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Note

Interactions between Elk (*Cervus canadensis*) and invasive Feral Swine (*Sus scrofa*) on the Canadian Prairies

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Abstract

Elk (*Cervus canadensis*), a native species on the Canadian Prairies, makes extensive use of agro-ecosystems. Feral Swine (*Sus scrofa*) is a highly invasive species introduced to western Canada in the late 1980s; it is now endemic and rapidly expanding its range across the Canadian Prairies. Here we consider a series of 14 trail camera photos obtained near St. Breiux, Saskatchewan on 18 November 2018. Taken at night over 67 minutes, they document close, non-aggressive encounters between Elk and Feral Swine. We believe that these are the first documented observations of close (<5 m) interactions between free-ranging Elk and Feral Swine in North America that include no indications of fear response or displacement of one species by the other. These types of indirect interactions among species have important implications in terms of potential risk of disease transmission and interpreting potential ecological impacts of invasive Feral Swine on native large mammals.

Key words: Behaviour; *Cervus canadensis*; Elk; Eurasian Wild Boar; indirect contact; invasive species; *Sus scrofa*; Feral Swine

Feral Swine (*Sus scrofa*), also known as feral pig or wild hog, is not native to North America and is a complex hybrid of Eurasian Wild Boar and domestic pigs (Keiter *et al.* 2017; Michel *et al.* 2017). Over the last 35 years, the species has been imported from Europe and Asia to all ten Canadian provinces and Yukon as domestic livestock for meat production and penned shoot operations in Alberta, Saskatchewan, and Quebec (Michel *et al.* 2017). Escapes and purposeful releases of domestic animals have resulted in endemic populations of free-ranging Feral Swine in all provinces except Atlantic Canada (Brook and van Beest 2014; Michel *et al.* 2017; Aschim and Brook 2019). Currently, most Feral Swine in Canada are in Saskatchewan, where they continue to spread rapidly (Aschim and Brook 2019). Ecological impacts of Feral Swine on large mammals have been well documented through habitat damage, predation, and aggressive interactions that displace native mammals (Barrios-Garcia and Ballari 2012).

Trail camera photos of large mammals in central Saskatchewan have confirmed the presence of both Elk (*Cervus canadensis*) and Feral Swine on the landscape, but show that Elk avoid Feral Swine at the scale of the individual trail camera location (O'Brien 2019). Contrary to these findings, herein we report an observation of a prolonged, non-aggressive close interaction (<5 m) between a young male Elk and a sounder group of Feral Swine in the same study area as that of O'Brien (2019). A sounder group typically comprises a mature female along with several generations of her mature female offspring and one or two litters of young born that year. Adult males visit sounders regularly and mate with any receptive females. On the Canadian Prairies, observed sounder size ranges from three to 36 animals (R.K.B. unpubl. data).

We obtained a set of trail camera photos (Figure 1) from a landowner living near the town of St. Breiux (52°37′N, 104°51′W) in central Saskatchewan, Canada, that included Elk and Feral Swine in the same images. The study area is an agro-ecosystem that includes extensive annual and perennial agricultural cropland mixed with patches of deciduous forest and wetland (Stolle *et al.* 2015; O'Brien *et al.* 2019). On 18 November 2018, 14 images were collected from an unbaited trail camera (Moultrie, Calera, Alabama,

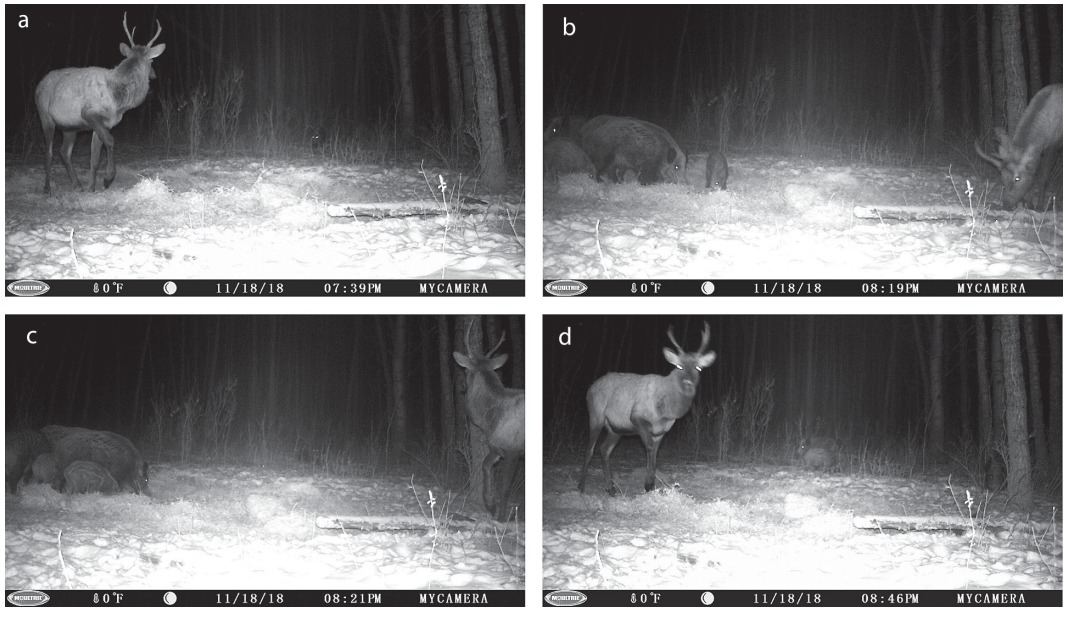

FIGURE 1. A subset of trail camera photos of a juvenile yearling male Elk (*Cervus canadensis*) interacting with a group of five invasive Feral Swine (*Sus scrofa*) from 14 images taken near St. Brieux, Saskatchewan on 18 November 2018. a. Elk looking at a Feral Swine moving into the site (1939). b. Elk feeding near Feral Swine (2219). c. Elk looking up at another Feral Swine moving into the site (2021). d. Elk looking at the trail camera with three Feral Swine in the background. Piglets (<6 months of age) are distinguished by their smaller size and horizontal lighter coloured stripes.

USA) over 67 minutes from 1939 to 2046 (Figure 1). At the time the images were taken, there was a thin ground cover of snow and the temperature recorded by the camera was −18°C. Each image includes a yearling "spike" bull Elk. A spike bull is defined as an antlered juvenile male with no branching of either antler (Slabach *et al.* 2018). The same images also included one to five Feral Swine that were part of the sounder group described above and were in the general area, sometimes within the range of the camera and sometimes not. In the images, the animals are standing or feeding on vegetation (Figure 1). To our knowledge, this is the first published photographic evidence of fine-scale, non-aggressive interactions between Elk and Feral Swine in North America.

Trail camera photographs of wildlife interactions provide important insights into their complex behaviour and ecology in the absence of human observers (Caravaggi *et al.* 2018). Feral Swine are highly invasive in Canada and are spreading rapidly, especially on the Canadian Prairies (Aschim and Brook 2019). They can be extremely aggressive toward other animals and will predate a range of species (Desbiez *et al.* 2009; Barrios-Garcia and Ballari 2012). Feral Swine are opportunistic, generalist feeders and have been found to eat various vertebrate species (Ballari and Barrios-Garcia 2013). In a comprehensive worldwide review of diets of introduced Feral Swine in North America (hybrids of Wild Boar and domestic pigs) and native Wild Boar in Europe and Asia, Ballari and Barrios-Garcia (2013) concluded that, in their native ranges, Wild Boar populations generally consume fewer vertebrate prey than those where Feral Swine have been introduced. The increased consumption of vertebrates in areas where Feral Swine were introduced is likely a result of the evolution of native vertebrates without Feral Swine as predators (Ballari and Barrios-Garcia 2013). Because Feral Swine are opportunistic, generalist feeders, they are able to switch to a local, seasonally abundant, vertebrate prey, such as Elk calves or deer fawns (Wilcox 2015). Habitat damage by Feral Swine may also displace native mammals (Singer *et al.* 1981; Barrios-Garcia and Ballari 2012).

Contrary to past evidence, our trail camera photos document a prolonged (>1 h) interaction between a juvenile male Elk and a sounder group of Feral Swine. Observations of the Elk feeding and lying <5 m from actively foraging Feral Swine, and in some cases much closer, indicate a lack of aggressive response by the Feral Swine and a corresponding lack of detectable fear response or displacement of one species by the other. These observations indicate that not all interactions between Elk and Feral Swine are

aggressive. In contrast, Pellerin (1993) found that Roe Deer (*Capreolus capreolus*) avoided Wild Boar feeding areas. Indeed, Feral Swine are more recognized as competitors with and predators on other large mammals such as White-tailed Deer (*Odocoileus virginianus*; Seward *et al.* 2004).

Indirect interactions among species through shared feeding sites that are close together in time and space are an important concern in terms of disease transmission, as vegetation and soil can act as fomites, carrying pathogens. Elk and Feral Swine share food sources, and this may function as an indirect route of disease transmission (Richomme *et al*. 2005). Both Elk and Feral Swine are effective hosts of bovine tuberculosis, and the *Mycobacterium bovis* bacterium can be spread via saliva on feed, especially in winter when cold temperatures allow it to survive for up to six months in the environment (Phillips *et al.* 2003). Similarly, chronic wasting disease (CWD) prions can be spread through the environment among many species including Elk, Feral Swine, Mule Deer (*Odocoileus hemionus*), White-tailed Deer, and Moose (*Alces americanus*), which are all found in this study area (O'Brien *et al.* 2019). CWD prions can survive in the environment for years, likely resulting in a very high risk of indirect disease transmission among species (Zabel and Ortega 2017). The potential for disease transmission will likely increase in species that show tolerance toward Feral Swine and remain in close proximity. If an individual Feral Swine becomes infected with CWD, transmission will be much more frequent within its group than between different groups of Feral Swine, potentially imposing social constraints on disease transmission and limiting spread (Podgorski *et al.* 2018). Further research using global positioning system (GPS) collars, trail cameras, habitat analysis, and disease testing is required to better understand the impacts and risks of invasive Feral Swine to Elk and other native large mammals on the Canadian Prairies.

Author Contributions

Writing – Original Draft: R.K.B.; Writing – Review and Editing: R.K.B. and M.J.C.; Conceptualization R.K.B. and M.J.C.; Funding Acquisition: R.K.B.

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