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Review paper

Conservation significance of alternative nests of golden eagles

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ABSTRACT

Golden eagles (*Aquila chrysaetos*) are long-lived raptors that maintain nesting territories that may be occupied for a century or longer. Within occupied nesting territories there is one nest in which eagles lay their eggs in a given year (i.e., the used nest), but there are usually other nests (i.e., alternative nests). Conservation plans often protect used nests, but not alternative nests or nesting territories that appear vacant. Our objective is to review literature on golden eagle use of alternative nests and occupancy of nesting territories to determine if alternative nests are biologically significant and warrant greater conservation consideration. Our review shows that: (1) alternative nests or their associated habitat are most often in core areas of golden eagle nesting territories; (2) alternative nests likely will become used in the future; (3) probability of an alternative nest becoming used is greatest where prey availability is high and alternative nest sites are limited; (4) likelihood of annual occupancy or reoccupancy of golden eagle nesting territories is high; and (5) prey availability is the most important determinant of nesting territory occupancy and breeding activity. We recommend alternative nests be treated with the same deference as used nests in land use planning.

Contents

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1. Introduction

In the United States, the US Fish and Wildlife Service (Service) and state fish and wildlife agencies (States) have responsibility for protecting and managing golden eagles under a variety of laws, most notably the Bald and Golden Eagle Protection Act (16 United States Code 668–668d; hereafter Act). The Act delegates to the Service the ability to permit take (defined by regulations to include disturbance, injury or death of eagles or destruction of nests and eggs) as "necessary for the protection of other interests in any particular locality" after determining the take is "compatible with the preservation of the bald eagle (*Haliaeetus leucocephalus*) or golden eagle (*Aquila chrysaetos*)" (scientific names added). Take by disturbance results when disruptive activities cause a decrease in eagle productivity by interfering with normal breeding, feeding, or sheltering behavior, or cause nest abandonment. Under these regulations, the Service can permit take of eagles and eagle nests under certain circumstances, but it must first assess the likely extent of take and determine that the take is compatible with the preservation of eagles. The Service defines "compatible with the preservation of eagles" as maintaining stable numbers of breeding pairs (US Fish and Wildlife Service, 2009).

The Service provides guidance on how to avoid non-lethal take of bald eagles from disturbance (US Fish and Wildlife Service, 2007) and how to assess potential lethal take of either eagle species at wind energy facilities (US Fish and Wildlife Service, 2013). Both documents acknowledge that alternative nests should be considered when assessing and predicting effects of take on eagles, but neither bases this on scientific information. Take is possible at alternative nests if potentially lethal or disturbing structures are constructed nearby and eagles subsequently re-use the alternative nest or spend time in the area. Thus, the likelihood of take associated with alternative nests depends on the probability they will be used for nesting or as activity centers in the future. Currently, wildlife managers do not know how to objectively and consistently assess the value of alternative nests to golden eagles when assessing actions that might take eagles.

Golden eagles are long-lived raptors that, in the absence of persecution and with adequate prey, generally exhibit a high degree of population stability (Kochert et al., 2002; Palmer, 1988). Under these conditions golden eagles maintain long-enduring nesting territories, some of which have been occupied at least intermittently for a century or longer (Palmer, 1988). This persistence extends long past life spans of individual eagles, such that long-term occupancy reflects serial reoccupation of nesting territories by successive individuals. Persistent occupancy of nesting territories is likely a function of: (1) long ($>$20 yr) reproductive careers of individual golden eagles (Kochert et al., 2002; Watson, 2010); (2) limited suitable nesting sites and territoriality, which constrain, in some landscapes, the number of golden eagle pairs that can breed in a given area (Hunt, 1998; Kochert et al., 2002; Palmer, 1988); and (3) long-term pair bonds (Collopy and Edwards, 1989; Harmata, 1982; Watson, 2010).

Within a typical golden eagle nesting territory in a given year there are multiple alternative nests, but eggs are laid in only one (the used nest); in rare cases, re-nesting may occur in a different nest, in which case there may be two used nests. Nests per nesting territory averaged $<$2.0 on 36 territories in Montana (McGahan, 1968), 2.4 on 49 territories in Sweden (Tjenberg, 1983), 3.4 on 411 territories in Britain (Watson, 2010; Watson and Brockie, 1997), 4.5 on 20 territories in Scotland (Watson, 2010), and 6.9 on 66 territories in Idaho (Kochert and Steenhof, 2012). Given the near universal presence of alternative nests in golden eagle territories across the species' range, it seems they serve an important function. An obvious question, then, is of what conservation significance are these alternative nests? More specifically, in situations where wildlife managers must protect golden eagles, do presence and location of alternative nests predict relatively high levels of current or future use of an area by golden eagles? Or, do they solely reflect past use?

In this paper we review scientific literature and identify knowledge gaps on use of alternative nests by golden eagles. We distinguish between two types of alternative nests: (1) currently un-used nests in occupied nesting territories, where there is also a used nest, and (2) un-used nests in nesting territories that are currently vacant, where there is no used nest. Our intent in conducting the review was to compile and summarize the available literature on the biological and management importance of alternative (or inactive) nests of golden eagles to better understand the importance of these structures and their surrounding habitat. This is a question of increasing management importance as our agencies and others seek to balance resource development in eagle habitat with legal mandates and eagle population objectives. We organized our review around two broad questions, with a subset of more specific questions under each. We use this query structure as the framework for this paper:

(3.1.) What is the biological and conservation significance of alternative nests in nesting territories occupied by golden eagles? (see 2.1 for definitions):