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Observation and DNA Confirmation of a Fisher (*Pekania pennanti*) Hunting and Killing a Muskrat (*Ondatra zibethicus*)

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Abstract - *Pekania pennanti* (Fisher) is a generalist mesocarnivore that has been documented to prey on a diversity of mammals, but there have been no previous documented incidents of a Fisher hunting and killing a semi-aquatic mammal. Here, we report a first-hand observation and DNA evidence of a Fisher hunting and killing an *Ondatra zibethicus* (Muskrat) from inside a beaver lodge along a lakeshore.

Pekania pennanti (Erxleben) (Fisher) is a generalist mesopredator that is constrained to hunting small and medium-sized prey items because of their solitary hunting habits (Powell 1993, Rosenzweig 1966). Previous studies have identified the remains of semi-aquatic mammals (particularly *Castor canadensis* Kuhl [Beaver] and *Ondatra zibethicus* (L.) [Muskrat]) within Fisher scats and gastrointestinal (GI) tracts (e.g., Kelly 1977, Kuehn 1989, Weir et al. 2005). Most of these studies attributed the remains to bait used by trappers, who commonly use skinned remains of Beaver and Muskrat to attract mustelids, and most of the studies used GI contents from trapped animals. However, there is some evidence Fishers may occasionally prey on semi-aquatic mammals. Hamilton and Cook (1955) found within the GI tract of a Fisher the remains of a Muskrat, which the authors speculated did not come from trapper bait. Giuliano et al. (1989) concluded that while all Beaver remains within Fisher carcasses were probably trapper bait, only 31–50% of Muskrat remains were provisioned by trappers, meaning the remaining portion of Muskrat remains were likely consumed naturally in their study; it is unknown whether the Fishers were hunting Muskrats or scavenging carcasses.

Leonard (1980) provides the only known observation of Fishers hunting semi-aquatic mammals. He found evidence Fishers were apparently hunting Muskrats that had been frozen out of their winter push-ups. Based on GI contents, he estimated as much as 6.5% of a Fisher's diet consisted of Muskrat. Raine (1981) conducted a diet analysis study within the same study area, and likewise concluded Fishers were consuming Muskrats; however, Muskrat remains were only found within 1 scat (Raine 1987), suggesting this behavior was uncommon. Despite these claims, neither author mentioned whether they ever located a Muskrat killed by a Fisher. There has not been a verified observation of a Fisher hunting and killing a semi-aquatic mammal prior to the observation described below.

At approximately 12:15 PM on 27 August 2018, lead author Sean Johnson-Bice (SJB) observed an adult Fisher (sex unknown) moving along the shoreline of a secluded bay within Voyageurs National Park (VNP), International Falls, MN. SJB was operating a small, single-engine motorboat ~20–25 m from shore when he spotted the Fisher. The Fisher was first observed approaching a small, inactive beaver lodge from the rear (a visual inspection on land later confirmed the lodge was inactive, and had several openings that were accessible to a predator). The Fisher approached the lodge and wedged its head into an opening

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within the rear, then proceeded to pull its head out and walk around to the right (from SJB's perspective) side of the lodge. It then climbed on top and attempted to force its head into another small opening that SJB could see on the front side of the lodge before leaping back onto shore. Although the Fisher was clearly aware of SJB's presence during the entire incident (it paused its hunt several times to peer out at SJB in the boat), this did not appear to deter the Fisher from continuing its hunt.

This activity of jumping onto and off of the lodge and pushing its head into openings continued for more than a minute, with the Fisher constantly moving about. Finally, the Fisher's head disappeared into the rear of the lodge once again, and after ~5–7 s, the Fisher re-emerged with a small, grey mammal between its teeth. The mammal's size was ~40–60% of the adult Fisher, and although the Fisher's jaws obscured the species identity, SJB noted it was clearly either an adult Muskrat or a Beaver kit based on its size, pelage, and location within the lodge. With the prey item between its teeth, the Fisher moved ~2 m onto shore. The Fisher bit and tore into its prey at least 3 separate times in the thoracic region, and SJB clearly observed raw flesh and blood through his binoculars. The Fisher then picked up its prey around the neck and retreated into the forest.

The entire hunting incident lasted ~2 min from when SJB first observed the Fisher until it withdrew back into the forest. After the incident, SJB searched the shoreline for blood and hair evidence to collect for DNA species identification of the prey item. SJB located and collected several small plant items with blood droplets on them, and placed them into a freezer 2–3 hours later. In the lab, we used nuclease-free water to re-suspend the dried blood from the plant material and performed 2 separate DNA extractions using the QIAGEN QIAamp DNA Investigator Kit (Qiagen, Valencia, CA) and the protocol for small volumes of blood. We amplified ~350 base pairs using 16S rRNA universal primers (Hoezel and Green 1992) and purified the PCR products using ExoSap-IT (Affymetrix-USB Corporation, OH) according to manufacturer's instructions. Reactions were sequenced at Eurofins Genomics (Louisville, KY) using standard Sanger sequencing protocols. DNA sequence data were viewed and aligned with Sequencher (Gene Codes Corporation, Ann Arbor, MI). Both samples yielded DNA sequences that matched GenBank reference sequences KX377316 and KU177045 from Muskrat.

To our knowledge, this is the first documented account of a Fisher hunting and killing a semi-aquatic mammal. Fishers generally prefer forests with continuous canopy cover (Powell 1993), so foraging along an aquatic environment is uncommon. The previous study that documented evidence of Fishers apparently hunting Muskrats (Leonard 1980) occurred during winter when the lake was completely frozen over; thus, the frozen lake effectively acted as an extension of the terrestrial environment. Our observation occurred in early autumn when the lake was entirely ice-free.

Muskrats often use beaver lodges for refuge (Mott et al. 2013, Rosell et al. 2005), but our observation clearly indicates they are vulnerable to predation when they take shelter within inactive lodges. While the inactive lodge from our observation had openings that allowed direct access to its interior, we suspect Fishers have the ability to tear apart old or rudimentary lodges to look for prey, as has been documented with other woody structures (Coulter 1966, Raine 1987). In contrast with the huts constructed by Muskrats, which are usually surrounded by water, beaver lodges are frequently built into lake and pond shorelines and may therefore provide Fishers access to Muskrats that would otherwise be inaccessible.

Our observation, further confirmed by DNA, provides evidence that Fishers should also be able to hunt and kill other semi-aquatic mammals, such as Beavers, on land. Though Fishers have been observed entering occupied beaver lodges (S.K. Windels, 2008 pers.

observ.), there are no accounts of Fishers preying on Beavers. However, Fishers are likely capable of killing small Beavers, especially kits, which typically weigh ≤7 kg in late autumn (Novak 1987). Beaver kits have been observed on land as early as 15 June in VNP (T. Gable, University of Minnesota, St. Paul, MN, 2018 unpubl. data), indicating there are several months when kits would be susceptible to Fisher predation while on land prior to freeze-up.

Based on this single observation, we cannot say whether Fishers seek out semi-aquatic mammals as prey items, but lake shorelines may function as natural habitat features that offer predictable prey patches while facilitating movement between foraging areas. Fishers generally avoid traveling in open areas (Powell 1993), but lake shorelines in VNP likely offer a safe and efficient travel corridor. Beaver densities in VNP are also some of the highest reported in the conterminous United States (Johnston and Windels 2015), so there are abundant opportunities for Fishers to encounter Beaver structures while traveling. It is reasonable to assume Fishers could quickly learn to associate beaver lodges with food opportunities and incorporate lodges into their foraging routine. Lake shorelines may thus offer an energetically cost-effective method of travel for Fishers who have learned (or are learning) to exploit semi-aquatic mammal prey.

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