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COMMENTARY

Food waste is still an underappreciated threat to wildlife

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Large quantities of food produced for human or livestock consumption are lost during production, transportation and storage, or simply dumped and discarded (Oro *et al.*, 2013; Gordon *et al.*, 2016). If this food is subsequently eaten by wildlife it can alter their ecology and behavior (Newsome *et al.*, 2015), in some instances affecting their health and exacerbating human-wildlife conflicts (Newsome & van Eeden, 2017). Despite such outcomes, and the potential to improve food security, there does not appear to be a major management shift to reduce food waste today. The study by Gangadharan *et al.* (2017) goes some way to addressing this issue for two reasons.

First, it is one of few studies to quantify the amount of food that is wasted by humans, in this instance grain that has spilled from moving freight trains. Gangadharan *et al.* found that around 110 tons of grain may be deposited on average per year in Banff and Yoho National Parks.

Second, Gangadharan *et al.* use their results to determine how many grizzly bears *Ursus arctos horribilis* could be supplemented by the spilt grain. They found that 42–54 grizzly bears could be supported, which is a high number given the total regional population is estimated at 50–73 animals. Without this estimate it would be very difficult to convince those who operate the trains to make substantial changes in grain management, because the amount of grain lost represents a tiny fraction of the total transported (millions of tons).

An outstanding question, however, is what happens to grizzly bear populations when the grain is removed? Gangadharan *et al.* note that the removal of the grain needs to be carefully planned so as to minimize the impact on bears that may rely on the grain as a food source. But what is needed, in addition to careful planning, is an investigation into the population density and dynamics of grizzly bear populations before, during and after a concerted effort to remove or properly transport the grain. Such insights would aid in determining how best to deal with the fact the many animals around the world have become dependent on human-provided foods (Oro *et al.*, 2013; Newsome *et al.*, 2015).

Gangadharan *et al.*'s focus was on the quantity of grain that may be available to grizzly bears. But bears represent a small part of the food chain and it is important to consider the broader consequences of this food source on ecosystems (Newsome & van Eeden, 2017). Grain deposition, for example, can disperse seeds (Bailleul *et al.*, 2012) and alter soil nutrients, and provides resources for organisms from invertebrates to large vertebrates (Oro *et al.*, 2013). Thus, there are likely to be ecosystem-wide effects when grain is available, rather than on single species. Indeed, Murray *et al.* (2017) analyzed scat content in the same area and found that not only were grizzly bear scats collected near the railway line more likely to contain grain, but they were also more likely to contain hair from ungulate carcasses and exoskeletons from ants, as the bears consumed other scavengers also using the grain resources, indicating that food waste can influence multi-level trophic systems in complex ways.

More broadly, research on the impacts of food waste has mostly focused on large, charismatic species and birds. Research on the effects of railway lines on wildlife, in particular, has focused mostly on large-bodied animals like bears and moose (Dorsey, 2011), perhaps because these species are conspicuous, receive conservation attention, and as large-bodied animals can cause damage to trains (Dorsey, Olsson & Rew, 2015). A bias typical of scientific research in general (Clark & May, 2002), there appears to be limited research on the effect of food waste on non-marine invertebrates, and thus our knowledge of food waste impacts is limited to a small component of whole ecosystems from a mostly top-down perspective.

Evidently, there remain several major gaps in our understanding of the consequences of food waste on ecosystems and wildlife. By quantifying grain spillage in these Canadian National Parks and the potential significance for bears, Gangadharan *et al.* has opened up opportunities for further research on consequences to the broader ecosystem. We need

to quantify various examples of resource provision and expand our research to include broader trophic levels, in order to appreciate the full extent to which food waste impacts on wildlife.

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