University of Sopron

Theses of doctoral (PhD) dissertation

Study on the Common Quail *Coturnix coturnix* (Linnaeus, 1758) in agricultural environment, with particular regard to the habitat selection

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Sopron
2019

Doctoral School: Roth Gyula Doctoral School of Forestry and Wildlife Management Science

Doctoral Program: Wildlife management (E5)

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1. Introduction

Habitats and living conditions were transformed by human activities, which have affected the entire fauna. One of the main purposes of this action was to gain/get more farmlands. As a result of agricultural intensification – high use of fertilizer and pesticides, large scale farming systems instead of mosaic landscape structure, pressure of mechanization, overgrazing –, several species have become extinct or have become endangered. Thus, agricultural intensification has been one of the reasons for the decline in farmland bird populations over the last decades.

The Common quail (*Coturnix coturnix* LINNAEUS, 1758) was a typical species of grassland areas, and also preferred open forest steppe habitat. Due to habitat transformations associated with agricultural development, this species became one of the typical species of farmland breeders. At the end of the 19th century a slight population decrease was already observed, but a larger decline in its West-European population started in the 1920s. In Hungary, its population shows a moderate decline, so it is important to understand the results of studies on its habitat selection and apply them during the habitat management.

The aim of the present dissertation is to present the important ecological factors of the habitat selection of the Common quail in different agricultural landscapes.

The main questions of the research were the followings:

- Which open farmland habitats (different types of crops, set-aside, fallows) are preferred or avoided by quails?

- Which habitat parameters, including vegetation structure, food availability (Arthropoda), landscape structure, influence the presence and habitat selection of quails the most?

- Is there any difference in the habitat selection between intensively and extensively managed farmlands?

- Can bioacoustics methods be used for individual identification and re-identification of calling males?

- What is the impact of the unmown refuge-strips on the density and breeding site fidelity of the Common quails?

2. Materials and methods

2.1. Study area

The study sites (the intensively managed LAJTA Project and the extensively managed MOSON Project) are situated in the Moson plane. Both sites were established in 1992 by the Department of Wildlife Management of the former University of Forestry and Wood Sciences to monitor the population of small game species and their environment. An intensive, large-scale farming can be found in the area of the LAJTA Project (3065 ha), and the fields are cultivated with ecologically sustainable methods in the area of MOSON Project (880 ha), where extensively cultivated fields are changed to fallowing in 1-5 years.

2.2. Survey methods

Common quail population estimation

Since there no standardised methods have been developed to estimate quail population in Hungary, a method used by Spanish researchers was adapted to the study area (LAJTA Project). At dawns, under suitable weather conditions (rainless, calm/windless), at every listening point the observer waited for 1.5 minutes to count the number of singing males.

After this procedure, playback of a female call was used for 20-25 seconds to stimulate silent males present at the listening point. Listening points were at least 500 m far from each other to prevent overlap and double counting of individuals.

Habitat parameter survey

Based on the literature, two scales were applied; in a smaller area with a radius of 75 m (~ 1.5 ha), considered as a territory, and as landscape scale in an area with a radius 500 m (~ 79 ha). In 2014, 14 occupied and 14 unoccupied, i.e. control areas were compared, and further 14 occupied areas were analysed in the area of MOSON Project to represent the extensively managed area as well. Total length of forest belts, total length of field margins, the smallest distance from forest edge and the smallest distance to field edges were the analysed variables in the landscape scale.

Vegetation surveys were carried out in the occupied and control sites in the areas of territory scale only. A total of 5 quadrats of 5 x 5 m were surveyed within the radius of 75 m.

Barber pitfall trapping was used for collecting ground-active arthropods in each field crops, with 300 ml volume plastic cups. Cups were filled with 70% ethylene glycol solution and were placed in the areas of territory scale of each field, so a total of 5 pitfall traps were worked in the vegetation quadrats. Traps operated between 30 April and 20 August 2014 at two-week intervals. The collected arthropod specimens were identified at higher taxa level, then dried at 85–90°C for the dry biomass determination.

Unmown refuge strip survey – effect of mowing on the habitat selection of quails

Density and site fidelity of quails were tested in the unmown refuge strips in the area of the MOSON Project. Surveys were taken a week before the mowing in June, and then two weeks after the mowing. Along the selected transect

line, apart from the survey of singing males, recordings were made with an Olympus LS-5 PCM (i.e. pulse-code modulation) recorder to identify quail individuals. For individual recognition bioacoustics method was used.

2.3. Data analysis

Coenological analysis

Plant species were determined, and the cover was estimated in the quadrates. The Shannon formula was used to calculate vegetation diversity.

Food availability evaulation

Arthropod samples collected by Barber pitfall traps were sorted with stereo microscope and then the number of individuals per taxon was determined. The Shannon formula was used to calculate taxon diversity.

Evaulation of habitat selection

For comparing field crops in the area of the LAJTA Project (sites preferred by quails), Jacobs' preference index was calculated.

Based on the occupied and control sites, a data system (compiled from the values of vegetation surveys, food availability and habitat characteristics) was compiled. Principal component analysis (PCA) was used to determine correlations of the habitat preference of quails. To explore more detailed relationships, the data of MOSON Project were also entered in the analysis. Using the new variables obtained from PCA, a generalized linear model (GLMs) was used to predict the occurrence of quails. Since territory occupation by quails was considered as a binary response variable (presence – 1, absence – 0), the logistic link functions was applied with binomial error structure. Forward stepwise (likelihood ratio) method was applied to select the final variable in the model.

Discriminant analysis (DA) was used to analyse the slight differences of the habitat selection of quails in the intensively and extensively managed areas.

Analysis of audio recordings

For individual recognition, six sound variables were measured, which characterize properly the quails vocalization. The intervals between syllables (sec) and the peak frequency of syllables (Hz) were measured instead of the length of syllables. The measured parameters were used to perform a stepwise cross-validated discriminant function analysis (DFA).

The Euclidean distance was measured with the coordinates of discriminant function and individual variables of re-identified calls were tested with paired sample *t* test. The recognition was classified to correct (both recordings belong to the same individual), if the Euclidean distance was ≤ 4.

3. Theses

1. The population number of quails in the area of LAJTA Project was estimated to 127 singing males in 2013 and 105 singing males in 2014, thus the density was 1,31 and 1,14 singing males/100 ha, respectively. Moderate decline was found between the two years (17,3%), but the difference is not significant (Mann-Whitney U = 11, z = -0,208, p = 0,83).

2. According to the habitat preference analysis, the author determined that the quails mostly preferred fallows in both years (D= 0,906–0,954), but triticale (D= 0,771–0,845) and autumn crop mixtures (D= 0,676–0,753) were also favoured. Crops as colza, maize, mustard and sorghum were completely avoided by quails (D= -1).

3. Based on the results of multivariate analysis, protective cover, plant diversity, arthropod number and the distance from the nearest woody ecotone were key components of the environment that positively affected the occurrence of Common quails in the intensively managed areas (LAJTA Project). The total length of woody ecotones and the distance from the nearest grassy field margins were less crucial variables, still affecting significantly the occurrence of quails.

4. Based on the results of principal component analysis, plant cover and diversity; arthropod number and diversity components play an important role in the habitat selection in both farmland types (LAJTA and MOSON Project). Discriminant function analysis showed that quail habitats in the areas of differently managed farmland systems are

characterized by distinct habitat parameters, which mainly vary from the plant cover and the variables of woody ecotones.

5. The individual quail recognition method based on sound variables and described in the literature was found insufficient during the field tests because some sound variables can hardly be determined due to the additional noises. Thus, with introduced new variables (measuring the intervals between syllables instead of the length of syllables), an alternative method was developed, which can be used efficiently to discriminate and re-identify calls of singing males even if background noises are present.

6. After mowing 9 quails were re-identified with high probability in the unmown refuge strips of the extensively managed area (MOSON Project). As the results of the survey revealed, leaving uncut 15-20 m wide refuge-strips in grassland area can still provide suitable habitat for Common quails, furthermore it can also reduce migration of the species from the area.

4. Publications related to the topic of the dissertation

Scientific publications (in English)

Németh, T. M., Kelemen, P., Csiszár, Á., Kovács, Gy., Faragó, S. & Winkler, D. (2019): Habitat selection of Common quail (*Cotrunix coturnix*) in an intensively managed agricultural land. *Ornis Hungarica* 27(1): 99–109. (Q3)

Németh, T. M. & Winkler, D. (2017): The impact of unmown refuge-strips on the breeding site fidelity of Common Quail (*Coturnix coturnix*) – a case study. *Magyar Apróvad Közlemények* 13: 289–296.

Scientific publications (in Hungarian)

Németh T. M. (2017): Agrártájhoz kötődő madárfajok („farmland birds") állományának változása, helyzete Európában. *Magyar Apróvad Közlemények* 13: 143–160.

Németh T. M., Winkler D. & Faragó S. (2014): A LAJTA Project fürj (*Coturnix coturnix* Linnaeus, 1758) állományának vizsgálata a 2013-2014 időszakban. *Magyar Apróvad Közlemények* 12: 125–134.

Conference books

Németh T. M., Kelemen P., Csiszár Á., Faragó S. & Winkler D. (2017): A fürj (*Coturnix coturnix*) habitatválasztása intenzív és extenzív agrárkörnyezetben. Soproni Egyetem Erdőmérnöki Kar VI. Kari Tudományos Konferencia. Konferencia kötet, p. 59.

Németh T. M., Winkler D. & Kovács Gy. (2014): A fürj (*Coturnix coturnix*) befogás és jelölés módszertani

kérdései – előzetes tapasztalatok a LAJTA Project területén. Nyugat-magyarországi Egyetem Erdőmérnöki Kar IV. Kari Tudományos Konferencia. Konferencia kötet, pp. 288–290.

Further publications

Kovács Gy., **Németh T. M.**, Winkler D. & Faragó S. (2015): Ragadozó madarak élőhelyhasználata a Lajta Project területén. Nyugat-magyarországi Egyetem Erdőmérnöki Kar V. Kari Tudományos Konferencia. Konferencia kötet, p. 15.

Winkler D., Bender F. & **Németh T. M.** (2014): A haris [*Crex crex* (Linnaeus, 1758)] bioakusztikai vizsgálata a Hanságban. *Magyar Apróvad Közlemények* 12: 135–149.

Keszkenyős A., **Németh T. M.** & Winkler D. (2013): A lappantyú (*Caprimulgus europaeus* L.) habitatválasztásának vizsgálata a Barcsi Borókás Tájvédelmi Körzet területén. Nyugat-magyarországi Egyetem Erdőmérnöki Kar III. Kari Tudományos Konferencia. Konferencia kötet, p. 99.

Németh T. M. (2012): A haris (*Crex crex*) állományvizsgálata az Őrségben. *Magyar Apróvad Közlemények* 11: 49–58.

Winkler D. & **Németh T. M.** (2011): Bird community succession in primary and secondary forests in the Sopron Mountain, Hungary. XXXth IUGB Congress (International Union of Game Biologists) and Perdix XIII. p. 341.

Németh T. M. & Szentirmai I. (2008): A védett hamvas küllő élőhelyválasztása az Őrségi Nemzeti Parkban. Az V. Magyar Természetvédelmi Biológiai Konferencia. p. 136.