus Williams (Coldwater Crayfish)	G2	EN B1+2c, D2	AR, MO
Orconectes forceps (Faxon) (Surgeon Crayfish)	G5	LR lc	AL, GA, TN, VA
Orconectes hartfieldi Fitzpatrick and Suttkus (Yazoo Crayfish)	G2	VU B1+2c	MS
Orconectes hathawayi Penn (Teche Painted Crayfish)	G3	VU B1+2c	LA
Orconectes hobbsi Penn (Pontchartrain Painted Crayfish)	G4	LR lc	LA, MS
Orconectes holti Cooper and Hobbs (Bimaculate Crayfish)	G3	VU B1+2c	AL
Orconectes immunis (Hagen) (Calico Crayfish)	G5	LR lc	AL, KY, TN
Orconectes incomptus Hobbs and Barr (Tennessee Cave Crayfish)	G1	VU B1+2c, D1	TN
Orconectes inermis inermis Cope (Northern Cave Crayfish)	G5T4	LR lc	KY
Orconectes jeffersoni Rhoades (Louisville Crayfish)	G1	VU B1+2c, D1	KY
Orconectes jonesi Fitzpatrick (Sucarnoochee River Crayfish)	G3	VU B1+2c	AL, MS
Orconectes juvenilis (Hagen) (Kentucky River Crayfish)	G4	LR lc	KY
Orconectes kentuckiensis Rhoades (Kentucky Crayfish)	G4	VU B1+2c	KY
Orconectes lancifer (Hagen) (Shrimp Crayfish)	G5	LR lc	AL, AR, KY, LA, MS, OK, TN, TX
Orconectes leptogonopodus Hobbs (Little River Creek Crayfish)	G4	LR lc	AR, OK
Orconectes limosus (Rafinesque) (Spinycheek Crayfish)	G5	VU A1, B1	MD, WV
Orconectes longidigitus (Faxon) (Longpincered Crayfish)	G4	LR lc	AR
Orconectes luteus (Creaser) (Golden Crayfish)	G5	LR lc	AR
Orconectes macrus Williams (Neosho Midget Crayfish)	G4	LR lc	AR, OK
Orconectes maletae Walls (Kisatchie Painted Crayfish)	G2	VU B1+2c	LA, TX
Orconectes marchandi Hobbs (Sharp River Crayfish)	G2	VU B1+2c, D1	AR
Orconectes margorectus Taylor (Livingston Crayfish)	G2	EN B1+2c	KY

Table 1.—Continued.

Species	Global Rank	Red List	Distribution
Orconectes meeki brevis Williams (Meek's Short Pointed Crayfish)	G4T3	EN B1+2c	AR, OK
Orconectes meeki meeki (Faxon) (Meek's Crayfish)	G4T4	LR lc	AR
Orconectes menae (Creaser) (Mena Crayfish)	G3	VU B1+2c	AR, OK
Orconectes mirus (Ortmann) (Wonderful Crayfish)	G4	LR lc	AL, TN
Orconectes mississippiensis (Faxon) (Mississippi Crayfish)	G3	VU B1+2c	MS
Orconectes nais (Faxon) (Water Nymph Crayfish)	G5	LR lc	AR, OK, TX
Orconectes nana Williams (Midget Crayfish)	G3	VU B1+2c	AR, OK
Orconectes neglectus chaenodactylus Williams (Gaped Ringed Crayfish)	G5T3	VU B1+2c	AR
Orconectes neglectus neglectus (Faxon) (Ringed Crayfish)	G5T5	LR lc	AR, OK
Orconectes obscurus (Hagen) (Allegheny Crayfish)	G5	LR lc	MD, VA, WV
Orconectes ozarkae Williams (Ozark Crayfish)	G5	LR lc	AR
Orconectes pagei Taylor and Sabaj (Mottled Crayfish)	G4	LR lc	TN
Orconectes palmeri creolanus (Creaser) (Creole Painted Crayfish)	G5T4	LR lc	(GA), LA, MS
Orconectes palmeri longimanus (Faxon) (Western Painted Crayfish)	G5T5	LR lc	AR, OK, TX
Orconectes palmeri palmeri (Faxon) (Gray-speckled Crayfish)	G5T5	LR lc	AR, KY, MS, TN
Orconectes pardalotus Wetzel, Poly, Fetzner (Leopard Crayfish)	G1	VU B1+2C	KY
Orconectes pellucidus (Tellkampf) (Mammoth Cave Crayfish)	G4	LR lc	KY, TN
Orconectes perfectus Walls (Complete Crayfish)	G4G5	LR lc	AL, MS
Orconectes placidus (Hagen) (Placid Crayfish)	G5	LR lc	AL, KY, TN
Orconectes punctimanus (Creaser) (Spothand Crayfish)	G4G5	LR lc	AR
Orconectes putnami (Faxon) (Phallic Crayfish)	G5	LR lc	AL, KY, TN
Orconectes rafinesquei Rhoades (Rafinesque Crayfish)	G3	VU B1+2c, D1	KY
Orconectes rhoadesi Hobbs (Fishhook Crayfish)	G4	LR lc	TN
Orconectes ronaldi Taylor (Mud River Crayfish)	G3	LR lc	KY

Table 1.—Continued.

Species	Global Rank	Red List	Distribution
Orconectes rusticus (Girard) (Rusty Crayfish)	G5	LR lc	KY, (NC), (TN), (VA), (WV)
Orconectes sanbornii erismophorous Hobbs and Fitzpatrick	G4G5	LR lc	WV
Orconectes sanbornii sanbornii (Faxon) (Sanborn's Crayfish)	G4G5T4	LR lc	KY, WV
Orconectes saxatilis Bouchard and Bouchard (Kiamichi Crayfish)	G1	CR B1+2c	OK
Orconectes sheltae Cooper and Cooper (Shelta Cave Crayfish)	G1	EN B1+2c, D1	AL
Orconectes shoupi Hobbs (Nashville Crayfish)	G1G2	CR B1+2c	TN
Orconectes spinosus (Bundy) (Coosa River Spiny Crayfish)	G4	LR lc	AL, GA, TN
Orconectes taylori Schuster (Crescent Crayfish)	G2	VU B1+2C	TN
Orconectes tricuspis Rhoades (Rhode Crayfish)	G4	LR lc	KY
Orconectes validus (Faxon) (Powerful Crayfish)	G5	LR lc	AL, MS, TN
Orconectes virginiensis Hobbs (Chowanoke Crayfish)	G3	LR lc	NC, VA
Orconectes virilis Hagen (Virile Crayfish)	G5	LR lc	(AL), AR, (MD), MS, (NC), OK, (TN), TX, (VA), (WV)
Orconectes williamsi Fitzpatrick (Williams Crayfish)	G3G4	LR lc	AR
Orconectes wrighti Hobbs (Hardin Crayfish)	G2	VU B1+2c, D1	MS, TN
Procambarus ablusus Penn (Hatchie River Crayfish)	G4	LR lc	MS, TN
Procambarus acherontis (Lonnberg) (Orlando Cave Crayfish)	G1	EN B1+2c	FL
Procambarus acutissimus (Girard) (Sharpnose Crayfish)	G5	LR lc	AL, GA, MS
Procambarus acutus (Girard) (White River Crawfish)	G5	LR lc	AL, AR, DC, FL, GA, KY, LA, MD, MS, NC, OK, SC, TN, TX, VA, WV
Procambarus advena (LeConte) (Vidalia Crayfish)	G3	LR lc	GA
Procambarus alleni (Faxon) (Everglades Crayfish)	G4	LR lc	FL
Procambarus ancylus Hobbs (Coastal Plain Crayfish)	G4G5	LR lc	NC, SC
Procambarus angustatus (LeConte) (Sandhills Crayfish)	GX	CR B1+2c	GA
Procambarus apalachicolae Hobbs (Coastal Flatwoods Crayfish)	G2	VU B1+2c	FL
Procambarus attiguus Hobbs and Franz (Silver Glen Springs Crayfish)	G1G2	CR B1+2c	FL

Table 1.—Continued.

Species	Global Rank	Red List	Distribution
Procambarus barbatus (Faxon) (Wandering Crayfish)	G5	LR lc	GA, SC
Procambarus barbiger Fitzpatrick (Jackson Prairie Crayfish)	G2	VU B1+2c	MS
Procambarus bivittatus Hobbs (Ribbon Crayfish)	G5	LR lc	AL, FL, LA, MS
Procambarus blandingii (Harlan) (Santee Crayfish)	G4	LR lc	NC, SC
Procambarus braswelli Cooper (Waccamaw Crayfish)	G3	VU B1+2c	NC, SC
Procambarus brazoriensis Albaugh (Brazoria Crayfish)	G1	VU B1+2c, D1	TX
Procambarus capillatus Hobbs (Capillaceous Crayfish)	G3	VU B1+2c	AL, FL
Procambarus caritus Hobbs (Poor Crayfish)	G4	LR lc	GA
Procambarus ceruleus Fitzpatrick and Wicksten (Blueclaw Chimney Crayfish)	G1G3	EN B1+2c	TX
Procambarus chacei Hobbs (Cedar Creek Crayfish)	G4	LR lc	GA, SC
Procambarus clarkii (Girard) (Red Swamp Crawfish)	G5	LR lc	AL, AR, FL, (GA), KY, LA, (MD), MS, (NC), OK, (SC), TN, TX, (VA)
Procambarus clemmeri Hobbs (Cockscomb Crayfish)	G5	LR lc	AL, LA, MS
Procambarus cometes Fitzpatrick (Mississippi Flatwoods Crayfish)	G1	VU B1+2c, D1	MS
Procambarus connus Fitzpatrick (Carrollton Crayfish)	GH	VU B1+2c, D1	MS
Procambarus curdi Reimer (Red River Burrowing Crayfish)	G5	LR lc	AR, OK, TX
Procambarus delicatus Hobbs and Franz (Bigcheek Cave Crayfish)	G1	CR B1+2c	FL
Procambarus dupratzii Penn (Southwestern Creek Crayfish)	G5	LR lc	AR, OK, LA, TX
Procambarus echinatus Hobbs (Edisto Crayfish)	G3	VU B1+2c	SC
Procambarus econfinae Hobbs (Panama City Crayfish)	G1	EN B1+2c	FL
Procambarus elegans Hobbs (Elegant Creek Crayfish)	G4	LR lc	AR, LA, MS
Procambarus enoplosternum Hobbs (Black Mottled Crayfish)	G4G5	LR lc	GA, SC
Procambarus epicyrtus Hobbs (Humpback Crayfish)	G3	VU B1+2c	GA
Procambarus erythrops Relyea and Sutton (Santa Fe Cave Crayfish)	G1G2	EN B1+2c	FL
Procambarus escambiensis Hobbs (Escambia Crayfish)	G2	VU B1+2c, D1	AL, FL

Table 1.—Continued.

Species	Global Rank	Red List	Distribution
Procambarus evermanni (Faxon) (Panhandle Crayfish)	G4	LR lc	AL, FL, MS
Procambarus fallax (Hagen) (Slough Crayfish)	G5	LR lc	FL, GA
Procambarus ferrugineus Hobbs and Robison (Lonoke Crayfish)	G1	EN B1+2c	AR
Procambarus fitzpatricki Hobbs (Spinytail Crayfish)	G2	VU B1+2c	MS
Procambarus franzi Hobbs and Lee (Orange Lake Cave Crayfish)	G1G2	EN B1+2c	FL
Procambarus geminus Hobbs (Twin Crawfish)	G3G4	LR lc	AR, LA
Procambarus geodytes Hobbs (Muddiver Crayfish)	G4	LR lc	FL
Procambarus gibbus Hobbs (Muckalee Crayfish)	G3	VU B1+2c	GA
Procambarus gracilis (Bundy) (Prairie Crayfish)	G5	LR lc	AR, OK, TX
Procambarus hagenianus hagenianus (Faxon) (Southeastern Prairie Crayfish)	G4G5T4	LR lc	AL, MS
Procambarus hagenianus vesticeps Fitzpatrick (Egyptian Crayfish)	G4G5T3	VU B1+2c	MS
Procambarus hayi (Faxon) (Straightedge Crayfish)	G5	LR lc	AL, MS, TN
Procambarus hinei (Ortmann) (Marsh Crayfish)	G5	LR lc	LA, TX
Procambarus hirsutus Hobbs (Shaggy Crayfish)	G4	LR lc	SC
Procambarus horsti Hobbs and Means (Big Blue Springs Crayfish)	G1	EN B1+2c	FL
Procambarus howellae Hobbs (Ornate Crayfish)	G5	LR lc	GA
Procambarus hubbelli (Hobbs) (Jackknife Crayfish)	G4	LR lc	AL, FL
Procambarus hybus Hobbs and Walton (Smoothnose Crayfish)	G5	LR lc	AL, MS
Procambarus incilis Penn (Cut Crayfish)	G4	LR lc	TX
Procambarus jaculus Hobbs and Walton (Javelin Crayfish)	G4	LR lc	LA, MS
Procambarus kensleyi Hobbs (Free State Chimney Crayfish)	G4	LR lc	LA, TX
Procambarus kilbyi (Hobbs) (Hachet Crayfish)	G4	LR lc	FL
Procambarus lagniappe Black (Lagniappe Crayfish)	G2	VU B1+2c	AL, MS
Procambarus latipleurum Hobbs (Wingtail Crayfish)	G2	VU B1+2c, D1	FL
Procambarus lecontei (Hagen) (Mobile Crayfish)	G3G4	VU B2+3a	AL, MS

Table 1.—Continued.

Species	Global Rank	Red List	Distribution
Procambarus leitheuseri Franz and Hobbs (Coastal Lowland Cave Crayfish)	G1G2	VU B1+2c, D1	FL
Procambarus leonensis Hobbs (Blacknose Crayfish)	G4	LR lc	FL
Procambarus lepidodactylus Hobbs (Pee Dee Lotic Crayfish)	G4	LR lc	SC
Procambarus lewisi Hobbs and Walton (Spur Crayfish)	G4	VU B2+3a	AL
Procambarus liberorum Fitzpatrick (Osage Burrowing Crayfish)	G4	LR lc	AR, OK
Procambarus litosternum Hobbs (Blackwater Crayfish)	G4	LR lc	GA
Procambarus lophotus Hobbs and Walton (Mane Crayfish)	G5	LR lc	AL, GA, TN
Procambarus lucifugus alachua (Hobbs) (Alachua Light Fleeing Crayfish)	G2G3T2T3	VU B2+3a, D2	FL
Procambarus lucifugus lucifugus (Hobbs) (Florida Cave Crayfish)	G2G3T2	EN B1+2c	FL
Procambarus lunzi (Hobbs) (Hummock Crayfish)	G4	LR lc	GA, SC
Procambarus lylei Fitzpatrick and Hobbs (Shutispear Crayfish)	G2	VU B1+2c	MS
Procambarus machardyi Walls (Caddo Chimney Crawfish)	G1G2	LR lc	LA
Procambarus mancus Hobbs and Walton (Lame Crayfish)	G4	EN B1+2c	MS
Procambarus marthae Hobbs (Crisscross Crayfish)	G3	VU B1+2c	AL
Procambarus medialis Hobbs (Tar River Crayfish)	G3	VU B1+2c	NC
Procambarus milleri Hobbs (Miami Cave Crayfish)	G1	EN B1+2c	FL
Procambarus morrisi Hobbs and Franz (Putnum County Cave Crayfish)	G1	CR B1+2ae, C1+2b	FL
Procambarus natchitochae Penn (Red River Crayfish)	G5	LR lc	AR, LA, TX
Procambarus nechesae Hobbs (Neches Crayfish)	G2	VU B1+2c	TX
Procambarus nigrocinctus Hobbs (Blackbelted Crayfish)	G1G2	VU B1+2c, D1	TX
Procambarus nueces Hobbs and Hobbs (Nueces Crayfish)	G1	CR B1+2c	TX
Procambarus okaloosae Hobbs (Okaloosa Crayfish)	G4	LR lc	AL, FL
Procambarus orcinus Hobbs and Means (Woodville Karst Cave Crayfish)	G1	VU B1+2c, D1	FL
Procambarus ouachitae Penn (Ouachita River Crayfish)	G5	LR lc	AR, MS

Table 1.—Continued.

Species	Global Rank	Red List	Distribution
Procambarus paeninsulanus (Faxon) (Peninsula Crayfish)	G5	LR lc	AL, FL, GA
Procambarus pallidus (Hobbs) (Pallid Cave Crayfish)	G2G3	VU B1+2c, D1	FL
Procambarus parasimulans Hobbs and Robison (Bismark Burrowing Crayfish)	G4	LR lc	AR
Procambarus pearsei (Creaser) (Sandhills Crayfish)	G4	LR lc	NC, SC
Procambarus penni Hobbs (Pearl Blackwater Crayfish)	G3	VU B1+2c	AL, LA, MS
Procambarus pentastylus Walls and Black (Calcasieu Creek Crayfish)	G3	LR lc	LA
Procambarus petersi Hobbs (Ogeechee Crayfish)	G3	VU B1+2c	GA
Procambarus pictus (Hobbs) (Spotted Royal Crayfish)	G2	VU B1+2c	FL
Procambarus planirostris Penn (Flatnose Crayfish)	G4	LR lc	LA, MS
Procambarus plumimanus Hobbs and Walton (Croatan Crayfish)	G4	VU B1+2c	NC
Procambarus pogum Fitzpatrick (Bearded Red Crayfish)	G1	VU B1+2c, D1	MS
Procambarus pubescens (Faxon) (Brushnose Crayfish)	G4G5	LR lc	GA, SC
Procambarus pubischelae deficiens Hobbs (Hookless Crayfish)	G5T3	LR lc	GA
Procambarus pubischelae pubishelae Hobbs (Brushpalm Crayfish)	G5T5	LR lc	FL, GA
Procambarus pycnogonopodus Hobbs (Stud Crayfish)	G4G5	LR lc	FL
Procambarus pygmaeus Hobbs (Christmas Tree Crayfish)	G4	LR lc	FL, GA
Procambarus raneyi Hobbs (Disjunct Crayfish)	G4	LR lc	GA, SC
Procambarus rathbunae (Hobbs) (Comb Claw Crayfish)	G2	VU B1+2c	FL
Procambarus regalis Hobbs and Robison (Regal Burrowing Crayfish)	G2G3	VU B1+2c	AR
Procambarus reimeri Hobbs (Irons Fork Burrowing Crayfish)	G1	VU B1+2c, D1	AR
Procambarus rogersi campestris Hobbs (Field Crayfish)	G4T3	VU B1+2c, D1	FL
Procambarus rogersi expletus Hobbs and Hart (Perfect Crayfish)	G4T1	EN B1+2c	FL
Procambarus rogersi ochlocknensis Hobbs (Ochlockonee Crayfish)	G4T2T3	VU B1+2c	FL
Procambarus rogersi rogersi (Hobbs) (Seepage Crayfish)	G4T1T2	EN B1+2c	FL

Table 1.—Continued.

Species	Global Rank	Red List	Distribution
Procambarus seminolae Hobbs (Seminole Crayfish)	G5	LR lc	FL, GA
Procambarus shermani Hobbs (Gulf Crayfish)	G4	LR lc	AL, FL, LA, MS
Procambarus simulans (Faxon) (Southern Plains Crayfish)	G5	LR lc	AR, LA, OK, TX
Procambarus spiculifer (LeConte) (White Tubercled Crayfish)	G5	LR lc	AL, FL, GA, TN, SC
Procambarus steigmani Hobbs (Parkhill Prairie Crayfish)	G1G2	CR B1+2c	TX
Procambarus suttkusi Hobbs (Choctawhatchee Crayfish)	G3G4	LR lc	AL, FL
Procambarus talpoides Hobbs (Mole Crayfish)	G5	LR lc	FL, GA
Procambarus tenuis Hobbs (Ouachita Mountain Crayfish)	G3	VU B1+2c	AR, OK
Procambarus texanus Hobbs (Bastrop Crayfish)	G1	CR B1+2c	TX
Procambarus troglodytes (LeConte) (Eastern Red Swamp Crayfish)	G5	LR lc	GA, SC
Procambarus truculentus Hobbs (Bog Crayfish)	G3	LR lc	GA
Procambarus tulanei Penn (Giant Bearded Crayfish)	G5	LR lc	AR, LA
Procambarus verrucosus Hobbs (Grainy Crayfish)	G4	LR lc	AL, GA
Procambarus versutus (Hagen) (Sly Crayfish)	G5	LR lc	AL, FL, GA
Procambarus viaeviridis (Faxon) (Vernal Crayfish)	G5	LR lc	AL, AR, KY, LA, MS, TN
Procambarus vioscai paynei Fitzpatrick (Payne's Creek Crayfish)	G5T4	LR lc	AL, MS, TN
Procambarus vioscai vioscai Penn (Percy's Creek Crayfish)	G5T4	LR lc	AR, LA
Procambarus youngi Hobbs (Florida Longbeak Crayfish)	G2	EN B1+2c	FL
Procambarus zonangulus Hobbs and Hobbs (Southern White River Crawfish)	G5	LR lc	AL, LA, (MD), MS, TX, VA, (WV)
Troglocambarus maclanei Hobbs (Spider Cave Crayfish)	G2	VU B1+2c	FL
Troglocambarus sp. 1 (Orlando Spider Cave Crayfish)	G1	VU B1+2c, D1	FL

by Master (1991) as species in need of conservation attention.

The causes of loss of aquatic species and population declines have been attributed to three major categories: (1) habitat fragmentation due to loss, degradation, or alteration of habitat; (2) chemical pollution from contaminants and disturbance from anthropogenic use; and (3) introduction of nonindigenous organisms and overexploitation (Allan & Flecker 1993; Richter et al. 1997; Wilcove et al. 2000). The imperilment of some crayfish taxa is due to limited natural range (e.g., one locality or one drainage system). The lack of recent distributional information is problematic; however, significant progress has been made mostly as a result of the publication of numerous state field guides. Life history, ecological, and current distribution information

Figure 1.—Distribution of states included in the conservation status assessment of southeastern crayfishes. State inclusion is based on membership in the American Fisheries Society Southern Division. States in gray are included in the conservation status, while those in white are excluded.

are still lacking for about 60% of the North American fauna (Flinders & Magoulick 2005). For crayfishes, land use change can affect habitat resources (Burskey & Simon 2010) by degrading habitat and homogenization of substrate surfaces. Loss of such habitat components through dredging and channelization can drastically affect crayfish populations by making them more susceptible to predation. Crayfish depend on instream cover including gravel and boulder substrates, woody debris, and vegetation for refuge from predators (Stein 1977; Burskey & Simon 2010). These factors increase fish predation by impounding lotic habitat, which affects relative abundance of crayfish by increasing concentrations of major predators on crayfish, such as black basses and sunfish, and altering both the physical and chemical structure of streams (Williams et al. 1993).

Crayfish are among the most sensitive aquatic organisms and exhibit specific differences in tolerance to contaminants (Simon & Morris 2009). Crayfish show extreme sensitivity when exposed to pesticides and metals (Mayer & Ellersieck 1986; Jarvinen & Ankley 1999; Besser et al. 2006) and data show significant variability among genera, species, and life stages (Berrill et al. 1985; Peake et al. 2004; Wigginton & Birge 2007; Simon & Morris 2009). These observations suggest that crayfish may be important indicators of habitat degradation due to pollutants (Burskey & Simon 2010).

The introduction of nonindigenous organisms may be among the most serious threats to conservation of biodiversity of native crayfish (Lodge et al. 2000; Clavero & García-Berthou 2005). In North America, crayfishes are transported easily and can be inadvertently introduced into aquatic habitats when they are discarded as unused bait (Simon 2002). Such bait-bucket introductions have led to dramatic range extensions of several species, most notably *Orconectes rusticus* (Rusty Crayfish) and *Procambarus clarkii* (Red Swamp Crawfish). The Rusty Crayfish is native to the Greater Miami River in Ohio and Indiana, northern Kentucky, and the Maumee River drainage in Indiana, northwestern Ohio, and extreme southeastern Michigan. The species has been introduced across the upper midwestern United States and Canada (Page 1985; Lodge et al. 2000) by expanding its range and displacing native crayfishes (Taylor & Redmer 1996). Possible displacement mechanisms include faster individual growth rates (Hill et al. 1993), differential susceptibility to fish predation (DiDonato & Lodge 1993), and hybridization (Perry et al. 2001). Imperiled crayfishes also have been affected by nonindigenous species. The federally endangered *Pacifastacus fortis* has been displaced over large portions of its native range by the nonindigenous *P. leniusculus* (Erman et al. 1993).

Additional risk from non-indigenous crayfish is due to the escape of pets from the aquarium and aquaculture trade (Simon 2002); however, increased prevention requires bait regulations that reduce nonindigenous crayfish spread (Holdrich 1999). States have either banned the sale of crayfish as bait or created a list of prohibited species, restricting the sale by bait dealers of nonindigenous species including transport across state lines. While no known North American cases of overexploitation of crayfish have been documented, commercial harvest has the potential of being a serious contributing factor when harvesting from wild populations. Species most vulnerable to over-harvesting are those with small native ranges, long life spans prior to adult maturation, and low reproductive potential. Gulf Coast populations are perhaps the most vulnerable to over-harvesting if not managed properly because of exposure to hurricanes. However, the majority of states that possess a highly diverse crayfish fauna with high levels of endemism lack any

protective measures or adequate funding structures to monitor the status of their respective state faunas.

In conclusion, more than half of the southern crayfish species are stable and slightly less are in need of critical management intervention to protect remaining populations. More effort is needed to document distribution and habitat needs. Human encroachment causing habitat fragmentation, followed by contaminants and introductions of nonindigenous species, are among the most frequent reasons for imperilment. Wise land use development, protection of riparian corridors, and control of anthropogenic influences are needed to protect crayfish biodiversity in North America.

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APPENDIX 1.
THE INTERNATIONAL UNION FOR CONSERVATION OF NATURE AND NATURAL RESOURCES (IUCN) RED LIST CRITERIA ASSESSMENT PROCESS FOR CONSERVATION STATUS DETERMINATIONS.

CRITICALLY ENDANGERED (CR)

A) A taxon is Critically Endangered when it is facing an extremely high risk of extinction in the wild in the immediate future, as defined by any of the following criteria (A to E):

1) An observed, estimated, inferred or suspected reduction of at least 80% over the last 10 years or three generations, whichever is the longer, based on (and specifying) any of the following:

a) direct observation
b) an index of abundance appropriate for the taxon
c) a decline in area of occupancy, extent of occurrence and/or quality of habitat
d) actual or potential levels of exploitation
e) the effects of introduced taxa, hybridization, pathogens, pollutants, competitors or parasites.

2) A reduction of at least 80%, projected or suspected to be met within the next 10 years or three generations, whichever is the longer, based on (and specifying) any of (b), (c), (d) or (e) above.

B) Extent of occurrence estimated to be less than 100 km^2 or area of occupancy estimated to be less than 10 km^2, and estimates indicating any two of the following:

1) Severely fragmented or known to exist at only a single location.
2) Continuing decline, observed, inferred or projected, in any of the following:

a) extent of occurrence
b) area of occupancy
c) area, extent and/or quality of habitat
d) number of locations or subpopulations
e) number of mature individuals

3) Extreme fluctuations in any of the following:

a) extent of occurrence
b) area of occupancy
c) number of locations or subpopulations
d) number of mature individuals

C) Population estimated to number less than 250 mature individuals and either:

1) An estimated continuing decline of at least 25% within three years or one generation, whichever is longer or
2) A continuing decline, observed, projected, or inferred, in numbers of mature individuals and population structure in the form of either:

a) severely fragmented (i.e. no subpopulation estimated to contain more than 50 mature individuals)
b) all individuals are in a single subpopulation

D) Population estimated to number less than 50 mature individuals.

E) Quantitative analysis showing the probability of extinction in the wild is at least 50% within 10 years or three generations, whichever is the longer.

ENDANGERED (EN)

A taxon is Endangered when it is not Critically Endangered but is facing a very high risk of extinction in the wild in the near future, as defined by any of the following criteria (A to E):

A) Population reduction in the form of either of the following:

1) An observed, estimated, inferred or suspected reduction of at least 50% over the last 10 years or three generations, whichever is the longer, based on (and specifying) any of the following:

a) direct observation
b) an index of abundance appropriate for the taxon
c) a decline in area of occupancy, extent of occurrence and/or quality of habitat
d) actual or potential levels of exploitation
e) the effects of introduced taxa, hybridisation, pathogens, pollutants, competitors or parasites.

2) A reduction of at least 50%, projected or suspected to be met within the next 10 years or three generations, whichever is the longer, based on (and specifying) any of (b), (c), (d), or (e) above.

B) Extent of occurrence estimated to be less than 5000 km^2 or area of occupancy estimated to be less than 500 km^2, and estimates indicating any two of the following:

1) Severely fragmented or known to exist at no more than five locations.
2) Continuing decline, inferred, observed or projected, in any of the following:

a) extent of occurrence
b) area of occupancy
c) area, extent and/or quality of habitat
d) number of locations or subpopulations
e) number of mature individuals

3) Extreme fluctuations in any of the following:

a) extent of occurrence
b) area of occupancy
c) number of locations or subpopulations
d) number of mature individuals

C) Population estimated to number less than 2500 mature individuals and either:

1) An estimated continuing decline of at least 20% within five years or two generations, whichever is longer, or
2) A continuing decline, observed, projected, or inferred, in numbers of mature individuals and population structure in the form of either:

a) severely fragmented (i.e. no subpopulation estimated to contain more than 250 mature individuals)
b) all individuals are in a single subpopulation.

D) Population estimated to number less than 250 mature individuals.

E) Quantitative analysis showing the probability of extinction in the wild is at least 20% within 20 years or five generations, whichever is the longer.

VULNERABLE (VU)

A taxon is Vulnerable when it is not Critically Endangered or Endangered but is facing a high risk of extinction in the wild in the medium-term future, as defined by any of the following criteria (A to E):

A) Population reduction in the form of either of the following:

1) An observed, estimated, inferred or suspected reduction of at least 20% over the last 10 years or three generations, whichever is the longer, based on (and specifying) any of the following:

a) direct observation
b) an index of abundance appropriate for the taxon
c) a decline in area of occupancy, extent of occurrence and/or quality of habitat
d) actual or potential levels of exploitation
e) the effects of introduced taxa, hybridisation, pathogens, pollutants, competitors or parasites.

2) A reduction of at least 20%, projected or suspected to be met within the next ten years or three generations, whichever is the longer, based on (and specifying) any of (b), (c), (d) or (e) above.

B) Extent of occurrence estimated to be less than 20,000 km^2 or area of occupancy estimated to be less than 2000 km^2, and estimates indicating any two of the following:

1) Severely fragmented or known to exist at no more than ten locations.
2) Continuing decline, inferred, observed or projected, in any of the following:

a) extent of occurrence
b) area of occupancy
c) area, extent and/or quality of habitat
d) number of locations or subpopulations
e) number of mature individuals

3) Extreme fluctuations in any of the following:

a) extent of occurrence
b) area of occupancy
c) number of locations or subpopulations
d) number of mature individuals

C) Population estimated to number less than 10,000 mature individuals and either:

1) An estimated continuing decline of at least 10% within 10 years or three generations, whichever is longer, or
2) A continuing decline, observed, projected, or inferred, in numbers of mature individuals and population structure in the form of either:

a) severely fragmented (i.e. no subpopulation estimated to contain more than 1000 mature individuals)
b) all individuals are in a single subpopulation

D) Population very small or restricted in the form of either of the following:

1) Population estimated to number less than 1000 mature individuals.
2) Population is characterized by an acute restriction in its area of occupancy (typically less than 100 km^2) or in the number of locations (typically less than five). Such a taxon would thus be prone to the effects of human activities (or stochastic events whose impact is increased by human activities) within a very short period of time in an unforeseeable future, and is thus capable of becoming Critically Endangered or even Extinct in a very short period.

E) Quantitative analysis showing the probability of extinction in the wild is at least 10% within 100 years.

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