POLISH JOURNAL OF NATURAL SCIENCES
Abbrev.: Pol. J. Natur. Sc., Vol 39(3): 143–150, Y. 2024

DOI: 10.31648/pjns.10220

INFLUENCE OF SELECTED PARAMETERS OF MATING VOCALIZATION OF PHEASANTS *(PHASIANUS COLCHICUS)* ON REPRODUCTIVE SUCCESS*

***Piotr Czyżowski*[1], *Piotr Nawłatyna*[2], *Sławomir Beeger*[3]**

[1] ORCID: 0000-0002-8587-246X
[2] ORCID: 0009-0001-5979-1594
[3] ORCID: 0000-0003-4569-8273
[1–3] Department of Animal Ethology and Wildlife Management
University of Life Sciences in Lublin, Lublin, Poland

Key words: pheasant, vocalization, reproductive behaviour.

Abstract

The purpose of this study was to analyze the mating vocalizations of pheasant roosters (time between successive vocalizations, peak frequency of sound amplitudes) and to demonstrate the relationship between vocalization parameters and the number of hens accumulated by the roosters (reproductive success). The research was conducted based on recordings of the sounds of 6 rolling roosters. A total of 79 isolated vocalizations constituted the study material. The recordings were made using a Zoom H1 portable sound recording device based on two microphones in an X/Y arrangement, enabling correct recording of stereophony. Roosters leading two or one hen were characterized by more active vocalizations, which increases their attractiveness to hens choosing them. Cooks leading two or one hen were characterized by a lower peak frequency of the vocalization sound produced than roosters without hens. This may indicate that roosters making sounds at lower frequencies are more attractive to hens.

Introduction

The study and analysis of bird sounds are essential in studying bird ecology and behaviour (SLABBEKOORN and SMITH 2002, NEAL et al. 2011). There are few studies on the acoustic characteristics of tooting pheasants *Phasianus colhicus* (HEINZ and GYSEL 1970, SHIREN et al. 1996), although the species is easy to observe and is characterized by a spectacular mating

Address: Sławomir Beeger, University of Life Sciences in Lublin, Akademicka 13, 20-950 Lublin, e-mail: slawomir.beeger@up.lublin.pl

* The research was financed from the statutory funds of Department of Animal Ethology and Wildlife Management, University of Life Sciences in Lublin, Poland.

ritual and loud vocalizations. With the arrival of spring, male pheasants mark out territories by demonstrating this with vocalizations (drinking). This behaviour attracts females and informs other males that a territory has been occupied. The sound of a rooster provides pheasant hens with acoustic information about the fitness of males, which indirectly translates into the male's choice of a particular habitat. The most attractive males to hens show greater territoriality – they move less during the day, have better territories and moult more often (GRAHN et al. 1993, MATEOS 1998). The more attractive and diverse the territory, the better the access to food and nesting sites, and the easier the escape from possible danger (JOHNSGARD 2017). Females make their choice among tooting males probably based on morphology (GÖRANSSON et al. 1990, VON SCHANZT et al. 1994), courtship behaviour (MATEOS and CARRANZA 1999), and based on significant tissue compatibility system (MHC) genes (BARATTI et al. 2012). The sound of a rooster can also provide pheasant hens with acoustic information on male fitness, which indirectly translates into the male's choice of a particular habitat (SLABBEKOORN and SMITH 2002, HARMA 2003).

The purpose of this study was to analyze the mating vocalizations of pheasant roosters (time between successive vocalizations, peak frequency of sound amplitudes) and to demonstrate the relationship between vocalization parameters and the number of hens accumulated by the roosters (reproductive success).

Materials and Methods

The study was based on recordings of the sounds of 6 tooting roosters in the Lublin area, including allotment gardens, a city park and ruderal areas. The area is located in the valley of the Bystrzyca River and includes a section from the allotments near Muzyczna Street to the former Riding Club. The dominant habitat in the club's vicinity was shrubbery and woodland adjacent to an area of meadows and formerly functioning pastures, while the allotment gardens are a mosaic of cultivated and ornamental plants.

The sounds were recorded in 2023, from April to June. A total of 79 isolated vocalizations constituted the study material. The total length of the recordings made in the different terms ranged from 12 to 60 minutes. The recordings were made with a Zoom H1 portable sound recording device based on two microphones in an X/Y arrangement, enabling correct recording of stereophony. Due to later analysis and archiving, the files with recorded vocalizations of roosters were divided into 3-minute recordings,

which were analyzed in Cool Edit Pro 2.1 software. Individual vocalizations of roosters were extracted and evaluated in terms of peak amplitude frequency, the duration of the first and second syllables, and pauses between syllables. Pheasants were divided into three groups based on the number of hens they had (0, 1, 2), and the average values of the sound frequency of peak amplitudes and the duration of pauses between vocalizations (vocalization frequency) were calculated for each group. For each song, the duration of the first syllable (in seconds), the duration of the second syllable (in seconds), the duration of the pause between syllables (in seconds), the interval between vocalizations (in minutes) and the peak frequency for the first and second syllables (in Hz) were determined. The duration of syllables and pauses between syllables and vocalizations were determined by spectrogram evaluation (Figure 1). At the same time, direct observations of roosters were made using binoculars to determine the number of hens led by males.

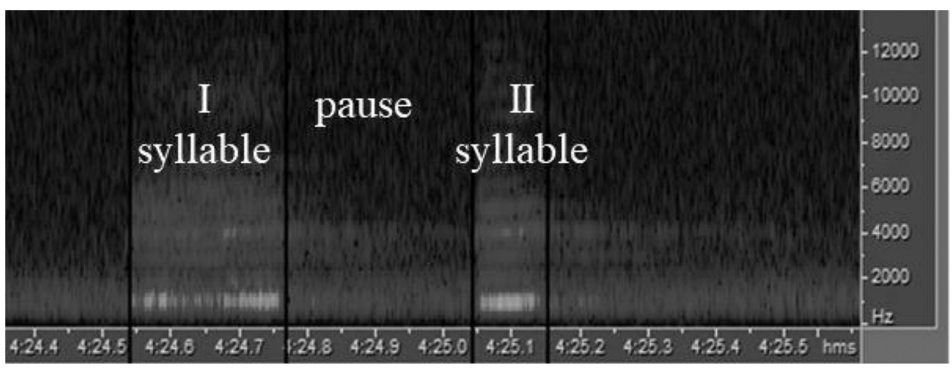

Fig. 1. Screenshot from Cool Edit Pro with spectrogram and highlighted rooster song phrases

Statistical analysis of the study results was carried out using the Statistica 13.3 PL statistical package. Since the distributions of the analyzed traits significantly deviated from normality, nonparametric (rank) tests were used to test the significance of differences between their distributions. For comparisons of mean values of sound frequencies (independent variables) between groups (number of hens gathered by the rooster), a nonparametric analysis of variance – Kruskal-Wallis ANOVA and a multiple comparisons test of mean ranks for pairwise comparisons were performed. The significance of differences between groups was determined by nonparametric analysis of variance – Kruskal-Wallis ANOVA.

Results and Discussion

The mean time between vocalizations of roosters leading two hens was significantly lower compared to roosters in which no hens were present (Table 1), and these differences assessed by nonparametric ANOVA were statistically significant (Figure 2).

Table 1

Average values of analyzed parameters of pheasant cock depending on the number of hens [$\overline{x}$ / n (min–max)]

Number of hens by the pheasant cock (n)	The time between vocalizations [(min : sec)/n min–max)]	Peak amplitude frequency of syllable I [(Hz/n) min–max)]	Peak amplitude frequency of syllable II [(Hz/n) min–max)]
0	02:53/29 (00:18–06:00)	1731/29 (1041–4190)	1635/29 (933–4508)
1	01:54/26 (00:30–03:00)	1085/26 (1015–1181)	1092/26 (967–1261)
2	01:36/24 (00:12–06:00)	1176/24 (968–4110)	1190/24 (958–4092)

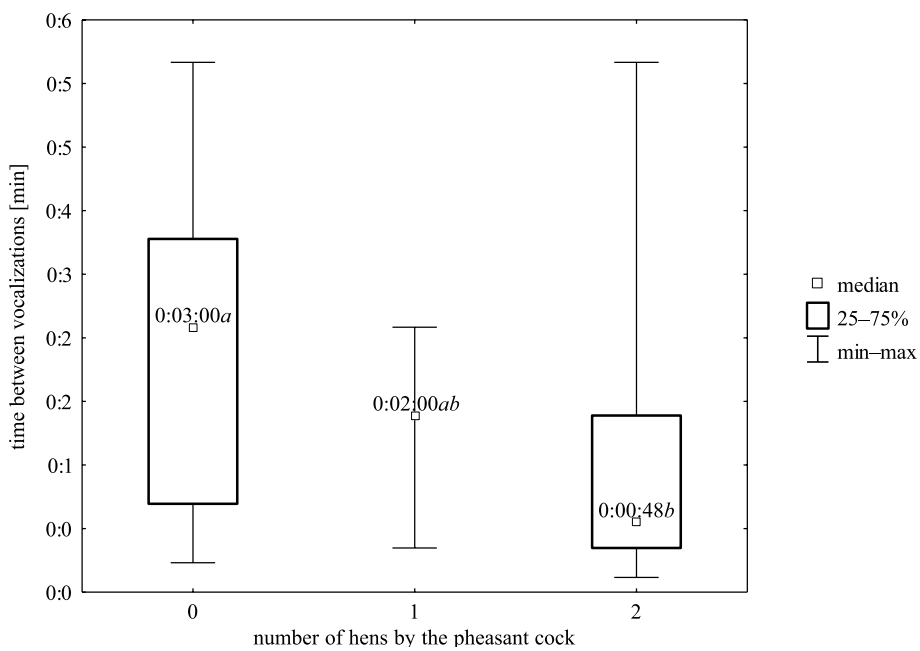

Fig. 2. The time between vocalizations [min] due to the number of hens at the pheasant cock

The total sound frequency range of pheasants' vocalizations was from 900 to 4500 Hz, and 50% of all observations (between quartiles I and II) were in the 1000–1300 Hz range. According to studies by other authors (HEINZ and GYSEL 1970, SHIREN et al. 1996), in pheasants, the frequency of vocalizations is in the range of 250–10500 Hz, and the most distinct frequency of pheasant singing syllables is usually in the range of 800 Hz to 1000 Hz.

The highest peak amplitude of the first syllable of vocalization was characterized by roosters at which no hens were observed. Roosters that gathered 1 or 2 hens were characterized by lower peak amplitude values (Table 1), and these differences were statistically significant (Figure 3). Similar results were obtained by analyzing the peak amplitudes of the second syllable – the highest amplitude was characterized by roosters at which no hens were observed, and these were also statistically significant differences (Figure 4). A lower sound frequency means that sound waves carry less energy, reducing their susceptibility to absorption by obstacles. Low-frequency sounds propagate further and can be heard by more females. (COSENS and FALLS 1984, SLABBEKOORN et al. 2002). Vocalization behaviour is significantly influenced by hormonal factors, as evidenced by the relationship between vocalization frequency and gonad mass, and thus testosterone levels (HEINZ and GYSEL 1970), which fluctuate cyclically (KIM and YANG 2001). The singing of male birds is a secondary sexual trait under the control of gonadal steroids, so it increases and disappears with the seasonal cycle of testicular growth and regression (MARLER 1988). Thus, analysis of the sounds made by birds can be an indirect determinant of the individual quality of roosters. This is also supported by studies on Gallus gallus, which have shown that vocalization quality is an indicator of body size and individual fitness (HAO et al. 2022). According to GREIG et al. (2013), low vocalization frequency is more strongly associated with larger body size, indicating that morphological limitations also affect the acoustic quality of vocalizations.

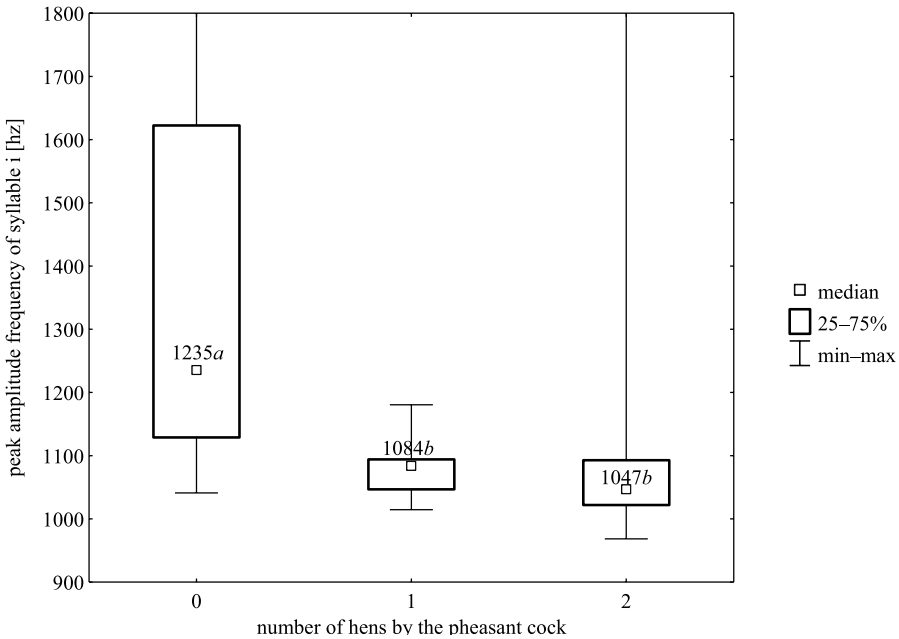

Fig. 3. Peak amplitude frequency of syllable I [Hz] due to the number of hens at the pheasant cock

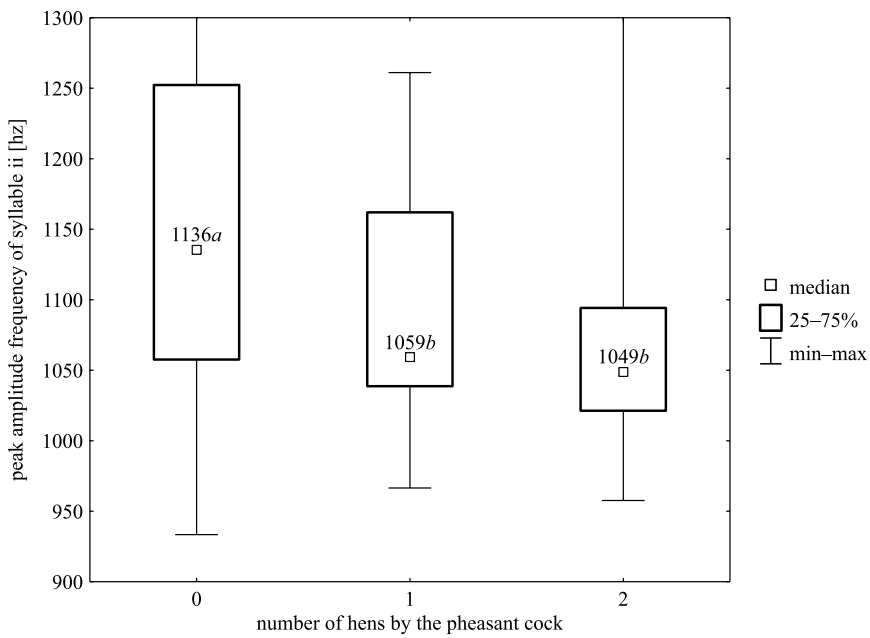

Fig. 4. Peak amplitude frequency of syllable II [Hz] due to the number of hens at the pheasant cock

Conclusion

1. Cooks leading two or one hen were characterized by higher vocalization activity, which increases their attractiveness to hens choosing them.

2. Cooks leading two or one hen were characterized by a lower peak frequency of the vocalization sound compared to roosters without hens. This may indicate that roosters making lower-frequency sounds are more attractive to hens.

3. Our work may provide a basis for further research on the relationship of vocalization with reproductive success and testosterone levels.

References

Baratti M., Dessì-Fulgheri F., Ambrosini R., Bonisoli-Alquati A., Caprioli M., Goti E., Matteo A., Monnanni R., Ragionieri L., Ristori E., Romano M., Rubolini D., Scialpi A. Saino N. 2012. *MHC genotype predicts mate choice in the ring-necked pheasant Phasianus colchicus*. J. Evol. Biol., 25(8): 1531–1542. https://doi: 10.1111/j.1420-9101.2012.02534.x.

Cosens S.E., Falls J.B. 1984. *A comparison of sound propagation and song frequency in temperate marsh and grassland habitats*. Behav. Ecol. Sociobiol., 15: 161–170.

Göransson G., Von Schantz T., Fröberg I., Helgee A. Wittzell H. 1990. *Male characteristics, viability and harem size in the pheasant, Phasianus colchicus. Anim. Behav.,* 40(1): 89–104. https://doi.org/10.1016/S0003-3472(05)80668-2.

Grahn M., Göransson G., von Schantz T. 1993. *Spacing behaviour of male pheasants, Phasianus colchicus, in relation to dominance and mate acquisition. Anim. Behav.,* 45(1): 93–103. https://doi.org/10.1006/anbe.1993.1009.

Greig E.I., Price J.J., Pruett-Jones S. 2013. *Song evolution in maluridae: Influences of natural and sexual selection on acoustic 407 structure*. Emu, 113: 270–281.

Hao P., Zhao K., Huang X., Rao X., Liang W., Zhang Y., 2022. *The vocalization of the red junglefowl is a signal of body size and 410 individual health*. Curr. Zool., 69: 393–400.

Harma A. 2003. *Automatic identification of bird species based on sinusoidal modeling of syllables.* [In:] *IEEE International Conference on Acoustics*, *Speech and Signal Processing*, pp. 545–548.

Heinz G.H., Gysel L.W. 1970. *Vocalization behavior of the Ring-necked Pheasant*. The Auk, 87(2): 279–295. https://www.jstor.org/stable/4083920, access: 5.06.2024.

Johnsgard P. 2017. *North American quails, partridges, and pheasants*. Lulu. com., pp. 97–104.

Kim I.S., Yang H.H. 2001. *Seasonal changes of testicular weight, sperm production, serum testosterone, and in vitro testosterone release in Korean ring-necked pheasants (Phasianus colchicus karpowi).* J. Vet. Med. Sci., 63(2):151–156. https://doi.org/10.1292/jvms.63.151.

Marler P., Peters S., Ball G.F., Dufty Jr. A.M., Wingfield J.C. 1988. *The role of sex steroids in the acquisition and production of birdsong*. Nature, 336(6201): 770–772.

Mateos C. Carranza J. 1999. *Effects of male dominance and courtship display on female choice in the ring-necked pheasant*. Behav. *Ecol. Sociobiol.* 45(3–4): 235–244. https://doi.org/10.1007/s002650050558.

Mateos C. 1998. *Sexual selection in the ring-necked pheasant: a review*. Ethol. Ecol. Evol. 10(4): 313–332. https://doi.org/10.1080/08927014.1998.9522846.

Neal L., Briggs F., Raich R., Fern X. Z. 2011. *Time-frequency segmentation of bird song in noisy acoustic environments.* [In:] *2011 IEEE International Conference on Acoustics, Speech and Signal Processing* (ICASSP): 2012–2015. https://doi.org/10.1109/ICASSP.2011.5946906.

SHIREN J., PING D., JIANHUA L., YANG Z. 1996. *The sound spectrographic analyses on the call of golden pheasant Chrysolophus pictus*. Zool. Res., 17(4): 403–409.

SLABBEKOORN H., SMITH T.B. 2002. *Bird song, ecology and speciation*. Philos. Trans. R. Soc. Lond. B Biol. Sci., 357(1420): 493–503. https://doi.org/10.1098/rstb.2001.1056.

SLABBEKOORN H., ELLERS J., SMITH T.B. 2002. *Birdsong and sound transmission: the benefits of reverberations*. The Condor, 104(3): 564–573.

VON SCHANTZ T., GRAHN M., GORANSSON G. 1994. *Intersexual selection and reproductive success in the pheasant Phasianus colchicus*. Am. Nat., 144(3): 510–527.