

Methodology for the study of breeding birds for the Atlas of Birds in Bulgaria

Study period

The main period for data collection is April-June - the breeding season for most of the bird species. The exact seasons for the individual species and groups of species are presented in the field research methodologies. In practice, data on breeding birds can be collected throughout the year, by assessing the observed behaviour or traces of vital activity in terms of the degree of breeding evidence, according to the scale below. The full study of a 10x10 km square is expected to take a minimum of 4-5 days, which are necessary to apply all field methodologies suitable for the habitats and the expected species. The abundance study methodology requires two visits to each of the four one-kilometre squares over a minimum of 15 days in one breeding season, while the other methodologies can be applied in different years.

Data collection method

It is recommended that the data is collected with the SmartBirds Pro mobile application. The application is developed for tablets and smartphones running the Android operating system and can be downloaded [here](#). It can also be used with devices with another operating system if an internet connection is available. Data collected with other applications can also be used, but it is not possible to apply the abundance research methodology to them. At the end of each day of the field study, observers send the collected data via the "Upload" button. (See "[SmartBirds Pro Instructions](#)"). The selection of ten-kilometre squares for research is done in the personal profile of the [SmartBirds.org](#) internet site (Fig. 1). Each ten-kilometre square is selected in the [Atlas](#) module, which, after synchronization with the mobile application, is visible in the SmartBirds Pro mobile application on your device (Fig. 2).

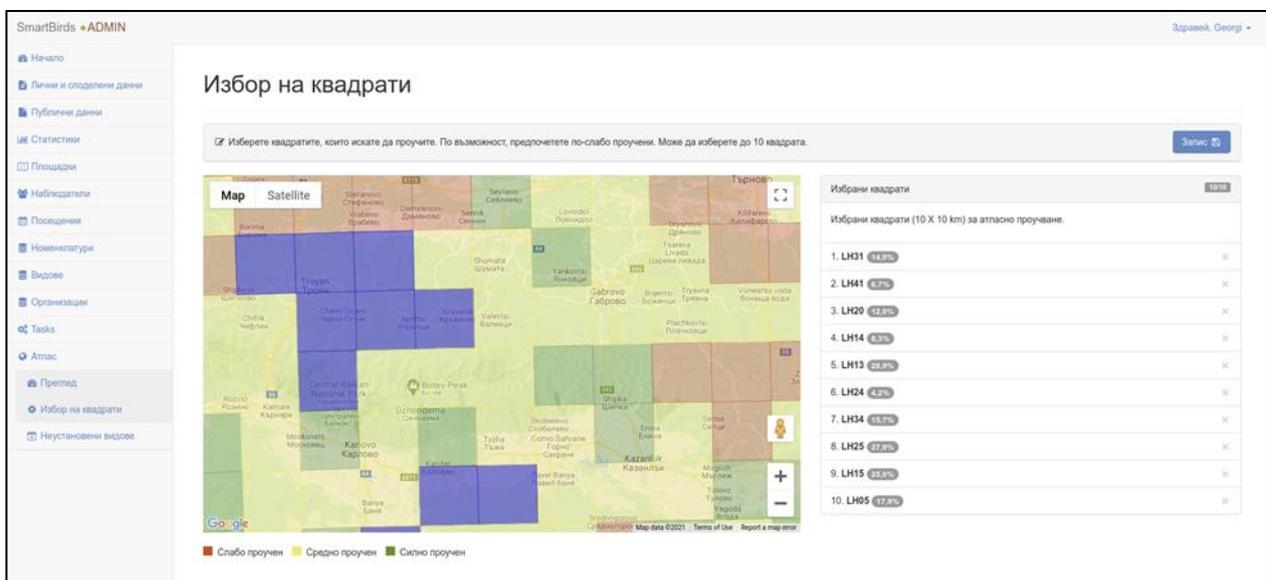


Figure 1. Selected squares for research in a personal profile on the site SmartBirds.org, highlighted in blue.

Each user has the opportunity to choose a maximum of 10 squares to study. It is preferable to select initially the least studied squares, which are highlighted in red. After recording, the system provides the ability to view the available data for the selected squares. For each square, you can see: 1) a list of species identified by the observer, 2) a list of species identified in the square **during the study for the previous Atlas** (Iankov, 2007) and 3) a complete list of species identified since 2016, including from other observers (Fig. 3). The full list of observations after 2016 does not show some rare and endangered species that are subject to violation.

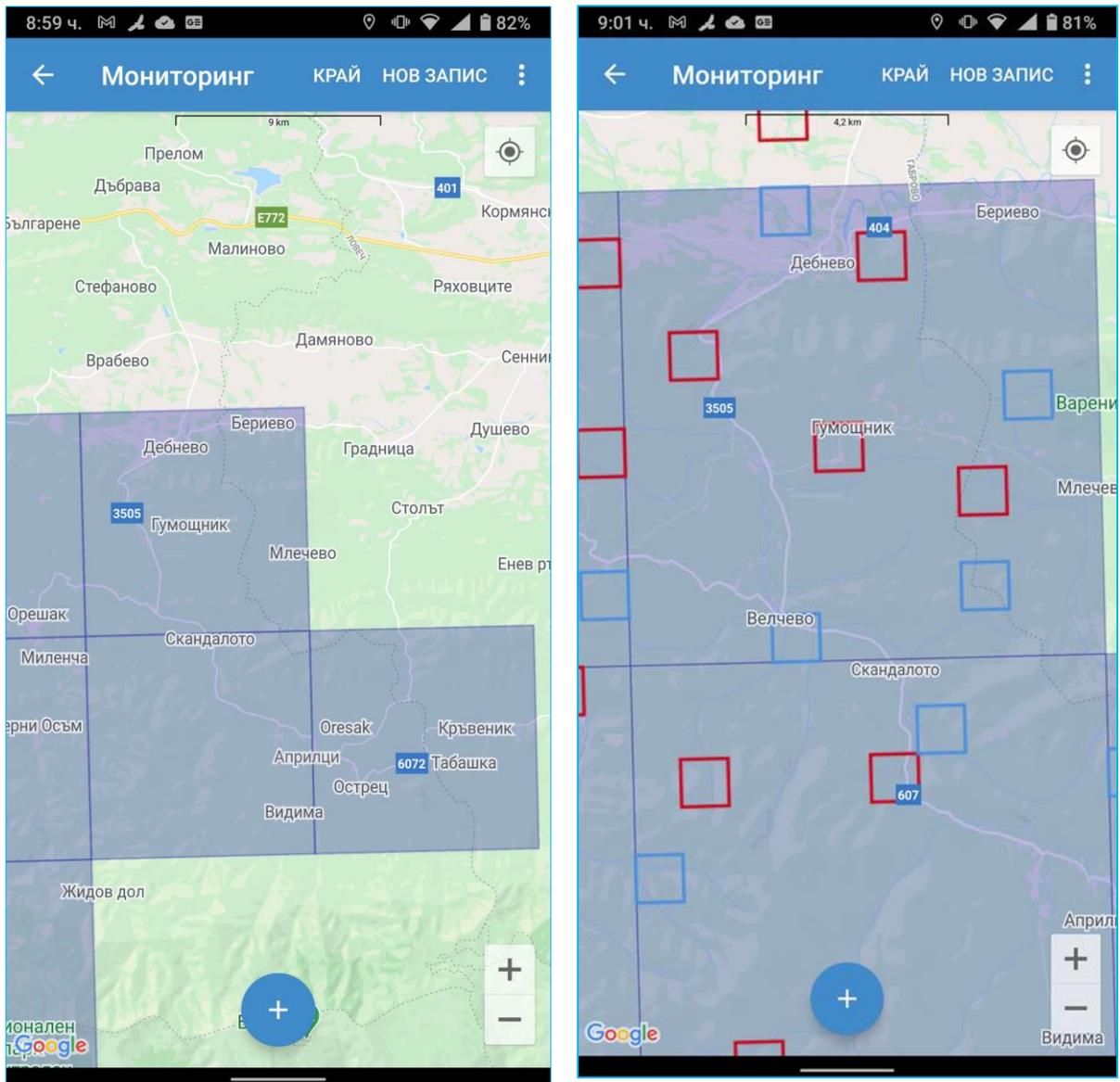


Figure 2. Visualization on a mobile device of the selected for research ten-kilometre squares and the randomly selected 1x1 km squares for the study of the abundance of birds in them.

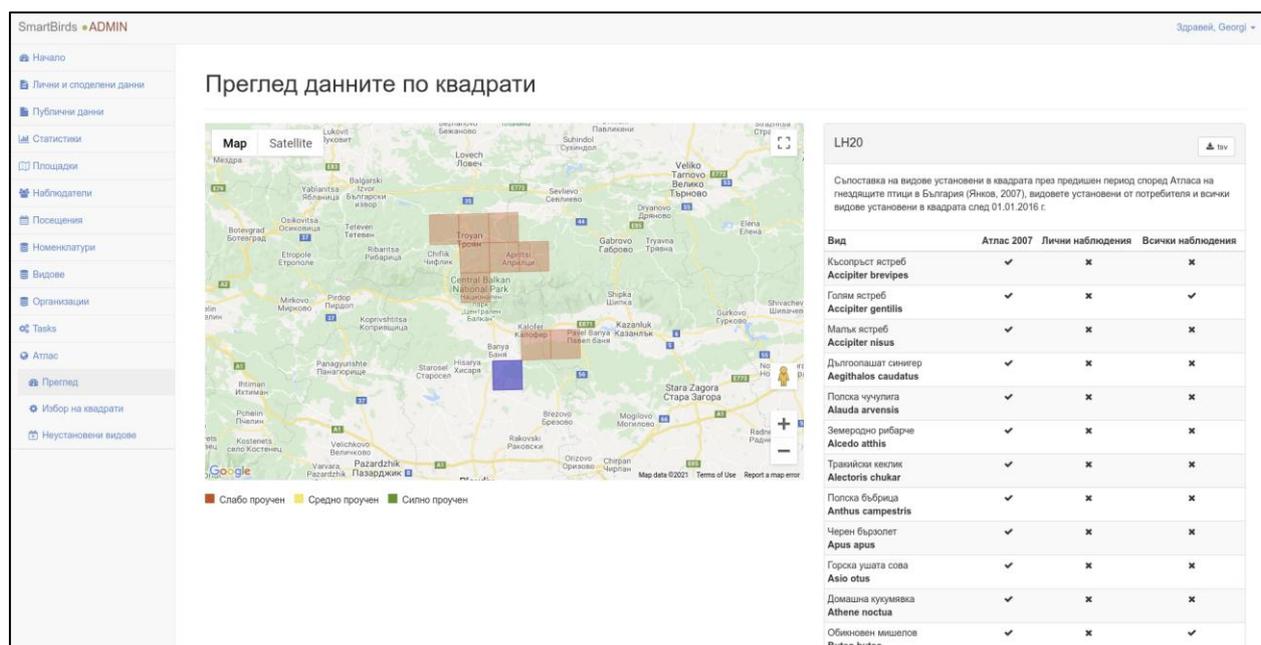


Figure 3. Visualization of the lists of the identified species in a 10x10 km square selected for research

Breeding evidence

Gathering information about the evidence of breeding of a bird species in the studied square is of particular importance for achieving the goals of the atlas. The **"Status of the species"** field in the SmartBirds Pro application **must be filled in** for each separately registered species observation.

Three degrees of breeding evidence are accepted - possible, probable and confirmed breeding with 16 specific categories. **Table 1** presents the degrees of breeding evidence and the observed evidence for each of them, as well as their presentation in SmartBirds Pro application. **Observers must select one of the 16 categories for each observation.** If the observed species is not nesting in the area, the evidence in the field "Status of the species" it is marked as- *Wintering, Migrating or Vagrant / Non-nesting* at the discretion of the observer.

Table 1. Degree of breeding evidence

Degree of breeding evidence	Summary label in SmartBirds Pro App
0. Non-breeding species (it is assumed that the observed individuals are still migrants, vagrants or non-breeding due to lack of suitable habitats in the area)	Non-breeding, Unknown, Migrant Vagrant, Wintering
A. Possible Breeding	
1. Species in nesting habitat (observed in the breeding season in suitable nesting habitat)	Species in nesting habitat
2. Singing male (s), observed at least once during the breeding season	Singing male
B. Probable Breeding	
3. Pair in nesting habitat (pair observed in a suitable nesting habitat during the breeding season)	Pair in nesting habitat

4. Permanent territory presumed through registration of territorial behaviour (song, etc.) on at least two different days, a week or more a part at the same place	Permanent territory
5. Courtship and display	Courtship and display
6. Visiting a probable nesting site, flights for changing partners during hatching	Visiting probable nest-site
7. Agitated behaviour or anxiety calls from adults	Agitated behaviour/anxiety calls
8. Brood patch on adult examined in the hand	Brood patch
9. Nest building or excavating nest-hole	Nest-building
C. Confirmed Breeding	
10. Distraction-display or injury-feigning	Distraction display
11. Used nest or eggshells found (occupied or laid within period of survey)	Used nest or eggshells
12. Recently fledged young (nidicolous species) or downy young (nidifugous species)	Recently fledged/downy young
13. Frequent visits to a hidden nest / incubating (adults entering or leaving nest-site in circumstances indicating occupied nest, including high nests or nest holes, the content of which cannot be seen).	Visiting hidden nest/incubating
14. Carrying a faecal sac or food for young (adult birds feeding the young or cleaning the nest of feces)	Carrying a faecal sac or food for young
15. Nest containing eggs	Nest with eggs
16. Nest with young (young observed in the nest or young heard in the nest)	Nest with young

Field study methodologies

The study includes four main methodologies that shall be used to collect data and determine the distribution, abundance and number of breeding birds:

1. Study of bird abundance (Ab) (Atlas 1 km)
2. Mapping of rare, nocturnal, localized and colonial species
3. Common Bird Monitoring (CBM)
4. Single observations.

Each observer who chooses to map a ten-kilometre square must apply methodologies 1 and 2. Further information on the methodologies and their application can be obtained from the coordinators of the initiative.

1. Study of bird abundance

1.1. Selection of squares and periods of study

A minimum of four 1x1 km-squares have to be studied in each 10x10 km -square selected for mapping. They are chosen randomly, but in a way that there is one in each quarter of the square (5 km). The survey squares are loaded into the ten-kilometre squares selected by the observer in the SmartBirds Pro application. They become visible by selecting "Squares" and "Atlas - 1 km" from the "Settings" menu. Their borders are in red.

If some of them are not available for study, spare ones, in blue, are suggested (Fig. 4). The replacement is done with a spare square located in the same quarter where the inaccessible one is. Each one-kilometre square is visited twice in one season during the atlas survey period. The first visit takes place in the period April 1-May 15, and the second in the period May 16-June 30. In squares over 1500 meters above sea level, visits are made between May 15 and June 15 and between June 15 and July 15.

It is recommended to visit the squares in advance, before collecting data for route planning and identification of impassable and / or risky sections.

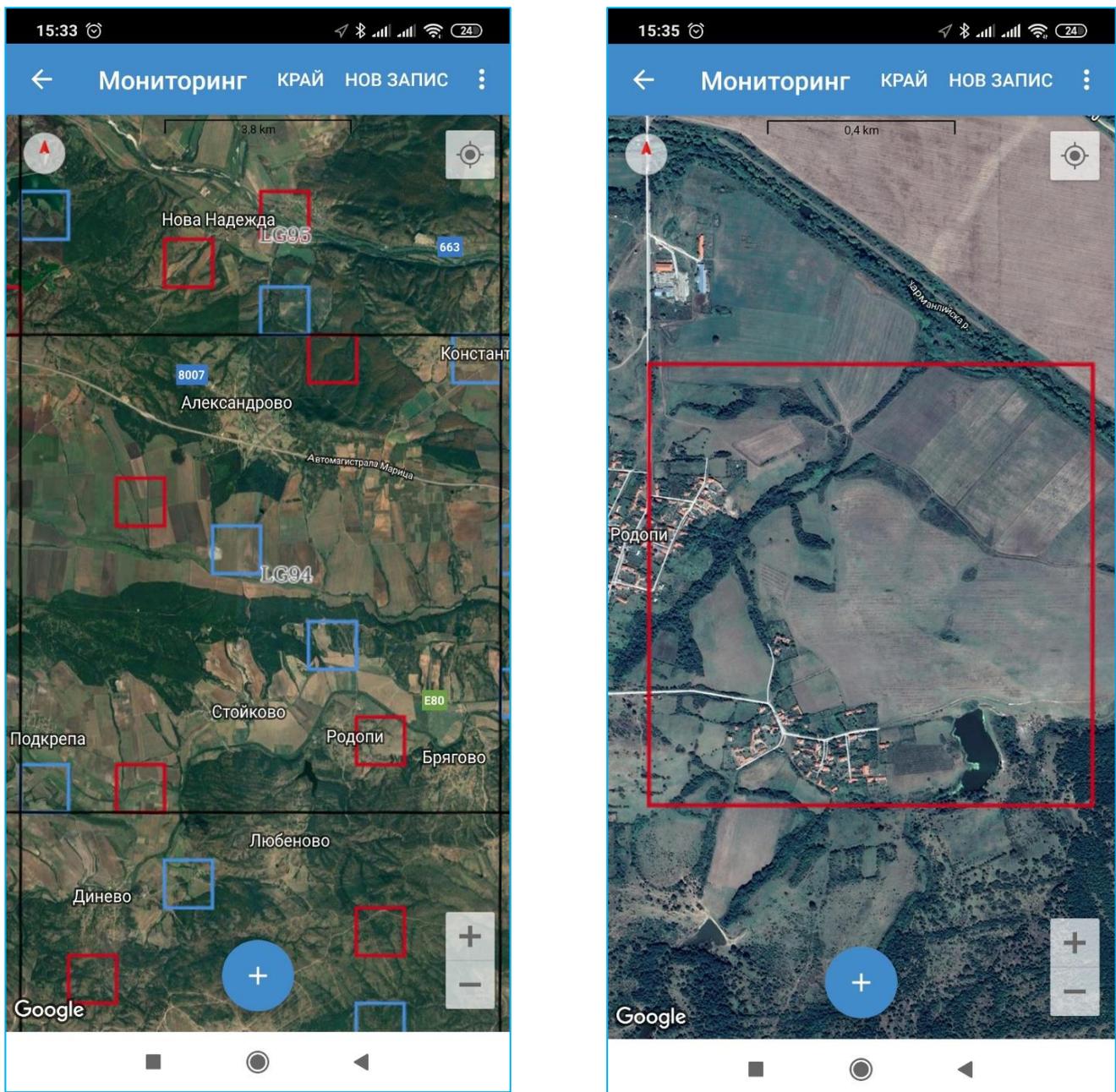


Figure 1. Visualization of the required and spare one-kilometre squares in the SmartBirds Pro application on the screen of a mobile phone.

1.2. Method of data collection

The observations are made in the morning from sunrise to 10.00 am. Data collection takes place within exactly **one hour**, in each one-kilometre square within each of the two visits. The researcher moves in the square, planning his route to visit all types of habitats, such as forest, pasture, bushes, waterbody. Start the SmartBirds Pro application just when you start collecting square data. Select the source "Atlas 1 km" and after one hour, the session ends by selecting "end". If there is likely to be no access to the Internet or mobile data in the study area, the [ten-kilometres](#) and [one-kilometre](#) squares are saved on the phone and launched via Google Earth. The files with the borders of the squares are in *.kmz format and their visualization is done with the Google Earth application, which you can download [here](#). With its help, you will be able to visualize the boundaries of the squares and your location, so that you can collect data in the required square even if you do not have access to mobile data.

All observed birds, their exact location (by placing the point where the bird was seen or heard) and the degree of breeding evidence are recorded. Species that obviously do not nest in the one-kilometre square, such as swifts over a pasture square, are recorded with the corresponding "non-breeding" status. If, after one hour, a new species is found in the surveyed one-kilometre square, it is recorded separately under the "single observations" source.

2. Mapping of rare, nocturnal, localized and colonial species

This part of the methodology provides guidance for the study of all habitat types and the application of species-specific methods in each ten-kilometre square, in order to register the maximum number of species during the breeding season and determine their numbers. Representative sections of all specific habitats in each of the 10x10 km UTM squares are to be visited - dam, river, swamp, rock formations, quarry, old forest, settlement, land slopes, dry stony pastures, etc. and all identified species are mapped. There is a search for species with specific behaviour and habitat – Eagle Owl, Bittern and Little Bittern, Little Grebe, Eurasian Woodcock, Eurasian Thick-knee, crakes, etc. Their round-the-clock activity is taken into account in order to have a maximum probability of their detection. Sound stimulation is performed for the species for which it is suitable. The use of ornithological nets for difficult-to-observe / identify species is also permitted as long as appropriate permits are obtained. All identified species are registered in each habitat. Each observation of the targeted bird species, rare species or species that are specific for the present habitat, must be recorded separately, but for the abundant species, only the observation with the highest breeding evidence along the study transect or observation point is to be recorded. The "Atlas-nesting" source in SmartBirds Pro App is used. Mapping must involve the implementation of some or all of the methods described below, depending on the available habitats in the square.

2.1. Mapping of soaring birds from stationary points

The main target species are diurnal birds of prey and the black stork. The observations are made from stationary points, with good visibility, selected according to the relief and forest cover of the square, located as close as possible to the centre of each quarter of the 10x10 km square or at least 3 km from each other and outside settlements. It is applied in the period May-June in suitable weather conditions - good visibility, no rain and strong wind. The recommended number of observation points is four in each ten-kilometre square. The number and location of points can vary according to the relief of the square and the forest cover. In squares occupied mainly by open spaces, the points should be close to patches of forest vegetation and along rivers with strips of trees and gallery vegetation. In squares with predominant forest vegetation, the points **must provide visibility** to pastures and open spaces. Observations are carried out between 9.00 and

18.00, when soaring bird species are most active. The duration of observations is at least one hour from each point. During the observations, all individuals of diurnal birds of prey and black storks are registered and the determined degree of probability of nesting is indicated. Only one location of each bird is recorded, preferably that closest to a potential nest, determined by the behaviour of the bird and the habitats in the area. All other bird species observed or identified by call are recorded, indicating the highest degree of nesting probability. The "Atlas-nesting" source in SmartBirds Pro is used.

2.2. Mapping of species inhabiting open spaces by using a vehicle

The main target species are harriers, kestrel and roller, but a large number of other species can be registered. It is applied in squares with predominant open habitats in the Danube plain, Dobrudzha and the Thracian lowland. The observations are made in the period June 1-July 15 between 8.00 and 11.00 and after 18.00. The observer drives on pre-selected routes with a total length of 10 km within the square. Dirt roads or third class roads between settlements are used. If parallel routes are crossed, the distance between them must be not less than 3 km. **The observer stops at every kilometre outside the** settlements and observations are made within 10 minutes. All identified species are recorded, as well as and the degree of breeding evidence for each of them. The "Atlas-nesting" source in SmartBirds Pro is used. For safety reasons, it is not recommended to apply the methodology on main and busy roads.

2.3. Mapping of twilight and night active birds

It is **performed** after sunset in suitable habitats. Includes the application of one or more of the following methodologies, depending on the altitude and the habitat in the square:

2.3.1. Mapping of Nightjar and owls in the plains

The main target species are the Nightjar, the Scops Owl, the Barn Owl and the Little Owl, but other nocturnally active birds can be identified. It is performed in the period from May 1 to June 15. The study combines mapping of species in and out of settlements to save time. It is applied in all squares in the plains and low mountainous parts of the country up to about 800 m above sea level. A separate study only for Little Owl can be conducted in the settlements in the period February-March. The researcher pre-selects a route with a length of 5-10 km following dirt roads or third-class roads between settlements within the ten-kilometre square. At about every 500 m, stops and listens for 5 minutes and records the identified species. The sounds of the target species that are not registered according to the habitat is then used. Play for 5 minutes and listen for 3 minutes, then repeat the cycle. First the sound of the Nightjar (outside the settlements) is reproduced, then of the Scops Owl, the Little Owl (in the settlements) and the Barn Owl. In the settlements, the listening points are planned around churches and schools, as well as in the outskirts close to farms and farm buildings. The points are selected to be close to streetlights so that owls can be seen flying in without calling. The Barn Owl is sought not only in the settlements but also around substations, farms and other buildings outside them. The researcher is recommended, when playing the sound, to move away from the device to hear better long-distance calls. When the species is established, the imitation of the sound is stopped. All identified species are recorded, as well as and the degree of breeding evidence for each of them. The "Atlas-nesting" source SmartBirds Pro is used. Mapping of nocturnal birds is not done in rain, snow and strong winds. For safety reasons, it is not recommended to apply the methodology on main and busy roads.

2.3.2. Mapping of Eurasian Woodcock and owls in forest habitats in the mountains

Target species are Eurasian Woodcock, Tawny Owl, Ural Owl, Boreal Owl and Pygmy-ow. It is performed between April 1 and May 20, and owls can be mapped between September 1 and October 31. The researcher moves along a pre-selected transect with a length between 2–5 km, depending on the peculiarities of the terrain and the location of the old forests. It is recommended to move between the listening points by car where possible. It starts half an hour before sunset with mapping of the Eurasian Woodcock, and then continues with the owls. **The researcher stops and listens** every 800 m for 5 minutes. If the sought-after owl species is not heard, a sound recording of the call of the species characteristic of the respective habitat is used. Sound recordings of smaller owl species are played first. Play for 5 minutes and listen for 3 minutes, then repeat the cycle. The "Atlas-nesting" source SmartBirds Pro is used. When the species is registered, the imitation of the sound is stopped.

2.3.3. Eagle Owl mapping in rock habitats and quarries

The main target species is the Eagle Owl, but it can be expected other species such as the Tawny Owl and the Little Owl to be found, as well as to register partridges, which also call in the evening and after sunset. The best period for applying this methodology is February-March, but it can also be applied in April and May. After March, however, owls call less often and usually at sunset. Rock formations, gorges, and larger quarries, especially abandoned ones, are visited. The observation / listening point is recommended to be 300–500 m from the presumed nesting niche. Long rock valleys and canyons are explored through transects, with listening points located a kilometre away. **The observer waits** for 20 minutes at each point and if the species is not registered, a sound recording is used. The "Atlas-nesting" source SmartBirds Pro is used. The best time to apply the method is from half an hour before dusk until twilight, when the owls call from the centre of the nesting area near the breeding site.

2.3.4. Mapping of crakes and warblers in meadows and wetlands

The main target species are the Corncrake, the three species of crakes, the River Warbler and the Savi's Warbler, but the Bittern and the Little Bittern can be registered as well. It is applied in the period May 15-June 15, except for the mapping of the great trout, which can be registered in the period April 15-May 15, when the call is more intensive. Suitable habitats are visited during the dark part of the day. The researcher moves along a pre-selected route and registers the target types of calls. For the corncrake, the observer can use a car, stopping every 200 m to listen. If the Corncrake call is not heard, a sound recording is used. Sound recording is also used to identify warblers and all three species of crakes. The "Atlas-nesting" source SmartBirds Pro is used.

2.3.5. Mapping in Eurasian Thick-knee

The main target species is the Eurasian Thick-knee, but depending on the area, other species can be identified. Suitable habitats (dry stony pastures, places with steppe vegetation, sand quarries, riverbanks, and sandy islands) are visited in the period 1 May-30 June. **The observation** can be done by car. Every 500 m, the sound of the species is reproduced and then listen for 15 minutes. Mapping is most successful before sunrise and after sunset. Visits to suitable habitats can be planned to start before sunset, as well as to continue after sunrise, so that other species can be mapped, especially along the banks of the water bodies

- plovers, ruddy shelduck and others. All established individuals are recorded. The "Atlas-nesting" source SmartBirds Pro is used.

2.4 Mapping of woodpeckers

The main target species are woodpeckers, but depending on the type of forest, other species can be found. It is carried out in the period March 1-June 15 observing a transect with a length of 3-5 km, passing through, if possible, in all major types of forests found in the square, especially old ones. After May 1, the method can also be used to map the rare semi-collared and red-breasted flycatcher. The transects can be several and one or two kilometres long, depending on the type and location of the forests in the square. Every 700 m, depending on the habitat, a sound recording is used to detect the rarer three-toed, white-backed, black and grey woodpeckers. All identified individuals are also recorded. All other bird species observed or identified by sound are also recorded, indicating the highest probability of nesting. The "Atlas-nesting" source in SmartBirds Pro is used.

2.5. Mapping of waterfowl

Target species are ducks, divers, grebes, herons and other wetland bird species. It takes place in the period April 1 - June 30. All major types of wetlands in the square, large dam, micro-dam, river, swamp, etc. are visited. It is recommended to make two visits, one before April 30 to register courtship and display of birds and the second after May 1. To detect colonies of herons, terns, sand martins, etc. special attention is to be paid to islands, estuaries of rivers, dams, sandbars and steep shores. If a larger river passes through the square, a transect survey is conducted by walking along the bank or by boat. The most suitable periods are until 10.00 in the morning and after 6.00 until sunset, but the search for colonies can be done at any time of the day. To find a Bittern, a Little Grebe, etc. it is recommended to use sound recordings. All registered individuals are recorded, and in the case of colonies, the nests are counted. All other bird species observed or identified by sound shall also be recorded, indicating the highest breeding evidence. The "Atlas-nesting" source SmartBirds Pro is used. For some difficult to register species (woodpeckers, crickets) data will be collected by capture with ornithological nets from experts holding the relevant permit.

2.6. Mapping of rock-nesting species

Target species are rock thrushes, wheatears, birds of prey, black storks and other species inhabiting rock habitats, including quarries. There are two visits, one in March and one in May-June. The most suitable periods are in the morning until 11.00 and after 6.00 until sunset, but the search for nests can be done at any time of the day. Observations are made within one hour of a minimum of two points. A sound recording can be used to register rare species. All established individuals are recorded, and nests are counted in colonies. All other bird species observed or identified by sound are also recorded, indicating the highest breeding evidence. The "Atlas-nesting" source SmartBirds Pro is used.

2.7. Mapping of synanthropic bird species

Target species are birds of various groups inhabiting the settlements - sparrows, swallows, swifts, crows, birds of prey and others. It is performed before 10.00 in the morning or after 6.00 in the evening in the period May-June. The largest possible number of settlements in the square is visited. If it is not possible to visit all, settlements of all types are visited according to size (district town, small town, and village) and location (lowland, hilly areas, coastal, mountainous). The data collection is performed within the settlement for one hour. The observer visits all possible habitats - streets, gardens, abandoned buildings, overgrown yards. The

"Atlas-nesting" source in SmartBirds Pro is used. Each individual observation is recorded. If a new species is registered after the end of the study hour, it is recorded as single observations.

2.8. Study of the distribution and abundance of the capercaillie

The study of the distribution of the capercaillie is conducted during the breeding period of the species - between March 15 and May 31, when male birds concentrate in **the leks** and show the highest activity, and the presence of snow cover allows easy identification of traces of vital activity. For the establishment of **lek (localities)** territories are surveyed that meet the known requirements of the species to the habitat: "open", clean or mixed coniferous communities mixed with blueberries from 1 000 – 1 200 m above sea level to the forest boundary. Less frequently, the species inhabits mixed coniferous-deciduous forests and as an exception in deciduous forests dominated by beech.

The following indicators are used to establish the distribution of capercaillie and to confirm active leks: (1) visual observation or audible identification of one or more birds; (2) visual observation of clusters or copulations of male and female birds; (3) presence of trees with traces of activity of the species - identification of trees used for overnight / rest and / or food trees. They are determined on the basis of the presence of excrement (sometimes hundreds) accumulated under food trees (accumulated excrement and scattered needles and twigs) and overnight trees (excrement only), mainly in winter; (4) establishment of additional signs of presence such as footprints of male and female birds, traces of dragging of wings, feathers or nests.

The determination of the number is based on a direct count of the calling male birds. For this purpose, before the start of the calling, about 120-90 minutes before sunrise, the researcher goes to the predetermined centre of the lek. Going and waiting for the beginning of the calling must be as quiet as possible, not to disturb the birds, which would compromise the count. Capercaillies call perched on thick branches of pruning trees, on stumps or fallen trees and less often on the ground (snow). Males are counted acoustically and visually during the calling, which lasts about 30-40 minutes after sunrise. The sounds made during the calling are best heard at a distance of up to about 100 m. In this regard, if the distance to the pre-defined calling trees is longer and the sounds made by birds are not heard, it is acceptable to move quietly towards the lek in the direction of these trees in order to optimize the conditions for acoustic and visual registration.

Female individuals, as a rule, cannot be counted accurately. However, individuals who are visually identifiable or audible (giving contact calls) should be accounted for and, where possible, their exact location should be determined.

2. Common Bird Monitoring (CBM)

The data collected by the Common Bird Monitoring scheme will be used both to map the distribution and to determine the densities of the populations in the different habitats. Details of the methodology can be found **here**.

4. Single observations

Randomly collected individual data, without applying a certain methodology, will also be used for the preparation of the atlas. Practically any observation with registered bird species, location, degree of breeding evidence and date will be used. Observations of species with limited distribution and secretive lifestyle or

observations showing a high probability of nesting - carrying food for young, nest with eggs or young - can be particularly valuable.