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Source: *Waterbirds*, 45(2) : 213-217

Published By: The Waterbird Society

URL: <https://doi.org/10.1675/063.045.0212>

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Vocal Activity of Little Bittern (*Ixobrychus m. minutus*) during the Breeding Season

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Abstract.—Heron vocalization and its behavioral functions are one of the least researched aspects of heron biology. The main aim of this study was to investigate the patterns of seasonal and daily vocal output of male Little Bittern (*Ixobrychus m. minutus*; $n = 8$) during the breeding season (May–August). The advertising call started on 10th May, and finished on 28th July. The first peak of calling activity occurred between 21st May and 1st June, and the second one was between 14th June and 7th July. The daily vocal activity fluctuated and depended on the time of day. The males were most active between 0300–0900 hours and 1600–2200 hours, with the highest peaks in vocal output occurring before sunrise and before sunset. Higher vocal activity was observed in the evening compared to the morning hours. Moreover, the vocal activity of males was not related to air temperature. Received 11 Feb 2022, accepted 28 Apr 2022.

Key words.— advertising call, call functions, fishponds, herons, male vocalization, sexual functions, territorial behavior

Waterbirds 45(2): 213-217, 2022

Bird song during the breeding season has several functions such as territory defense, mate attraction, mate guarding, or communication between pair members, and it is one of the main strategies for sexual selection in many species (Emlen and Oring 1977; Kroodsma and Byers 1991; Clutton-Brock 2007). The role of song used by males during courtship display is variable and it can be divided into two major categories: 1) male-male intra-sexual territorial defending functions; and 2) male-female inter-sexual mate attracting and stimulating functions (Catchpole and Slater 2008).

Vocal activity and its behavioral functions are one of the least studied aspects of heron biology (Kushlan and Hancock 2005), and only a few species have been investigated, e.g., Great Bittern (*Botaurus stellaris*; Puglisi et al. 1997; Polak 2006). The nominate subspecies of Little Bittern (*Ixobrychus m. minutus*) is a long-distance migrant which breeds mainly in Europe (May–August) and winters in Africa (Voisin 1991). This heron species is secretive and nests in emergent vegetation or shrubs in different natural and artificial habitats, such as eutrophic lakes, flooded river valleys and fishponds (Flis and Betleja 2015). The Little Bittern is a monogamous species which breeds solitarily, sometimes in semi-colonies (Voisin 1991; Flis 2016). After arriving at the breeding grounds, the male

starts building a nest alone at a selected location in its territory, and also starts uttering the mating call (named as the advertising call) both by day and night (Cramp and Simmons 1977; Kushlan and Hancock 2005). Intra-sexual territory defense and inter-sexual female attraction are the main functions of advertising call (Voisin 1991; Kushlan and Hancock 2005). In many monogamous bird species, the call functions are related to the pattern of male vocal activity during the breeding season (Catchpole and Slater 2008), but in the case of Little Bittern this pattern has never been researched before.

The principal aim of this study was to determine the seasonal and daily patterns of vocal output of male Little Bittern during the breeding season.

METHODS

Study Area

This study was conducted in 2010–2012 (May–August) at the common carp (*Cyprinus carpio*) fishponds complex (Stawy Małe), situated in the Łasy Janowskie Landscape Park, Southeast Poland (50° 36' 29.64" N, 22° 24' 38.39" E). The area of the eight ponds in the study complex varied from 3.3 to 19.5 ha (total area of 60 ha). The number of pairs of Little Bittern nesting in these fishponds was estimated to be 8 in 2010, 12 in 2011, and 8 in 2012 (Flis 2013; A. Flis, unpubl. data). Poland is located in the northern range of Little Bittern's occurrence in Europe (BirdLife International

2015), and the first birds usually arrive at the breeding grounds in early May when new emergent vegetation appears (Flis and Betleja 2015).

Advertising Call Description

The advertising call consists of far-carrying low sounds which are repeated every 2 to 3 seconds (Fig. 1). These sounds have been described as croaking, frog-like voice or resembling a deep barking of a dog, rendered as ‘hogh, hogh, hogh’, or ‘woof, woof, woof’ (Voisin 1991). The advertising call is given in a very long series lasting up to 10 minutes. It is usually recorded from a distance of about 200 m, but can also be recorded from a distance of 600 m during windless weather (Flis and Betleja 2015). Little Bittern males are the most vocally active during late afternoon and evening (Voisin 1991). High temperature and muggy weather may increase vocal activity in males (Betleja 2009).

Fieldwork

The sampling methods were similar to those used to study the temporal pattern of vocal activity of the Water Rail (*Rallus aquaticus*) and Little Crake (*Zapornia parva*, formerly *Porzana* genus; Polak 2005), and the seasonal booming activity of the Great Bittern (Puglisi *et al.* 1997).

A preliminary study of Little Bittern vocalization was conducted from 2010 to 2011. The study involved recording of the calling males and the relationship between male vocal activity and air temperature. 40 listening sessions (20 each year) were conducted at 3 days intervals for a total of 20 males between 15th May and 15th July in 2010 and 2011. The listening sessions were held between 1800–2100 hours since higher vocal activity has been previously observed in males in the evening hours (Voisin 1991). During each listening session, vocal activity was recorded under two categories: active and inactive males were coded as 1 and 0, respectively. The air temperature was measured at the start and end of the session using a mercury thermometer with an accuracy of 1.0°C.

Male vocal activity was also studied in 2012 during the breeding season to understand the seasonal and daily patterns. 48 listening sessions at 2 days intervals were conducted on a total of eight males between 9th May and 12th August in 2012 (the study period was

extended to capture the entire breeding season). Each standard session lasted 4 hours, and was successively started from: 0000–0400, 0400–0800, 0800–1200, 1200–1600, 1600–2000, 2000–2400 hours (six consecutive sessions equal one full day, and 48 sessions equal eight full days). During each session, the time of individual calling males was recorded separately for each hour. Vocalization rate was calculated as the percentage of time within an hour during which at least one male was vocally active. Significantly higher vocal activity was defined as vocalization rate of greater than or equal to 10% for each study period/hour.

All listening sessions between 2010 and 2012 were carried out from a single point located centrally in the fishpond complex (see coordinates in Study Area). All call locations were plotted on a plan of the fishponds from a distance of 40–300 m. The research was conducted without voice playback and only spontaneous calls were recorded.

Data Analysis

The Mann-Whitney test was used to determine the effect of air temperature on male vocal activity. Mean air temperature of the session was chosen as the independent variable, and vocal activity as the dependent variable. The results were considered statistically significant when the probability of type I error was set at $P \leq 0.05$. The mean values were presented with standard deviation (\pm SD). The statistical analysis was performed using Statistica (StatSoft 2014).

RESULTS

The air temperature in listening sessions when the Little Bittern males ($n = 20$) were active vocally (mean = $19.3 \pm 3.4^\circ\text{C}$, range = $12\text{--}24.5^\circ\text{C}$, $n = 22$) and inactive vocally (mean = $18.7 \pm 4.3^\circ\text{C}$, range = $12\text{--}27^\circ\text{C}$, $n = 18$) was not statistically different ($Z = 0.802$, $P = 0.424$, $n = 40$).

The Little Bittern males ($n = 8$) were active vocally from May to July (Fig. 2). The advertising call started on 10th May, and finished on 28th July. The first peak of vocal output occurred between 21st May and 1st June. The second peak was extended in time and occurred between 14th June and 7th July.

The daily vocal activity was variable and depended on the time of day (Fig. 3). The male’s call the most intensively between 0300–0900 hours and 1600–2200 hours, with the highest peaks in vocal output occurring before sunrise and sunset. Higher vocal activity was in the evening hours than in the morning hours. Vocal produc-

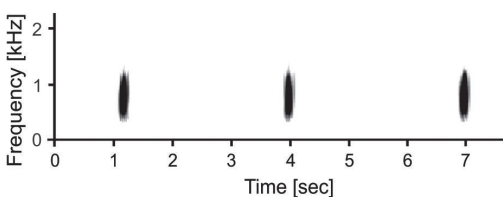


Figure 1. The example of a spectrogram of the advertising call of male Little Bittern (*Ixobrychus m. minutus*) recorded in May 2011 at the Stawy Male fishponds (South-east Poland).

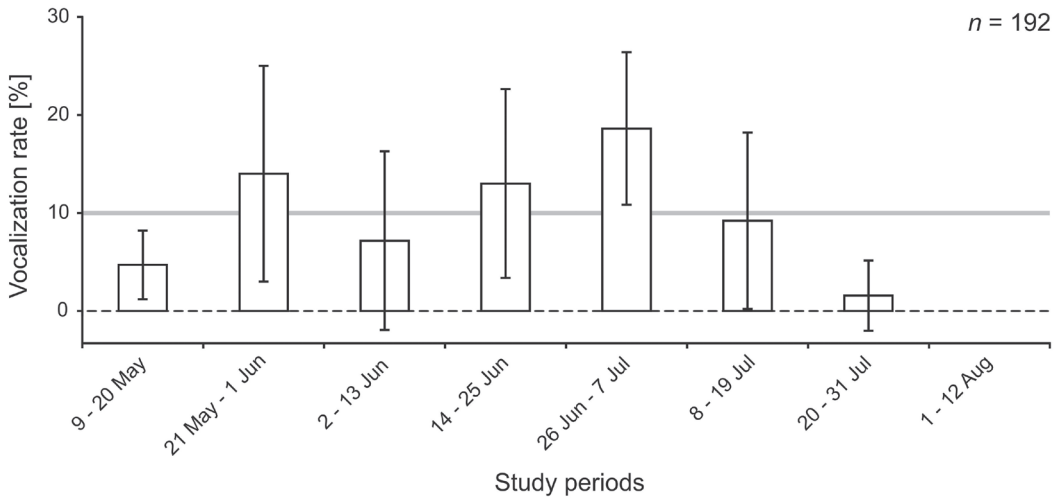


Figure 2. The vocal activity of the males of Little Bittern (*Ixobrychus m. minutus*; $n = 8$) between 9th May and 12th August 2012 at the Stawy Male fishpond complex (Southeast Poland). Means \pm SD are shown and the line determining the limit of significantly higher vocal activity is marked.

tion decreased between 0900–1600 hours, and completely ceased between 2200–0200 hours.

DISCUSSION

The breeding and wintering ranges of Little Bittern indicate that this species prefers a warm summer climate (Kushlan and Hancock 2005; BirdLife International 2015), and lower temperatures may affect

their behavior. In this preliminary study, air temperature did not have an observable adverse effect on male vocal activity during the breeding season, but it is possible that lower temperatures ($< 12^{\circ}\text{C}$) in combination with other weather factors such as rainfall or strong wind may significantly affect the male's vocalization.

The Little Bittern is a rather silent heron species except during the breeding season, when the advertising call can be heard from May to July (Voisin 1991). Similar ob-

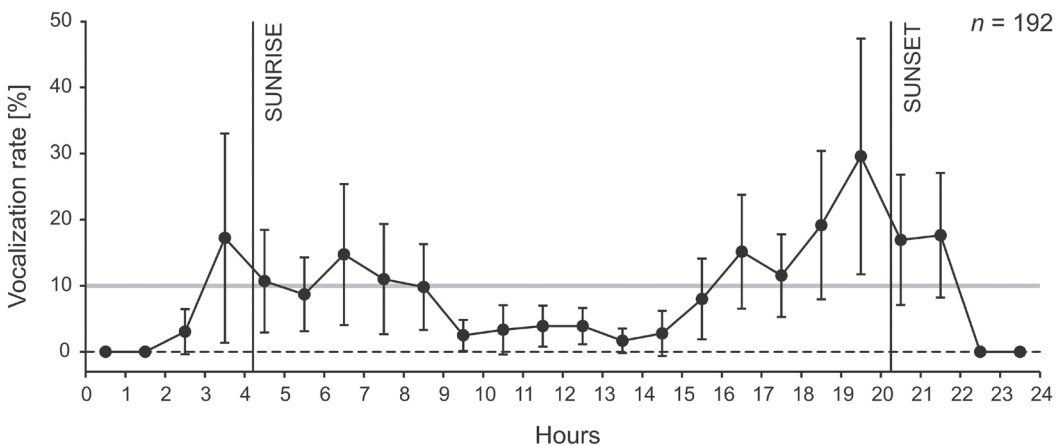


Figure 3. The daily pattern of vocal output of the males of Little Bittern (*Ixobrychus m. minutus*; $n = 8$) between 9th May and 12th August 2012 at the Stawy Male fishponds (Southeast Poland). Means \pm SD are shown and the line determining the limit of significantly higher vocal activity is marked. The average times of sunrise and sunset during the studied period are reported.

servations were also made during this study wherein the advertising call was recorded during most of the study period. In Poland, some very early arriving males can be vocally active at the very beginning of breeding season (late April), but they are usually silent until the growth of emergent vegetation. Territorial males are easy to identify by behaviors such as chasing other males from the occupied habitat patch and simultaneously uttering an advertising call (territorial function of call; although see Flis *et al.* [2020] for male territorial behavior during the incubation period). The males were significantly less active vocally at the end of July and were inactive in August, but it may vary across years (e.g., one male was still calling on 2nd August 2010 in the Study Area; A. Flis, pers. obs.). Despite a short breeding season in Europe (Voisin 1991), the Little Bittern is a double-brooding species (Filipiuk and Kucharczyk 2016) and the second (late-season) broods occur in August (Kushlan and Hancock 2005; Flis 2013).

There were two major peaks of a male's vocal output during the breeding season. The first peak was short, in contrast to the second one which was extended in time, and they occurred respectively at the beginning and in the middle of the breeding season. The first peak occurred shortly before the first egg-laying dates in the Study Area (see Flis 2013). This suggests that the second peak may be related to the start of the second broods (Filipiuk and Kucharczyk 2016), and the advertising call is uttered only in the pre-laying period, where only unpaired males or males that failed in their breeding attempt are heard calling during the main egg-laying period (Flis 2013). The last statement may also be confirmed by observation (recording from the trail camera; Flis *et al.* 2020) of the nesting pair of Little Bitterns whose incubated eggs were predated: the male returned to the nest just a few hours later and started calling intensively again, which resulted in the arrival of female and a brief courtship display that ended with copulation (mate stimulation function of call).

The male's daily distribution of vocalization shows the highest activity before sunrise

and sunset, which may be partially explained by the crepuscular behavior of Little Bittern (Flis *et al.* 2020). A similar pattern was reported for other birds living in dense marsh vegetation (e.g., Little Crake or Water Rail). Depending on the species' biology, their calling activity can be related with territoriality and intra-males/pairs long distance communication only during the pair formation period or throughout the breeding season (Merilä and Sorjonen 1994; Polak 2005, 2006).

The quality of a male's advertising call testifies about individual condition, and is crucial in the case of secretive bird species (Polak 2005; Delgado and Penteriani 2007; Murphy *et al.* 2008). Furthermore, some males can use vocal activity in the pre-laying period as a signal of his territory and nest stand quality (Penteriani *et al.* 2002). The male Little Bittern has a unique mating system among all herons by building two nest types (breeding nest and mock nest; see Cramp and Simmons 1977; Flis 2016). The male mating strategy of starting to build a nest alone in its territory in the pre-laying period seems to be strongly related with the advertising call because this behavioral signal is usually the first step in enticing a female (mate attraction function of call and pair-bond formation).

The collected data suggests that the Little Bittern males vocalized in the pre-laying period, calling intensively after arrival and becoming silent at the start of egg-laying/incubation period. Such behavior indicates mainly an inter-sexual function of the advertising call. The territory defense function also occurs, but after egg-laying the male is probably more focused on defending and guarding only the nest site rather than the whole area of its territory, and this could explain how Little Bitterns can nest in semi-colonies (Flis *et al.* 2020).

ACKNOWLEDGMENTS

I would like to acknowledge the editor and two anonymous referees for very important and helpful comments which improved this manuscript. I would also like to thank Agata Flis for help with the field work. I greatly appreciate the cooperation of local fish farmers. The field work was carried out under permission of

the General Directorate for Environmental Protection (DOPozgiz-4200/III-162/2212/10/dl). The research methods meet all ethical guidelines for the study of wild birds, and were in compliance with the current standards and policies of Polish law. This study was partly supported by statutory funds of the Institute of Nature Conservation, Polish Academy of Sciences.

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