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BALD EAGLE PREDATION ON SITKA BLACK-TAILED DEER FAWNS

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Bald Eagles (*Haliaeetus leucocephalus*) are known predators, but records of predation on large mammals are limited and highly seasonal. During winter, Bald Eagles are known to scavenge but not predate large mammals (Ewins and Andress 1995; Elliott and others 2011). In contrast, while records of active predation are rare even during nesting season, several instances have been documented (Vermeer and Morgan 1989; Hayward 2009). Diets of nesting Bald Eagles are diverse, and include large mammals such as deer (Vermeer and Morgan 1989; Watson 2002), in addition to other dietary items ranging from anthropogenic trash to dead and live fish, marine invertebrates, seabird eggs and young, and other mammal species (Hansen and Hodges 1985; Vermeer and Morgan 1989; Watson 2002; Anthony and others 2008). While consumption of large mammals by Bald Eagles typically occurs when they scavenge dead animals, evidence is accumulating that Bald Eagles actively predate the young of large mammals during nesting season. For example, Bald Eagles have been documented preying on Harbor Seal pups (*Phoca vitulina*; Hayward 2009) and Sea Otters (*Enhydra lutris*; Anthony and others 2008) during summer. In addition, Bald Eagles have killed young ungulates during summer, including fawns of White-tailed Deer (*Odocoileus virginianus*; Duquette and others 2011), lambs of domestic sheep (Smith 1936; McEneaney and Jenkins 1983), and likely Woodland Caribou calves (*Rangifer tarandus caribou*; Environment Canada 2011).

Southeast Alaska is home to the largest population of Bald Eagles in the United States (Hodges 2011), where abundant marine resources are important for breeding success and survival (Anthony 2001; Elliott and others 2011). In this ecosystem, Sitka Black-tailed Deer (*Odocoileus hemionus sitkensis*) are the dominant large ungulate (Hanley 1993; Alaska Department of Fish and Game 2009). Neonatal fawns are small and highly vulnerable to predation (Gilbert and others 2014), and are thus a potential source of prey to nesting Bald Eagles on Prince of Wales Island.

Here, I report the likely predation of 2 Sitka Black-Tailed Deer fawns by Bald Eagles. These are the 1st recorded incidents of Bald Eagle predation on deer fawns in this ecosystem and, to my knowledge, of *Odocoileus hemionus*; however, there have been 2 previously recorded predation events on White-Tailed Deer fawns (Line 1961; Duquette and others 2011).

Between 2010 and 2012, I radio-collared 154 neonatal deer on central Prince of Wales Island, the largest island in the Alexander Archipelago of Southeast Alaska (Fig. 1). All animal capture and handling was carried out in accordance with the University of Alaska Fairbanks Institutional Animal Care and Use Committee (IACUC #136040-14) regulations. Fawns were captured as part of a study of deer habitat and predator-prey relationships in the temperate rainforest ecosystem of Southeast Alaska. Fawn capture methods are described in detail in Gilbert and others (2014). Following capture, I monitored fawns in early morning and late afternoon of each day during the summer (from birth until 1 August), and investigated mortalities as soon as possible when a mortality signal was received from a radio collar. As a result, I investigated all mortalities within 24 h, and typically within 12 h, allowing accurate identification of cause of death based on site and carcass conditions. In addition, this twice-daily monitoring schedule allowed for classification of diurnal versus nocturnal mortalities.

Prince of Wales Island is known to support the highest density of nesting Bald Eagles ever recorded, with average distances between neighboring nests of 3.1 km (Anthony 2001). In addition, Anthony (2001) recorded extremely low nest success and number of fledglings per nest, and suggested food limitation during early nesting season, before the arrival of anadromous salmon in streams, as a probable cause. Bald Eagles were common in the study area, and

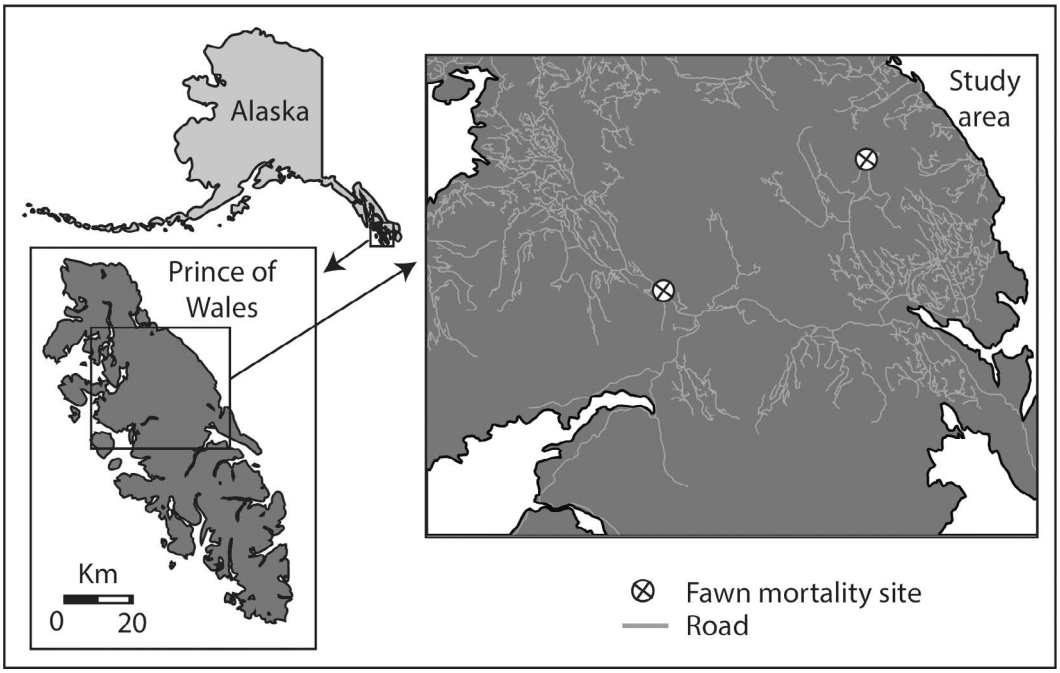

FIGURE 1. The study area, located on central Prince of Wales Island, the largest island in the Alexander Archipelago of Southeast Alaska. Roads are shown as pale grey lines, while fawn mortality sites where Bald Eagles likely killed fawns are shown as black crosses in white circles.

while I did not record nesting activity as part of this study, eagle sightings were frequent throughout the summer months. Given the high recorded nest densities, most fawns likely had active eagle nests relatively nearby.

In 2011, I recovered 2 radio-collared (VHF) fawns on Prince of Wales Island that I suspected succumbed from Bald Eagle predation. These fawns accounted for 3.5% of 56 radio-collared fawns in that year and 3% of total fawn mortality ($n = 63$) across the 3 y of the study, equating to a 1.3% mortality rate from eagles across the 3 y of the study. The 2 fawns were radio-collared on 3 June and 6 June, weighed 2.9 and 3.1 kg at capture, and were killed 8 June and 7 June, respectively. Fawns were approximately 5 d old at capture (Gilbert and others 2014), and thus were <2 wk old at death. Fawns spend much of their time bedded and sedentary during the first 2 wk of life, but engage in several nursing bouts each day, and thus could have been either active or sedentary at the time of attack. Based on the timing of last-known-alive and detection of mortality signals of fawns, mortalities occurred between 08:00 and 12:00, and 08:00 and 18:00, respectively, although 1 mortality was not investigated until the following day due to logistic constraints. The circumstances of mortality were similar: both mortalities occurred between 100 to 200 m from capture location, within 10 m of roads that were frequently used for transit and timber harvest, among low-growing (<30 cm) grasses and forbs with no direct canopy cover, but near forest edges.

The fawn carcasses initially appeared unharmed (Fig. 2), but upon further inspection had puncture wounds in the abdomen and thorax. Carcasses were transported to the field station for necropsy, revealing 2 to 5 clean, deep, parallel puncture wounds with corresponding severe internal hemorrhages and organ damage in both fawns.

While I did not witness the Bald Eagle predation events I describe here, the weight of evidence for Bald Eagle predation of live Sitka Black-tailed Deer fawns is strong. The profuse internal hemorrhaging of the fawns indicated that the talon-induced puncture wounds occurred while fawns were still alive (Wiley and Bolen 1971). The timing of mortality events

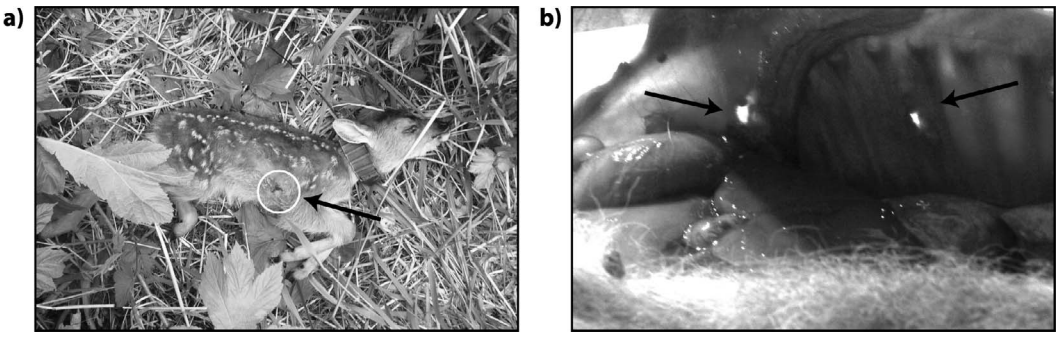

FIGURE 2. Eagle predation was the cause of death for 2 fawns during 2011. Fawns were a) killed in low vegetation near roadways, and not carried off or consumed, and b) died from puncture wounds and associated internal hemorrhaging. Arrows indicate locations of puncture wounds.

indicated that they occurred during the day, and there are no other diurnal avian predators of sufficient size in the ecosystem to have caused the observed injuries. Golden Eagles (*Aquila chrysaetos*), while much better known as predators of young ungulates, occur only rarely and sporadically and are not known to breed in Southeast Alaska (Kochert and others 2002). Other documented fawn predators in the ecosystem include Black Bears (*Ursus americanus*; Gilbert and others 2014) and Wolves (*Canis* spp.; Dave Person, Alaska Department of Fish and Game, pers. comm.). These mammalian predators would not inflict the observed clean, parallel wounds, nor leave the fawn carcasses unconsumed. As a result, I feel confident that the mortalities were caused by Bald Eagles.

I suggest that fawns were predated by Bald Eagles because sight-ability along roads is high for Bald Eagles compared to most other habitats in the dense vegetation of the study area; and while fawns were marginally too heavy to carry away, eagles may still have perceived fawns as potential prey. Also, fawns may have been more prone to mortality along roads because adult female Sitka Black-Tailed Deer spatially select for roads (Alaska Department of Fish and Game 2009). Predation along roads may also explain why fawn carcasses were abandoned. The roads along which the likely eagle attacks occurred were frequently used by vehicles, and eagles could have been flushed during the initial attack on fawns, or before eagles could feed. While lifting ability of Bald Eagles has not been directly measured, the similarly-sized Golden Eagle can lift 2 lbs (0.91 kg) easily, and up to 4 lbs (1.8 kg) with difficulty (Huey 1962). Mean capture weight for fawns in our study was 5.79 lbs (2.63 kg), and the weights of the eagle-killed fawns were 4.18 and 6.82 lbs at capture, suggesting that most but not all fawns in this ecosystem are outside the weight-lifting capacity of Bald Eagles, and that the eagle-killed fawns reported here were likely too heavy to be lifted by an eagle.

Bald Eagle populations were greatly reduced in many areas of the lower 48 states and Canada during the late 20th century, but populations have rebounded in recent years due to changes in environmental policy (Elliot and others 2011; Hodges 2011). The increase in Bald Eagle populations is raising concerns in some areas that prey populations could be impacted (Hayward and others 2010; Elliot and others 2011). However, I found that the high-density eagle population in our study area in Southeast Alaska (Anthony 2001) predated fawns at very low rates. As a result, I suggest that recovering breeding populations of Bald Eagles in the Pacific Northwest (Watson 2002; Elliot and others 2011; Harvey and others 2011) are unlikely to negatively impact Black-Tailed Deer populations. Instead, high-density breeding populations of Bald Eagles appear to compete for food resources (Anthony 2001; Elliot and others 2011), which can be highly variable among years (Anthony 2001), likely leading to eagles seeking alternative prey such as deer fawns during years of food scarcity.

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