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Golden Eagle (*Aquila chrysaetos*) breeding phenology and tree nesting in Wapusk National Park, Manitoba

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Abstract

Golden Eagle (*Aquila chrysaetos*) is a wide-ranging apex predator, yet the breeding ecology of eastern populations in North America remains poorly documented, particularly near the northern and western extent of their breeding range. Here, we present evidence of Golden Eagle reproduction in Wapusk National Park, northern Manitoba, documenting three in-use nests containing nestlings. All nests were located in large White Spruce (*Picea glauca*) trees in riparian forest, highlighting trees as an important nesting structure in this low-relief, cliff-free landscape. Estimated laying and hatch dates suggest that breeding phenology aligns with northern populations in Nunavut, Northwest Territories, Yukon, and northern Quebec. These observations provide new insight into breeding timing and nest-site use by Golden Eagles in a subarctic environment, where reproduction likely occurs within a narrow seasonal window. Despite a small sample size, our study establishes a baseline for future monitoring in Wapusk National Park and contributes to a broader understanding of Golden Eagle breeding ecology in northern Canada.

Key words: Golden Eagle; *Aquila chrysaetos*; Wapusk National Park; Manitoba; Hudson Bay Lowlands; subarctic ecology; raptors; breeding phenology; life history; egg laying and hatch dates

Introduction

Golden Eagle (*Aquila chrysaetos*) is a large, territorial raptor with a circumpolar distribution that includes diverse ecosystems from deserts to boreal forests and tundra (Watson *et al.* 2010; Morneau *et al.* 2015). Despite their wide range, significant knowledge gaps remain regarding the ecology, demographics, and breeding biology of eastern populations of Golden Eagles, found in central and eastern Canada, spanning Manitoba, Ontario, Quebec, and Labrador (Katzner *et al.* 2012, 2023; Morneau *et al.* 2015). Most research on Golden Eagles has focussed on western populations in North America, from Saskatchewan to Alaska, or on European populations (Katzner *et al.* 2020). In contrast, eastern populations breed at low densities in remote and often inaccessible landscapes, limiting direct observations during the nesting season and making it difficult to assess their population status and life history. Nevertheless, recent work has begun to address these gaps. This includes evidence of geographic genetic structure across North America (e.g., Doyle *et al.* 2016 found animals living closer together had similar genetic profiles), documentation of seasonal home-range use from global positioning system (GPS) telemetry (Miller *et al.* 2017), and identification of key breeding habitats in eastern Canada (Maynard *et al.* 2024).

The subarctic environment of Wapusk National Park in northern Manitoba presents unique ecological challenges for breeding Golden Eagles. A short breeding season, seasonal prey fluctuations, and limited nesting opportunities likely affect their reproductive success and behaviour. Golden Eagles are long-lived, monogamous raptors that exhibit high site fidelity, often reusing nest sites over multiple years (Watson *et al.* 2010; Katzner *et al.* 2020). Their breeding cycle varies by latitude, with northern populations having a condensed nesting season because they migrate. In southern populations, territoriality and nest-building may begin as early as October and extend up to 12 months, whereas in migratory northern populations, the cycle is shorter, beginning in March–April and

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typically concluding by September (Katzner *et al.* 2020). Egg laying in northern latitudes occurs from late March to early May, with hatching from late May to early June (Young *et al.* 1995; Sinclair *et al.* 2011; McIntyre and Schmidt 2012; Morneau *et al.* 2012). The post-fledging dependency period can last weeks to months after young leave the nest, making it difficult to determine timing of final dispersal (Katzner *et al.* 2020).

Breeding-site selection varies across their range. Breeding home ranges of eastern populations of Golden Eagle are dominated by forest in southern portions of their range and by more open areas farther north (Miller *et al.* 2017; Maynard *et al.* 2024). Eagles appear to favour open or semi-open landscapes, which provide key habitat for prey species and facilitate hunting (Watson *et al.* 2014; Miller *et al.* 2017; Maynard *et al.* 2024). Golden Eagles typically nest on cliffs where suitable sites are available; however, in a landscape lacking cliffs, trees may be used as an alternative nesting substrate (Watson *et al.* 2010). Tree nesting appears to represent a secondary strategy rather than a preferred option and is most often observed where cliff habitat is absent or limited.

A typical Golden Eagle nesting territory contains multiple nests that the pair may switch between from year to year (Millsap *et al.* 2015). Alternative nests are often within core territorial areas and may be revisited even when not used during a breeding season (Millsap *et al.* 2015). Although eagles frequently reuse nests, they may also construct new ones following failed breeding attempts, loss of nest, or after returning from migration (Kochert and Steenhof 2012).

Previous reports in Wapusk National Park (Asselin *et al.* 2013) suggest probable breeding activity, indicated by the presence of adult Golden Eagles near nests and white down feathers, a sign of successful reproduction. In 2011, during surveys for the Manitoba Breeding Bird Atlas, four pairs were observed along the Owl River, although no nests were documented. In 2012, three pairs were observed near stick nests in trees along the Broad River (Asselin *et al.* 2013; Figure 1). In 2013, a motion activated trail camera deployed near one nest (GOEA4; Figure 1) photographed a nestling (Asselin and Koes 2018). Additional nesting locations in Wapusk National Park have been suspected based on telemetry records and inferences of broader species distribution (A.B. unpubl. data; McCabe *et al.* 2021).

Building on this foundation, opportunistic visits to known and suspected nests in 2023 and 2024 provided photographs of nestlings at multiple sites and confirmed suspected nests. These observations allowed us to estimate age of nestlings and approximate key breeding dates, adding phenological detail that has not previously been reported for Golden Eagles breeding in northern Manitoba. Here, we present our observations and discuss their significance for understanding Golden Eagle life history, conservation, and management in northern Manitoba.

Methods

Our observations were in Wapusk National Park (58.66201°N, 93.19061°W), northeastern Manitoba (Figure 1). The park encompasses a transition from extensive coastal fens and bogs to taiga forest in the southwest and barren Arctic tundra in the northeast (Brook 2001; Brook and Kenkel 2002). The terrain is relatively flat, with elevations ranging from sea level along the Hudson Bay coastline to a peak of 86 m in the park's western region. Wapusk National Park lacks cliffs, which are commonly associated with eagle nesting habitat (Miller *et al.* 2017; Maynard *et al.* 2024). Trees suitable for nesting are largely confined to riparian corridors along rivers and creeks and form forested bands around lakes. This landscape presents unique ecological conditions that may influence Golden Eagle nest-site selection, breeding success, and prey availability.

Previously documented Golden Eagle nests in Wapusk National Park (GOEA nests 1–4; Figure 1; Asselin *et al.* 2013) and one additional nest location, suspected based on GPS data (GOEA nest 5), were opportunistically surveyed by helicopter during other monitoring activities in July, August, and September 2023 and in July 2024. At each site, observers documented the presence and number of eagles, photographed birds and nests using a telephoto lens, and recorded potential signs of breeding activity, such as the presence of white down feathers or nestlings.

Free-flying Golden Eagles were aged based on photographic evidence of four primary plumage characteristics (Coble 2013, adapted from Liguori 2004). Individuals were categorized as nestlings (≤1 year old), subadults (2–4 years old), or adults (≥5 years old).

Nestling age (in days) was estimated using the photographic reference guide outlined by Hardey *et al.* (2014). We then back-calculated probable hatch dates and, using an average incubation period of 42 days (range 41–45 days as reported by Katzner *et al.* 2020), estimated egg-laying dates.

Results

During the summers of 2023 and 2024, we conducted 12 visits to four known Golden Eagle nests and one suspected nest in Wapusk National Park (Figure 1). Over this period, we recorded 19 individual Golden Eagles at or near the nests and successfully photographed and aged 12 of them. Among the aged

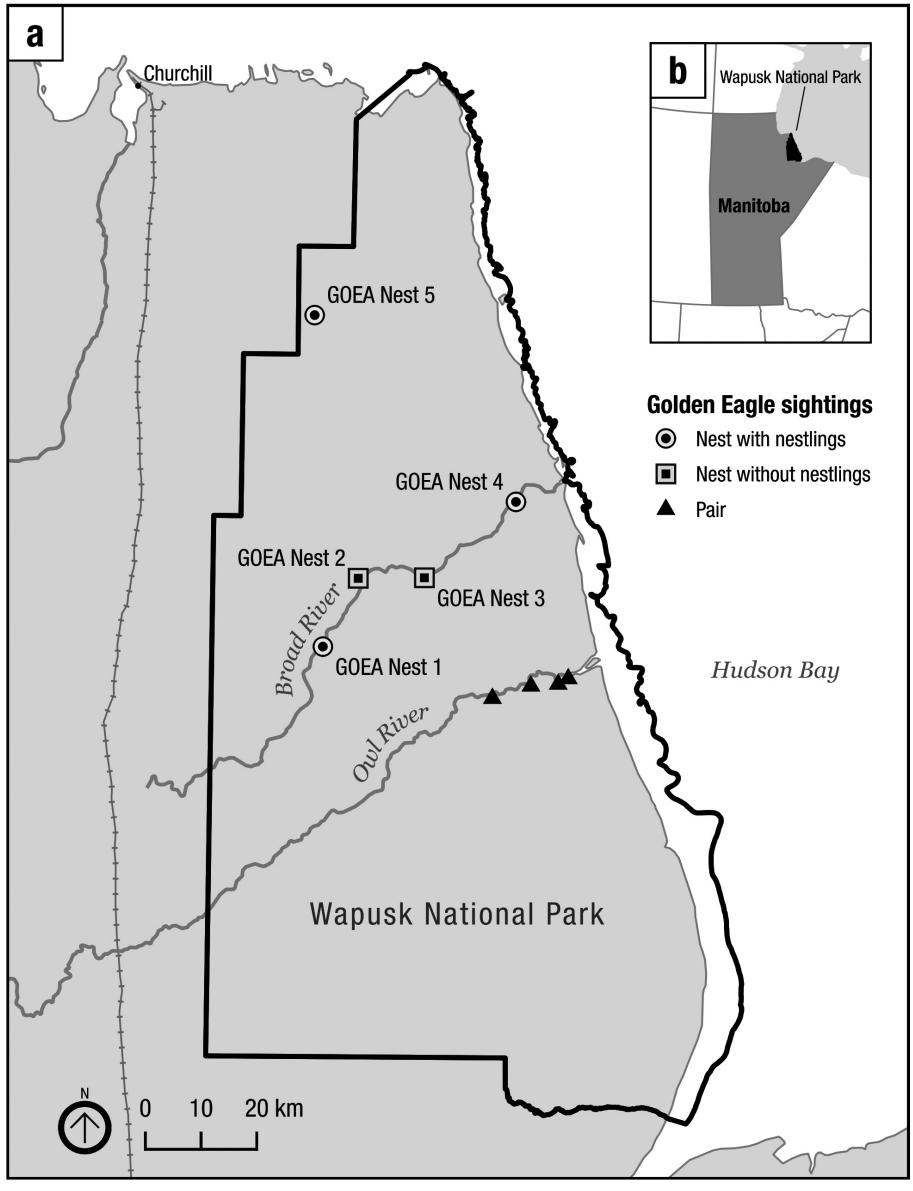


FIGURE 1. a. Locations of all known Golden Eagle (*Aquila chrysaetos*) nests and territories in Wapusk National Park. Circles indicate nests where nestlings were observed during surveys in 2023 and 2024, squares indicate nests without nestlings, and triangles indicate paired adults observed during the Manitoba Breeding Bird Atlas surveys in 2011 (Asselin *et al.* 2013). b. Location of Wapusk National Park in Manitoba, Canada.

individuals, we identified four nestlings, two subadults, and six adults (Figure 2, Table 1). At all five nests, we observed Golden Eagles on or near the nest during at least one visit. Only adults were observed at or near nests containing nestlings.

Three nests were confirmed as in use during the study period, each containing nestlings; one contained two nestlings, while the other two each contained a single nestling, for a total of four. We estimated their ages and hatch and egg-laying dates (Figure 2, Table 2).

All five nests were located in large White Spruce (*Picea glauca* (Moench) Voss) trees in riparian corridors adjacent to rivers or lakes. All nests were constructed of sticks, of varying apparent age.



Figure 2. Photographs of Golden Eagle (*Aquila chrysaetos*) observed during opportunistic surveys of nests in Wapusk National Park in 2023 and 2024. Photographs a–c document nestlings aged at a (left): 48–50 days old, b: 70–72 days old, and c (left): 55–57 days old and (right): 57–60 days old. Photographs a, d, and f document mature adults aged a (right): 5+ years old (known to be at least 10 years old as this bird was banded and tagged with a GPS backpack in 2019 as an adult), d: 5+ years old, and f: 6+ years old. Photograph e documents a subadult aged 2 years old. Photos a–c, e, and f: Russell Turner. Photo d: Emily Hunt.

Discussion

Our documentation of three active nests containing four nestlings close to fledging age provide the first estimates of key breeding dates for Golden Eagles in Wapusk National Park. These findings are particularly significant as the breeding ecology and population dynamics of eastern populations of Golden Eagles remain poorly documented. By estimating

TABLE 1. Age estimates for subadult (2–4 years) and adult (5+ years) Golden Eagle (*Aquila chrysaetos*) photographed at or near nest sites in 2023 and 2024 in Wapusk National Park, northeastern Manitoba, Canada.

Nest ID	Visit date	Age estimate* (classification)	Figure 2 photo	Nest with nestling
GOEA 5	20 June 2023	5+ years (adult)	n/a	Yes
GOEA 5	25 July 2023	5+ years (adult)†	a (right)	Yes
GOEA 2	15 Sept 2023	5–6 years (adult)	n/a	No
GOEA 2	15 Sept 2023	5+ years (adult)	d	No
GOEA 2	25 July 2024	2 years (subadult)	e	No
GOEA 3	25 July 2024	4+ years (subadult)	n/a	No
GOEA 1	25 July 2024	6+ years (adult)	f	Yes

*Based on Coble's (2013) aging key.
†Known to be at least 10 years old, banded and tagged with a GPS backpack in 2019 as an adult.

nestling ages from photographs, we back-calculated hatch dates and egg-laying periods, establishing a baseline for future monitoring in the area that allows comparisons across years and populations. Together, our findings offer insight into breeding phenology and reproductive ecology in a subarctic environment.

The estimated hatch and egg-laying dates align with reported breeding timelines for other northern Golden Eagle populations in Nunavut (Poole and Bromley 1988), Northwest Territories (Shank and Poole 2016), and Yukon (Sinclair *et al.* 2011). Notably, our findings are consistent with the late May–early June hatch dates documented in northern Quebec, a region of similar latitude that is also used by eastern populations of Golden Eagles (Morneau *et al.* 2012). This similarity in nesting chronology across high-latitude regions is consistent with evidence that eastern populations of Canadian Golden Eagles exhibit high repeatability and low within-individual variation in timing of spring migration, which likely constrains the onset of breeding to a relatively narrow seasonal window (Maynard *et al.* 2024).

All nests we found were in large White Spruce trees in riparian areas near lakes and rivers. This exclusive use of tree nests is notable, as Golden Eagles most commonly nest on cliffs across much of their range in North America. Tree nesting has been documented in some regions, but typically represents a secondary strategy where cliffs are available and, in many parts of Europe, occurs in <10% of nests (Katzner *et al.* 2020). The absence of cliffs in Wapusk National Park likely necessitates reliance on trees as a nesting substrate, underscoring the species' flexibility in low-relief landscapes. All nests we observed were constructed with sticks of varying ages (Asselin *et al.* 2013), suggesting reuse across years and reflecting a strong site fidelity characteristic of Golden Eagles. Bald Eagle (*Haliaeetus leucocephalus*) are also known to nest in the region, commonly in trees (R.R.T. pers. obs.), causing potential overlap and competition for suitable locations.

Our observations highlight the importance of riparian forest habitats as nesting locations for Golden Eagles in subarctic environments lacking traditional cliff substrate. Tree nesting in riparian locations may also influence prey availability during the breeding season. Golden Eagles depend on diverse prey during the breeding season, with previous studies identifying sciurids (squirrels and marmots), leporids (jackrabbits and hares), and waterfowl (geese and ducks) as key dietary components in northern Canada (Poole and Bromley 1988). Wapusk National Park supports a rich prey community, including Snowshoe Hare (*Lepus americanus*) and migratory waterfowl, most prominently Canada Goose (*Branta canadensis*) and Snow Goose (*Anser caerulescens*). These prey species likely play a crucial role in chick provisioning during the breeding season, although fluctuations in prey abundance and climate-driven shifts in species distributions may influence reproductive success.

TABLE 2. Age estimates and laying and hatch dates for nestling Golden Eagle (*Aquila chrysaetos*) observed in Wapusk National Park, northeastern Manitoba, Canada in 2023 and 2024.

Nest ID	Visit date	Age estimate	Laying date	Hatch date	Figure 2 photo
GOEA 5	25 July 2023	48–50 days	24–26 April	5–7 June	a (left)
GOEA 4	19 August 2023	70–72 days	27–29 April	8–10 June	b
GOEA 1	25 July 2024	55–57 days	17–21 April	29–31 May	c (left)
GOEA 1	25 July 2024	57–60 days	13–15 April	25–27 May	c (right)

Demography of Golden Eagles on breeding grounds in Alaska responded strongly to environmental conditions, particularly prey availability and weather during the early nesting period (McIntyre and Schmidt 2012). In that system, variation in nesting probability and fledgling production was closely linked to prey dynamics and climatic conditions, highlighting that reproductive output can decline even when territory occupancy remains stable. Although we did not assess prey abundance or reproductive success beyond nestling age in Wapusk National Park, similar sensitivities may be expected in subarctic environments where breeding occurs within a narrow seasonal window and prey is limited. As climate change reshapes subarctic ecosystems, shifts in prey populations, weather extremes, and breeding phenology may influence nesting success and long-term population dynamics. Our findings contribute new information about the breeding ecology of an eastern population of Golden Eagles in the subarctic and highlight the importance of continued monitoring to detect changes in reproduction and habitat use in this region. Future research integrating diet analysis, nest content assessment or remote monitoring (e.g., trail cameras), and longer-term demographic monitoring would be particularly valuable.

Author Contributions

Writing – Original Draft: R.R.T. and J.S.; Writing – Reviewing & Editing: R.R.T., J.S., E.H., N.S., M.P., E.R., L.F., T.A.M., and A.B.; Conceptualization: R.R.T., J.S., E.H., N.S., M.P., E.R., L.F., T.A.M., and A.B.; Investigation: R.R.T., J.S., E.R., L.F., and E.H.; Methodology: R.R.T. and E.H.; Funding Acquisition: R.R.T. and L.F.

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