MONITORING PROGRAMME FOR THE URAL OWL *STRIX URALENSIS*

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Range

The Ural Owl occurs throughout the Palaearctic region in boreal climatic zones. Its breeding range extends from Norway in the west to Japan in the east. Disjunct populations occur in mountains (Dinaric Alps, Carpathian and Rhodopi Mountains) of central and south-east Europe. Those relict populations belong to the subspecies *S. u. macroura* while birds breeding in north Europe and north-west Russia belong to *S. u. liturata* (Cramp 1977, Mikkola 1983).

Distribution in Croatia

The Ural Owl has been found in all three regions of Croatia: i.e. Lowland, Mountain and Mediterranean Croatia (Tutiš et al. 2009). The Croatian breeding population is estimated at 700-1000 pairs. The majority of the population, around 80%, breeds in Mountain Croatia. In Lowland Croatia the Ural Owl has been found only in the western part (west of 17º17' E), both on hills and mountains, as well as in floodplain areas. A small population of 15-25 pairs occurs in the thermophile beech forests of Mediterranean Croatia. There is no evidence of a change in the Ural Owl breeding distribution or range during the last century in Croatia. Although investigations carried out in the last twenty years showed that the population and range of the Ural Owl in Croatia is much larger than previously thought it seems most probable that previously the species was simply under-recorded and that more exhaustive survey has given a more representative picture of the species's range in Croatia.

Habitat

The Ural Owl inhabits a variety of old growth forests in Croatia, from montane beech and mixed fir–beech forests to common oak and sessile oak forests. Dinaric fir–beech forests are the major habitat. It usually nests in large tree-holes, old stick nests of raptors and crows or in tree stumps. The major prey are small rodents (voles, dormice). It also preys upon wide range of birds, frogs and insects.

Habitat types according to the National Habitat Classification:

major habitats: E 5. (E 5.2.), E 4., E 2.2., E 3.1., E 3.2., E 7.1., E 7.2., E7.3.
less important habitats (suitable as connected to major habitats): E 3.4., E 6.

Phenology and population biology

It is a resident bird and strongly territorial. The breeding season lasts from February to July. Ural Owls are monogamous: the pair-bond is most probably life-long and maintained throughout the year (Saurola 1987). Clutch size is 2-4 (1-7) eggs, varying with rodent density.

Pressures and threats

Pressures and threats are basically the same, related mainly to forestry practices which include: forest management and use (B02), especially removal of dead and dying trees (B02.04), forest replanting

with non-native trees (B02.02); forest exploitation without replanting or natural regrowth (B03); grazing in forests/ woodland (B06), forest fragmentation (B07) and use of biocides, hormones and chemicals (B04) - use of rodenticides in forestry could cause poisoning and reduce prey availability.

Current forest management practice in Croatia, basically close-to-nature and unchanged for decades, probably does not seriously affect the Ural Owl population in Croatia. However, any changes in management that leads to intensification (such as increased felling rates, changes of growing stock levels, decrease of large-diameter trees) potentially threatens the Ural Owl population. It is feared that logging concessions planned to be granted to private companies could result in intensification of forest management practices and extensive logging of old-growth forests. All processes that have negative effects on forest habitats also impact Ural Owls, including human induced changes in hydraulic conditions (J02), acid rain pollution (H04.01) and forest fragmentation (J03.02). Drainage of wet lowland forests also reduces the prey availability for Ural Owls.

Like other birds of prey, the Ural Owl is still persecuted in Croatia: poisoning and poaching (F03.02.03) increase mortality rates and pose threats (pressures) to Ural Owl populations. If global climate change will result in significantly warmer conditions, as predicted, then forests (especially in Alpine region of Croatia) could undergo major changes in range, growth and natural structure. It can be assumed that the Ural Owl, as basically a boreal species, would be negatively influenced by those changes.

Conservation measures

Current forest management is basically suitable for Ural Owls, so there is no need for any special measures. However, any intensification of forest management should be prevented. It is important that forests are managed to maintain and enhance the condition of semi-natural forest. Increasing the density of standing and fallen dead wood should be encouraged. Population recruitment can be enhanced by installing nest-boxes. The hydrology of riverine forests should be maintained in a natural state. The use of rodenticides in forestry should be eliminated (or minimized and carefully monitored). Mortality from poaching (including poisoning) should be reduced through awareness campaigns and increasing the rate of prosecutions and the severity of judicial sentences for poaching.

Approximate 70% of the total Ural Owl population in Croatia is covered by the proposed SPA network. It is a target species in 9 proposed SPAs: Gorski kotar & sjeverna Lika, Velebit, NP Plitvička jezera, Bilogora & Kalničko gorje, Donja Posavina, Učka & Ćićarija, Pokupski bazen, Turopolje and Lička krška polja. Appropriate assessments for projects affecting SPAs are obligatory.

Description of national legislative protection

The Ural Owl is strictly protected species in Croatia by Nature Protection Act NN 70/05, NN 139/08, NN 57/11).

Annexes of the Birds Directive
Annex I

Croatian Red List
2010 Near Threatened

MONITORING PROGRAMME

Extensive surveys of the Ural Owl in Croatia have been carried out from 1993 to 2007 (Tutiš 1998, Tutiš et al. 2009). The study employed a standard method systematically covering all of the major forest types in Croatia. The national population size was estimated in 2007. The range and habitat preferences of Ural Owls in Croatia are relatively well-known. Monitoring on plots with call playback and nest-box surveys are the proposed methods for monitoring Ural Owls in Croatia. These methods are widely used for monitoring owl ranges and population size.

Monitoring on plots

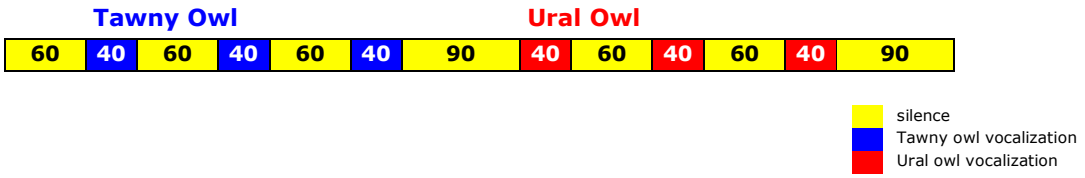
CALL PLAYBACK SURVEY

The call playback method has been widely used for studying owl distributions, habitat associations and numbers (Forsman et al. 1977, Fuller & Mosher 1987, Bosakowski 1987, Mihelič et al. 2000, Vrezec 2003, Tutiš et al. 2009). It has also been used in monitoring programmes for owls – in North America for almost two decades (reviewed in Takats et al. 2001) and recently in some European countries as well (Hardey et al. 2006, Hora et al. 2010).

The method relies on the response of owls to the playback of recorded calls. In order to defend their territories owls react to "intruder" by vocal response or even flying to the calling point which makes it easier for surveyor to locate their position and movement. For monitoring purposes, using a standard procedure for the call playback method is crucial.

Call playback method protocol

The call playback protocol consists of silent listening periods alternating with broadcast of Tawny Owl and Ural Owl territorial vocalizations. The recommended protocol for call playback comprises the following sequence (duration of each sequence is in seconds):



The Tawny Owl calls are broadcast first and the total duration of the call playback protocol is about 12 minutes. It starts with a one-minute listening period; the calls of each species are broadcast in three distinct bouts (each lasting approximately 40 seconds) followed by 60 second listening periods. The last playback bout of each species is followed by a 90 second listening period.

Broadcasting equipment

All surveyors should use the same type of broadcasting equipment, which comprises car radio with CD player and >40W amplifiers; >60W water-resistant loudspeakers in a sound box; battery for charging equipment (or a cord that plugs into the car cigarette lighter); CD with the playback protocol pre-recorded.

Frequency of surveys

Surveys should be carried out in one cycle of three consecutive years during the six-year reporting period. All calling points (transects/plots) should be surveyed in each year of a cycle.

Time of year

Each calling point (transect/plot) should be surveyed twice per year (once during each of the windows specified below), and separated by at least 10 days. In the second survey, the direction of travel should be reversed if possible (i.e. the calling stations surveyed first during the first survey should be surveyed last during the second survey).

	Mountain Croatia	**Lowland Croatia**
First survey window	1 March to 15 April	1 February to 15 April
Second survey window	15 April to 15 June	15 April to 30 May

Time of night

The survey should start about half an hour after sunset. Normally, 3 calling points can be surveyed per hour. Accordingly, a transect survey (comprising 12 calling points) should be completed in 4-5 hours; and a plot survey (about 20 calling points) completed in 6-7 hours.

Environmental conditions

Adverse weather conditions (strong wind, rain, snow, thick fog, extremely cold temperature etc.) can influence owl activity and the ability of surveyors to detect them. Surveys should therefore be done only during favourable weather conditions: wind velocity Beaufort scale 3 or below, no precipitation, and temperature close to the average for the season. If bad weather with falling air pressure is forecast it is best to postpone the survey until the pressure starts to rise. If weather conditions deteriorate over the course of an evening, surveyors must use their judgement whether the route should be completed, or run again (as soon as possible) on another evening. Data on weather conditions should be recorded at the beginning and end of each survey, and preferably at every point, so that weather variables can be used as covariates to reduce variance in count indices.

Survey team

Surveyors should be trained in surveying owls before staring a monitoring programme. Training includes learning the vocalizations of target species as well as other owl species that inhabit the survey area. The National Coordinator for owl monitoring should provide surveyors with materials and recordings of vocalizations. Before first use, surveyors also need to practice with call playback equipment in the field – at least 4 km away from any survey point so the owls are not unnecessarily disturbed.

A team for each transect should comprise 2 surveyors. The team leader (principal surveyor) must be familiar with the methodology and monitoring protocols; be able to identify, by vocalization, all species of owls that regularly occur in their area; have good hearing ability; and have a good enough sense of direction to determine the direction of any calling owls from a compass. The assistant surveyor should be familiar with the vocalizations of the target species as well as those of other possibly confusing species.

Field procedure at calling stations

The total time spent at each point ought to be approximately 15 minutes of which 12 minutes are spent on the playback protocol.

After arriving at the calling point position, the surveyors should stop the car engine, exit, and set up the loudspeakers on the roof of the car (approximately 2 m above the ground) to broadcast in opposite directions. Thereafter they should start the CD to broadcast the call playback protocol: the beginning of the protocol, i.e. start of first silent period, is marked by a soft beep, and the end of the protocol, i.e. end of the last silent period, is marked by louder beep.

During the protocol, the surveyors should stand still, silent and all necessary movements should be done without making any noise (conversation should be restricted to the broadcasting period). They should be a short distance (10-20 m) away from the loudspeakers so any owl responses to the broadcast can be more easily heard. When listening, the surveyors should move their heads, and occasionally whole body, in order to record an owl's position as accurately as possible. It is most efficient when the surveyors stand back to back (facing opposite directions) since one can record an owl's position most precisely when facing the sound source.

If the reaction of owls to call playback is weak, i.e. owl vocal activity is much lower than usual, the survey can be either finished or aborted, but then repeated as soon as possible at the same transect/plot.

Recording of owl position and activities

During the initial one-minute silent period all spontaneous owl vocalisations should be recorded.

The first position of an owl, as well as all subsequent changes in position, and activities should be recorded on the data form. Data on all owl species, not just the target ones, should be recorded during the stay at the survey point.

The following data should be recorded: owl species (using a four letter code - abbreviation of species Latin name), estimated distance and direction, phase of the response, response (type of vocalization, flying to the station, flying over etc.), sex (if possible to distinguish) as well as all changes in owl position. If several birds respond simultaneously every bird should be marked with a number in superscript (i.e. SURA^{1}, SURA^{2}, etc.).

The direction (azimuth bearing) of the vocalization should be determined by compass and distance to the owl should be estimated. Distances can be recorded indicating an uncertainty (±50 m, ±100 m) or in ranges: 0-100 m, 100-500 m, 500-1000, >1000 m.

At each survey point other information should also be recorded according to data form provided.

NEST-BOX SURVEY

The nest-box survey component of the monitoring programme should be undertaken at least in the Alpine region. It allows not only monitoring of breeding population size but also monitoring of important breeding and demographic parameters (annual variation in a number of nesting pairs, breeding phenology, clutch and brood size, breeding success, rates of reproduction, and overall activity during the breeding season). It provides more insight into the causes of population changes

than the surveillance of numbers alone, and the results are not influenced by experience of the surveyors, quality of equipment, weather etc. However, a nest-box survey is not representative of the wider breeding population, so the two approaches complement each other.

To carry out a nest-box survey, surveyors need to have only a basic knowledge of the target species and follow the instructions provided. There is no special training needed, so much less experienced volunteers can be included in the programme. Moreover, changes of surveyors over time, in any given area, will not influence the monitoring results. Nest-boxes are checked in the daytime so the survey is safer and easier to carry out in mountain areas. Including local foresters and hunters in nest-box surveys is important and valuable in remote and poorly accessible areas.

Frequency of surveys

Nest-box examination should be carried out every year. They should be checked at least four times per year. In addition, all used nest-boxes should be cleaned after the breeding season.

Time of year

In the Alpine region a first examination of nest-boxes should be carried out in April. Second and third visits can be done in May-June (depending on the annual variation in phenology).

The nest-boxes should be inspected from a ground with a baby-monitor mounted on a telescopic pole and also by direct observation (climbing to the nest-boxes).

Many female Ural Owls are highly aggressive in protecting their young. Therefore, surveyors should be protected by helmets, goggles, gloves and strong clothes. Helmets should be covered with 15-20 cm of sponge, foam or similar soft material to prevent injury of the bird if it strikes the helmet.

Sampling design

CALL PLAYBACK SURVEY

Because of differences in forest cover, forest harvesting strategies, forest road distribution, and the Ural Owl distribution pattern and density between Lowland and Mountain Croatia (Table 1), different survey strategies are recommended for these two regions. In Mountain Croatia, survey points should be arranged in transects (12 survey points per transect, and 25 transects altogether), while in Lowland Croatia survey points should be arranged in plots (about 20 survey point per plot, and 12 survey plots altogether).

In the Mediterranean region there is only one area (Učka-Ćićarija Mountains) where the forest is compact enough to accommodate a survey plot or point-transect. For the monitoring programme, the existing survey plot could be used or a transect established instead.

Table 1: Difference in conditions for establishment of Ural Owl monitoring in Mountain and Lowland Croatia

	Mountain Croatia	**Lowland Croatia**
Elevation	up to 1831 m a.s.l. app 70% of the area 500-1000 m a.s.l	up to 1180 m a.s.l app. 80% of the area < 200 m a.s.l
Forest cover	almost continuous forest belt	patchy
Forest management system	forest exploited by selection cutting ↓ continuous uneven-aged forest	forest exploited mainly by clear-cutting (only higher altitude forests are exploited by selection cutting) ↓ regular forests distributed in 7 age-classes ↓ forests "fragmented" in even-aged stands (young stands of forest, i.e. stands where forest age is less than 40 years are unsuitable for Ural and Tawny Owls)
Network of forest roads	dense; because of continuous forest cover forest roads are long and in many areas could accommodate the full length of a 12 point transect (about 14 km length) ↓ random sampling of transects is possible	dense; because of patchy forest cover in the majority of forests the roads are too short to accommodate the full length of a 12 point transect (about 14 km length) ↓ random sampling of transects is difficult to implement
Passability of forest roads in the survey period	low because of deep snow cover to the end of April (beginning of May) ↓ surveys on plots (which require a lot more driving than surveys along transects) are difficult to implement	good, in April and in May the majority of roads are passable ↓ random sampling of plots is possible
Relief	very diverse ↓ complex topography may inhibit detection of calls across ridges or gullies ↓ uniform coverage of survey plot with call stations more difficult to achieve	much less diverse ↓ uniform coverage of plots with call stations easier to achieve
Ural Owl distribution	almost continuous	patchy
Ural Owl density	0.6 - 1.4 pairs/10 km^2 (average 0.8 pairs/10 km^2)	1.1. – 5.4./10 km^2 (average 2.3 pairs/10 km^2)
Ural Owl population estimate	550 to 750 pairs	150 to 220 pairs

Survey point-transects

Survey point-transects consist of 12 calling points spaced 1 km apart (straight-line distance). Transects should along roads, preferably secondary forest roads with little traffic.

Survey plots

The area of survey plots is ideally 50-60 km^2, and not less than 30 km^2. 15-20 calling points within the survey plot should be arranged along forest roads, spaced 1.0 – 2.5 km apart (depending on the topography) and distributed so that a uniform coverage of the plot can be achieved.

Coverage

Each transect/plot should be surveyed in a single night.

Surveys will be carried out at some 560 calling points (survey stations) of which 300 (25 transects x 12 survey points) will be distributed in Mountain Croatia, about 240 in Lowland Croatia (12 plots x about 20 survey points per plot) and 12-20 in Mediterranean Croatia (1 plot or 1 transect).

Based on previous research it is estimated that this survey intensity will cover about 20% of the Ural Owl population (100-200 Ural Owl territories in Mountain Croatia and 35-45 territories in Lowland Croatia).

Transect/plot selection

Transects/plots need to be selected so that they are representative of the region in order to make valid statistical inferences about the owl population in the region. Ideally, random sampling or random stratified sampling should be applied.

In order to incorporate already established plots/transects and also to ensure that SPAs where the Ural Owl is a target species are appropriately covered with monitoring, a semi-random sampling approach was applied (Hardey et al). New transects and plots selected by random stratified sampling comprise about 67% of the total number of transects and plots, while already established (and previously surveyed) plots/transects comprise about 33%. In Lowland Croatia, the monitoring programme covers 4 established plots and 8 selected randomly. In Mountain Croatia, the monitoring programme covers 10 established transects and 15 selected randomly.

Random stratified sampling procedure

The process of transect/plot selection is presented in Appendix 1.

1. Selection of areas with extensive forest cover. Croatia is covered by a total of 827 10x10 km grid squares. Those having forest cover >40% (according to the Corine Land Cover Map - CLC) were identified. CLC was used because it is presently the best available GIS layer for forest cover. The 40% forest cover threshold was set because monitoring plots or transects can only be placed in larger forest areas and squares with >40% forest cover include the majority of larger forest stands in Croatia (a small area was excluded because it fell across squares). Moreover, Ural Owls usually do not inhabit small isolated forest patches. A total of 207 grid squares were thus selected for the next step.

2. From the 207 squares selected in first step above, those which are inside the Ural Owl range were identified – giving 141 grid squares.

3. The 141 grid squares from step 2 were grouped by region and classified by predominant forest type. Lowland Croatia had 57 squares with three main forest types: beech and beech fir forests (29 squares), sessile oak forests (20 squares), and pedunculate oak forests (8 squares). In Mountain Croatia there were 77 squares with two main forest types: Dinaric mixed fir-beech/fir/spruce forests (31 squares) and beech forests (46 squares).

4. 14 grid squares containing existing survey plots or transects, located inside SPAs, were excluded: 4 squares in Lowland Croatia (2 of pedunculate oak forest and 2 of beech forests) and 14 in Mountain Croatia (10 squares of fir-beech forests and 4 of beech forests).

5. Within the remaining regional groups of grid squares, a proportion of them was selected randomly according to the main forest type present. In Lowland Croatia, 20% of squares containing beech and beech fir forests were randomly selected (giving 5 squares), and 15% of squares with sessile oak forests (3 squares). No squares were selected with pedunculate oak forests since this habitat was already well covered by 3 existing plots. In Mountain Croatia, 30% of squares with mixed fir-beech-spruce forests (the best habitat for Ural Owl) were randomly selected (6 squares) and 20% with beech forests (9 squares).

6. Once the grid squares for monitoring had been randomly selected, the survey plots and transects can be located in them using all appropriate digital maps (topography 1:25,000, ortho-photographs, vegetation/forest cover and forest roads). However, the placement of survey plots and transect routes depends on the distribution of forests and roads within the selected squares. Because of the large size of plots and long routes of transects, and the uneven distribution of forest roads, in the majority of cases it will not be possible to accommodate the whole area of a plot or the full length of a transect within a single square – the transects and plots will partly "overflow" into neighbouring squares. Therefore, transects should be placed so that the starting point is on the road nearest to the square centre, and the rest of the counting points distributed along the road at the proper interval, without any restriction on direction. Similarly, the counting points of plots should start from the centre of the square and be distributed without any restriction on direction.

7. If it is not possible to place a transect or plot in the way described above (because of unfavorable distribution of roads or forest stands inside the selected square), a replacement square should be chosen from the neighbouring squares. Replacement squares should have the same characteristics (same prevailing habitat type), starting from the north; if the is also not suitable, then move east, south and finally west. If none of the neighbouring squares are suitable, random sampling of a new square from the sampling pool should be carried out.

<u>Working effort</u>

For each transect/plot, 6 surveyor nights per year should be planned: 2 surveyors x 2 nights for surveys carried out twice plus one additional night in case the survey has to be repeated owing to bad weather (which is regularly the case in Mountain Croatia). Therefore, to survey 38 transects/plots, at least 228 person-days working effort per year is needed.

NEST-BOX SURVEY

Nest-box monitoring is already undertaken in the survey plot at Gorski Kotar (Velika Kapela; Ravna gora – Mrkopalj). This plot has an area of about 180 km^2, with 100 nest-boxes evenly distributed within it. In 2011, under conditions of peak rodent density, 49 pairs bred in the nest-boxes.

In addition to this plot, at least two more (smaller) nest-box plots should be established in the Alpine region. Inside each plot (of about 60 km^2), 30 nest-boxes should be evenly distributed. Plots ought to be established in areas where foresters express their willingness to participate in the survey. Ideally, one plot should on Velebit Mountain and the other in western part of Gorski kotar. The plots should

not overlap with routes of transects for call playback surveys. The only exceptions are gor the two transects for detection probability studies to be carried out at Velika Kaplea (see below).

It would be beneficial if nest-box plots are also established in Lowland Croatia. However, because of the much lower population density, the occupation rate of nest-boxes would be considerably lower and therefore not so effective for monitoring as in the Alpine region.

Working effort

Nest-boxes should be checked at least 4 times per year. In addition, all used nest-boxes should be cleaned after the breeding season. About 30 nest-boxes can be examined by a two-person team per day (with 10 hours work/person/day). Therefore, to cover a total of 150 nest-boxes requires about 40 person-days per year.

Research on localities

PILOT STUDY

A pilot study should be carried during the first three years of the six-year reporting period. This will allow any necessary modifications to the monitoring programme and protocols resulting from the experience gained, before the start of the formal monitoring programme. The pilot study should include research of detection probability (which should cover all six years of the reporting period), the value of autumn playback surveys against spring surveys and the potential for implementing multi-species surveys.

Detection probability

The most substantial limitation of the call playback method is that some changes in the numbers of owls detected may be hard to interpret. Annual variation in the number of owls detected (from call response) may be related to many factors, not just to a real change in the number of territory holders. For example:

- in years with low rodent density, the number of pairs (occupied territories) remains the same but they do not breed and so are much less vocal.
- the overall breeding season is quite long and the peak calling period associated with the onset of laying varies considerably from year to year. Accordingly, the optimum timing for surveys also changes each year. A higher number of surveys per year could minimize the censusing error, but greatly increases the cost of monitoring.
- differences in surveyor ability affects detection rates and the inevitable turnover of surveyors during long-term monitoring can further influence the results.
- changes in playback equipment over time can affect the response rate of owls.

Such fluctuations in counts reduce the power of this type of survey to estimate long-term population trends. Because owl detections are not temporally or spatially constant, it would be valuable to incorporate detection probabilities when calculating population indices to improve their accuracy (Pollock et al. 2002), as well as improve the current survey design if necessary.

To estimate the detection probability of territorial owls in any particular year, some additional surveys should be carried out: at least two transects should be censused at least four times during the breeding season in every year of the six-year cycle. This work is best done at transects laid out in the

survey plot at Gorski Kotar which already has 100 nest-boxes in it. In this location, the year to year variation in detection of Ural Owls using call playback surveys can be related to the actual occupation of next-boxes and a detection factor estimated for the region.

Value of autumn call playback surveys for monitoring

The call playback method is very sensitive to weather conditions. As the most important part of the monitoring programme should be carried out in mountain areas where weather conditions are rarely stable in spring and many roads are covered by snow far into the breeding season it would be important to determine value of autumn counts, i.e. to clarify if it is possible to replace one or both spring counts with autumn counts.

To determine the value of autumn counts, the transects at Gorski Kotar should also be surveyed in autumn, with the same intensity (four times) between1 September and 20 October. Depending on the results, autumn counts could be incorporated (or not) in the monitoring programme.

Potential for multi-species surveys

In order to test the potential for a multi-species monitoring programme covering Ural, Tawny, Tengmalm's and Pygmy Owls in the Alpine region, a specific survey should be carried out. The ranges and population densities of these species varies greatly, as well as their daily and seasonal activity patterns. All these parameters could affect the effectiveness of a survey to detect changes in abundance over time.

A common monitoring protocol can be tested in which the call playback sequence for monitoring of Tawny and Ural Owls incorporates the vocalizations of Pygmy and Tegmalm's Owls at the beginning. In addition, the broadcast period for each species will be reduced to only two bouts, so the total duration of the call playback protocol for four target species will be 16 minutes. As this will increase stop duration, the number of stops per transect should be reduced from 12 to 10.

Furthermore, detectability surveys of every species in their major habitat types should be carried out.

Evaluation of the conservation status components

Population size

The population units are breeding pairs. One territorial male or male and female recorded is interpreted as a breeding pair.

With this monitoring programme, the Ural Owl population will be sampled to derive an index of abundance (population index). Changes in the population index over a long time period will indicate the population trend. The population size will be estimated using the population index obtained for sampled plots, corrected with detection probability in each stratum, and extrapolated to the whole range in Croatia. If the population index indicates negative or positive population trends, additional surveys using the same methodology would be needed to recalculate the national population size.

Breeding distribution map and range size

Although the range of the Ural Owl in Croatia is pretty well known, some unsurveyed areas (Appendix 2, area A,) and areas not surveyed enough (Appendix 2, area B,) should be surveyed during the first three years of first six-year reporting cycle to gain a more precise definition of the present range of the Ural Owl in Lowland Croatia and provide a more reliable basis for the future assessment of range size changes.

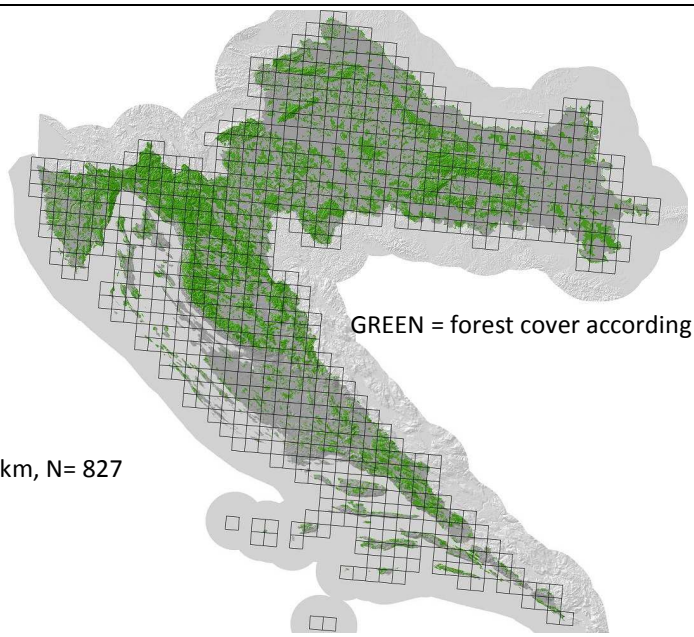
Call playback surveys should be carried out periodically (every ten years) in suitable habitats (old growth forests) outside the boundaries of the known range to determine whether the range is expanding. The surveys should be done in randomly selected 10x10 km squares with forest cover >40% outside the known breeding range of the Ural Owl in Lowland Croatia.

If the population index indicates a negative or positive population trend, additional surveys would facilitate re-determination of the breeding range size.

Main pressures and threats

This monitoring programme should reveal the population trend of the Ural Owl over the long term. The underlying reasons for any population changes, however, can not be determined from the surveys alone (though monitoring of owls in nest-boxes covers some breeding and demographic parameters). Additional research would be needed in order to determine the actual reasons for population changes and effective conservation measures.

Appendix 1. The process of transect/plot selection

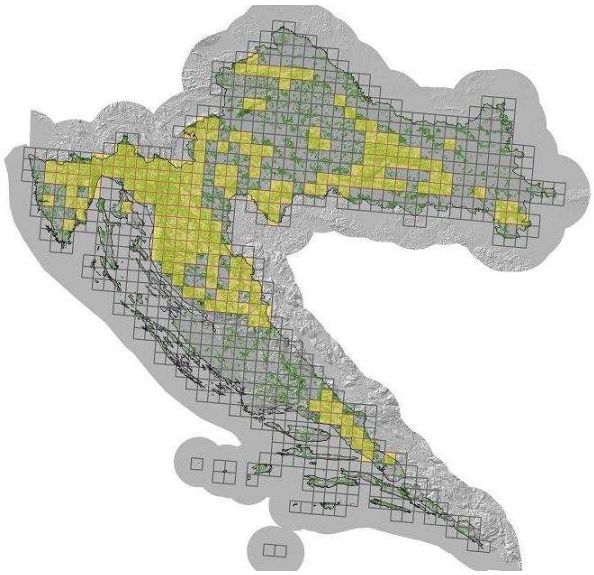


GREEN = forest cover according to Corine Land Cover Map

GIRD = grid cells 10 x 10 km, N= 827

FIRST STEP

⇒ from a total number of grid cells (10x10 km) that covers Croatia, cells with forest cover > 40 % (according to Corine Land Cover, CLC, layer) are selected

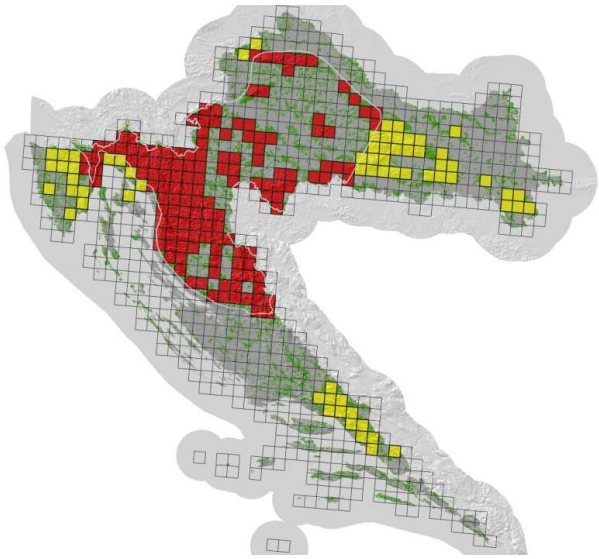


Total number of 10x10 km grid cells, N = 827

Grid cells 10 x 10 km with forest cover > 40 % (yellow), N = 207

SECOND STEP

⇒ from cells selected in the first step those which are inside the Ural Owl range are selected



Grid cells 10x10 with total forest cover > 40% (red + yellow), N = 207

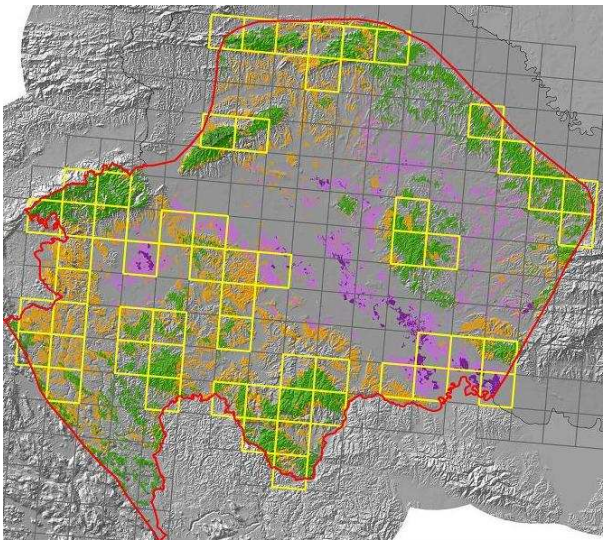
- red → grid cells inside the known range of Ural Owl in Croatia; N = 141
- yellow → grid cells outside the known range of Ural Owl in Croatia, N= 66

Appendix 1. The process of transect/plot selection

THIRD STEP

⇒ cells selected in the second step are grouped according to predominated forest type inside cells (per two geographic regions, i.e. Lowland and Mountain Croatia)

Lowland Croatia



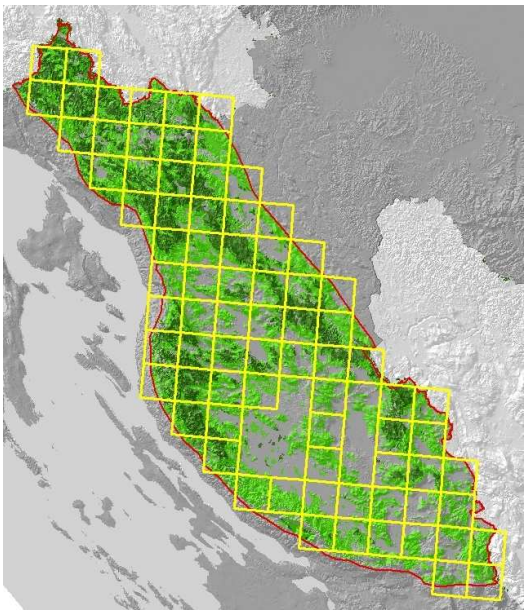
57 cells with total forest cover > 40%

green – predominantly Beech forests

orange – predominantly Sessile Oak forests

pink – predominantly Pedunculate Oak forests

Mountain Croatia



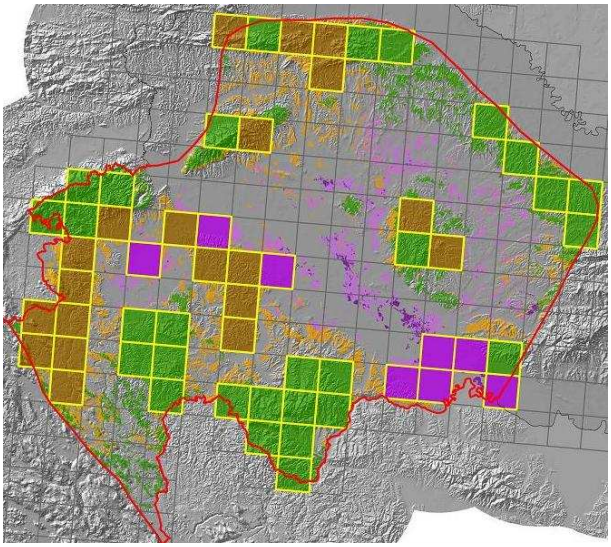
77 cells with total forest cover > 40%

light green – predominantly Beech forests

dark green – predominantly mixed Fir-Beech/Spruce forests

THIRD STEP – *continue*

Lowland Croatia

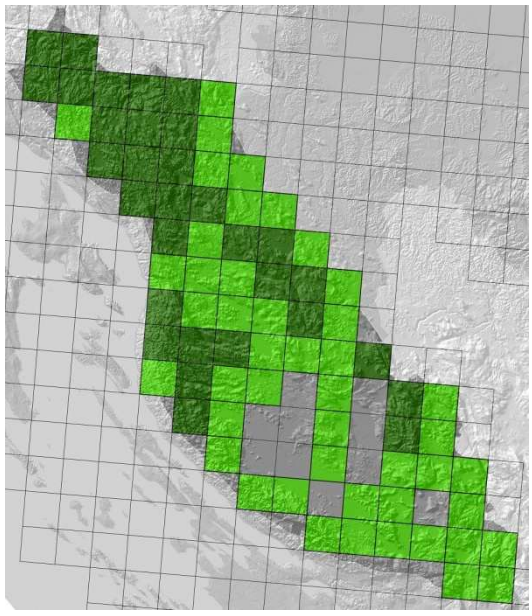


green cells = > 40% forest, predominantly Beech forests, N = 29

brown cells = > 40% forest, predominantly Sessile Oak forests, N = 20

pink cells = > 40% forest, predominantly Pedunculate Oak forests, N = 8

Mountain Croatia



light green cells = 46, predominantly Beech forests, N = 46

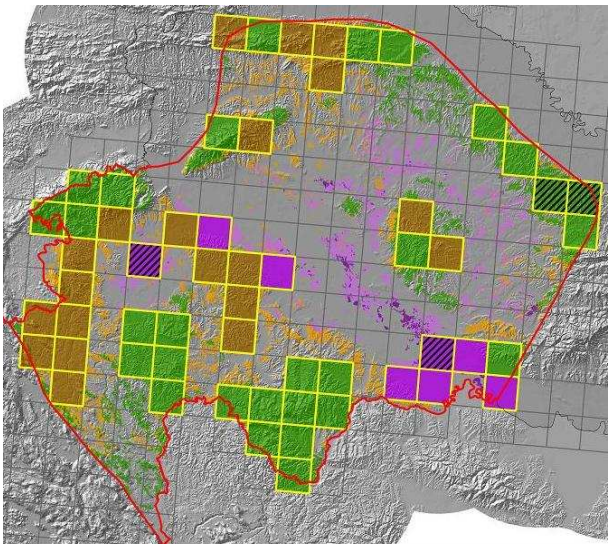
dark green cells = 31, predominantly mixed Fir-Beech, Spruce forests, N = 31

Appendix 1. The process of transect/plot selection

FOURT STEP

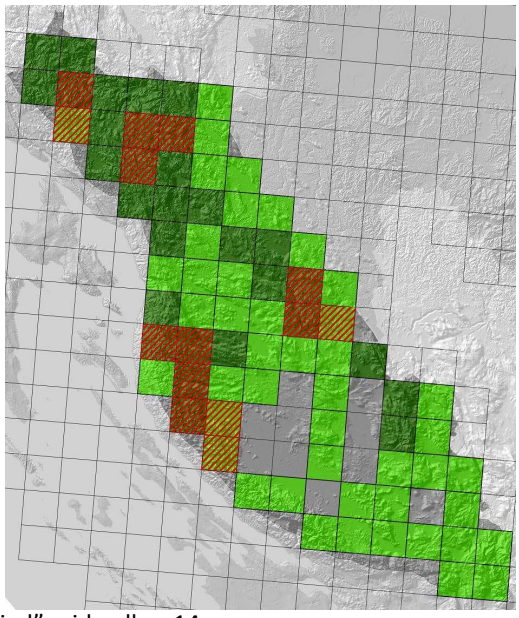
⇒ Prior random sampling grid-cells fully or partly covered with existing survey plots or transects, settled inside SPA areas, are excluded – those already "occupied"cells are marked with striped filling

Lowland Croatia



"occupied" grid-cells" = 4

Mountain Croatia



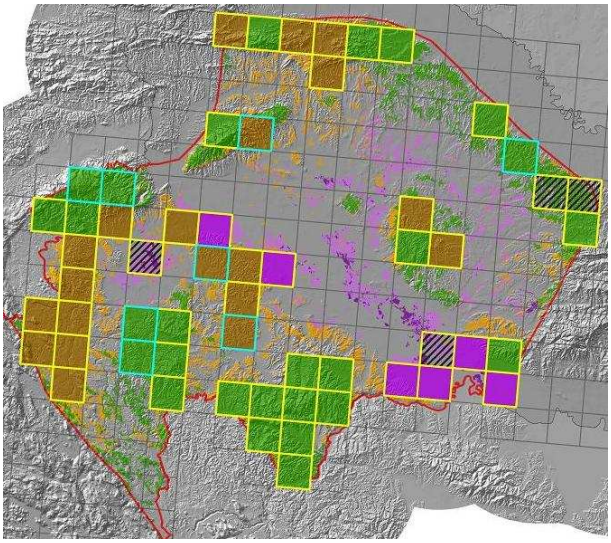
"occupied" grid-cells = 14

FIFTH STEP

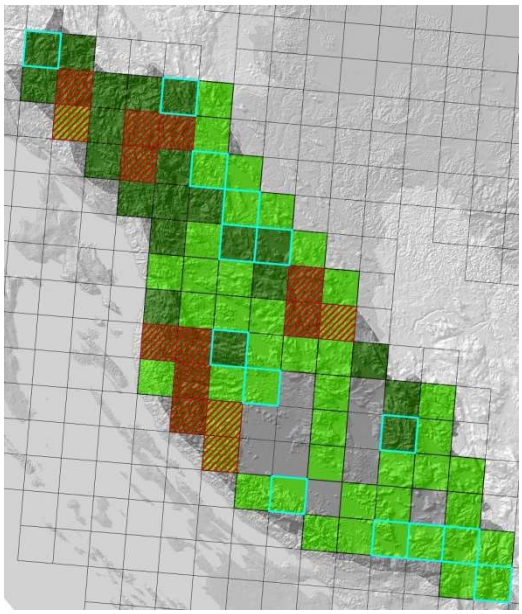
⇒ within each group of cells, number of cells are randomly sampled.

⇒ sampling intensity of different "forest types" is different – the sampling intensity is the highest (30%) in the Ural Owl prime habitat, i.e. in Dinaric mixed forest.

Lowland Croatia



Mountain Croatia



Predominated forest type	Sampling intensity	Output
green cells N = 29 (Beech forests)	15%	N = 5
brown cells N = 20 (Sessile Oak forests)	20%	N = 3
pink cells N = 8 (Pedunculate Oak forests)	0%	N = 0

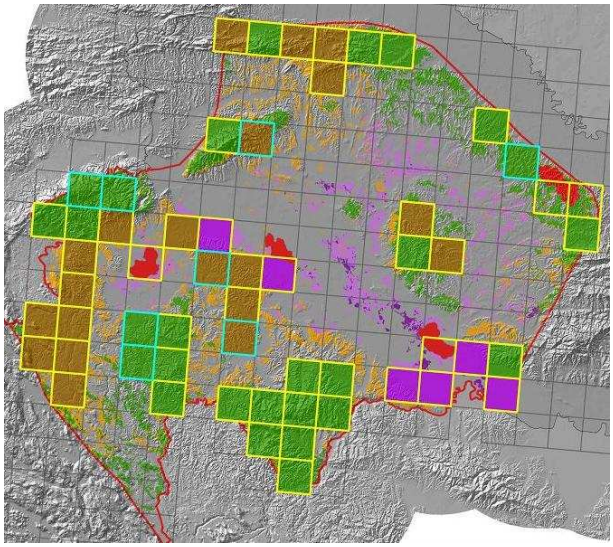
Predominated forest type	Sampling intensity.	Output
light green cells, N = 46 (Beech forests)	20%	N = 9
dark green cells, N = 31 mixed Fir-Beech/Spruce forests	30%	N = 6

Note: randomly selected grid cells are cells with light blue (turquoise) border

Appendix 1. The process of transect/plot selection

FIFTH STEP – Output

Lowland Croatia

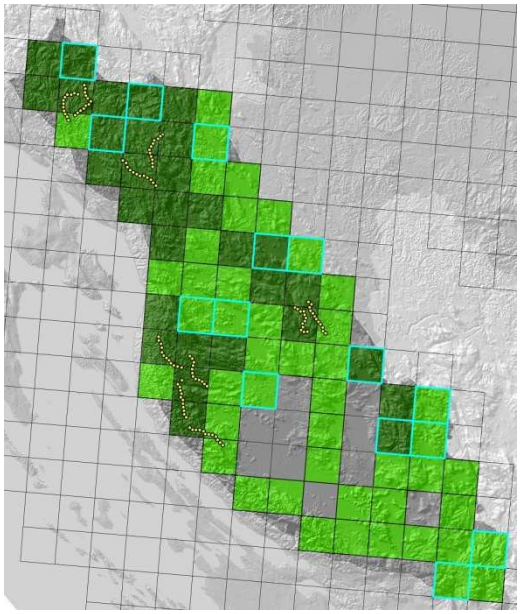


8 randomly selected grid cells
(cells with light blue border)
+
4 already established plots
(shapes filler red)

↓

12 survey plots:

Mountain Croatia

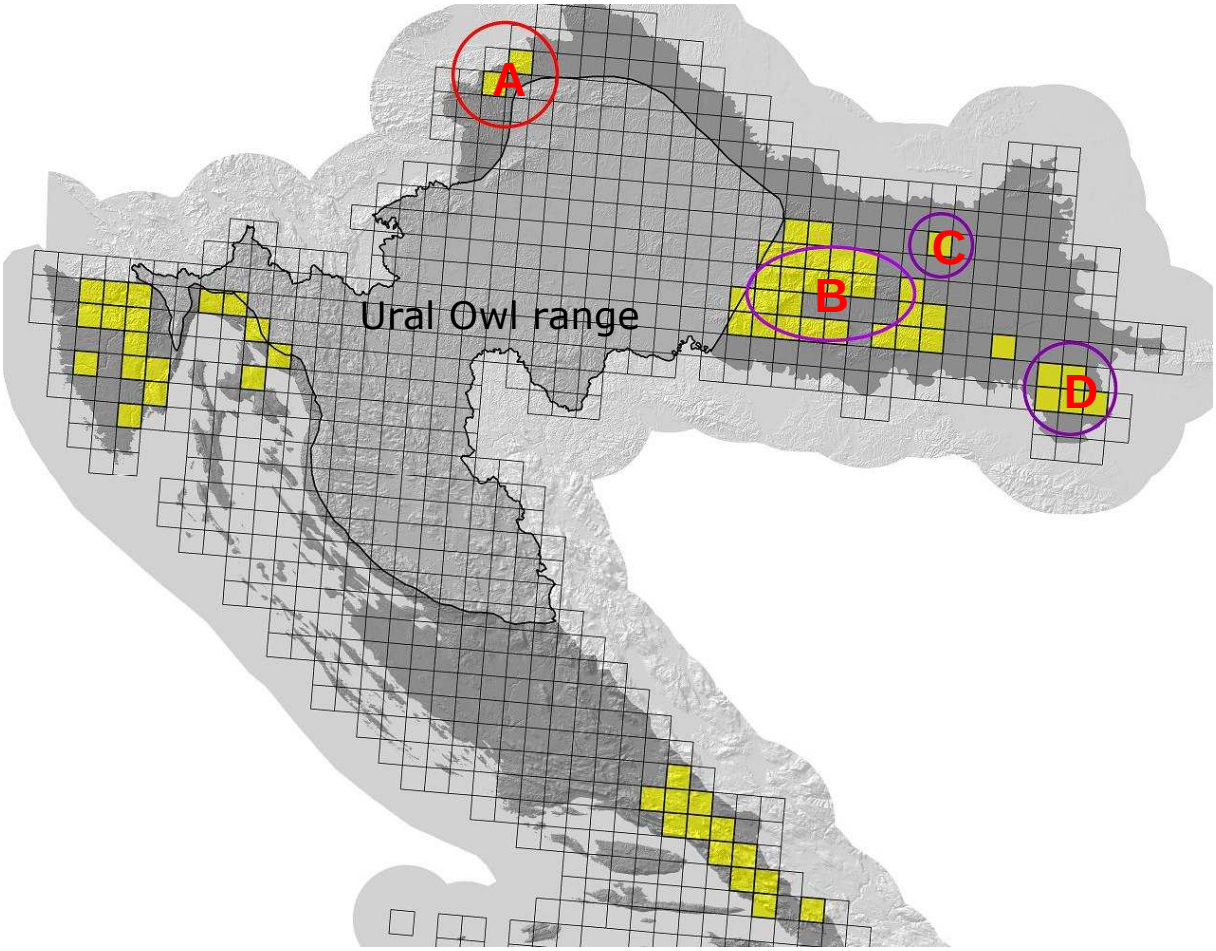


15 randomly selected grid cells
(cells with light blue border)
+
10 already established transects
(yellow)

↓

25 point-transects

Appendix 2. Ural Owl - breeding range survey



MONITORING – OWLS (Call playback survey)

Date:	Surveyors:	Weather conditions:
Area:	Route Name	
Species:		

station	time	phase	species	direction	distance	sex	Comments

MONITORING – OWLS (Call playback survey)

station	t (◦C)	wind (Beufort)	cloud cover	fog	precipitation	moonlight	noise	Comment
1								
2								
3								
4								
5								
6								
7								
8								
9								
10								
11								
12								

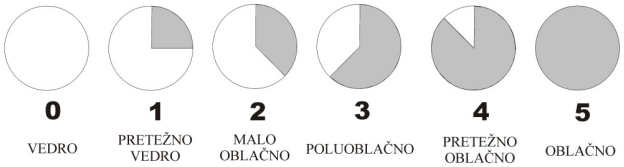
Wind Seed (Beaufort Scales)

	force	name	km/h	Appearance of wind effect
OK	**0**	Calm	0-1	Smoke rises vertically
OK	**1**	Light air	1-5	Wind direction shown by smoke drift
OK	**2**	Light breeze	6-11	Wind felt on face, leaves rustle
	3	Gentle breeze	12-19	Leaves, small twigs in constant motion; wind extends light flag.
	4	Moderate breeze	20-29	Raises dust and loose paper, small branches move
	5	Fresh breeze	30-39	Small trees in leaf sway
	6	Strong Breeze	40-50	Larger tree branches moving, whistling in wires, umbrella difficult to control

Codes and scientific names of owl species breeding in Croatia

TALB	*Tyto alba*
OSCO	*Otus scops*
BBUB	*Bubo bubo*
GPAS	*Glaucidium passerinum*
ANOC	*Athene noctua*
SALU	*Strix aluco*
SURA	*Strix uralensis*
AOTU	*Asio otus*
AFLA	*Asio flammeus*
AFUN	*Aegolius funereus*

Cloud Cover



Snow cower

N none
P patchy
C continuous

max. depth

min. depth

PROTOCOL PHASE

0 listening (silence) at the beginning of the procotol
1 listening period during vocalization of 1. species (1^1, 1^2, 1^3)
2 listening period during vocalization of 2. species (2^1,2^2,2^3)
etc.

NOISE

Q quiet
SN some noise, but not distracting
SG significant noise that may have reduced owl detectability
CN constant noise (ie. heavy traffic, compressor station, roaring creek)

MONITORING

Call playback survey

Equipment

1. Car-radio CD player
2. Battery for battery for charging car radio or a cord that plugs into the car cigarette lighter
3. >60 W water-resistant loudspeakers in a sound box
4. CD with the playback protocol
5. Topographic map 1: 25.000
6. Data Forms
7. GPS with stored survey points positions
8. Headlamp
9. Pen/Pencil
10. Watch
11. Thermometer
12. Warm clothes

MONITORING

Nest – box survey

Equipment

1. GPS with stored records on nest-box positions
2. Topographic map with nest-box locations
3. Notebook or Data Form
4. Pencil or waterproof pen
5. Binoculars
6. Baby monitor (mirror) + telescopic pole
7. Ladders
8. Camera