

Muddling with Mudbugs



West Virginia's burrowing crayfishes

By Zachary J. Loughman

It's 11 p.m., and I'm staring into a roadside ditch just outside Terra Alta, West Virginia. As I slowly amble down the road, neck bent sharply, the beam of my headlamp illuminates a myriad of creatures. Movement to the left of my beam causes a quick, instinctual call to action. I crouch down to investigate further, only to find a mountain dusky salamander staring back at me. Normally this find would cause a bit of excitement, but tonight I'm after a more elusive species.

The ditch is littered with holes and mounds of mud, which indicates to me the animal I'm seeking definitely lives here. As my headlamp beam lights up the ditch, I investigate each hole with specific intent. Suddenly, from the depths of a hole, a flame orange animal is stirring. This is what I'm looking for, and I deliberately crouch again to investigate further. Up from the bowels of the hole climbs an inch-long upland burrowing crayfish. Nested in its chelae (claws) is a round ball of fresh mud the size of a pea, which it releases at the entrance of its burrow after its climb.

Before the crayfish heads back down the hole, I quickly pin the crayfish and extract it from the burrow. In a futile attempt at scaring me off, the crayfish raises its chelae and gurgles water trapped inside its cephalothorax (the fused head and middle section of the body). Every capture is as exciting as the first it seems, and after a moment of admiration, I sit down on the road, grab my calipers, and collect data for the next five minutes. After data collection, the crayfish is released back into its burrow, and I continue down the ditch.

The above scene is part of my research project supported by the West Virginia Division of Natural Resources Wildlife Diversity Program to better understand crayfish populations within the Mountain State. In the late 1980s, Ray Jezerinac led an effort to document West Virginia's crayfish fauna (also supported by the DNR Wildlife Resources Section). This project ultimately resulted in the publication of *Crayfishes of West Virginia*.

West Virginia's landscape has changed greatly in some parts of the state since the 1980s, and the ultimate impact of these alterations on crayfishes is unknown. Also, since the printing of that publication, new genetic techniques have arisen that aid in the description of new species. To better understand their current taxonomy and what factors have impacted crayfishes since the 1980s, a second statewide crayfish census was started in the summer of 2007. I am working with Stuart Welsh, who works with the U.S. Geological Survey Cooperative Fish and Wildlife Research Unit at West Virginia University, to complete the study over the next four years. While stream forms of crayfish are easily studied, and a wealth of information can be gleaned from these aquatic populations over a short time, burrowing species present an all together different problem. This has everything to do with their unique natural history.

*Chimney of the digger crayfish.
Inset photo - Digger crayfish with eggs.*

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Chimney of upland burrowing crayfish.

Horton Hobbs Jr., the father of American astacology (the study of freshwater crayfish), classified North American crayfishes behaviorally as tertiary, secondary and primary burrowers based on a species propensity to burrow. Tertiary burrowers make shallow depressions under cobbles and boulders in streams and do not exhibit complex burrowing behaviors. West Virginia's members of the crayfish genus *Orconectes* are all tertiary burrowers, and are frequently encountered under rocks in large rivers and streams.

Secondary burrowers construct somewhat complex burrows, and often inhabit situations that experience predictable stream drawdown during summer months. As surface waters retreat underground, secondary burrowers construct burrows that remain inundated by the available water table. Secondary burrower's burrows tend to be relatively simplistic and direct, leading straight to the water table. In some instance, these burrows can be quite deep, but the majority range between 20 to 39 inches deep.

Primary burrowers exhibit extreme levels of burrowing behavior, and are dependent on the maintenance and construction of their burrows for

various aspects of their life history. When biologists speak of burrowing crayfishes, this is the behavioral group they are talking about. Often there is a vertical mud structure surrounding the burrow entrance called a chimney. Crayfish build these chimneys with mud they bring to the surface while cleaning their burrow. Crayfish are the only animals that make these structures, so if you have chimneys in your yard, you have burrowing crayfish as well.

Burrows usually have multiple entrances which meet under ground, creating a central tunnel that leads to an enlarged resting chamber. Resting chamber depth appears to be correlated to mean annual water table depth. This structure is normally inundated with ground water. Resting chamber depth can range from as shallow as 18 inches to almost six feet underground!

Within the resting chamber, crayfish mate, stockpile vegetation and construct additional tunnels. Female crayfish carry eggs underneath their abdomens, and primary burrowing crayfish often sequester themselves in their burrows during this time. Two to four weeks after hatching, neonates (newborn crayfish) enter their mother's resting chamber and tunnels, staying there for an unknown period of time. Upland burrowing crayfish neonates in Terra Alta were present for an entire summer from May through September within the confines of their mother's burrow, indicating that females do not necessarily rush off their young.

Radiating in all directions from the walls of the resting chamber are ancillary tunnels. It is theorized that crayfish use these tunnels to gain access to resources, hunt earthworms, feed on root tips, and expand their burrow complexes. Though the number and placement of these additional tunnels vary both on an individual and species level, one tunnel usually is always present. This tunnel leads from the floor of the resting chamber deep into the earth. The purpose of this tunnel is to follow the water table during drought conditions, always ensuring the crayfish has access to groundwater for respiration (crayfish breathe through gills). Including this tunnel, primary

burrower burrows can be quite deep, with several documented greater than eight feet in depth. Pretty impressive, given that they're constructed by organisms only one- to two-inches long! Several animal species, ranging from leopard frogs to jumping mice, use these burrows, making burrowing crayfish a keystone species in the habitats they occupy.

Burrowing crayfish in West Virginia are separated into two distinct groupings determined by the state's geographic characteristics. Lower elevations associated with the Appalachian Plateau, specifically the Ohio River Floodplain, harbor a greater diversity of crayfish. Burrowing crayfishes found in the Plateau include little brown mudbugs, digger crayfish, upland burrowing crayfish and blue crayfish. High elevation wetlands and forests above 2,500 feet in the Allegheny Mountains are home to the second distinct burrowing crayfish fauna in West Virginia, and consist of upland burrowing crayfish and blue crayfish. Species found in the Allegheny Mountains can also be found in the Appalachian Plateau, though high elevation populations do show structural differences from plateau populations.

The Ohio River Floodplain is home to the little brown mudbug (*Cambarus thomai*) and the digger crayfish (*Fallicambarus fodiens*). Little brown mudbugs are common throughout the Floodplain, reaching their highest densities in mature bottomland forests. Wildlife



Little brown mudbug.

management areas like Green Bottom and McClintic have thriving little brown mudbug populations. Little brown mudbugs actually aren't little, and in fact are our largest burrowing species, reaching seven inches in length. Coloration ranges from drab browns to brilliant blues and greens for this powerful species.

Digger crayfish are rare in West Virginia, and are the most imperiled burrowing crayfish in the state. Interestingly, West Virginia's populations of digger crayfish are isolated from core populations across Central North America. Intensive survey efforts were recently undertaken to find digger crayfish populations. Prior to this survey, two populations were known in West Virginia. Although more than 80 potential sites were surveyed, researchers discovered only two new populations. Digger crayfish in West Virginia are likely prehistoric Marietta River relicts, left over from the Teays River system from which Teays Valley gets its name. This helps to explain why digger crayfish populations are limited within the state. The natural history of this animal in West Virginia is relatively unknown. Discovering ecological data on this species, as well as finding additional populations, are major objectives of the current West Virginia crayfish survey.

Upland burrowing crayfish (*Cambarus dubius*) are found both in the Appalachian Plateau and the Allegheny Mountains. This species is polymorphic, with three distinct color phases in West Virginia. Populations in the Teays River Valley and lower elevations in the Guyandotte, Coal and Kanawha river basins are blue. High elevation Appalachian Plateau upland burrowing crayfish populations in southern West Virginia are orange and black, and are sometimes referred to as the "halloween morph." Allegheny



Upland burrowing crayfish.



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Blue crayfish

Mountain populations above 2,300 feet are all bright orange. This dynamic color scheme makes this species West Virginia's most variable crayfish species.

Over the past three years, I have conducted intensive studies on the natural history of this species at Terra Alta, West Virginia. Focus areas of this research include feeding ecology, life history, behavior and activity patterns, all aspects of burrowing crayfish biology that have received very little attention by astacologists. Results from these studies are changing biologists' ideas on the behavioral ecology and ecological role burrowing crayfish play in Appalachian ecosystems.

The final burrowing crayfish found within West Virginia is the blue crayfish (*Cambarus monongalensis*). Many tourists and West Virginians have encountered this species while hiking through Cranberry Glades or Dolly Sods. Two populations inhabit our mountains and hills; one in the Appalachian Plateau and one in the Allegheny Mountains. Several biologists have suggested that these populations be treated as subspecies, or even distinct species. One objective of the current study is to decide exactly how this species should be classified.

Both the blue crayfish and upland burrowing crayfish exist in specialized forest habitats called seeps. Seeps are wet areas where the aquifer (water-bearing rock formation) is fractured, resulting in the water table making contact with the earth's surface. In habitats like this, up to 11 burrows occur for every square meter of seep. This can result in seeps the size of your living room having as many as 275 burrow portals! In disturbed environments, like yards, burrowing crayfish can still be present, though burrow portal densities are drastically reduced.

Burrowing crayfishes are unique, important members of West Virginia's natural communities. The burrowing activities of these colorful animals create structures used by more than 400 animal species. In addition, their burrowing activity aids in maintaining healthy ecosystems by transferring nutrients between the topsoil and subsoil. Through increased efforts by the DNR Wildlife Resources Section, conservation plans for burrowing crayfishes will be created and implemented so

future generations can experience the thrill of finding a brilliant blue crayfish in the Mountain State.

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You can help this effort!

You can aid biologists in understanding burrowing crayfish distribution across West Virginia! If you have chimneys or burrows in your yard or on your property, have seen the crayfishes pictured in this article, and want to get involved in the survey, email WestVirginiaCrayfish@gmail.com or contact **Zac Loughman** at **304-336-8923** to share your discoveries. If you stumble upon a burrowing crayfish, please take a picture of the animal and record information on your location and email it to the above address. This information can be added to our growing crayfish distribution database, and ultimately is invaluable in understanding burrowing crayfish distributions across West Virginia.