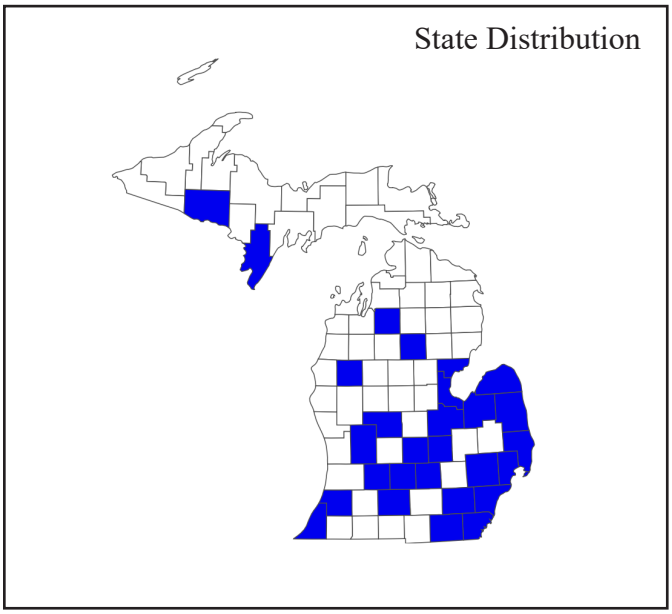
Faxonius immunis Hagen, 1870 — Calico Crayfish



Best Survey Period

State Status: Special concern (no legal protection)

Global and State Rank: G5 (globally secure) / S4 (apparently secure in the state)

Family: Cambaridae

Synonyms: *Orconectes immunis*, *Cambarus immunis*, *Cambarus signifer*, *Faxonius immunis pedianus*

Other Common Names: Papershell crayfish

Total Range: Calico crayfish has a large native range across North America extending from New York and southern Quebec, west to Montana and Manitoba, south to Colorado, and east to Tennessee. The species is considered an introduced species in certain watersheds in Maine, Connecticut, Massachusetts, Vermont, and New Hampshire (NatureServe 2025). Throughout its North American range, it is well distributed across suitable habitat. Calico crayfish has also been introduced in Europe through the aquarium trade. Populations along the Upper Rhine River in Germany and France have been established since at least 1997 (Dehus et al. 1999).

State Distribution: Calico crayfish has been documented across most Michigan counties in the lower peninsula (MNFI 2025). Most of these observations have been documented in the southeastern portion of the state, particularly Saginaw, Sanilac, and Monroe Counties, but lower peninsula observations have also been made as far north as Kalkaska County and as far west as Berrien County. Calico crayfish has also been observed in two counties in the western upper peninsula: Iron and Menominee. This species has not been documented in the eastern upper peninsula or northeastern lower peninsula, though this may be due to a lack of survey effort or documentation through accessible channels.

Recognition: The calico crayfish is a small to medium sized crayfish with a maximum carapace length between 3 and 4 centimeters (Tack 1941, Dehus et al. 1999). Calico crayfish may be in a wide range of colors from light grays and blues to dark brown or black. Many calico crayfish have alternating lines of dark and light colors along their abdomens forming a banded pattern ending in a mottled pattern at the base of the abdomen on or near the tail (Schainost 2014, USFWS 2015). Tips of the chelae (claws) often are an orange to yellow color, but males in breeding condition may show a purple tint (Smith 2013). Areola (area between the left and right sides of the carapace along the midline of the dorsal side of the carapace) is slightly open, and the rostrum (pointed structure between eyes) is slightly depressed and terminates into small spines on the edges, though these may be worn or unable to be observed by the naked eye

Michigan Natural Features Inventory
Phone: (517) 284-6200 Email: mnfi@msu.edu
Website: mnfi.anr.msu.edu

on older individuals (Smith et. al. 2024).

This species may be easily confused with the virile crayfish (*Faxonius virilis*). Key identifiers to differentiate between these species are the presence of a deep notch near the base of the moveable dactyl in adult calico crayfish claws, and the absence of a large forward-facing tubercle (lump) near the base of dactyls on chela of the virile crayfish (Smith et al. 2024). Additionally, the gonopods (1st anterior set of appendages underneath abdomen in male crayfish) of calico crayfish end in two small structures of nearly even length, whereas one structure will be shorter in virile crayfish. These structures in male calico crayfish in breeding condition (form I) will also be very angled, almost 90 degrees (Smith et al. 2024). Crayfish may also be distinguished as male or female based on the presence of the annulus ventralis (seminal receptacle) on females which would appear as a relatively large opening on the abdomen; this feature will be absent in males (Schainost 2014).

Best Survey Time: Several different survey methods may be implemented at different periods of the year to maximize survey results for crayfish (Parkyn 2015). Throughout the active season of late March through October the most used method is placing baited traps (minnow traps, crab pots, pyramid crayfish traps) in suitable habitat overnight and checking the following day to collect/identify crayfish (De Palma-Dow et al. 2020). Many of these traps also favor collection of form I males, which are relatively large, so estimates of sex ratio and age classes may be skewed; in addition to large amounts of potential bycatch including tadpoles and fish (Welch and Price 2009). There have also been attempts to capture crayfish using traps that serve as artificial refugia or hides; often made of tubing connected to a holding container, that do not utilize a bait and have been found to capture a more even spread of sexes and smaller individuals (Green 2018). Other manual capture methods for crayfish include dip nets, electrofishing, and in shallow waters nocturnal hand capture surveys can be implemented throughout the active season (Alonso 2001, Hilber et al. 2020).

In the non-active season detection methods for calico crayfish include the collection of water from burrows for environmental DNA detection, but this method has had mixed results for other crayfish species and requires pre-emptive genetic work to be done for the species (Harper 2018, Chucholl et al 2021). Calico crayfish can also be collected in the inactive season through excavation of burrows, but this method is highly disruptive to the environment as burrows may be over a meter deep and should not be utilized in most situations (Schainost 2014, Crandall 2016).

Habitat: The calico crayfish inhabits a wide range of aquatic habitats, favoring habitats with slow moving or stagnant water (Pflieger 1996). Historically, calico crayfish have been most associated with waterbodies that contain muddy bottoms and a large amount of aquatic vegetation (Tack 1941). This includes ponds, lakes, ditches, slow moving streams, and ephemeral wetlands (Adams et al. 2010). Like all crayfish, calico crayfish need habitats with adequate amounts of dissolved calcium to ensure correct development of exoskeletons (Reynolds et.al. 2013). Calico crayfish can tolerate a wide range of abiotic conditions including turbidity, pH, and temperature; but calico crayfish will rarely establish in fast flowing waters, generally only doing so when displaced by a more competitive crayfish species (Tack 1941, Pflieger 1996, Smith et al. 2024). Calico crayfish also appear to be more tolerant of lower levels of dissolved oxygen than other crayfish species and may be able to utilize habitats other crayfish species cannot (Newkirk et al. 2023). Calico crayfish may be found in terrestrial habitats as well but require a connection to a nearby waterbody or the groundwater table to create burrows in more arid conditions, generally only moving over terrestrial habitats during times of precipitation (USFWS 2015, Smith et.al. 2024). During movement over terrestrial habitats calico crayfish may temporarily utilize shallow and less permanent water bodies including ditches, man-made ponds, and vernal pools (Herrmann et al. 2018). Calico crayfish have been observed across a wide range of habitats in Michigan including lake edges, riparian corridors, vernal pools, retention ponds, and ditches (MNFI 2025).

Biology: Calico crayfish has a biology and life history niche like that of other crayfish within its genus. They are semi-aquatic; spending most of their life in water but able to move over land to find more suitable habitats (Tack 1941, Herrmann et al. 2018). Calico crayfish can be described as either a secondary or tertiary burrower throughout its range depending on the habitat they are in (Smith et al. 2024, NatureServe 2025). Secondary burrower crayfish will readily create burrows into the soil to access the groundwater table during times of drought or cold temperatures; whereas tertiary burrowers will

generally stay within a permanent waterbody their entire life and will only create burrows during extreme climate conditions for cover (Smith et al. 2024). In Michigan, the calico crayfish is considered a secondary burrower; but it may inhabit deep enough water bodies where burrowing may not be necessary for survival (Lippson 1975, USFWS 2015, Smith et al. 2024). Life history research found that in periods of water drawdown or local drought conditions approximately half of calico crayfish would emigrate to new sites over land while the other half would bury down (Tack 1941). Periods of high precipitation may create conditions where calico crayfish are more likely to be observed moving over terrestrial environments (Tack 1941). Calico crayfish are opportunist, omnivore feeders with most of their diet composed of detritus or algae (Tack 1941, Chucholl 2012). Like many crayfish, calico crayfish may be active throughout the day but are most likely to be active nocturnally (Schainost 2014). Like all arthropods, calico crayfish possess a hard exoskeleton that must molt to grow. Calico crayfish exoskeletons are known to be slightly softer and easier to puncture than other crayfish leading to their other common name of the paper shell crayfish. Molting timing for calico crayfish is based on growth rates and available resources, with many more molts occurring earlier in the crayfish's lifespan (Tack 1941).

The calico crayfish active season in Michigan begins in early spring once water temperatures become suitable for crayfish activity (Tack 1941, Lippson 1975). Immediately following spring emergence crayfish may begin to forage and quickly molt into a breeding state known as a form I individual (Tack 1941). It has been found that the calico crayfish has the potential to breed year-round based on the growth of individuals from the previous year, but there appears to be a larger proportion of breeding individuals in the late summer (Chucholl 2012). Male calico crayfish may also delay molting into a form I individual in a given year and remain in a non-mating form (form II) based on factors including available resources and interspecific competition (Chucholl 2012). Calico crayfish reproduce sexually, with males courting a female to insert a structure known as a sperm plug into the female's seminal receptacle which the female will store for later fertilization of eggs (Schainost 2014). There is evidence that competing males may be able to remove this sperm plug allowing for multiple mating events to occur with each individual crayfish (Tack 1941, USFWS 2015). Females will then retreat to burrows shortly after mating to being the process of fertilization of eggs; nearly all males die shortly after mating (Tack 1941, Schainost 2014). After fertilization females will produce between 60 and 300 eggs, and eggs will be stored underneath the tail of the abdomen until hatching, with individuals holding eggs known as being "in berry" (Tack 1941, Rach and Dawson 1991). Females in berry are most often observed October through December, and eggs are held onto through the winter months and hatch early next spring when the female emerges (Rach and Dawson 1991). Higher water temperatures may lead to faster development and in warm waters eggs may hatch in as little as 10 days but generally hatch within a month after emergence, around mid to late May in Michigan (Tack 1941, Rach and Dawson 1991). Females will continue to protect and carry newly hatched calico crayfish under their abdomens, generally until the first three molts of the young individuals; after this nearly all adult female calico crayfish die off and do not produce a second brood (Tack 1941, Chucholl 2012, Schainost 2014). Young calico crayfish then develop rapidly throughout their first year, and while some may become sexually mature and mate in their first year, most do not reach a size where they are sexually mature until after their first winter (Chucholl 2012).

Calico crayfish play an important role in their native food webs in the habitats in which they occur. Calico crayfish of all sizes in Michigan are readily preyed upon by several fish species including sportfish such as smallmouth (*Micropterus dolomieu*) and largemouth bass (*M. nigricans*) (Dorn et al. 1999). Freshly molted crayfish in Michigan also serve as a critical food source for the Special Concern queen snake (*Regina septemvittata*), which is an obligate predator on crayfish, but may be unable to prey upon larger, more aggressive invasive crayfish (Harding 1997). Crayfish burrows also serve as refugia for several other species in Michigan including the Hine's emerald dragonfly *(Somatochlora hineana*, State and Federal Endangered) and the eastern Massasauga (*Sistrurus catenatus*, State and Federal Threatened). Grazing crayfish like the calico crayfish also play a role in shaping the habitats they inhabit, by foraging and keeping detritus clear, which may help to shape the macrophyte community present (Reynolds et al. 2013).

Conservation/Management: The largest known threat to calico crayfish in Michigan most likely is the introduction of non-native crayfish that outcompete and

displace native crayfish populations. Globally, these introductions have caused drastic population declines in native crayfish species (Lodge et al. 2000). Crayfish introductions have been observed in Michigan including the invasive rusty crayfish (*Faxonius rusticus*) and red swamp crayfish (*Procambarus clarkii*) (Budnick et al. 2023, Homan et al. 2023). Two other crayfish species have not yet been observed in Michigan but have regulations restricting their possession to prevent possible introduction: the common yabby (*Cherax destructor*) and marbled crayfish (*Procambarus virginalis*). Preventing introduction of these species to new habitats is the best way to protect calico crayfish populations, and observations of these non-native species should be reported to the Michigan Department of Natural Resources and the Midwest Invasive Species Network. In areas where invasive crayfish have already established removal methods may be used including trapping and hand removal (De Palma-Dow et al. 2020). In cases of severe non-native crayfish invasion other methods such as chemical control or introduction of a disease biocontrol may be applied to reduce invasive crayfish populations, but many of these methods will be lethal to native crayfish and cause lethal or sublethal effects in other aquatic taxa (Manfrin et al. 2019).

Beyond invasive crayfish species, other threats to calico crayfish in Michigan are similar to other threats for crayfish as a whole. Crayfish are sensitive to acidification of water bodies they inhabit and the groundwater table where they may overwinter so actions to reduce point and non-point source pollution to these waterbodies should be taken (Beaune et al. 2018). Additionally, if waterbodies in an area dry up or become unsuitable at any time of year; calico crayfish require nearby soft soils to burrow into; to facilitate this burrowing, buffers of protected upland habitat should be applied to protected waterbodies where calico crayfish occur. Other human activities in waterbodies such as shoreline hardening and dredging may negatively impact calico crayfish populations (Smith 2013). Finally, there have been documented cases of the crayfish plague parasite (*Aphanomyces astaci*) being transmitted by the calico crayfish in its introduced range (Schrimpf et al. 2013). While apparently adapted to this in its native range newly introduced crayfish pathogens should be monitored for and if discovered rapid response may be required to protect native crayfish populations.

Research Needs: More research into the population sizes and distribution of calico crayfish is needed to better understand the status of the species in Michigan. Targeted surveys for the species, or general crayfish community surveys across Michigan may be warranted to help fill in these knowledge gaps. This would include identifying key habitats for the calico crayfish in Michigan, and populations that are stable to implement further protections if warranted. Research is also needed on the specific life histories of introduced crayfish including the rusty crayfish (*Faxonius rusticus*) and red swamp crayfish (*Procambarus clarkii*) and how they may specifically impact the calico crayfish at different portions of its life cycle in Michigan. This would help to identify priority protection areas for calico crayfish and how to best manage for introduced species while causing minimum disturbance to the calico crayfish.

Related Abstracts: Northern clearwater crayfish, queen snake, eastern massasauga, Hine's emerald dragonfly

Selected References

Adams, S., G.A. Schuster, and C.A. Taylor. 2010. *Orconectes immunis.* The IUCN Red List of Threatened Species 2010: e.T153925A4564415. https://dx.doi.org/10.2305/IUCN.UK.2010-3.RLTS.T153925A4564415.en.

Alonso, F. 2001. Efficiency of electrofishing as a sampling method for freshwater crayfish populations in small creeks. Limnetica 20:59-72.

Beaune, D., Y. Sellier, G. Luquet, and F. Grandjean. 2018. Freshwater acidification: an example of an endangered crayfish species sensitive to pH. Hydrobiologia 813:41-50.

Budnick, W.R., D. Hayes, S. Herbst, J. Kanefsky, L. Nathan, B. Roth, N. Sard, K.T. Scribner, K. Smith, and S. Thomas. 2024. Factors influencing detection of invasive Red Swamp Crayfish *Procambarus clarkii* (Girard, 1852) in Michigan ponds. Hydrobologia 851.

Chucholl, F. 2012. Understanding invasion success: life-history traits and feeding habits of the alien crayfish *Orconectes immunis* (Decapoda, Astacida, Cambaridae). Knowledge and Management of Aquatic Ecosystems 404.

Chucholl, F., F. Fiolka, G. Segelbacher, and L.S. Epp. 2021. eDNA detection of native and invasive crayfish species allows for year-round monitoring and large-scale screening of lotic systems. Frontiers in Environmental Science 9:1-12.

Crandall, K.A and S. DeGrave. 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.

Crandall, K.A. 2016. Collecting and processing freshwater crayfishes. Journal of Crustacean Biology 36:761-766.

Dehus, P., U. Dussling, and C. Hoffman. 1999. Notes on the occurrence of the calico crayfish (*Orconectes immunis*) in Germany. Freshwater Crayfish 12.

De Palma-Dow, A., J. Curti, and E. Fergus. 2020. It's a trap! An evaluation of different passive trap types to effectively catch and control the invasive red swamp crayfish (*Procambarus clarkii*) in streams of the Santa Monica Mountains. Management of Biological Invasions 11:44-62.

Dorn N.J., G.G. Mittelbach, and W.K. Kellogg. 1999. More than predator and prey: a review of interactions between fish and crayfish. Vie et Milieu / Life & Environment :229-237.

Green, N., M. Bentley, P. Stebbing, D. Andreou, and R. Britton. 2018. Trapping for invasive crayfish: comparisons of efficacy and selectivity of baited traps versus novel artificial refuge traps. Knowledge and Management of Aquatic Ecosystems:419.

Harper, K., P. Anucha, J. Turnbull, C. Bean, and M. Leaver. 2018. Searching for a signal: environmental DNA (eDNA) for the detection of invasive signal crayfish, *Pacifastacus leniusculus* (Dana, 1852). Management of Biological Invasions 9:137-148.

Harding, J.H. 1997. Amphibians and reptiles of the Great Lakes Region. The University of Michigan Press, Ann Arbor, MI.

Herrmann, A., A. Schnabler, and A. Martens. 2018. Phenology of overland dispersal in the invasive crayfish *Faxonius immunis* (Hagen) at the Upper Rhine River area. Knowledge and Management of Aquatic Ecosystems: 419.

Hilber, T., J. Oehm, M. Effenberger, and G. Maier. 2020. Evaluating the efficiency of three methods for monitoring of native crayfish in Germany. Limnologica 85:1-8.

Homan, R., K. Baker, B. Roth, and K. Smith. 2023. Creating a distribution model of three crayfish species in the genus *Faxonius* (Decapoda, Cambaridae) in Michigan streams using publicly accessible data. Crustaceana 96:715-750.

Lippson, R.L. 1975. The distribution of the crayfish of Michigan with aspects of their life cycle and physiology. PhD dissertation, Michigan State University, East Lansing, MI.

Manfrin, C., C. Souty-Grosset, J. Anastácio, P. M., Reynolds, and P.G. Giulianini. 2019. Detection and control of invasive freshwater crayfish: from traditional to innovative methods. Diversity 11:5.

Michigan Natural Features Inventory (MNFI). 2025. Michigan Natural Heritage Database. Lansing, MI.

NatureServe. 2025. NatureServe Explorer page for Calico Crayfish (*Faxonius immunis*). <https://explorer.natureserve.org/Taxon/ELEMENT_GLOBAL.2.120402/Faxonius_immunis>. Accessed 3 April 2025.

Newkirk, B., E. Larson, A. Walker, and A. Walters. 2023. Winners and losers over a ½ century of change in crayfish assemblages of Wyoming, USA. Freshwater Science 42.

Parkyn, S. 2015. A review of current techniques for sampling freshwater crayfish. Pages 205-220 *in* T. Kawai, Z. Faulkes, and G. Scholtz, editors. Freshwater Crayfish: A Global Review. CRC Press, Taylor & Francis Group, Boca Raton, FL.

Pflieger, W.L. 1996. The crayfishes of Missouri. Missouri Department of Conservation, Jefferson City, MO.

Tack, P. 1941. The life history and ecology of the

crayfish *Cambarus immunis* Hagan. The American Midland Naturalist 25:420-446.

Rach, J.J. and V.K. Dawson. 1991. Aspects of the life history of the calico crayfish with special reference to egg hatching success. The Progressive Fish Culturalist 53:141-145.

Reynolds, J., C. Souty-Grosset, and A. Richardson. 2013. Ecological roles of crayfish in freshwater and terrestrial habitats. Freshwater Crayfish 19:197-218.

Sawyer, E.K., J.H. Hartman, D.K. Szydlowski, and E.R. Larson. 2024. Investigating calico crayfish (*Faxonius immunis* Hagan, 1870) as a possible "sleeper" invasive species in northern Wisconsin, United States. Aquatic Invasions 19:191-209.

Schainost, S. 2014. The crayfishes of Nebraska. Nebraska Game and Parks Commission. Lincoln, NE.

Schrimpf, A., C. Chucholl, T. Schmidt, and R. Schulz. 2013. Crayfish plague agent detected in populations of the invasive North American crayfish *Orconectes immunis* (Hagen, 1870) in the Rhine River, Germany. Aquatic Invasions 8:103-109.

Smith, K., L. Nathan, T. Page, K. Quebedeaux, and W. Budnick. 2024. Field Guide to Michigan Crayfishes. Edition 4. Michigan State University Department of Fisheries and Wildlife and Michigan Department of Natural Resources.

Smith, R. 2013. Calico crayfish (*Orconectes immunis*). Ninnescah life. Witchita State University Ninnescah Biology Field Station, Viola, KS.

Taylor, C. A., Schuster, G. A., & Wylie, D. 2015. Field guide to crayfishes of the Midwest. (Illinois Natural History Survey Manual; No. 15). Illinois Natural History Survey, Champaign, IL.

United States Fish and Wildlife Service (USFWS). 2015. Calico crayfish (*Orconectes immunis*) ecological risk screen summary.

Welch, S. M., and J.E. Price. 2009. Semi-quantitative methods for crayfish sampling: sex, size, and habitat bias. Journal of Crustacean Biology 29:208-216.

Abstract Citation: Earl, D. 2025. Special animal abstract for *Faxonius immunis* (calico crayfish). Michigan Natural Features Inventory. Lansing, MI

Funding for abstract provided by Michigan Department of Transportation.