

Fort Hays State University

FHSU Scholars Repository

Sternberg Museum of Natural History Faculty
Publications

Sternberg Museum of Natural History

10-12-2020

Crayfishes of Kansas: List of Taxa, Synonyms, and References

Mark E. Eberle

Fort Hays State University, meberle@fhsu.edu

Follow this and additional works at: https://scholars.fhsu.edu/sternberg_facpubs



Part of the [Biology Commons](#)

Recommended Citation

Eberle, Mark E., "Crayfishes of Kansas: List of Taxa, Synonyms, and References" (2020). *Sternberg Museum of Natural History Faculty Publications*. 1.

https://scholars.fhsu.edu/sternberg_facpubs/1

This Article is brought to you for free and open access by the Sternberg Museum of Natural History at FHSU Scholars Repository. It has been accepted for inclusion in Sternberg Museum of Natural History Faculty Publications by an authorized administrator of FHSU Scholars Repository.

Crayfishes of Kansas:

List of Taxa, Synonyms, and References

Mark E. Eberle
Sternberg Museum of Natural History
Fort Hays State University, Hays, Kansas 67601
meberle@fhsu.edu

12 October 2020

There are currently 12 species of crayfishes (Decapoda: Cambaridae) reported from Kansas, although there are questions about the systematics of some taxa. Research and the corresponding scientific literature on crayfishes conducted in the state since 1885 are limited, but they cover a variety of topics. It is hoped this list of species and references will aid those who seek to add to our knowledge. Only published references are included, but a few Master's theses about Kansas crayfishes are available. Also not included among the references cited in the list are regional, national, or international publications that mention Kansas in the broader distributions of species but do not add to the information in the sources cited here.

To use this list, you can take the currently accepted name of a taxon to check for publications that included that name. These references are listed under the name of each species. Also listed are taxa that represent probable synonyms or assumed misidentifications (under the subheading "Synonyms"). Entries for each of these names will provide additional references that referred to the species by these other names. You can also select the name of a taxon from one of the published references and find that name in the list. This will provide you with a scientific name that is currently recommended. Scientific and common names of the state's 12 reported species are highlighted in bold print. Scientific names were taken from the summary by Crandall and De Grave (2017), which updated earlier lists by Hobbs (1974; 1989) and McLaughlin et al. (2005), and from Glon et al. (2018). Common names were taken from references by Pflieger (1996), McLaughlin et al. (2005), and Robison et al. (2017).

Within the list, an equal symbol (=) usually indicates that the first name given is not currently recognized as a valid taxon and is a synonym of the second name given. In other instances, a misidentification is assumed, and the second name represents the likely identity of the specimen collected in Kansas. No voucher specimens were checked while compiling this list. The summaries of Williams and Leonard (1954), Bouchard and Robison (1980), Pflieger (1996), and Robison et al. (2017) were used in conjunction with the synonymies provided by Crandall and De Grave (2017) to assign synonyms.

Two of the currently recognized species were first described by Walter Faxon (1885c) from collections of crayfish in Kansas. *Faxonius nais* (reported as *Cambarus Nais*) was based on 17 specimens collected by W.S. Newlon in Labette County in southeastern Kansas. The county is on the border with Oklahoma and is drained by the Neosho and Verdigris river systems, which are part of the Arkansas River basin. *Faxonius neglectus* (reported as *Cambarus neglectus*) was described from three specimens collected by F.W. Cragin and J.B. Fields from

Mill Creek in Wabaunsee County, which is a tributary of the Kansas River in the Missouri River basin. In addition, William Hay (1899) described *Cambarus pilosus* from specimens collected at Beloit in Mitchell County, which sits along the Solomon River, another tributary system in the Missouri River basin. It is currently considered a synonym of *F. nais*.

Species listed by the state of Kansas as endangered (E), threatened (T), or in need of conservation (SINC) are noted in the list. Presently, only *Faxonius macrus*, the Neosho Midget Crayfish, is protected as a species in need of conservation.

There are taxonomic issues with some of the crayfishes included in this list that require explanation. Phylogenetic analyses have shown that the species-rich genera *Cambarus*, *Orconectes*, and *Procambarus* are not monophyletic, and efforts are underway to complete a systematic revision of crayfish in these and other genera (Sinclair et al. 2004; Owen et al. 2015). Thus far, surface-dwelling species of *Orconectes* have been assigned to the resurrected genus *Faxonius*, while the monophyletic group of cave-dwelling species retains the name *Orconectes* (Crandall and De Grave 2017). Some species now in *Faxonius* may be reassigned to other genera. Similarly, the former subgenus *Lacunicambarus* was split from the genus *Cambarus*. The single species in Kansas, *L. diogenes* (Devil Crayfish), is a species complex that needs to be evaluated (Glon et al. 2018). This will likely change the name of the species in Kansas.

Other issues involve particular species. Kansas records from 1890–1903 of the Rusty Crayfish, *Faxonius rusticus* (reported as *Cambarus rusticus*), were misidentifications of the Golden Crayfish, *F. luteus*, which was not described until 1933. *Faxonius rusticus* is native to Indiana, western Ohio, central Kentucky, and small areas of adjacent states, but its range is expanding. In our region, the species has been reported in Colorado, Nebraska, and Iowa, but not in Kansas, Missouri, Oklahoma, or Arkansas. Introduced populations pose threats to native species of crayfish and ecosystem processes (Wetzel et al. 2004; Durland Donahou et al. 2019).

The most challenging taxonomic issue among Kansas taxa is a longstanding problem involving a group of three species—*Faxonius virilis* (Virile or Northern Crayfish), *F. nais* (Water Nymph Crayfish), and *F. causeyi* (Western Plains Crayfish). Based on morphology, *F. causeyi* is nearly indistinguishable from *F. virilis* (Hobbs 1989, pages 39–40). However, Unger (1978) considered *F. causeyi* in Colorado to be more similar to *F. nais*, and he referred to his specimens as “*Orconectes nais* form *causeyi*.” Hobbs (1989) recommended retaining all three species until a thorough study of their systematics is conducted. That view is reflected in this list, but the systematics of these and similar species are presently uncertain.

Uncertainty about the identities of the taxa in this species group is especially perplexing in Kansas because the zone of overlap among the distributions of the three species is apparently in the Arkansas River basin and Kansas River basin (part of the Missouri River basin) in Kansas, Oklahoma, and portions of adjacent states. The following explanation and interpretation are based primarily on statewide assessments of crayfishes conducted in Arkansas, Colorado, Iowa, Kansas, Missouri, Nebraska, and Oklahoma. However, only a comprehensive study of the morphological, ecological, and genetic attributes of populations of these species will resolve the questions of their identities and distributions.

Original Descriptions. Of the three species reported from Kansas, *Faxonius virilis* was the first to be described (Hagen 1870). The type locality was later designated as Lake Superior (Crandall and De Grave 2017).

As previously mentioned, *Faxonius nais* was described in 1885 based on 17 specimens— five form I males, five form II males, and seven females.¹ The specimens were collected in Labette County, Kansas (Faxon 1885c). In addition to the type locality for *F. nais*, the type locality for the conspecific *Cambarus pilosus* is Beloit in Mitchell County, Kansas (Hay 1899).

The third species, *Faxonius caseyi*, was not described until 1967 from specimens collected at Conchas Reservoir on the (South) Canadian River (Arkansas River basin) in New Mexico (Jester 1967). Jester noted that the species was related to others in the *F. virilis* group, but he did not compare it to either *F. virilis* or *F. nais*. He reported that Horton Hobbs Jr. considered *F. caseyi* to be “more closely related to *O. palmeri longimanus* than to other species.” *Faxonius palmeri longimanus*, the Western Painted Crayfish, has been reported from the Caney River system (Arkansas River basin) in Cowley County, Kansas (Metcalf and Distler 1963). In 1975, Reimer and Jester described another new species from the samples collected at Conchas Reservoir. *Faxonius deanae*, the Conchas Crayfish, is native to the Canadian River basin from northeastern New Mexico to western Oklahoma, and it most closely resembles *F. palmeri longimanus* (Morehouse and Tobler 2013).

Distinguishing the Species. Morphologically, the gonopods on form I males are currently used to distinguish taxa in this species group. The distal ends of the gonopods are bifurcated, relatively long, and slender. The distinguishing features are the relative length and degree of curvature of these processes (rami) (Figure 1). However, there is natural variation.

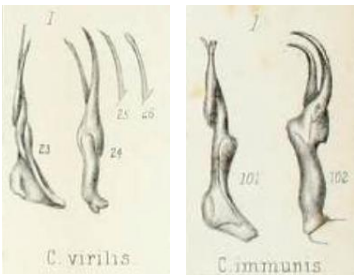


Figure 1.—Drawings of gonopods of *Faxonius virilis* and *F. immunis* from form I males associated with the original descriptions by Hagen (1870, plate I).

When he first described *Faxonius nais* (as *Cambarus Nais*), Faxon (1885c) compared it to *F. virilis* and *F. immunis*.

This species much resembles *C. virilis*, especially the form called *variety A* by Dr. Hagen. It differs in the shape of the first abdominal appendages [gonopods] of the male. In *C. Nais* the rami of these appendages are shorter and more strongly curved than in *C. virilis*, but not so much recurved as in *C. immunis*. The areola is narrower than in *C. virilis*.²

¹ Form I males are reproductively active; form II males are not. Male crayfish alternate between these forms by molting. Gonopods are accessory reproductive structures on the ventral surface at the anterior end of the abdomen used by the male to deliver sperm into a cup-like structure (annulus ventralis) on the female. She stores the sperm until ready to release eggs, which she will carry on the underside of her abdomen as they develop.

² The areola is an hourglass-shaped area on the top of the carapace of some *Faxonius* species.

Pflieger (1996), using the genus *Orconectes*, noted that specimens from northeastern Missouri and scattered locations elsewhere were “identifiable as *O. nais* or are intermediate between *O. nais* and *O. virilis*.” Given these intermediate forms, he tentatively considered all populations to be *Faxonius virilis*. He also included *F. causeyi* records with *F. virilis*. In Arkansas, Bouchard and Robison (1980) considered the specimens Williams (1954a) identified as *O. nais* as “mostly if not completely referable to *O. virilis*.” That view had not changed when an annotated list was published in 2017, which included Arkansas records of *F. nais* and *F. causeyi* under *F. virilis* (Robison et al. 2017). The same conclusion was reached in Nebraska. Schainost (2016) examined morphological features in several populations and concluded there was greater variation within populations than among populations, all of which he assigned to *F. virilis*. Phillips (1980) compared *F. virilis* from Iowa and *F. nais* from northeastern Kansas and noted intermediate forms in southwestern Iowa, which he classified as *F. virilis*.

The general unity of the conclusions regarding these species in Arkansas, Iowa, Missouri, and Nebraska differed somewhat from the view of Unger (1978) in Colorado, where he distinguished *F. virilis*, *F. nais*, and *F. nais* form *causeyi*. Similarly, in Oklahoma, Morehouse and Tobler (2013) included all three species in their summary of the state’s crayfishes. However, they included only *F. nais* and *F. virilis* in their key. *Faxonius nais* was reported to be statewide in distribution, while *F. virilis* was limited to the Arkansas and Cimarron river basins in northern Oklahoma. *Faxonius causeyi* was confirmed only in the upper Canadian River basin, as was *F. deanae*.

Confusion in Kansas. The questions of which of the species are present in Kansas and where they occur are as unsettled as they are elsewhere in the region. The first list of Kansas crayfishes published by Faxon (1885c) listed seven species, including *Faxonius virilis* and the original descriptions of *F. nais* and *F. neglectus* (Table 1). In 1900, Harris added what is now recognized as *F. lutens* to bring the number of species to eight. He listed 21 localities across Kansas where *F. virilis* was collected and stated that it “seems to be the most widely distributed species in our state.” In contrast, he listed only two sites for *F. nais* (Harris 1900).

Five decades later, Williams and Leonard (1952) reduced the number of species to seven by including all Kansas records of *Faxonius virilis* under *F. nais*, which had a statewide distribution. They also remarked on the challenge distinguishing these species. “The distinction between *Orconectes nais* and a closely related species, *O. virilis*, which occurs in the northern and eastern Mississippi Valley drainage, has long been a subject of confusion. The exact limits of the ranges of these two species is [sic] not known.” This view generally matched the distributions given by Hagen (1870, page 91) for *Cambarus virilis* (from Lake Winnipeg in Canada through the upper Mississippi River basin and Great Lakes) and *C. virilis* “variety A” (Ohio through Texas).

After another four decades, the list of Kansas crayfishes reached its current size, but Ghedotti (1998) followed Pflieger (1996) in treating *Faxonius nais* and *F. causeyi* as conspecific with *F. virilis*. The list presented here includes the same species reported by Ghedotti (1998) but separates *F. nais* and *F. causeyi* from *F. virilis*, while acknowledging they require additional study.

Distributions. Given the difficulty distinguishing similar species of *Faxonius* reported from Kansas, their distributions are poorly defined. Based on information in the publications cited, I offer the following interpretation of their distributions as a starting point.

Table 1.—Species included in lists of Kansas crayfishes published since 1885. The names have been updated to correspond to currently recognized taxa in the genera *Faxonius*, *Lacunicambarus*, and *Procambarus*.

Species	Faxon (1885c)	Harris (1900)	Williams and Leonard (1952)	Ghedotti (1998)	Eberle (2020)
<i>F. causeyi</i>					•
<i>F. immunis</i>	•	•	•	•	•
<i>F. luteus</i>		•	•	•	•
<i>F. macrus</i>				•	•
<i>F. nais</i>	•	•	•		•
<i>F. neglectus neglectus</i>	•	•	•	•	•
<i>F. palmeri longimanus</i>				•	•
<i>F. virilis</i>	•	•		•	•
<i>L. diogenes</i>	•	•	•	•	•
<i>P. acutus</i>				•	•
<i>P. gracilis</i>	•	•	•	•	•
<i>P. simulans</i>	•	•	•	•	•
Total species	7	8	7	10	12

Faxonius virilis is a widespread, northern species. Its native distribution extends from the Rocky Mountains east through the Great Lakes and as far south as the Arkansas River basin in Kansas, Oklahoma, Missouri, Arkansas, and adjacent areas on the Great Plains. The species has also been transplanted well beyond its native range, even into western Europe, and it is considered a threat to native ecosystems in these areas (Hobbs 1989; Pflieger 1996; Filipová et al. 2010; Morehouse and Tobler 2013; Robison et al. 2017). This would suggest a generally statewide distribution in Kansas, as indicated by Faxon (1885c) and Harris (1900).

The distribution of *Faxonius nais* is more restricted. The opinions of experts in Arkansas, Iowa, Missouri, and Nebraska suggested that reports of *F. nais* were mostly, if not entirely, attributable to morphological variations in *F. virilis* or intermediate forms (Bouchard and Robison 1980; Phillips 1980; Pflieger 1996; Schainost 2016; Robison et al. 2017). Thus, the native distribution of *F. nais* might be limited to the Kansas, Arkansas, and Red river basins on the Great Plains, primarily in Kansas, Oklahoma, and Texas, but also in parts of adjacent states (Faxon 1885c; Harris 1900; Unger 1978; Morehouse and Tobler 2013). The type locality for *F. nais* is in the Arkansas River basin, and the type locality of the conspecific *Cambarus pilosus* is in the Missouri River basin, both in Kansas (Faxon 1885c; Hay 1899).

Faxonius causeyi is native to the upper Canadian River basin on the Great Plains from northeastern New Mexico to western Oklahoma (Jester 1967; Morehouse and Tobler 2013). Other reports in the Arkansas River basin are possibly misidentifications (Pflieger 1996; Morehouse and Tobler 2013; Robison et al. 2017). However, the species has been established outside its native range (Jester 1967; Unger 1978). Given the taxonomic uncertainty and introductions, the presence of *F. causeyi* in the Spring River basin of Kansas (and adjacent states) reported by Beasley and Branson (1971) is uncertain and needs to be reexamined.

Faxonius palmeri longimanus was reported in Cowley County in southeastern Kansas. The record was based on 284 specimens collected in 1961–1962 (Metcalf and Distler 1963). However, a recent assessment of its distribution in Oklahoma indicated a concentration of records in the southeastern portion of the state, which corresponds with its reported distribution in southwestern Arkansas (Morehouse and Tobler 2013; Robison et al. 2017). Given the challenges with identification of this and similar species in the state, the status of *F. palmeri longimanus* in Kansas also needs to be reexamined.

Essential Research Needs. As additional research is conducted on crayfishes, a more accurate understanding of the species and their distributions will be one result. The recent lists of species in North America are undoubtedly incomplete, perhaps substantially so. As additional species are identified, especially within widespread species, there are likely to be changes in our understanding of the Kansas fauna. This is almost certain to occur within the *Faxonius virilis* and *Lacunicambarus diogenes* species complexes.

So far, two studies have examined genetic material from populations identified as *Faxonius virilis* and *F. nais*, including populations in Kansas. In the first study, Fetzner et al. (1997) assessed allelic frequencies in four populations of *F. virilis* from Illinois, Indiana, and Missouri, along with one population of *F. immunis* from Illinois and one population of *F. nais* from a pond at Manhattan, Kansas. The original source of the population in the pond is unknown. In the second study, Mathews et al. (2008) examined two mitochondrial genes and one nuclear gene from 10 populations in Massachusetts, one in New York, one in Rhode Island, and three in Kansas, all of which were identified as *F. virilis* or *F. nais*. They also included specimens from the US National Museum identified as *F. virilis* from Quebec (one individual), *F. nais* from Oklahoma (two individuals), and *F. deanae* from New Mexico (one individual).

Neither study was intended to be a comprehensive assessment that would resolve questions of the identities and distributions of taxa within this species group, and neither included specimens from type localities. However, the results of both studies, as well as related studies by Fetzner (1996) and Filipová et al. (2010), showed a substantial amount of genetic variability among the sampled populations. In addition to genetic diversity, Mathews et al. (2008) reported differences among the gonopods of form I males that corresponded to the clades identified in their genetic analysis. The gonopods in the samples from two creeks near Manhattan, Kansas differed from specimens in the Northeast identified as *F. virilis*. No form I males were collected in the third creek in Kansas. In light of the apparent genetic diversity and differences in gonopod morphology, this list includes both *F. virilis* and *F. nais*. The latter will likely stand as a valid species with its type locality in Kansas, but an accurate determination of what species in this complex occur in the state is not yet possible.

As stated earlier, only a comprehensive study of the morphological, ecological, and genetic attributes of these species will resolve the questions of their identities and distributions. In addition to a broad systematics project, surveys of all presumed crayfish species across Kansas are needed. It is essential that the surveys are documented with museum specimens (including form I males, form II males, and females of *Faxonius* species) fixed in ethanol to allow for additional genetic analysis. Only then will an accurate summary of the crayfish species and their distributions in Kansas be possible.

List of Kansas Crayfish Species, Synonyms, and References

Cambarus baumgartneri Harris = *Procambarus simulans* (Faxon)

- Harris (1901a)

Cambarus diogenes Girard = *Lacunicambarus diogenes* (Girard)

- Faxon (1885a)
- Faxon (1885b)
- Faxon (1885c)
- Ghedotti (1998)
- Harris (1900)
- Harris (1901a)
- Harris (1902)
- Harris (1903)
- Williams (1954a)
- Williams and Leonard (1952)

Cambarus gallinas [correct spelling: *gallinus*] Cockerell & Porter = *Procambarus simulans* (Faxon)

- Harris (1900)
- Harris (1902)

Cambarus gracilis Bundy = *Procambarus gracilis* (Bundy)

- Faxon (1885c)
- Faxon (1890)
- Harris (1900)
- Harris (1901a)
- Harris (1901b)
- Harris (1902)
- Harris (1903)

Cambarus immunis Hagen = *Faxonius immunis* (Hagen)

- Faxon (1885a)
- Faxon (1885b)
- Faxon (1885c)
- Harris (1900)
- Harris (1901a)
- Harris (1901b)
- Harris (1901c)
- Harris (1902)
- Harris (1903)

Cambarus immunis spinirostris Faxon = *Faxonius immunis* (Hagen)

- Faxon (1885c)
- Faxon (1890)
- Harris (1900)
- Harris (1901a)
- Harris (1901b); as *C. i. spinostris*
- Harris (1902)
- Harris (1903)

Cambarus nais Faxon = *Faxonius nais* (Faxon)

- Faxon (1885c); original description with Kansas type locality
- Faxon (1890)
- Harris (1900)
- Harris (1901a)
- Harris (1902)
- Harris (1903)

Cambarus neglectus Faxon = *Faxonius neglectus* (Faxon)

- Faxon (1885c); original description with Kansas type locality
- Faxon (1890)
- Harris (1900)
- Harris (1901a)
- Harris (1902)
- Harris (1903)
- Minckley and Deacon (1959)

Cambarus pilosus Hay = *Faxonius nais* (Faxon)

- Harris (1900)
- Harris (1901a); as *C. pelosus*
- Harris (1902)
- Harris (1903)
- Hay (1899); original description with Kansas type locality

Cambarus rusticus Girard = *Faxonius luteus* Creaser

- Faxon (1890)
- Harris (1900)
- Harris (1902)
- Harris (1903)

Cambarus simulans Faxon = *Procambarus simulans* (Faxon)

- Faxon (1885a)
- Faxon (1885b)
- Faxon (1885c)
- Faxon (1890)
- Harris (1900)
- Harris (1901a)
- Harris (1902)
- Harris (1903)

Cambarus virilis Hagen = *Orconectes virilis* (Hagen)

- Faxon (1885a)
- Faxon (1885b)
- Faxon (1885c)
- Faxon (1890)
- Harris (1900)
- Harris (1901a)
- Harris (1901b)
- Harris (1901c)
- Harris (1902)
- Harris (1903)

***Faxonius causeyi* (Jester 1967), Western Plains Crayfish**

Synonyms:

Orconectes causeyi Jester

***Faxonius immunis* (Hagen 1870), Calico [Papershell] Crayfish**

Synonyms:

Cambarus immunis Hagen

Cambarus immunis spinirostris Faxon

Faxonius immunis pedianus Creaser

Orconectes immunis (Hagen)

***Faxonius luteus* Creaser 1933, Golden Crayfish**

Synonyms:

Cambarus rusticus Girard [= *Faxonius rusticus* (Girard); assumed misidentification]

Orconectes luteus (Creaser)

***Faxonius macrus* (Williams 1952), Neosho Midget Crayfish (SINC)**

Synonyms:

Orconectes macrus (Williams)

***Faxonius nais* (Faxon 1885), Water Nymph Crayfish**

Synonyms:

Cambarus nais Faxon

Cambarus pilosus Hay

Orconectes nais (Faxon)

***Faxonius neglectus neglectus* (Faxon 1885), Ringed Crayfish**

Synonyms:

Cambarus neglectus Faxon

Orconectes neglectus (Faxon)

***Faxonius palmeri longimanus* (Faxon 1898), Western Painted Crayfish**

Synonyms:

Orconectes palmeri longimanus (Faxon)

***Faxonius virilis* (Hagen 1870), Virile [Northern] Crayfish**

- Holmgren (2019)

Synonyms:

Cambarus virilis Hagen

Orconectes virilis (Hagen)

Faxonius immunis pedianus Creaser = *Faxonius immunis* (Hagen)

- Creaser (1933); described as a new “western plains subspecies”

***Lacunicambarus diogenes* (Girard 1852), Devil Crayfish**

Synonyms:

Cambarus diogenes Girard

Orconectes causeyi Jester = *Faxonius causeyi* (Jester)

- Beasley and Branson (1971)

Orconectes immunis (Hagen) = *Faxonius immunis* (Hagen)

- Ghedotti (1998)
- Wiens and Armitage (1961)

Orconectes luteus (Creaser) = *Faxonius luteus* Creaser

- Ghedotti (1998)
- Metcalf and Distler (1961)
- Minckley and Deacon (1959)
- Williams (1954a)
- Williams and Leonard (1952)

Orconectes macrus (Williams) = *Faxonius macrus* (Williams)

- Ghedotti (1998)

Orconectes nais (Faxon) = *Faxonius nais* (Faxon)

- Armitage et al. (1972)
- Armitage et al. (1973)
- Armitage and Wall (1982)
- Bengtson et al. (2008)
- Evans-White et al. (2001)
- Evans-White et al. (2003)
- Fetzner (1996)
- Fetzner et al. (1997)
- Filipová et al. (2010)
- Gali-Muhtasib and Smith (1998)
- Klaassen (1997)
- Mathews et al. (2008)
- Morrissey and Edds (1994)
- Pippitt (1977)
- Rice and Armitage (1974)
- Shivers (1967)
- Wiens and Armitage (1961)
- Williams (1954a)
- Williams and Leonard (1952)

Orconectes neglectus (Faxon) = *Faxonius neglectus neglectus* (Faxon)

- Allert et al. (2012)
- Beasley and Branson (1971)
- Bengtson et al. (2008)
- Durbian et al. (1994)
- Evans-White et al. (2001)
- Evans-White et al. (2003)
- Ghedotti (1998)
- Schainost (2011)
- Williams (1954a)
- Williams (1954b)
- Williams and Leonard (1952)

Orconectes palmeri longimanus (Faxon) = *Faxonius palmeri longimanus* (Faxon)

- Metcalf and Distler (1963)
- Ghedotti (1998)

Orconectes virilis (Hagen) = *Faxonius virilis* (Hagen)

- Durbian et al. (1994)
- Eberle et al. (1986)
- Fetzner et al. (1997)
- Filipová et al. (2010)
- Ghedotti (1998)
- Li and Neufeld (2001)
- Mathews et al. (2008)

***Procambarus acutus* (Girard 1852), White River Crayfish**

- Ghedotti (1998)

***Procambarus gracilis* (Bundy 1876), Prairie [Grassland] Crayfish**

- Ghedotti (1998)
- Holmgren (2019)
- Minckley and Deacon (1959)
- Williams (1954a)
- Williams and Leonard (1952)

Synonyms:

Cambarus gracilis Bundy

***Procambarus simulans* (Faxon 1884), Southern Plains Crayfish**

- Ghedotti (1998)
- Williams (1954a)
- Williams and Leonard (1952)

Synonyms:

Cambarus gallinas Cockerell & Porter

Cambarus simulans Faxon

Literature for Kansas Crayfishes

1. Allert, A.L., R.J. DiStefano, C.J. Schmitt, J.F. Fairchild, and W.G. Brumbaugh. 2012. Effects of mining-derived metals on riffle-dwelling crayfish in southwestern Missouri and southeastern Kansas, USA. *Archives of Environmental Contamination and Toxicology* 63:563–573.
2. Armitage, K.B., A.L. Buikema Jr., and N.J. Willems. 1972. Organic constituents in the annual cycle of the crayfish *Orconectes nais* (Faxon). *Comparative Biochemistry and Physiology* 41A:825–842.
3. Armitage, K.B., A.L. Buikema Jr., and N.J. Willems. 1973. The effect of photoperiod on organic constituents and molting of the crayfish *Orconectes nais* (Faxon). *Comparative Biochemistry and Physiology* 44A:431–456.
4. Armitage, K.B., and T.J. Wall. 1982. The effects of body size, starvation and temperature acclimation on oxygen consumption of the crayfish *Orconectes nais*. *Comparative Biochemistry and Physiology* 73A:63–68.
5. Beasley, C.W., and B.A. Branson. 1971. A partial biological survey of the Spring River drainage in Kansas, Oklahoma, and Missouri Part III. The crayfishes. *Transactions of the Kansas Academy of Science* 74:228–233.
6. Bengtson, J.R., M.A. Evans-White, and K.B. Gido. 2008. Effects of grazing minnows (*Pbioxinus erythrogaster*) and crayfish (*Orconectes nais* and *O. neglectus*) on stream ecosystem structure and function. *Journal of the North American Benthological Society* 27:772–782.
7. Creaser, E.P. 1933. Descriptions of some new and poorly known species of North American crayfishes. *Occasional Papers of the Museum of Zoology, University of Michigan* 275:1–21.
8. Durbian III, F.E., B.J. Frey, and D.W. Moore. 1994. Crayfish species from creeks and rivers of Cherokee County, Kansas. *Transactions of the Kansas Academy of Science* 97:13–17.
9. Eberle, M.E., G.W. Ernsting, and J.R. Tomelleri. 1986. Aquatic macroinvertebrates and fishes of Big Creek in Trego, Ellis, and Russell counties, Kansas. *Transactions of the Kansas Academy of Science* 89:146–151.
10. Evans-White, M.A., W.K. Dodds, L.J. Gray, and K.M. Fritz. 2001. A comparison of the trophic ecology of the crayfishes (*Orconectes nais* (Faxon) and *Orconectes neglectus* (Faxon)) and the central stoneroller minnow (*Campostoma anomalum* (Rafinesque)): omnivory in a tallgrass prairie stream. *Hydrobiologia* 462:131–144.
11. Evans-White, M.A., W.K. Dodds, and M.R. Whiles. 2003. Ecosystem significance of crayfishes and stonerollers in a prairie stream: functional differences between co-occurring omnivores. *Journal of the North American Benthological Society* 22:423–441.
12. Faxon, W. 1885a. Descriptions of new species of *Cambarus*; to which is added a synonymical list of the known species of *Cambarus* and *Astacus*. *Proceedings of the American Academy of Arts and Sciences, New Series* 12(7):107–158.
13. Faxon, W. 1885b. A revision of the Astacidae. Part 1. The genera *Cambarus* and *Astacus*. *Bulletin of the Memoirs of the Museum of Comparative Zoology at Harvard College* 10(4):i–iv, 1–186, 10 plates.
14. Faxon, W. 1885c. Preliminary catalogue of the crayfishes of Kansas. *Bulletin of the Washburn College Laboratory of Natural History* 1:140–142.
15. Faxon, W. 1890. Notes on North American crayfishes—family Astacidae. *Proceedings of the US National Museum* 12(785):619–634.
16. Fetzner Jr., J.W. 1996. Biochemical systematics and evolution of the crayfish genus *Orconectes* (Decapoda: Cambaridae). *Journal of Crustacean Biology* 16:111–141.

17. Fetzner Jr., J.W., R.J. Sheehan, and L.W. Seeb. 1997. Genetic implications of broodstock selection for crayfish aquaculture in the midwestern United States. *Aquaculture* 154:39–55.
18. Filipová, L.H., D.M. Holdich, J. Lesobre, and F. Grandjean. 2010. Cryptic diversity within the invasive Virile Crayfish *Orconectes virilis* (Hagen, 1870) species complex: new lineages recorded in both native and introduced ranges. *Biological Invasions* 12:983–989.
19. Gali-Muhtasib, H.U., and C.C. Smith. 1998. The significance of residency and body size on the aggression and dominance of the crayfish *Orconectes nais*. *Transactions of the Kansas Academy of Science* 101:11–16.
20. Ghedotti, M.J. 1998. An annotated list of the crayfishes of Kansas with first records of *Orconectes macrus* and *Procambarus acutus* in Kansas. *Transactions of the Kansas Academy of Science* 101:54–57.
21. Harris, J.A. 1900. Annotated catalogue of the crayfishes of Kansas. *Kansas University Quarterly* 9:263–274.
22. Harris, J.A. 1901a. Annotated catalogue of the crayfishes of Kansas (Abstract). *Transactions of the Annual Meetings of the Kansas Academy of Science* 17:115.
23. Harris, J.A. 1901b. Notes on the habits of *Cambarus immunis* Hagen. *American Naturalist* 35:187–191.
24. Harris, J.A. 1901c. The dimorphism of *Cambarus*. *Kansas University Quarterly* 10:49–59.
25. Harris, J.A. 1902. Distribution of Kansas crayfishes. *Kansas University Science Bulletin* 1:1–11, 1 map.
26. Harris, J.A. 1903. An ecological catalogue of the crayfishes belonging to the genus *Cambarus*. *Kansas University Science Bulletin* 2:51–187.
27. Hay, W.P. 1899. Descriptions of two new species of crayfish. *Proceedings of the US National Museum* 22(1187):121–123.
28. Holmgren, J.G., D.M. Osterhaus, and J.A. Schaefer. 2019. Survey of fishes, semi-aquatic turtles, and crayfishes on the Emporia State University Natural Areas. *Transactions of the Kansas Academy of Science* 122:215–224.
29. Klaassen, H.E. 1997. The Kansas pond crayfish, *Orconectes nais* (Faxon). Pages 12–16 in P. Brown and J. Gunderson, editors. Culture potential of selected crayfishes in the North Central Region. Technical Bulletin Series #112, US Department of Agriculture, North Central Regional Aquaculture Center, Iowa State University, Ames.
30. Li, Z., and G.J. Neufeld. 2001. Isolation and characterization of mitochondrial F₁-ATPase from crayfish (*Orconectes virilis*) gills. *Comparative Biochemistry and Physiology Part B: Biochemistry and Molecular Biology* 128:325–338.
31. Mathews, L.M., L. Adams, E. Anderson, M. Basile, E. Gottardi, and M.A. Buckholt. 2008. Genetic and morphological evidence for substantial hidden biodiversity in a freshwater crayfish species complex. *Molecular Phylogenetics and Evolution* 48:126–135.
32. Metcalf, A.L., and D.A. Distler. 1961. New distributional records for two species of crayfish. *Transactions of the Kansas Academy of Science* 64:353–356.
33. Metcalf, A.L., and D.A. Distler. 1963. The crayfish *Orconectes palmeri longimanus* (Faxon) in Kansas. *Transactions of the Kansas Academy of Science* 66:141–147.
34. Minckley, W.L., and J.E. Deacon. 1959. New distributional records for three species of Kansas crayfish. *Transactions of the Kansas Academy of Science* 62:165–356.
35. Morrissey, J.R., and D.R. Edds. 1994. Metal pollution associated with a landfill: concentrations in water, sediment, crayfish, and fish. *Transactions of the Kansas Academy of Science* 97:18–25.

36. Pippitt, M.R. 1977. Mating behavior of the crayfish *Orconectes nais* (Faxon, 1885) (Decapoda, Astacoidea). *Crustacea* 32:265–271.
37. Rice, P.R., and K.B. Armitage. 1974. The effect of photoperiod on oxygen consumption of the crayfish *Orconectes nais* (Faxon). *Comparative Biochemistry and Physiology* 47:261–270.
38. Schainost, S.C. 2011. The Ringed Crayfish, *Orconectes neglectus neglectus*, in Nebraska with a revision of its distributional range. *Transactions of the Nebraska Academy of Sciences and Affiliated Societies* 32:59–68.
39. Shivers, R.R. 1967. Fine structure of crayfish optic ganglia. *University of Kansas Science Bulletin* 47:677–733.
40. Wiens, A.W., and K.B. Armitage. 1961. The oxygen consumption of the crayfish *Orconectes immunis* and *Orconectes nais* in response to temperature and to oxygen saturation. *Physiological Zoology* 34:39–54.
41. Williams, A.B. 1954a. Speciation and distribution of the crayfishes of the Ozark Plateaus and Ouachita Provinces. *University of Kansas Science Bulletin* 36(12):803–918.
42. Williams, A.B. 1954b. An explanation for the distribution of a North American crayfish. *Ecology* 35:573–575.
43. Williams, A.B., and A.B. Leonard. 1952. The crayfishes of Kansas. *University of Kansas Science Bulletin* 34(15):961–1012.

Regional and General References

- Bouchard, R.W., and H.W. Robison. 1980. An inventory of the decapod crustaceans (crayfishes and shrimps) of Arkansas with a discussion of their habitats. *Arkansas Academy of Science Proceedings* 34:22–30.
- Crandall, K.A., and S. De Grave. 2017. An updated classification of the freshwater crayfishes (Decapoda: Astacidea) of the world, with a complete species list. *Journal of Crustacean Biology* 37:615–653.
- Creaser, E.P., and A.I. Ortenburger. 1933. The decapod crustaceans of Oklahoma. *Publications of the University of Oklahoma Biological Survey* 5(2):13–47.
- Durland Donahou, A., W. Conard, K. Dettloff, A. Fusaro, and R. Sturtevant. 2019. *Faxonius rusticus* (Girard, 1852). US Geological Survey, Nonindigenous Aquatic Species Database, Gainesville, Florida. <https://nas.er.usgs.gov/queries/FactSheet.aspx?SpeciesID=214>.
- Glon, M.G, R.F. Thoma, C.A. Taylor, M. Daly, and J.V. Freudenstein. 2018. Molecular phylogenetic analysis of the Devil Crayfish group, with elevation of *Lacunnicambarus* Hobbs, 1969 to generic rank and a redescription of the Devil Crayfish, *Lacunnicambarus diogenes* (Girard, 1852) comb. nov. (Decapoda: Astacoidea: Cambaridae). *Journal of Crustacean Biology* 38:600–613.
- Hagen, H.A. 1870. Monograph of the North American Astacidae. *Illustrated Catalogue of the Museum of Comparative Zoology at Harvard College* 3:1–111, plates 1–11.
- Hobbs Jr., H.H. 1972. Crayfish (Astacidae) of North and Middle America. Biota of Freshwater Ecosystem Identification Manual Number 9, Water Pollution Control Research Series, US Environmental Protection Agency, Washington, DC.
- Hobbs Jr., H.H. 1974. A checklist of the North and Middle American crayfishes (Decapoda: Astacidae and Cambaridae). *Smithsonian Contributions to Zoology* 166:1–161.
- Hobbs Jr., H.H. 1989. An illustrated checklist of the American crayfishes (Decapoda: Astacidae, Cambaridae, and Parastacidae). *Smithsonian Contributions to Zoology* 480:1–236.

- Jester, D.B. 1967. A new crayfish of the genus *Orconectes* from New Mexico (Decapoda, Astacidae). *American Midland Naturalist* 77:518–524.
- McLaughlin, P.A., and 39 additional authors. 2005. Common and scientific names of aquatic invertebrates from the United States and Canada: crustaceans. (Superfamily Astacoidea—crayfishes, pages 227–234 and 282–297.) Special Publication 31, American Fisheries Society, Bethesda, Maryland.
- Morehouse, R.L., and M. Tobler. 2013. Crayfishes (Decapoda: Cambaridae) of Oklahoma: identification, distributions, and natural history. *Zootaxa* 3717(2):101–157. DOI: 10.11646/zootaxa.3717.2.1.
- Owen, C.L., H. Bracken-Grissom, D. Stern, and K.A. Crandall. 2015. A synthetic phylogeny of freshwater crayfish: insights for conservation. *Philosophical Transactions of the Royal Society B* 370:2014009.
- Pflieger, W.L. 1996. The crayfishes of Missouri. Missouri Department of Conservation, Jefferson City.
- Phillips, G.S. 1980. The decapod crustaceans of Iowa. *Proceedings of the Iowa Academy of Science* 87(3):81–95.
- Reimer, R.D., and D.B. Jester. 1975. A new crayfish of the genus *Orconectes* from Conchas Lake, New Mexico. *Tulane Studies in Zoology and Botany* 19:17–21.
- Robison, H.W., K.A. Crandall, and C.T. McAllister. 2017. An annotated checklist of the crayfishes (Decapoda: Cambaridae) of Arkansas. *Journal of the Arkansas Academy of Science* 71:17–34.
- Schainost, S.C. 2016. The crayfish of Nebraska. Nebraska Game and Parks Commission, Lincoln.
- Sinclair, E.A., J.W. Fetzner Jr., J. Buhay, and K.A. Crandall. 2004. Proposal to complete a phylogenetic taxonomy and systematic revision for freshwater crayfish (Astacidea). *Freshwater Crayfish* 14:21–29.
- Taylor, C.A., G.A. Schuster, J.E. Cooper, R.J. DiStefano, A.G. Eversole, P. Hamr, H.H. Hobbs III, H.W. Robison, C.E. Skelton, and R.F. Thoma. 2007. Conservation status of crayfishes of the United States and Canada after 10+ years of increased awareness. *Fisheries* 32:372–389.
- Taylor, C.A., G.A. Schuster, and D.B. Wylie. 2017. Field guide to crayfishes of the Midwest. Manual 15, Illinois Natural History Survey, Champaign.
- Unger, P.A. 1978. The crayfishes (Crustacea: Cambaridae) of Colorado. *Natural History Inventory of Colorado* 3:1–20.
- Wetzel, J.E., W.J. Poly, and J.W. Fetzner Jr. 2004. Morphological and genetic comparisons of Golden Crayfish, *Orconectes luteus*, and Rusty Crayfish, *O. rusticus*, with range corrections in Iowa and Minnesota. *Journal of Crustacean Biology* 24:603–617.
- Williams, A.B. 1952. Six new crayfishes of the genus *Orconectes* (Decapoda: Astacidae) from Arkansas, Missouri and Oklahoma. *Transactions of the Kansas Academy of Science* 55:330–351.