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Common Ravens Conditioned to a Nutritious Seasonal Aquatic Food Source in Rocky Mountain National Park

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Common Ravens (*Corvus corax*) are among the most intelligent of birds with extraordinary problem-solving capabilities (Heinrich 1995, Heinrich and Bugnyar 2005). Their intelligence, behavioral flexibility, and omnivorous diet allow ravens to adapt to many conditions and innovatively learn foraging behaviors, especially in context with human landscape changes and food sources (e.g., Ficken 1977, Andersson 1989, Heinrich 1995, Lefebvre et al. 1997). Ravens can also identify interconnections between stimuli and potential unseen food resources. For example, a controlled experiment in Wyoming found that Common Ravens learned to fly toward gunshots, but only in forested areas where the auditory stimuli would be most beneficial for locating carcasses or gut piles; they did not respond to other loud sounds like airhorns or slamming car doors (White 2005). In another study, ravens learned to follow researchers who were setting up artificial nests so they could immediately raid them (Vander Haegen et al. 2002).

Common Ravens in Rocky Mountain National Park (RMNP), Colorado, have learned to associate with human activity and obtain a nutritious aquatic food source during a seasonal event with a short timeframe. Near the Sprague Lake picnic area in RMNP there is an annual fall spawn run of nonnative brook trout (*Salvelinus fontinalis*) from Sprague Lake into Boulder Brook, its inlet creek. At this time, the spawning fish in the stream are targeted and readily caught by fishermen. The spawn run starts in late September and is usually available to fisherman until ice covers the water, typically early November. Many of the ripe female fish are bulging with eggs and often release varying amounts of eggs when handled by fishermen for hook removal or even just through struggling at the end of the line. Here, Common Ravens were observed on multiple occasions to have learned to obtain a human-enabled, but aquatic food source, brook trout eggs.

Common Ravens apparently have developed the behavior of waiting near a fishermen and then moving in to pick up eggs when released from a captured fish, having learned that these eggs are a

food source. This behavior for Common Ravens was not observed on 26 September 2017 during a visit early in the spawn run of brook trout. However, during a visit on 17 October 2017, a Common Raven was observed following fishermen and foraging on eggs released from female trout (Fig. 1). All eggs were swiftly consumed leaving only smear to indicate where they had been. During another visit on 2 November 2017 the same behavior was again observed, except this time a second raven joined in once one raven began obtaining brook trout eggs (Fig. 2). This is expected behavior because ravens are opportunistic scavengers that assemble in non-kin groups (Parker et al. 1994), often on ephemeral food sources.

This behavior of conditioning to fishermen during the brook trout spawn run at Sprague Lake was also observed for Gray Jays (*Perisoreus canadensis*) from 2010 to 2012 (Engeman and Wiloth 2014), but not thereafter. Gray Jays are common in many picnic areas such as at Sprague Lake because they also readily learn that humans can be excellent sources of food (e.g., Rutter 1969). However, during September 2013 the RMNP area experienced heavy rains on consecutive days, which led to significant flooding on all streams regionally. These floods destroyed the primary access routes to RMNP. The lack of access, coupled with a lapse in funding for the federal government that caused RMNP to be closed for a fortnight, resulted in few visitors to RMNP in general and Sprague Lake in particular. The attraction to anthropogenic food sources in the area by Gray Jays appeared broken. Consequently, observations on 18 October and 14 November 2013 at Sprague Lake found no Gray Jays at the nearby picnic ground nor were any seen in conjunction with a fisherman at the stream, even though captured female brook trout were releasing eggs when handled (Engeman and Wiloth 2014).

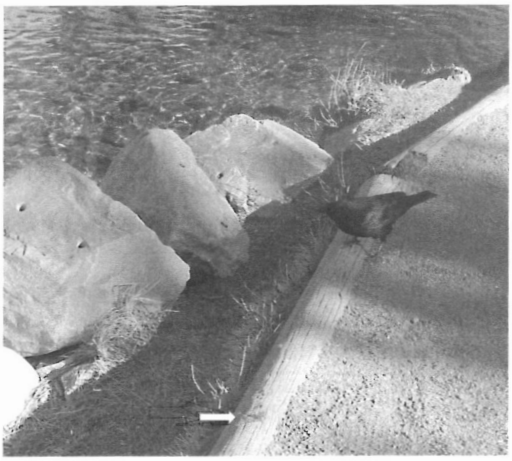

Fig. 1. In the foreground is a batch of brook trout eggs (arrow) released from a female fish, when handled by a fisherman, onto the log marking a path beside Boulder Brook in Rocky Mountain National Park. A Common Raven that had been following the fisherman is advancing along the log to consume the eggs.

Observations were also

made on a total of 12 occasions from September to November during the brook trout spawn runs across 2014, 2015, and 2016. Neither Common Ravens nor Gray Jays were observed using fishermen as a signal that a food source in the form of brook trout eggs would be forthcoming. The behavior observed for Common Ravens in 2017 appeared to have developed in the three weeks between 26 September and 17 October.

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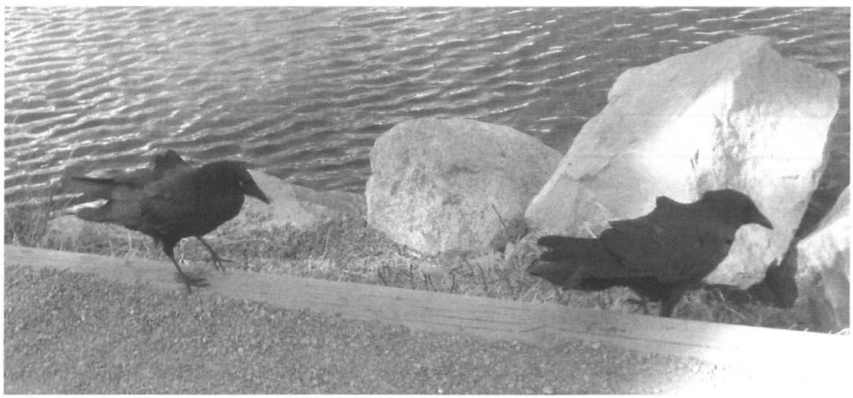

Fig. 2. After a single Common Raven that had been following a fisherman began consuming brook trout eggs released from a female fish handled by the fisherman a second raven arrived and also began foraging on the brook trout eggs.