# Direct Observation of Muskrat Feeding on Crayfish

Susan B. Adams[1] and Rebecca L. Rosamond[2,*]

**Abstract-** *Ondatra zibethicus* (Common Muskrat) are often considered herbivores; however, they also eat animal matter, especially mussels, which comprise a considerable part of their diet in some populations. Common Muskrats also feed on crayfish (Astacoidea), although such behavior is poorly documented. On 21 April 2022, we observed a Common Muskrat repeatedly catching crayfish (Cambaridae) and carrying them to its den. The site in the Coldwater River National Wildlife Refuge, Quitman County, MS, consisted of a ditch with a water-control structure on the edge of a waterfowl impoundment being dewatered. The consumption of crayfish by a Common Muskrat during a time when vegetation was presumably less available has important ramifications for the management of both species.

*Introduction*. *Ondatra zibethicus* (L.) (Common Muskrat, hereafter Muskrat) is often considered herbivorous, feeding mainly on aquatic herbaceous plants, such as *Typhus* spp. (cattails) and *Scirpus* spp. (bulrushes) (Bellrose 1950, Takos 1944). However, Muskrats will also eat animals, including mussels, crayfishes, fishes, snails, turtles, and animal carcasses (Bellrose 1950, Glass 1952, McDonald 2006, Neves and Odom 1989, O'Neil 1949, Willner et al. 1980), and they are sometimes classified as omnivores (Hersey et al. 2013, Neves and Odom 1989). The degree of omnivory appears to vary by population (Stearns and Goodwin 1941). For example, diets of Muskrat in coastal marshes of Louisiana consisted of ≤5% animal matter, including crayfish (O'Neil 1949). However, Muskrats in lakes slightly farther north were more carnivorous, with spring and summer diets consisting primarily of rice stalks, grain, and crayfish (O'Neil 1949). Evidence of Muskrats feeding on crayfish is mainly indirect, often consisting of observations of crayfish parts on feeding platforms or middens (Bellrose 1950, O'Neil 1949). We found no reports of direct observations of such behavior within the species' native range. Understanding trophic interactions is important to conserving species and ecosystems and predicting the impacts of species invasions. Therefore, our observation provides valuable information for understanding and managing Muskrats and crayfishes.

*Observation.* In April 2022, a large (30-ha) waterfowl impoundment was being drained on the Coldwater River National Wildlife Refuge near Crowder, MS (Quitman County). By 21 April 2022, the only open water remaining in the impoundment was in a borrow ditch created during levee construction (Fig. 1). A flashboard riser water-control structure (Massey 1998) attached to a steel culvert was located in the southwest corner of the unit (34°06'33.6"N, 90°08'40.1"W). A Muskrat den, consisting of a burrow excavated into the southern levee of the impoundment, was located about 17 m up the ditch from the water-control structure (Fig. 1). The entrance to the den was entirely out of the water. Additional flooded drainage ditches were located east, south, and west of the impoundment.

On 21 April 2022, at ~9:18 a.m., while conducting a playback survey for birds, we observed a Muskrat catching crayfish and carrying them to its den. The Muskrat would swim to the deeper water around the water-control structure and dive underwater. Its tail would thrash a few times before the Muskrat resurfaced, swimming toward its den while carrying a

[1]USDA Forest Service, Southern Research Station, Center for Bottomland Hardwood Research, Oxford, MS 38655. [2]US Department of the Interior, US Fish and Wildlife Service, North Mississippi Refuges, Grenada, MS 38901. [*]Corresponding author - becky_rosamond@fws.gov.

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crayfish in its mouth (Fig. 2A). When it reached the shoreline near its den, it left the water, walked up the bank (Fig. 2B), and entered its den, at which point we could no longer see it. The Muskrat repeated this process approximately every 5 minutes until we had to leave the site at ~9:38 a.m. Several times, the Muskrat caught a crayfish in the pool surrounding the water-control structure, but near the end of our observation period, we observed the Muskrat enter the water-control structure and emerge with a crayfish.

*Discussion.* Although vegetation was abundant at the observation site, with the impoundment dewatered, the Muskrat would have had to walk on land to reach it. In addition, when the refuge impoundments are drained, crayfishes sometimes congregate in large numbers in the debris and flowing water in the water-control structures and associated pipes

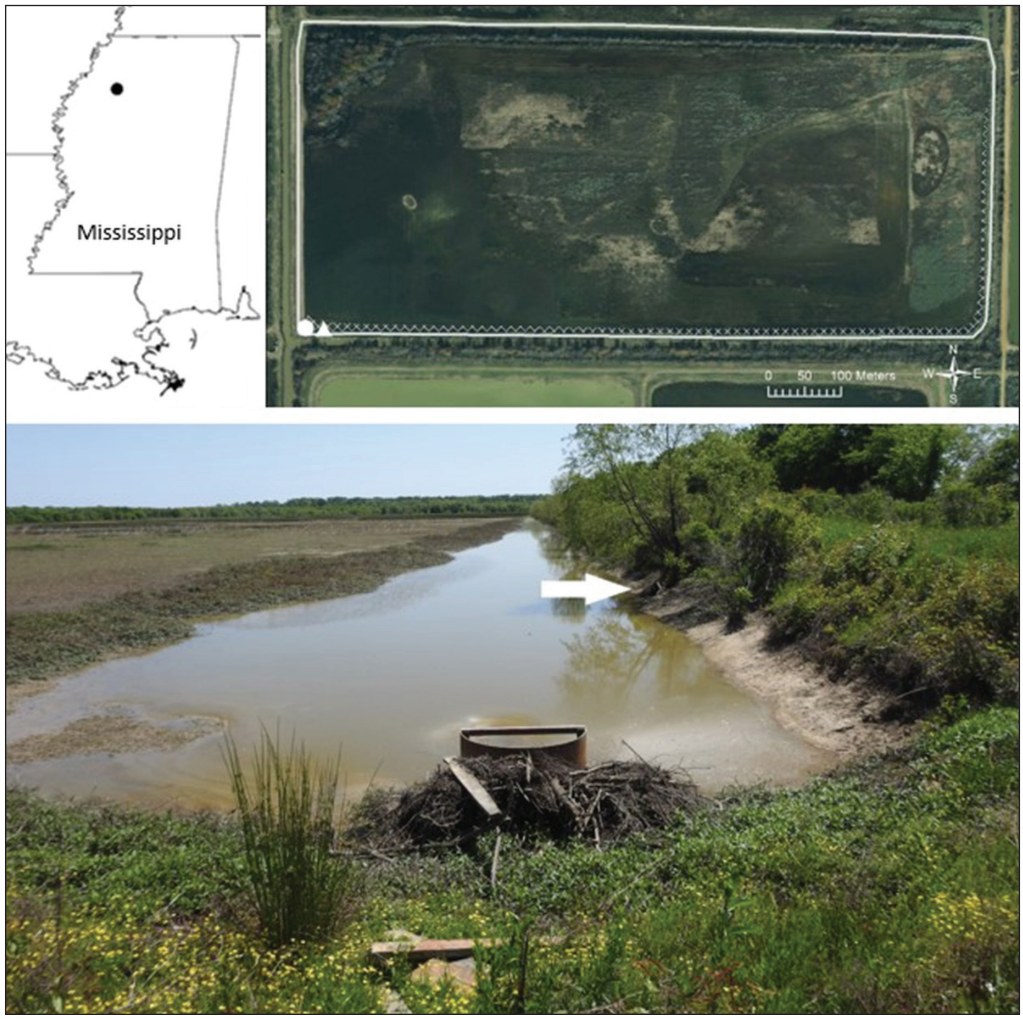


Figure 1. The map shows the location of Coldwater National Wildlife Refuge (black circle) in Quitman County, MS. The top right is a satellite image (National Agriculture Imagery Program 2018) of the large waterfowl impoundment (outlined in gray) with the water-control structure (circle) and Muskrat den (triangle) in the southwest corner. The borrow ditch is indicated by gray cross-hatching near the bottom of the image. The photograph on the bottom shows the water-control structure in the foreground and the Muskrat den (arrow).

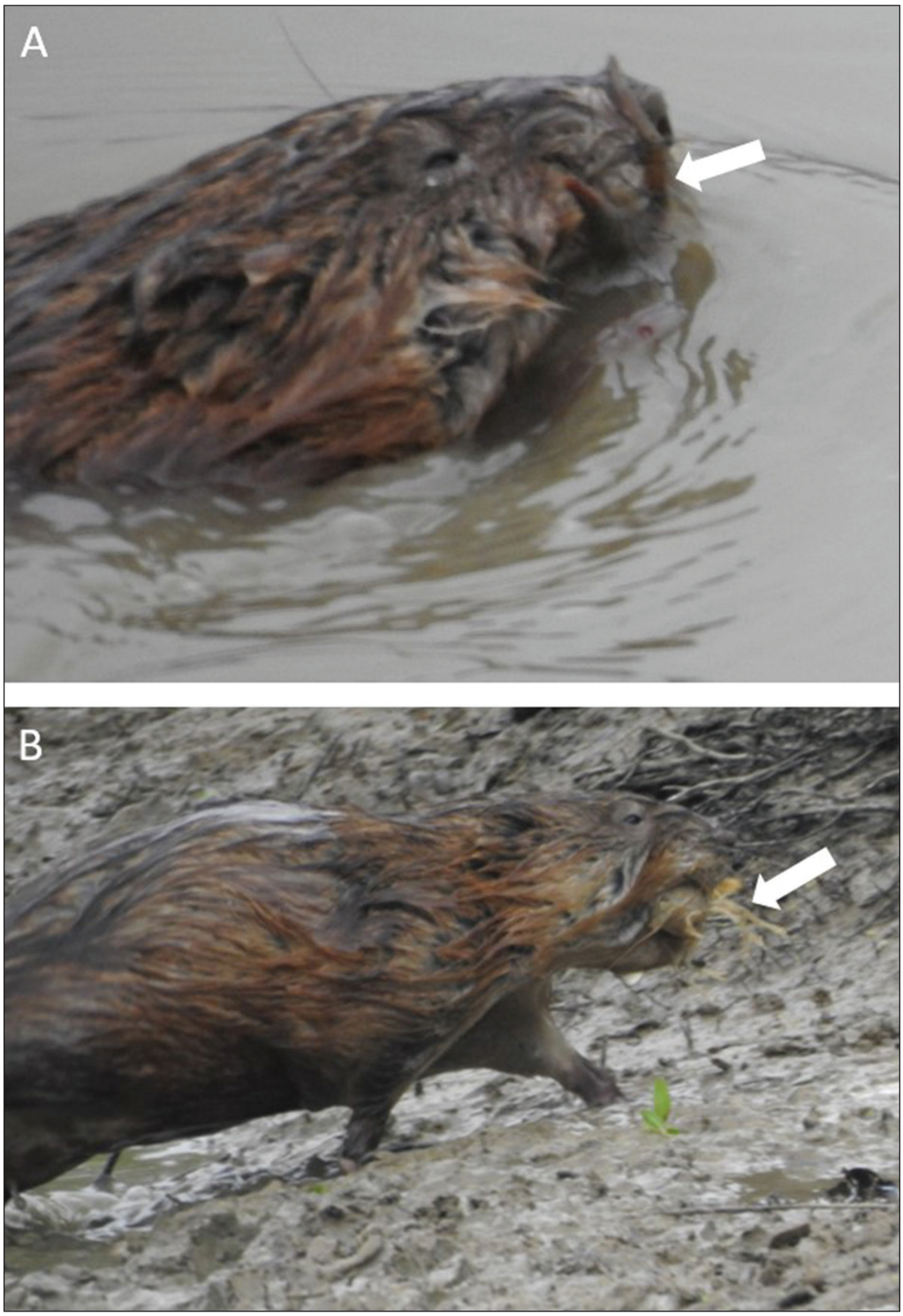


Figure 2. Muskrat swimming with crayfish in its mouth (A; crayfish chela indicated by arrow) and about to enter its den with a crayfish in its mouth (B; crayfish walking legs indicated by arrow).

(R.L. Rosamond, pers. observ.). The combination of having to leave the water to feed on plants and having an alternate, abundant food source in the water nearby may have made feeding on crayfishes an energetically viable option for the Muskrat while minimizing its predation risk. Muskrats tend to feed on the most abundant, readily accessible plants (Takos 1947), which may also extend to animal prey (Neves and Odom 1989). For example, mussel shells have been found to be abundant in Muskrat middens when vegetation was unavailable (Hersey et al. 2013). Conversely, eating crayfishes may be a relatively common, albeit poorly documented, Muskrat behavior.

The contribution of animal material to the Muskrat diet varies among populations, and reports differ on whether animal material is eaten regularly or primarily during food shortages or when highly abundant (Hersey et al. 2013). Based on the percentages of crude protein, crude fiber, and ash from over 2700 Muskrat stomachs collected in Delaware, Stearns and Goodwin (1941) concluded that Muskrats consumed an appreciable amount of animal matter during winter. Of animal matter eaten, Muskrat consumption of freshwater mussels is particularly well documented, in part because after feeding on mussels, shell middens remain as evidence (Hersey et al. 2013, Neves and Odom 1989, Takos 1947). Stable isotope analysis indicated that the median proportion of bivalves (native mussels and *Corbicula fluminea* (O.F. Müller) [Asian Clam]) in Muskrat diets on the Green River, KY, was 51% (Hersey et al. 2013). Muskrats also fed heavily and year-round on mussels in rivers in Tennessee and Kentucky (Neves and Odom 1989).

Muskrats sometimes feed extensively on crayfishes in their nonnative range (Ackefors 2000, Shuler 2000). In Finland and Austria, nonnative Muskrats are considered major crayfish predators (Ackefors 2000). At a site in Finland, 11 of 23 (48%) Muskrat stomachs examined contained crayfish (Ackefors 2000 citing Sundblom 1964). In northern California, introduced Muskrats reportedly preyed on the federally endangered *Pacifastacus fortis* (Faxon) (Shasta Crayfish), contributing to its decline (Shuler 2000).

Crayfish remains have been documented in Muskrat winter feeding houses (Bellrose 1950) and on middens. However, a study of a different species, *Neofiber alleni* True (Round-tailed Muskrat), cautioned about interpreting crayfish remains on middens (Birkenholz 1963). A previous paper had suggested that Round-tailed Muskrats ate crayfish based on finding crayfish parts on the rodents' feeding platforms. However, Birkenholz (1963) examined 330 Round-tailed Muskrat stomachs taken throughout the year and found no animal matter, despite commonly finding crayfish remains on the feeding platforms. He inferred that the crayfish parts were left by *Oryzomys palustris* (Harlan) (Marsh Rice Rat), which were known to eat crayfish and use Round-tailed Muskrat feeding platforms.

The Muskrat we observed did not immediately re-emerge after entering its den, so we inferred that it ate each crayfish immediately. Muskrats often store plant food in their dens, and Bellrose (1950) reported an intact crayfish was stored in a Muskrat's winter-feeding house in an Illinois lake. However, if the Muskrat we observed was caching the crayfish to eat later, it presumably would have re-emerged from its den soon after entering. Moreover, dead crayfish would rot very quickly in the warm temperatures on the observation day.

Water-level changes that influence Muskrats' access to plant foods may change their feeding behavior. In a Maine marsh, Muskrats ate sedges (Cyperaceae) predominantly when forced into sedge meadows by high water levels (Takos 1947). In Kentucky, Muskrats ate mussels more often when plants were less available, possibly due partly to altered river flows (Hersey et al. 2013). Therefore, the behavior we observed may have been restricted to periods of dewatering.

We suggest that further investigation of crayfish as a potentially important food item for Muskrats under various conditions would be useful. Such knowledge would inform the management of Muskrats and crayfishes and facilitate predicting trophic ramifications of invasions by either organism.

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**Literature Cited**

Ackefors, H.E. 2000. Freshwater crayfish farming technology in the 1990s: A European and global perspective. Fish and Fisheries 1:337–359.

Bellrose, F.C. 1950. The relationship of muskrat populations to various marsh and aquatic plants. Journal of Wildlife Management 14:299–315.

Birkenholz, D.E. 1963. A study of the life history and ecology of the Round-tailed Muskrat (*Neofiber alleni* True) in north-central Florida. Ecological Monographs 33:255–280.

Glass, B.P. 1952. Factors affecting the survival of the Plains Muskrat, *Ondatra zibethica cinnamomina*, in Oklahoma. Journal of Wildlife Management 16:484–491.

Hersey, K.A., J.D. Clark, and J.B. Layzer. 2013. Consumption of freshwater bivalves by muskrats in the Green River, Kentucky. American Midland Naturalist 170:248–259.

Massey, B., 1998. Wetlands engineering manual. Ducks Unlimited, Southern Regional Office, Jackson, MS. 16 pp.

McDonald, B.K. 2006. New records of occurrence and notes on the Muskrat (*Ondatra zibethicus*) in western Oklahoma. Proceedings of the Oklahoma Academy of Science 86:93–95.

Neves, R.J., and Odom, M.C. 1989. Muskrat predation on endangered freshwater mussels in Virginia. Journal of Wildlife Management 53:934–941.

O'Neil, T. 1949. The Muskrat in the Louisiana coastal marshes: A study of the ecological, geological, biological, tidal, and climatic factors governing the production and management of the Muskrat industry in Louisiana. Federal Aid Section, Fish and Game Division, Louisiana Department of Wildlife and Fisheries, New Orleans, LA. 152 pp.

Shuler, J. 2000. A history of Muskrat problems in northeastern California. Pp. 146–153, *In* F.P. Salmon and A.C. Crabb (Eds.). Proceedings of the 19th Vertebrate Pest Conference. University of California, Davis, CA. 730 pp.

Stearns, L,. and M. Goodwin. 1941. Notes on the winter feeding of the Muskrat in Delaware. Journal of Wildlife Management 5:1–12.

Sundblom, N.O. 1964. En undersökning av kräftbeståndet i insjöarna på Åland med beaktande av bisamrättans skadeverkŋingar. Husö Biologiska Station, Meddelanden 7:1–62.

Takos, M.J. 1944. Summer movements of Banded Muskrats. Journal of Wildlife Management 8:307–311.

Takos, M.J. 1947. A semi-quantitative study of muskrat food habits. Journal of Wildlife Management 11:331–339.

Willner, G.R., G.A. Feldhamer, E.E. Zueker, and J.A. Chapman. 1980. *Ondatra zibethicus*. Mammalian Species 141:1–8.