

## Beavers, *Castor canadensis*, Feeding on Salmon Carcasses: Opportunistic Use of a Seasonally Superabundant Food Source

JEFFREY S. GLEASON<sup>1</sup>, RYAN A. HOFFMAN<sup>2</sup>, and JAMES M. WENDLAND<sup>3</sup>

<sup>1</sup>Corresponding author: 9715 Independence Drive, Apartment B109, Anchorage, Alaska 99507 USA

<sup>2</sup>3738 D Gray Loop, Elmendorf AFB, Alaska 99506 USA

<sup>3</sup>Alaska Department of Fish and Game, 333 Raspberry Road, Anchorage, Alaska 99518 USA

Gleason, Jeffrey S., Ryan A. Hoffman, and James M. Wendland. 2005. Beavers, *Castor canadensis*, feeding on salmon carcasses: opportunistic use of a seasonally superabundant food source. *Canadian Field-Naturalist* 119(4): 591-593.

We report observations of Beavers (*Castor canadensis*) foraging and feeding on discarded Chinook Salmon (*Oncorhynchus tshawytscha*) carcasses within the confines of the Susitna River drainage in southcentral Alaska on three separate occasions between 1999 and 2004. In all three instances, Beavers were observed actively seeking out freshly discarded carcasses or transporting "fresh" salmon carcasses in their mouths. In one instance, Beavers were seen using their dextrous forefeet to "handle" chunks of salmon while hunched over carcasses and in this case we actually witnessed Beavers "chewing" and ingestion was assumed. In the other two instances, Beavers were observed swimming with salmon carcasses in their mouths. Though unique within the framework of Beaver foraging ecology, we suggest this behavior may be a fairly common strategy employed by Beavers in Alaskan streams and rivers to take advantage of a seasonally superabundant source of protein.

Key Words: Beaver, *Castor canadensis*, Chinook Salmon, feeding, *Oncorhynchus tshawytscha*, Alaska.

Many herbivorous mammals are known to ingest animal matter either occasionally or on a seasonal basis, (i.e., mice [*Peromyscus* spp.; Barry 1977; Lackey et al. 1985], Red Squirrels [*Tamiasciurus hudsonicus*; O'Donoghue 1994; Steele 1998; Yahner 2003] and Northern Flying Squirrels [*Glaucomys sabrinus*; Wells-Gosling and Heaney 1984], Muskrats [*Ondatra zibethicus*; Willner et al. 1980; Campbell and MacArthur 1996; Erb and Perry, Jr. 2003], and White-tailed Deer [*Odocoileus virginianus*; Shaw 1963; Case and McCullough 1987; Pietz and Granfors 2000]). However, such observations are lacking for Beavers (*Castor canadensis*). The Beaver is considered a generalist herbivore, relying primarily on woody and herbaceous materials throughout its range to meet its energy requirements (Jenkins and Busher 1979; Novak 1987; Baker and Hill 2003; Muller-Schwarze and Sun 2003). Unlike other herbivorous mammals that are known to ingest animal matter to meet seasonal food shortages or sex and age-specific nutrient requirements (Robbins 1993), observations of carnivory are lacking for Beavers. We report here on observations of Beavers feeding on animal matter in the form of Chinook Salmon (*Oncorhynchus tshawytscha*) carcasses and discuss the potential importance of this readily available food source to Beavers in Alaska.

On 5 July 2004, at around 0800 AST, we observed three Beavers feeding on Chinook Salmon carcasses discarded after being filleted by anglers along a relatively deep-water pool of Montana Creek located roughly 200 m upstream of the Parks Highway bridge (150°03'W, 62°06'N). The upper reaches of this creek and others in the Susitna River drainage represent important spawning areas for Chinook Salmon in the region. This stretch of the stream opened to salmon fishing on 3 July. Beavers fed on freshly discarded carcasses aground in shallow areas upstream and down-

stream of the pool where the Chinook Salmon were holding. This pool was roughly 1.5 m at its deepest and was approximately 18 × 46 m in size, bounded on its upper and lower ends by shallow-water riffles. A variety of both woody (willows [*Salix* spp.], birch [*Betula* spp.], alder [*Alnus* spp.]) and herbaceous vegetation [sedges (*Carex* spp.)] were abundant within the creek corridor. Weather conditions on this date were sunny to partly sunny with temperature ranging from 15 to 20°C and no precipitation. The Beavers we observed appeared to be adults (based on their relatively large body size) and they fed for approximately 10-15 min on a carcass before moving on to another carcass. Foraging and travel between carcasses occurred nearly continuously for about 60 min in close proximity (5 m) to the observer (RAH). Chewing was evident as the Beavers fed while hunched over carcasses using their forefeet to "handle" chunks of remaining salmon muscle tissue (not organs).

On two previous occasions approximately 6 km from the location of the above incident, we (JMW) observed apparent foraging behavior by Beavers that also involved Chinook Salmon. Two Beavers on 12 June 1999 (07:00 ADT) and 2 on 17 June 2000 (04:00 ADT) swam from the Susitna River upstream into Goose Creek (150°05'W, 62°03'N) about 20 m to the edge of a 1.5 m deep pool. The creek was roughly 30 m wide and vegetation composition along the creek was similar to that previously described for Montana Creek. The Beavers, which all appeared to be adults, picked-up recently filleted Chinook Salmon carcasses discarded by anglers that were aground at the edge of the pool. The Beavers swam downstream from the pool into the Susitna River channel each with a carcass in its mouth. In addition, on 17 June 2000, we (JWM) observed a Beaver actually bite into an intact Chinook Salmon that was hanging from an angler's stringer. The

angler and Beaver struggled briefly before the angler finally freed his catch. This bout resulted in two large (10–12 cm) gashes inflicted on the salmon from the Beaver's incisors.

We are unaware of other published observations of Beavers feeding on animal matter (see Jenkins and Busher 1979; Baker and Hill 2003). Given their morphological and physiological adaptations for feeding on woody and herbaceous vegetation (e.g., massive skull, dentition and large incisors, bacteria in cecum; Jenkins and Busher 1979; Novak 1987; Baker and Hill 2003), this observation seemed significant in the context of Beaver foraging ecology. We assume that ingestion of salmon muscle tissue occurred for at least one of the three observations since chewing was seen. We speculate that opportunistic feeding on salmon may not strictly be limited to Beavers in this watershed, but rather that it may be widespread in Alaskan rivers and streams where Beavers overlap large spawning runs of Pacific salmon. In fact, during our research we spoke with others (R. Prentki, Minerals Management Service) within the region who witnessed similar observations. We hypothesize that Beavers in Alaska and presumably elsewhere in the Pacific northwest may opportunistically use or even actively seek out "fresh" (not senescent) salmon carcasses as a readily available and predictable (both in space and time) source of energy (i.e., protein or fat), at least on a seasonal basis (Gende et al. 2001; 2004b; Hilderbrand et al. 2004). Salmon carcasses, including discarded carcasses from anglers, represent a large, seasonal nutrient (particularly  $^{15}\text{N}$ ) input into anadromous systems in Alaska and elsewhere (Cederholm et al. 1999; Hilderbrand et al. 1999; Helfield and Naiman 2001; Reimchen et al. 2003; Gende et al. 2004a). A diverse assemblage of birds and mammals utilize pre-spawning (predation) and post-spawning (scavenging) salmon for food (Willson and Halupka 1995; Hilderbrand et al. 2004). For example, Cederholm et al. (1989) documented forty-three taxa of birds and mammals on salmon streams in Washington, and of these 51% were thought to have consumed salmon. Thus, it is not surprising that many animal species including apparently Beavers, exploit this seasonally superabundant high energy food source.

## Acknowledgments

This manuscript benefited greatly from discussions with Howard Golden (Wildlife Biologist, Alaska Department of Fish and Game). H. Golden and K. F. Abraham (Wetlands Wildlife Scientist, Ontario Ministry of Natural Resources) provided comments on an earlier draft of this manuscript. Two anonymous reviewers provided suggestions that greatly improved the manuscript.

## Literature Cited

**Baker, B. W., and E. P. Hill.** 2003. Beaver (*Castor canadensis*). Pages 288–310 in *Wild mammals of North America: ecology, management, and conservation*. Edited by G. A.

Feldhamer, B. C. Thompson and J. A. Chapman. Second Edition. John Hopkins University Press, Baltimore, Maryland, USA.

**Barry, R. E., Jr.** 1977. Length and absorptive surface area apportionment of segments of the hindgut for eight species of small mammals. *Journal of Mammalogy* 58: 419–420.

**Campbell, K. L., and R. A. MacArthur.** 1996. Digestibility of animal tissue by muskrats. *Journal of Mammalogy* 77: 755–760.

**Case, D. J., and D. R. McCullough.** 1987. White-tailed deer forage on alewives. *Journal of Mammalogy* 68: 195–197.

**Cederholm, C. J., D. B. Houston, D. L. Cole, and W. J. Scarlett.** 1989. Fate of coho salmon (*Oncorhynchus kisutch*) carcasses in spawning streams. *Canadian Journal of Fisheries and Aquatic Sciences* 46: 1347–1355.

**Cederholm, C. J., M. D. Kunze, T. Murota, and A. Sibatani.** 1999. Pacific salmon carcasses: essential contributions of nutrients and energy for aquatic and terrestrial ecosystems. *Fisheries* 24: 6–15.

**Erb, J., and H. R. Perry, Jr.** 2003. Muskrats (*Ondatra zibethicus* and *Neofiber alleni*). Pages 311–348 in *Wild mammals of North America: ecology, management, and conservation*. Edited by G. A. Feldhamer, B. C. Thompson and J. A. Chapman. Second Edition. John Hopkins University Press, Baltimore, Maryland, USA.

**Gende, S. M., T. P. Quinn, and M. F. Willson.** 2001. Consumption choice by bears feeding on salmon. *Oecologia* 127: 372–382.

**Gende, T. P. Quinn, R. Hilborn, A. P. Hendry, and B. Dickerson.** 2004a. Brown bears selectively kill salmon with higher energy content but only in habitats that facilitate choice. *Oikos* 104: 518–528.

**Gende, S. M., T. P. Quinn, M. F. Willson, R. Heintz, and T. M. Scott.** 2004b. Magnitude and fate of salmon-derived nutrients and energy in a coastal stream ecosystem. *Journal of Freshwater Ecology* 19: 149–160.

**Helfield, J. M., and R. J. Naiman.** 2001. Effects of salmon-derived nitrogen on riparian forest growth and implications for stream habitat. *Ecology* 82: 2403–2409.

**Hilderbrand, G. V., S. D. Farley, C. C. Schwartz, and C. T. Robbins.** 2004. Importance of salmon to wildlife: implications for integrated management. *Ursus* 15: 1–9.

**Hilderbrand, G. V., T. A. Hanley, C. T. Robbins, and C. C. Schwartz.** 1999. Role of brown bears (*Ursus arctos*) in the flow of marine nitrogen into a terrestrial ecosystem. *Oecologia* 121: 546–550.

**Jenkins, S. H., and P. E. Busher.** 1979. *Castor canadensis*. *Mammalian Species* 120: 1–8.

**Lackey, J. A., D. G. Huckaby, and B. G. Ormiston.** 1985. *Peromyscus leucopus*. *Mammalian Species* 247: 1–10.

**Muller-Schwarze, D., and L. Sun.** 2003. The beaver: natural history of a wetland engineer. Cornell University Press, Ithaca, New York, USA.

**Novak, M.** 1987. Beaver. Pages 282–313 in *Wild furbearer management and conservation in North America*. Edited by M. Novak, J. A. Baker, M. E. Obbard, and B. Malloch. Ashton-Potter, Concord, Ontario, Canada.

**O'Donoghue, M.** 1994. Early survival of juvenile snowshoe hares. *Ecology* 75: 1582–1592.

**Pietz, P. J., and D. A. Granfors.** 2000. White-tailed deer (*Odocoileus virginianus*) predation on grassland songbird nestlings. *American Midland Naturalist* 144: 419–422.

**Reimchen, T. E., D. Mathewson, M. D. Hocking, J. Moran, and D. Harris.** 2003. Isotopic evidence for enrichment of salmon-derived nutrients in vegetation, soil, and insects in

- riparian zones in coastal British Columbia. Pages 59-69 in *Nutrients in salmonid ecosystems: sustaining production and biodiversity*. Edited by J. Stockner, American Fisheries Society Symposium 34, Bethesda, Maryland, USA.
- Robbins, C. T.** 1993. *Wildlife feeding and nutrition*. Academic Press, New York, New York, USA.
- Shaw, H.** 1963. Insectivorous white-tailed deer. *Journal of Mammalogy* 44: 284.
- Shea, D. S.** 1973. White-tailed deer eating salmon. *Murrelet* 54: 23.
- Steele, M. A.** 1998. *Tamiasciurus hudsonicus*. *Mammalian Species* 586: 1-9.
- Wells-Gosling, N., and L. R. Heaney.** 1984. *Glaucomys sabrinus*. *Mammalian Species* 229: 1-8.
- Willson, M. F., and K. C. Halupka.** 1995. Anadromous fish as keystone species in vertebrate communities. *Conservation Biology* 9: 489-497.
- Willner, G. R., G. A. Feldhamer, E. E. Zucker, and J. A. Chapman.** 1980. *Ondatra zibethicus*. *Mammalian Species* 141: 1-8.
- Yahner, R. H.** 2003. Pine squirrels (*Tamiasciurus hudsonicus* and *T. douglasii*). Pages 268-275 in *Wild mammals of North America: ecology, management, and conservation*. Edited by G. A. Feldhamer, B. C. Thompson and J. A. Chapman. Second Edition. John Hopkins University Press, Baltimore, Maryland, USA.

Received 4 November 2004

Accepted 5 December 2005