J. Field Ornithol., 63(4):462-465

ENVIRONMENTAL FACTORS INFLUENCING ROOST ARRIVAL OF BLACK-CROWNED NIGHT-HERONS

GARY B. PERLMUTTER[1]
Department of Biogical Sciences
Humboldt State University
Arcata, California 95521 USA

Abstract.—The arrival times of Black-crowned Night-Herons (*Nycticorax nycticorax*) in northwestern California were studied in February and March 1991. Birds arrived 56 min before sunrise at 3.07 lx light intensity, on average. Night-herons arrived earlier on cooler mornings, and mostly avoided the roost during moderate to high winds. Fewer birds arrived as the season progressed.

FACTORES AMBIENTALES QUE INFLUYEN EN LA LLEGADA A SUS ÁREAS DE PERNOCTACIÓN DE INDIVIDUOS DE *NYCTICORAX NYCTICORAX*

Sinopsis.—De febrero a marzo de 1991, se estudió en el noroeste de California, los tiempos de llegada a áreas de pernoctación de individuos de *Nycticorax nycticorax*. Las aves llegaron 56 minutos previo a la salida del sol con intensidad de luz promedio de 3.07 lx. Las aves llegaron más temprano en mañanas frías y evitaron posarse en el dormidero durante vientos moderados o fuertes. Un menor número de aves llegaron al dormidero según fue progresando la temporada.

Circadian rhythms in the Black-crowned Night-Heron (*Nycticorax nycticorax*) generally follow an activity period at night by a roosting period in trees during daylight hours (Hancock and Kushlan 1984). Exceptions to this pattern include activity in mornings and evenings (Hunter and Morris 1976, Watmough 1978). Roost flight behavior has been only sparsely examined, with arrival patterns less studied (Seibert 1951, Siegfried 1966). Both Seibert (1951) and Siegfried (1966) found that such behavior is strongly influenced by changes in light intensity. Seibert (1951) also found this influence to occur in other heron species. In this study, I examined how the arrival times of a roosting population of Black-crowned Night-Herons are related to light intensity, temperature and wind.

STUDY SITE AND METHODS

On 20 mornings in February and March 1991, I observed a roost site in a willow (*Salix* sp.) thicket in the western portion of Gearheart Pond in the Arcata Marsh and Wildlife Sanctuary in Arcata, Humboldt County, California, USA. I arrived 75 min before sunrise (from 0611 hours on 8 February to 0446 hours on 24 March), before any birds arrived. From the shore about 30 m from the roost, I recorded the time, temperature, weather conditions and light intensity at the beginning and end of each observation period. Temperature readings were taken at ground level; light intensity readings were taken at 2 m above ground. Prerecorded

[1] *Current address: ABC Laboratories, Inc., 29 N. Olive Street, Ventura, California 93001 USA.*

data included expected time of sunrise from the previous night's weather report.

Without the aid of a blind, I then observed the arrival of night-herons, noting the time and light intensity when each arrived. Light intensity was measured as illuminance expressed in lux (International Center of Photography 1984). I used a Gossen Luna Pro photographic exposure meter to measure illuminance, pointing the instrument at zenith and converted the readings into lux. I also recorded the observed time of sunrise when weather permitted; for cloudy mornings the time of sunrise was interpolated from the mean difference between observed and expected times of sunrise for clear mornings. Observations continued until 15 min had passed without my seeing an arrival. I analyzed the data using the Minitab statistical program with the level of significance of 0.05 set *a priori* for all inference tests (analysis of variance and correlation).

RESULTS

On a given morning 0–28 arrivals were observed (Table 1). Mean illuminance for all arrivals ($n = 220$) was 3.08 lx (SD = 11.36). Eighty-three arrivals (37.7%) were at illuminances below the sensitivity of the exposure meter (0.17 lx) and were thus recorded as 0.00 lx. All birds arrived at the roost at least 30 min before sunrise (Table 1). On average, night-herons arrived at the roost 56.6 min (SD = 8.05) before sunrise.

Mean temperature for the entire study period was 7.6 C (SD = 3.01). On 14 mornings I recorded a slight drop in temperature (1–5 C), yet overall this drop was not significant (single factor analysis of variance: $F = 1.76$; df = 2, 40; $P > 0.05$). Although I found no correlation between mean morning temperatures and numbers of arrivals, a significant correlation did exist between the former and mean arrival times, with night-herons arriving earlier on colder mornings ($r = 0.565$; df = 16; $P < 0.05$) (Table 1).

In addition, on two mornings, which experienced moderate to strong gusts of wind, only three birds were seen, flying past the roost. Finally, I found that night-herons arrived at the willow in smaller numbers as the season progressed ($r = -0.579$; df = 16; $P < 0.05$) (Table 1).

DISCUSSION

Black-crowned Night-Herons responded to changes in light intensity. The range of illuminance in which these birds arrived (0–88 lx) was much smaller than that from night to day on a clear morning (0–2800 lx). Also, most illuminances at which herons arrived were low enough to be independent of cloud conditions. This result is in agreement with Seibert (1951), who also found night-herons flying at low illuminances (<11 lx) at dawn (about 30 min before sunrise). The low illuminances indicate that these birds are sensitive to small changes in light intensity, which is reflective of their nocturnal activity.

Roost departure is also largely influenced by light intensity. In New Jersey, Seibert (1951) found that night-herons departed 16–19 min after

TABLE 1. Black-crowned Night-Heron roost arrivals with mean measurements of associated environmental variables.

Date	Arrivals	Time[1]	Illuminance (lx)	Temperature (C)
8 February	12	52.0	13.47	5.5
9 February	6	57.0	14.90	8.0
10 February	11	60.6	0.17	8.5
15 February	25	57.2	1.13	10.5
16 February	23	55.4	1.35	10.0
17 February	28	54.9	5.47	10.0
22 February	17	54.4	1.64	10.5
23 February	11	53.0	1.60	8.0
24 February	21	62.0	1.12	3.5
1 March	12	52.1	4.07	11.5
3 March[2]	0	—	—	13.5
8 March	10	52.5	3.29	7.0
10 March	4	54.5	<0.17	7.0
11 March	15	64.5	2.72	2.5
15 March	6	57.8	1.03	5.0
16 March	6	54.1	0.06	6.0
17 March	2	47.5	0.53	8.5
22 March	8	61.4	2.88	3.5
23 March[2]	0	—	—	8.0
24 March	3	57.7	0.11	5.5

[1] Expressed as minutes before sunrise.
[2] Mornings with gusty winds (max. speed: 22.4 and 12.2 m/s, respectively).

sunset, when illuminance was about 11 lx. In South Africa, Siegfried (1966) noted that night-herons departed from a roost with an earlier sunset before a roost in which the sunset was later. Therefore, light intensity plays an important role in the timing of roost flight in this species.

The roost arrival of night-herons at such low light intensities may be a strategy to avoid competition with sympatric diurnal heron species. Black-crowned Night-Herons are known to be displaced by their diurnal counterparts (Watmough 1978), and within the vicinity of my study site night-herons share marsh and tidal mudflat habitats with Snowy Egrets (*Egretta thula*), Great Egrets (*Casmoerodius albus*) and Great Blue Herons (*Ardea herodias*). Finally, Seibert's (1951) study of a mixed-species heronry found that night-herons arrived to roost before and during the departures of diurnal herons, thereby minimizing interactions at foraging sites.

Temperature also had an effect on the timing of roost arrival. The earlier arrivals during colder mornings could be a response to earlier departures of diurnal herons at foraging grounds. Although the activity of other heron species was not examained, such a pattern was noted by Seibert (1951). An alternative explanation is that the birds roosted earlier on colder mornings to avoid activity during the predawn temperature

drop, thereby conserving energy. This explanation, however, is problematic, because the temperature drop was not significant.

The arrival data from the two windy mornings suggest that most of the birds avoided tree roosting during such potentially hazardous landing conditions.

It seems that seasonal changes also alter roosting behavior. The decrease in arrival numbers over time could be a response to the willow's growing new leaves (first observed on 22 February), which could make landing more difficult. I have seen night-herons fly past the roost site, probably to roost elsewhere. Noting that the fly-bys were in different directions, I suspect that the birds roost or nest solitarily during the summer months. Alternatively, night-herons might have been flying to other foraging sites. Further study of seasonal influences on the circadian rhythms of this species is needed.

ACKNOWLEDGMENTS

I am most grateful to Mark Colwell, whose Ornithology class made this study possible and who provided comments on the manuscript. Also, I would like to thank Charles Biles for his statistical advice and James Waters for critically reviewing this paper.

LITERATURE CITED

HANCOCK, J., AND J. KUSHLAN. 1984. The herons handbook. Harper and Row, New York, New York. 288 pp.

HUNTER, R. A., AND R. D. MORRIS. 1976. Nocturnal predation by a Black-crowned Night Heron at a Common Tern colony. Auk 93:629–633.

INTERNATIONAL CENTER OF PHOTOGRAPHY. 1984. Encyclopedia of photography. Crown Publishers, Inc., New York, New York. 607 pp.

SEIBERT, H. C. 1951. Light intensity and the roosting flight of herons in New Jersey. Auk 68:63–74.

SIEGFRIED, W. R. 1966. Time of departure from the roost in the night heron. Ostrich 37: 235–236.

WATMOUGH, B. R. 1978. Observations on nocturnal feeding by night herons (*Nycticorax nycticorax*). Ibis 120:356–358.

Received 13 Sep. 1991; accepted 20 Dec. 1991.