The validity of using artificial nests to assess nest-predation rates in prairie nesting ducks

by Michael A Butler

A thesis submitted in partial fulfillment of the requirements for the degree of Master of Science in Fish and Wildlife Management
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Abstract:
Artificial nests have been used in numerous studies of nest success because they provide adequate sample sizes and can be placed according to experimental designs. However, concerns regarding the validity of their use in studying avian nesting ecology have been raised. For the use of artificial nests to be valid, nest success for artificial and natural nests must be strongly correlated. Additionally, increased knowledge of factors that affect artificial-nest survival would be useful. If correlates of survival can be identified, further refinement of the technique may be possible, thus improving its performance. Therefore, I conducted research to evaluate the validity of the artificial-nest technique by comparing rates of artificial- and natural-nest success, examining characteristics of artificial-nest predation, and evaluating the effects of corvid abundance and nest vegetation on artificial-nest survival.

I estimated survival of artificial (n = 1,210) and natural (n = 1,318) nests of upland-nesting waterfowl at 16 sites across northern Montana, in a variety of habitats, and over 2 nesting seasons. Correlations between artificial- and natural-nest success estimates were highly variable by year and habitat type (e.g., all nests from 1993 and 1994: R2 = 0.20, P = 0.08; nests in planted nesting cover in 1994: R2 = 0.87, P = 0.02; nests in native grass cover in 1993 and 1994: R2 = 0.01, P = 0.86). Thus, artificial nest success was not consistently correlated to natural nest success in all habitats or years. Artificial nests were depredated at a higher rate during daylight hours than at night (t = -4.93, P < 0.0001), were depredated at a higher rate during the first 10 days of exposure (P < 0.005), and were depredated less as the nesting season progressed (Log-rank test, P = 0.0007 - 0.07). Corvid abundance and nest vegetation were not good predictors of nest survival (logistic regression fit = 0.1127).

My results indicated that artificial nests may lead to erroneous conclusions regarding nest survival. Thus, I conclude that (1) the technique should not be used for upland-nesting ducks in the mid-continent and (2) researchers working in other areas/species should evaluate the usefulness of the technique over the range of habitats and nest-success rates they wish to consider.

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APPROVAL

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This thesis has been read by each member of the thesis committee and has been found to be satisfactory regarding content, English usage, format, citations, bibliographic style, and consistency, and is ready for submission to the College of Graduate Studies.

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TABLE OF CONTENTS

LIST OF TABLES

LIST OF FIGURES

ABSTRACT

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My results indicated that artificial nests may lead to erroneous conclusions regarding nest survival. Thus, I conclude that (1) the technique should not be used for upland-nesting ducks in the mid-continent and (2) researchers working in other areas/species should evaluate the usefulness of the technique over the range of habitats and nest-success rates they wish to consider.

CHAPTER 1

INTRODUCTION

Since the late 1960's, numerous species of migrant birds have significantly declined in number (Bohning-Gaese et al. 1993). This trend has been corroborated by a number of studies investigating continental bird-population trends (Kerlinger and Doremus 1981, Robbins et al. 1989, Terborgh 1992, Bohning-Gaese et al. 1993). Understandably, avian ecologists have attempted to identify environmental factors that might be responsible for these declines. Factors such as habitat loss and fragmentation resulting from intensive agriculture, suburban development, and urbanization, as well as increased nest depredation and parasitism are widely thought to contribute to population declines (Kerlinger and Doremus 1981, Robbins et al. 1989, Bohning-Gaese et al. 1993). However, it is difficult to evaluate how these factors affect avian population dynamics. Most avian ecologists agree that these factors lower the productivity of populations of birds (Robbins et al. 1989, Bohning-Gaese et al. 1993).

In avian populations, a common measure of reproductive productivity is recruitment rate, which can be defined as the number of young females in the fall population divided by the number of adult females in the spring population (Cowardin and Blohm 1992). Because nest success is one of the most important factors affecting recruitment rates of birds, biologists have sought nest-success information for many species (Ricklefs 1969, Martin and Guepel 1993). However, estimating nest success is typically problematic because nesting studies are expensive, time consuming, and logistically troublesome (Hammond and Forward 1956, Klett and Johnson 1982). Additionally, when working with natural nests it is difficult to meet the demands of experimental designs required for tests of many hypotheses (e.g., distance from edge of a habitat patch vs. nest success) (Rearden 1951, Balser et al. 1968, Willebrand and Marcstrom 1988). This has prompted many researchers to use artificial nests when studying nest success and associated factors (Henry 1969, Kurnat 1991, Burger et al. 1994, Thurber et al. 1994, Haskell 1995b).

Although artificial nests have been used often to test hypotheses and to develop management recommendations (Angelstam 1986, Yahner and Cypher 1987, Burger et al. 1994), concerns exist about the validity of inferences drawn from artificial-nest studies (Martin 1987, Storass 1988, Willebrand and Marcstrom 1988, Haskell 1995a). The greatest concerns regard inconsistencies and differences in the rates at which artificial and natural nests are depredated.

Surprisingly, only a few studies have attempted to explain why artificial nests experience different rates of depredation than natural nests (e.g., Storass 1988, Willebrand and Marcstrom 1988, Kulesza 1980, Kurnat 1991, Guyn and Clark In Press). For these reasons, I designed nest experiments to investigate these concerns.

Chapter 2 of this thesis addresses whether artificial-nest success can be used as a valid index to natural-nest success. If the artificial-nest technique is to be used validly, it must be shown that the most critical assumption of the technique is met: that nest success estimates from artificial nests and the natural nests they are designed to mimic are highly correlated. Chapter 3 addresses the effects of nest vegetation and corvid abundance on artificial-nest survival. Nest vegetation and corvid abundance have been identified as 2 factors that may influence nest survival, and I attempt to develop a model that will predict artificial-nest survival. Chapter 4 is an overall discussion of my research conclusions.

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CHAPTER 2

THE VALIDITY OF USING ARTIFICIAL NESTS TO ASSESS NEST-PREDATION RATES IN PRAIRIE-NESTING DUCKS

Introduction

Because nest success is one of the most important factors affecting recruitment rates of birds, biologists have sought nest-success information for many species for a wide variety of uses (Ricklefs 1969, Martin and Guepel 1993). However, estimating nest success is typically problematic because nesting studies are expensive, time consuming, and logistically troublesome (Hammond and Forward 1956, Klett and Johnson 1982). Additionally, when working with nests, it is difficult to meet the demands of experimental designs required for tests of many hypotheses (e.g., distance from edge vs. nest success) (Rearden 1951, Balser et al. 1968, Willebrand and Marcstrom 1988). Collectively, the restrictions associated with nesting studies have prompted many researchers to use artificial nests when studying nest success and associated factors (Henry 1969, Kurnat 1991, Burger et al. 1994, Thurber et al. 1994, Haskell 1995b).

By using artificial nests, investigators are able to achieve necessary sample sizes of nests at locations dictated by experimental designs. Research on artificial nests requires less expense, time, equipment, and manpower than conventional nesting studies (Storass 1988). Finally, nest-initiation dates, destruction dates, and population sizes are known, providing higher precision when estimating artificial-nest success.

Although artificial nests have been used often to test hypotheses and to develop management recommendations (Angelstam 1986, Yahner and Cypher 1987, Burger et al. 1994), concerns exist about the validity of inferences drawn from these studies (Martin 1987, Storass 1988, Willebrand and Marcstrom 1988, Haskell 1995a). Storass (1988) stated that the relationship between depredation of natural and artificial nests has not been properly evaluated. Similarly, Willebrand and Marcstrom (1988) noted that results of artificial-nest studies are often used without determining whether they are similar to results of studies of natural nests.

Results of studies that have examined the strength of the correlation between survival rates of artificial and natural nests are variable and conflicting. Chesness et al. (1968), Gottfried and Thompson (1978), Gotmark et al. (1990), and Kurnat (1991) found depredation rates of artificial and natural nests to be similar. However, Balser et al. (1968), Dwernychuk and Boag (1972), Martin (1987), Storass (1988), Willebrand and Marcstrom (1988), and Guyn and Clark (In Press) found depredation rates for artificial and natural nests to be markedly different.

Similarly, the relationship between vegetative structure and nest success has also been shown to vary for artificial and natural nests. Dwernychuk and Boag (1972) and Storass (1988) found nest concealment to have no effect on natural-nest success, but reported a positive relationship between nest concealment and artificial-nest success. However, Guyn and Clark (In Press) found no relationship between nest concealment and artificial-nest survival and a positive relationship between nest concealment and natural-nest success. Dwernychuk and Boag (1972) felt that the effect of nest concealment on survival differed for the 2 nest types because vegetation disturbance advertised artificial-nest locations to sight-oriented predators (e.g., corvid and larid species). Additionally, they felt that the lack of a relationship between nest concealment and natural-nest success resulted from the presence of the hen and her maintenance of concealing nest cover at the nest site. Storass (1988) hypothesized that differences in the effect of nest vegetation on survival were a result of the type of nest predator attracted to each nest type. He concluded that nest concealment of artificial nests was an important factor affecting survival when the primary predator was avian, but that odor associated with natural nests was an important factor affecting survival when the primary predator was mammalian. Willebrand and Marcstrom's (1987) results supported Storass' (1988) hypothesis that artificial nests are more vulnerable to avian depredation and natural nests are more vulnerable to mammalian depredations by finding their artificial nests eaten by corvids and natural nests eaten by mammals. Additionally, Guyn and Clark (In Press) found their nest predators to be mammalian, and observed no relationship between nest concealment and artificial-nest success.

Given potential differences between artificial- and natural-nest success and the factors affecting their survival, it appears that artificial nests may be inappropriate for evaluating natural-nest success. However, for the technique to be useful, it is not necessary for the 2 types of rates to be similar. Rather, it is necessary only for there to be a consistent and known relationship between survival of artificial and natural nests on the area of interest. Surprisingly, this relationship has not been properly evaluated (Storass 1988). Given the experimental advantages that the artificial-nest technique provides, I designed this study to further investigate the validity of using artificial-nest success as an index to natural-nest success in waterfowl and to evaluate the possible effect of vegetation density on nest success.

Specifically, I tested for a consistent relationship between survival rates of artificial and natural nests using duck nests. I chose duck nests because: (1)

there are important landscape-level hypotheses regarding duck population dynamics that can be tested with artificial nests (Clark and Nudds 1991) and (2) duck nests can be found, with great effort, in large enough samples to properly evaluate the relationship between the 2 nest types. To increase the inference space of the results, I tested the relationship over a broad geographic area on sites having a wide range of nest-success rates and 2 different habitat types.

To determine the possible effect of vegetation density on nest success, I investigated the relationship between vegetation density and artificial- and natural-nest success. I also discuss potential impacts of other ecological factors on nest survival.

Study Areas

I selected 4 study areas across the state of Montana (Fig. 1). The Ninepipe study area (47°26'N, 114°7'W), Benton Lake National Wildlife Refuge (NWR) (47°40'N, 111°20'W), Bowdoin NWR (48°25'N, 107°41'W), and Medicine Lake NWR (48°28'N, 104°26'W) were selected to ensure variation in nesting habitats, geographic regions, and predator communities. All study areas had a semi-arid continental climate.

Within study areas, I selected research sites (Fig. 1) based upon historical densities of nesting waterfowl and habitat abundance. The Ninepipe