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Productivity of Great Blue Herons in King County, Washington

Abstract

We studied productivity of great blue herons (*Ardea herodias*) at their nesting colonies in King County, western Washington in the 2000 breeding season. Rapid urbanization has been hypothesized to have limited heron population growth in recent years. Of the 354 active nests in 2000, 260 (74%) nests produced fledglings. Mean productivity for all active nests was 1.77 (SD = 1.37). Mean productivity for the 260 successful nests was 2.42 (SD = 1.01). Calculations of productivity for the active and successful nests are similar to or greater than results of 8 of 10 similar calculations from studies conducted in the Pacific Northwest, and one study that used band return data to determine the minimum productivity required to maintain a stable population. Herons that began incubating earlier in the season (prior to 17 April) had higher productivity than those that began nesting later in the season ($P < 0.001$).

Introduction

After a rapid rise in the number of great blue heron nests and nesting colonies in Puget Sound since the early 1980s (NOAA 1985, Stabins and Raedeke 1992), concern has been raised that heron numbers are now declining. Potential causes of this decline, if real, are commonly listed as low productivity due to disturbance associated with urbanization, predation, severe weather, and environmental contaminants.

Using age-specific mortality rates from band-return data collected across North America, Henny (1972) calculated that 1.91 young per breeding pair per year must be fledged in order to maintain a stable population. The purpose of our study was to determine if productivity of the nesting colonies was below the threshold value needed to maintain a stable heron population in the urbanizing lowlands of Puget Sound, and to compare current estimates of heron productivity with other historic estimates.

Study Area

We studied great blue heron colony sites in King County, Washington. The western boundary of King County is Puget Sound. While the eastern portion of King County is largely forest or rural, extending up into the Cascade Mountains, the western portion is highly urbanized, containing the city of Seattle and surrounding communities. Despite this largely urban environment, all of the active great blue heron colonies we found in 2000 were located in the urbanized western half of the county, near Puget Sound, Lake Washington, and Lake Sammamish.

Methods

We visited all previously known and newly reported heron nesting sites in King County in 2000 to determine if they were active. We visited all active heron colony sites every 1 to 10 days from 20 February before tree leaf-out until 28 August when all chicks had fledged. Frequent visits allowed new nests to be detected as they were built. We gave each nest detected a unique number within the colony, mapped its location, and relocated each nest on subsequent visits. On each visit we recorded the number of herons present, their age (adult or nestling), and classified their behavior as standing, copulating, nest building, incubating, egg turning, or feeding. We defined an 'active nest' as one with an adult or nestling heron(s) observed during the nesting season. This broad definition is intended to include all pairs that attempt to breed regardless of success. A 'successful nest' was defined as a nest that fledged young birds.

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We defined 'productivity' as the number of young herons seen in the nest at 7 weeks post-hatching, following the methods of Werschkul et al. (1977). We defined hatching as the date when a previously incubating adult is seen standing on the nest and is no longer in the incubation posture. At 7 weeks the majority of nest-site mortalities should have occurred, and few of the nestlings will have left the nest. If a greater number of nestlings were seen at a nest at a later date, this larger number was used in the productivity calculations.

The productivity of the study colonies was compared with regional estimates of productivity for active and successful nests, and with Henny's (1972) estimate of the minimum productivity required to maintain a stable population. For those studies that provided a variance for the mean productivity, we used a two-sample, two-tailed t-test ($P = 0.05$) with the null hypothesis H_0: $\mu_1 - \mu_2 = 0$. We tested for equality in variances with the F-test ($P = 0.05$); when the variances were found to be unequal the Welch's t-test replaced the standard t-test. When a variance was not provided, we used a one-sample, two-tailed t-test ($P = 0.05$) for a population mean with the null hypothesis H_0: $\mu = \mu_0$.

During the 2000 breeding season we noted that 21% of the herons began incubation late in the breeding season (Figure 1), with a distinct break around 17 April. We compared the productivity of early and late nesters using a two-sample, two-tailed t-test ($P = 0.05$) with the null hypothesis of H_0: $\mu_1 - \mu_2 = 0$. We used a chi-square goodness-of-fit test ($P = 0.05$) to compare the frequency of nest success among early and late nesters.

Results

Between 20 February and 28 August 2000 we conducted 206 visits to 13 active colonies and detected 383 active nests. We excluded 29 nests from study due to limited visibility. Of the 354 visible active nests, 260 (74%) nests produced fledglings, 29 (8%) produced chicks that did not fledge, and 65 (18%) failed to produce any chicks (some due to predation) (Table 1). Ten colonies produced and fledged young. The other 3 (Dumas Bay, Peasley Canyon, and The River) were abandoned shortly after nest predation by bald eagles (*Haliaeetus leucocephalus*).

Productivity of All Colonies

Mean productivity in the 13 colony sites in 2000 was 1.77 $\pm$ 0.14 fledglings per nest (range 0.0 to 3.00). Excluding the colonies that failed due to bald eagle predation, mean productivity increased

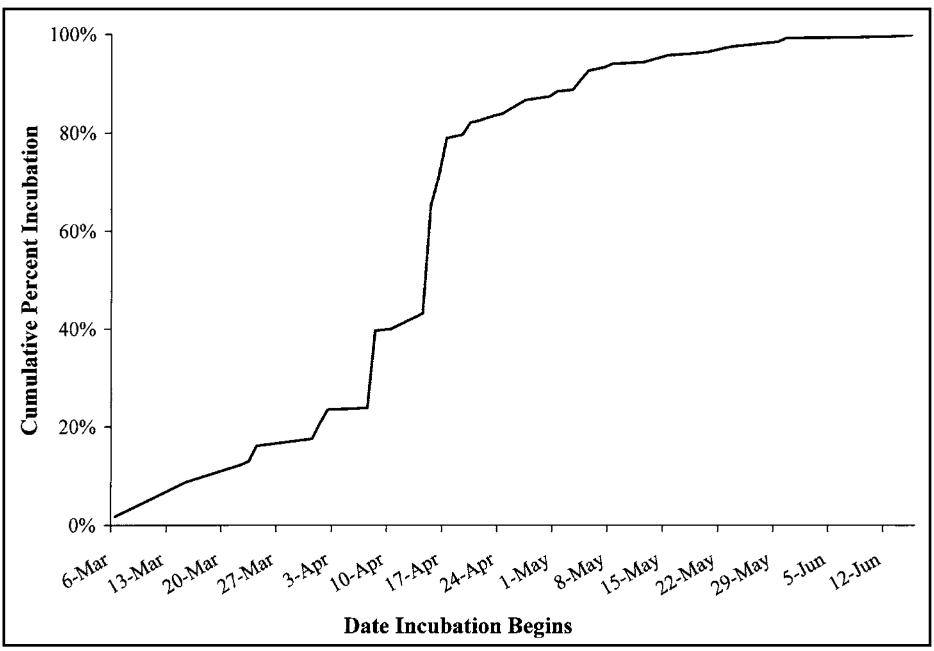

Figure 1. Cumulative percent of great blue herons beginning incubation in King County, Washington in 2000.

TABLE 1. Nest observations for great blue herons colonies active in King County in 2000. Productivity was calculated only for visible nests.

Colony Name	PHS number	Number visits	Active nests	Visible nests	Successful nests	Productivity	
						Active nests	Successful nests
Black Diamond	178-1	31	61	50	42	2.00 (1.21)	2.41 (0.89)
Des Moines	360-1	20	11	11	7	1.27 (1.10)	2.00 (0.58)
Dumas Bay	85-1	18	9	9	0	0.00	0.00
Kenmore	227-1	21	71	67	51	2.11 (1.51)	2.77 (1.07)
Kiwanis	217-1	17	40	37	30	2.16 (1.46)	2.67 (1.12)
Lake Sammamish	158-1	20	108	102	80	1.66 (1.17)	2.11 (0.87)
Mercer Slough	283-1	16	17	17	16	3.00 (1.32)	3.19 (1.11)
North Beach	338-1 & 2	24	15	15	14	1.80 (0.86)	1.93 (0.73)
Peasley Canyon	50-1	6	18	17	0	0.00	0.00
Redmond	344-1	19	25	21	17	1.81 (1.33)	2.24 (1.09)
The River	379-1	1	4	4	0	0.00	0.00
Soos Creek	380-1	1	1	1	1	3.00 (0.00)	3.00 (0.00)
South Auburn	376-1	12	3	3	2	1.33 (1.16)	2.00 (0.00)
All Colonies		206	383	354	260	1.77 (1.37)	2.42 (1.01)

to 1.94 ± 0.11 (range 1.27 to 3.0). The 1.77 mean productivity for active nests was not significantly different than Henny's (1972) estimate of a requirement of 1.91 fledglings per nest required to maintain a stable population ($P = 0.06$), and was not significantly different from the estimates of other studies in the northwest, 2.04 ($P = 0.46$) (Henny and Bethers 1971), 1.96 ($P = 0.49$) (English 1978), and 1.7 ($P = 0.31$) (Butler et al. 1995).

Productivity of Successful Nests

The 260 successful nests fledged 629 herons (x = 2.42 ± 0.12). Mean productivity in the individual colonies that fledged young ranged from 1.93 to 3.19 fledglings per successful nest. This mean productivity for successful nests in our study is not significantly different than 2.43 found by English (1978) or the 2.5 by Forbes et al. (1985), is significantly higher than the 2.18 ($P < 0.001$) found by Werschkul et al. (1977) and 2.2 ($P = 0.047$) by NOAA (1985), but is significantly lower than Henny and Bethers' (1971) calculated productivity of 2.61 ($P = 0.002$), Werschkul et al.'s (1977) calculated productivity of 2.7 ($P < 0.001$), and Kelsall and Simpson's (1979) calculated productivity of 2.6 ($P = 0.003$).

Comparison of Early and Late Nesters

The nests of early nesters had a higher mean productivity (x = 2.09) than the late nesters (x = 1.38; $P < 0.0001$). Of the 252 nests that began incubation early, 211 (84%) nests fledged young, while 48 (70%) of the 69 nests that began incubation late fledged young. The successful nests of early nesters had a higher mean productivity (x = 2.50) than the successful nests of late nesters (x = 2.02; $P < 0.004$). Early nesters fledged chicks with a significantly higher frequency than late nesters (X^2, $P < 0.0001$).

Discussion

Calculations of productivity for active and successful nests of King County in 2000 were similar to or greater than the results of 8 of 10 similar calculations from other studies conducted in the Pacific Northwest. Comparisons with studies in the same local region of Washington State show that productivity calculations of this study were higher.

In 2000 the heron population in King County reproduced at a rate not significantly different from Henny's (1972) estimate of the productivity level required for a population to maintain itself. Because the productivity calculated for this study is close to being significantly below the estimated productivity needed to maintain the population further monitoring to determine annual variation in productivity is warranted. The increase in the number of active heron nests from 79 in 1981 (Shipe and Scott 1981) to 383 in 2000 (Stabins

2001) supports our contention that productivity is adequate to maintain the population. However, Stenberg (2000) reported high numbers of nest failures in the 1999 breeding season due to predation, thus potentially lowering productivity below Henny's (1972) calculated level required to maintain the population in that year.

English (1978) reports that the number of fledged juveniles per nest is a conservative estimate, as some of the fledglings may not be detected, while others may fledge early. We found both to be true in our study; sometimes a higher number of nestlings were counted at a later date, and on more than one occasion a fledgling was seen flying off the nest before seven weeks.

A higher percentage of early nesters compared to late nesters produced chicks and fledged young. The late nesters may be young or inexperienced birds, pairs that are attempting a replacement clutch after a nesting failure, or birds that are of low social status that have trouble obtaining or keeping a suitable nest site. Late breeding in grey herons (*Ardea cinerea*) was explained by replacement clutches (Campos and Fernandez-Cruz 1991) and young pairs (Geroudet and Jeanmonod 1992). Fernandez-Cruz and Campos (1993) found that grey heron pairs that contained younger birds produced fewer chicks. Perhaps the energy expenditure required to produce a second clutch results in lower productivity.

There has been much concern over a perceived increase in the observations of bald eagle predation at heron colonies. Observers have watched as eagles move from nest to nest eating eggs and chicks (Butler 1997, Thomas and Anthony 2003). The abandonment of colonies in King County after such incidents has been common. However, bald eagle incursions at heron colonies are not always followed by colony abandonment. In 2000, we observed several bald eagle incursions at colonies that still fledged young (Stabins 2001).

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