Abandoned mine drainage (AMD), a consequence of poorly-regulated coal mining, has a widespread and pervasive effect on aquatic ecosystems in portions of the Appalachian region of the eastern United States. AMD is formed when sulfur-bearing rock, containing pyrites and marcasite, is exposed to air and water (Kimmel 1983). Sulfides are initially oxidized in the wet aerobic environment to ferrous sulfate and sulfuric acid. Ferrous sulfate, oxidized further by bacteria, produces ferric hydroxide which precipitates from the water column at low pH, forming a yellow or orange coating on the stream bed.

Occurrence of *Glyptemys insculpta* Le Conte in a stream impaired by abandoned mine drainage, Pennsylvania, USA

Charles E. Williams¹*

**Abstract.** The Wood Turtle, *Glyptemys insculpta*, is a semi-aquatic species of northeastern North America that hibernates in small to medium-sized hard-bottomed streams and rivers. I provide the first record of *G. insculpta* associated with an abandoned mine drainage-impaired (AMD) stream in Clarion County, Pennsylvania, USA. AMD-impaired streams may provide suitable hibernation sites for *G. insculpta*, regardless of low pH, sulfates and metals that are stressful to wholly aquatic organisms.

**Keywords.** *Glyptemys insculpta*, USA, abandoned mine drainage-impaired.

Abandoned mine drainage (AMD), a consequence of poorly-regulated coal mining, has a widespread and pervasive effect on aquatic ecosystems in portions of the

---

1 Western Pennsylvania Conservancy, Allegheny Field Office, 40 W. Main Street, Ridgway, Pennsylvania, USA, 15853; e-mail: chuckvt89@gmail.com

* corresponding author

---

**Figure 1.** View of Deer Creek, Clarion County, Pennsylvania, USA, in the locale where the adult *Glyptemys insculpta* was captured. Ferric hydroxide, a byproduct of abandoned mine drainage, coats the rocks in the stream bed.
the stream bottom commonly called “yellow boy”, a visible symptom of AMD-impairment. AMD-impaired waters with low pH typically have high acidity and high concentrations of sulfates and metals, especially iron, magnesium, manganese, and aluminum (Kimmel 1983). Few aquatic organisms can tolerate these chronically stressful conditions; thus AMD-impaired streams and rivers are among the most biotically impoverished in the region (Walsh et al. 2007). In Pennsylvania alone, over 7,000 km of streams and rivers are impaired by AMD (Pennsylvania Department of Environmental Protection 2008).

The wood turtle, *Glyptemys insculpta* Le Conte, is a medium-sized [average carapace length for Pennsylvania males is 176 mm; average for females is 158 mm (Hulse et al. 2001)], semi-aquatic species of northeastern North America, active in portions of its range from mid-March to October (Ernst and Lovich 2009; Hulse et al. 2001). In the summer months, it occurs in habitats as varied as forests, meadows, bogs and agricultural fields, usually in close association with streams. Courtship and mating also occur in streams, most often in summer or fall (Hulse et al. 2001). In the winter, *G. insculpta* usually hibernates in small to medium-sized hard-bottomed streams and rivers that are well-oxygenated, of moderate flow, and are not prone to extensive freezing (Greaves and Litzgus 2007; Hulse et al. 2001). Turtles may hibernate in deep pools, under stream-bank root masses, or below undercut banks, sometimes in large aggregations (Farrell and Graham 1991; Greaves and Litzgus 2007). Important threats to *G. insculpta* populations range-wide include habitat destruction and alteration, collecting for the pet trade, and highway mortality (Hulse et al. 2001). The species may also be sensitive to some forms of water pollution (Harding 1991).

On 18 April 2008, I captured an adult *Glyptemys insculpta* that had been observed motionless in a pool approximately 1 m deep in Deer Creek, Clarion County, Pennsylvania (41° 13.796 N; 79° 27.246 W), within State Game Land 63 (Figures 1 and 2). Deer Creek, a medium-sized tributary of the Clarion River, is located in the coal-rich Allegheny Low Plateau Ecoregion and has been impaired by AMD for many decades. The pH of the creek at the capture site was 3.95 with a conductivity of 300 μs, indicative of AMD-impairment. The turtle, a male, had a carapace length of 160 mm and appeared in good health when captured: no ectoparasites, wounds or deformities were observed. Notably, the carapace of the turtle was covered with an orange patina of ferric hydroxide deposition on the turtle and the rocks in the stream bed.
hydroxide nearly 1 mm thick (Figure 3), suggesting that the animal had spent the previous winter hibernating in Deer Creek. After photographs were taken, the turtle was released at the capture site. To my knowledge, this is the first record of *G. insculpta* associated with an AMD-impaired stream.

Unlike strictly aquatic organisms such as fish that spend their entire life cycles in a stream, *Glyptemys insculpta* can obtain its food from terrestrial sources and deposits its eggs within sandy stream banks above aquatic influences. Thus, it is removed in part from the chronic physiological and ecological challenges of AMD faced by wholly aquatic organisms. In the absence of other industrial or domestic pollutants (e.g., Harding 1991), well-oxygenated, hard-bottomed streams impaired by AMD, like Deer Creek, may provide suitable hibernation sites for *G. insculpta*, regardless of low pH, sulfates and metals. Moreover, the use of AMD-impaired streams

![Figure 3. Carapace view of adult *Glyptemys insculpta* collected from Deer Creek, Clarion County, Pennsylvania, USA, on 18 April 2008. The turtle’s orange hue is due to an accumulation of ferric hydroxide.](image-url)
for hibernation may yield some benefit to aquatic turtles: the elimination of parasites. The aquatic Common Turtle Leech, _Placobdella parasitica_ (Say), can heavily infest _G. insculpta_, with peak infestations occurring in spring and fall when turtles are most closely associated with streams (Farrell and Graham 1991; Saumure and Bider 1996). Leeches are largely unknown from acidic aquatic environments, perhaps due to low calcium availability (Pennak 1978); thus AMD-impaired streams could potentially provide parasite-free hibernation zones for wood turtles. AMD-impaired streams may also lack fish, frogs and mollusks that may attract turtle predators such as the North American River Otter [ _Lontra canadensis_ (Schreber)] and American Mink [ _Neovison vison_ (Schreber)]. Further studies are needed to better understand how _G. insculpta_ uses AMD-impaired streams and other ecological components of post-mining landscapes in the Appalachians.

**Acknowledgement.** Peter Petokas, Lycoming College, verified the identity and sex of _Glyptemys insculpta_ from digital images and, along with an anonymous reviewer, provided a helpful review of the manuscript. Stephen Rogers, Carnegie Museum of Natural History, supplied Pennsylvania location and habitat information for _G. insculpta_ in the Museum’s collection.

**References**


