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Source: Ardea, 97(4) : 403-412

Published By: Netherlands Ornithologists' Union

URL: https://doi.org/10.5253/078.097.0402

Survey protocol for the Little Owl *Athene noctua*

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Johnson D.H., Van Nieuwenhuyse D. & Génot J.-C. 2009. Survey protocol for the Little Owl *Athene noctua*. In: Johnson D.H., Van Nieuwenhuyse D. & Duncan J.R. (eds) Proc. Fourth World Owl Conf. Oct–Nov 2007, Groningen, The Netherlands. Ardea 97(4): 403–412.

We offer a protocol for conducting standardized nocturnal broadcast (playback) surveys on Little Owls *Athene noctua* across the range of the species. Based on differing objectives of researchers, two intensity levels of survey efforts are outlined: (1) demographic and density studies, and (2) presence and general distribution surveys. Both survey programs utilize the same field method, but vary in the number of visits required across the survey area. Objectives and definitions for these survey programs, and criteria for determining occupancy, reproduction, and turnover rates to support demographic and monitoring studies are given. The recommended survey period coincides with the breeding season, and depending on the latitude (and elevation), is approximately from 1 February – 30 April in western-Europe, and 1 March – 31 May in eastern Europe, Middle East, and Asia. Surveys are to be conducted from sunset to midnight and from two hours before sunrise to sunrise. Survey stations are located 500 m apart from one another along transects, or in a grid network. The tape-recorded call sequence consists of a 2-min track played three times, with each broadcast track separated by silent periods of 1 min each. The observer listens for 5 min after the last sequence. Thus a maximum of 13 min is spent at each survey station. Positions of all responding owls are recorded on a field map. While Little Owls have a repertoire of 22 vocalizations, two calls, the hoot ("*ghuk*") and the "*chewing*" call, are used by males in territorial contests and are the calls recommended for use in this protocol. Broadcast vocalizations should be played at volume and clarity levels consistent with that of wild owls. For *demographic and density studies*, we recommend 4 visits across each of the survey routes (and associated survey stations) to gain responses from >95% of the territorial owls. For nest-box programs where the objectives are demographic status and trends, and where the majority of owl territories are already known, survey efforts described in this protocol are used to fill in gaps and offer thorough and systematic coverage of the entire study area. For *presence* and *general distributional surveys*, we suggest a 1-visit survey be conducted. While a 1-visit strategy will not detect some of the owls actually present, the outcome of these surveys will illuminate general distributions of owls and highlight areas for further study. We anticipate that this protocol will be updated occasionally, following a normal scientific peer-review process. In particular, we urge additional research on the *detection probability* of territorial owls to provide clarification as to the number of visits needed to accurately determine the numbers of owls present in a given area. Prior observations have indicated a potential for differential responses from owls in high density populations (higher response rates) compared to owls residing in low density situations, and this needs further research.

Key words: monitoring, demography, density, distribution

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INTRODUCTION

Survey protocols are detailed study plans that explain how data are to be collected, managed, and reported, and are a key component of quality assurance for natural resource monitoring programs (Oakley *et al.* 2003). Survey protocols and monitoring programs are necessary to ensure that changes detected by fieldworkers actually are occurring in nature and not simply a result of measurements taken by different people or in slightly different ways. Broadcast surveys are one of the most widely used techniques to locate and survey owls. Owls vocalize to communicate with their mates and delineate territories. Imitating or broadcasting tape recordings of owl vocalizations can invoke vocal responses from many species of owls. Important in using broadcast surveys, is the type of call (e.g. call note, song), sex of the owl giving the source call, quality of the recording, sequence of calls, species included in broadcast, effect of timing on response, and nature of the broadcast equipment. The intent is to broadcast the calls of territorial owls in a volume and quality that mimics that of wild owls.

The Little Owl *Athene noctua* is a territorial species distributed in Palearctic regions across 84 countries (Van Nieuwenhuyse *et al.* 2008). It is a small owl that inhabits a wide variety of semi-open areas, from steppes and stony semi-deserts to farm-lands and open woodlands, villages and urban areas. It preys on insects, small mammals and birds, hunting mostly during nocturnal and crepuscular hours, but rarely during the day. Little Owl numbers have been declining in significant portions of their global range (e.g. most of Europe). The population status of the owl is unknown in much of the eastern portion of its range (Middle East and Asia). In some areas of its range (e.g. Bhutan, Nepal, Mongolia, Tibet) the distribution remains to be clarified.

There are three primary objectives in surveying and monitoring Little Owls:

(1) Assess population status and trends (population size, trends, density of territorial owls).
(2) Characterize habitat relationships.
(3) Conduct baseline surveys to document presence and determine general patterns of owl distribution.

Based on these objectives, survey programs of two differing intensities of field surveys are outlined in this protocol: (1) demographic and density studies, (2) presence and regional distribution surveys. The same call broadcast method is used in all surveys, the main difference is in the number of survey visits involved. In this paper, we utilize the following outline for Little Owl survey efforts: Part I. Field methods common to all surveys; Part II. Demographic and density studies; Part III. Surveys to supplement nest box programs; and Part IV. Presence and general distribution surveys.

PART I. FIELD METHODS COMMON TO ALL SURVEYS

Assumptions and terminology

We make two basic assumptions in the use of this protocol: (1) that the species will answer territorial calls consistently, and (2) that the vast majority of Little Owls maintain their territories from year to year (or vacant territories are readily re-occupied), so changes occurring over time can be interpreted as reflecting changes in the underlying population demographics.

Detection probability and response rate – Survey efforts are ultimately aimed at determining the total number of *territorial* owls (paired and unpaired) present in a given area. Not all territorial owls readily respond to broadcast, either because they are not within hearing range when broadcast surveys are conducted, or because they are engaged in other more pressing behaviours (e.g. hunting). It requires energy from the owls to respond to territorial intruders, and the owl must balance its energy expenditure in territorial defence against its other nightly and seasonal activities.

The *detection probability* reflects the proportion of owls that during a single survey effort, either vocalize on their own, or when within hearing range of broadcast calls, actually respond to the broadcast. For example, if 5 out of 10 owls that were within the broadcast range of playback recordings actually responded to the broadcast, this is a detection probability rate of 50%. However, unless the owls' locations are first determined with radio-telemetry, observers employing broadcast have no way of knowing whether surveys without responses reflect the absence of owls, whether the territory holders were outside of hearing range, or whether owls were present and did not reply. Centili (2001) assessed the response rate of Little Owls in the district of Roma, central Italy in 1994 and 1995, and found that three broadcast visits were needed to have an 87% chance of obtaining at least one reply from territorial owls. Exo & Hennes (1978) claim to detect 80% of the owls present after one survey visit. It is not always easy to determine if the responding owl(s) is male or female (especially if only 1 owl responds); the intent is to record the territory as having a pair or resident single status.

The *detection rate* is a summary of the number of owls that were recorded across a given area, e.g. number of individuals heard divided by the number of broadcast sessions performed (Galeotti 1989, Sará & Zanca 1989, Centili 2001). While easier to calculate, these summaries invariably yield rather low rates of detection, as they cannot separate owl absence from owl silence and incorporate surveys conducted in areas of unsuitable habitat (no owls present to respond). The calculated detection rate is inversely proportional to the number of broadcast stations surveyed with no owls responding.

Survey methods – Field and office

Setup for field work should commence in December or early January with the acquisition of field staff (initially a Project Manager), field and office equipment, maps and/or aerial photographs, data sheets, and details of the previous year's work (if any).

Survey stations should be identified, on the ground and on associated maps, prior to the survey season. These stations are to be distributed to insure that their detection radii encompass all of the study area. Establishing stations on a fixed grid in areas of level terrain is suggested. Survey stations are to be located 500 m apart from one another (straight line distance); a 500 m detection radius is reasonable if there are no obstacles to block sound diffusion (Centili 2001). A grid size of 500 m was used in Flanders (Belgium) (Van Nieuwenhuyse *et al.* 2001). In hilly or mountainous situations, it will be best to place stations on vantage points to assure the best coverage of the surrounding area. Record the location coordinates of the survey stations used.

Time of year – The recommended survey period coincides with the breeding season, and depending on the latitude (and elevation), is from 1 February – 30 April in western-Europe, and 1 March – 31 May in eastern Europe, Middle East, and Asia.

Time of night – Surveys are to be conducted from sunset to midnight and from two hours before sunrise to sunrise. In work done in April-May of 2002 by Navarro and associates in southeastern Spain (Navarro *et al.* 2005), the response of Little Owls was evaluated using passive and broadcast surveys 2 hrs before and 2 hr after sunset. Numbers of Little Owl detected by passive auditory surveys were significantly lower than broadcast surveys, both before and after dusk. Broadcast surveys detected more individuals after dusk than before. Their results strongly suggested that nocturnal broadcast surveys were the most effective method of surveying for Little Owl, both for detecting presence and counting individuals and/or territories. However, the use of broadcast just before sunset would be useful when looking for territories and nests, because individuals could be observed when calling (Navarro *et al.* 2005).

Playback details – The tape-recorded call sequence consists of a two-min track played three times, with each broadcast track separated by a silent period of 1 min each. A given 2-min segment of playback should contain: 3 hoots, 3 chew, 3 hoots, and 3 chew calls, with each call spaced about 8 s apart. Broadcast is stopped as soon as a Little Owl responds. If no owl responds, the observer listens 5 min after the last sequence. Positions of all responding owls on recorded on a field map. Thus a maximum of 13 min is spent at each survey station. The intent of surveys is to elicit a response from territorial owls; behaviourally, the best vocalizations to use are territorial calls of adult males.

While Little Owls have a repertoire of 22 vocalizations, two calls, the hoot and the "*chewing*" call, are used by males in territorial contests and are the calls recommended for use in this protocol. The male's hoot call sounds like "*goooek*"; a loud questioning "*huui*" or "*ghu(k)*", sometimes given in crescendo series; towards the end of these series it changes to an excited "*guiau*", or "*kwiau*" and ends abruptly with a shrill "*hoo-ee*" or "*miju*" (Haverschmidt 1946). The female's call is shorter than the male's and the tone is generally higher in pitch. Most calls are louder and clearer when given by the male and repeated monotonously in a varied group of notes, while the notes occur singly when uttered by the female (Exo 1984). The "kiew"call (Cramp 1985) or *chewing* call is the most commonly given call (Hardouin *et al.* 2008). It is a clear "*(k)weew*", "*huu*" or "*gwauu*"; sharp, complaining, "*kee-ew*" repeated irregularly. It is used in many cases of social contact such as mating, feeding young, sometimes at the end of the ordinary song during courtship, during copulation and nest-showing, or during disturbance at the nest-site, during territorial contests and as an alarm when predators are present. The tape recording used to solicit Little Owl response was obtained from the CD "Tous les Oiseaux de l'Europe," part 3, "Coucous – Hypolais" by Jean C. Roché (WildSounds, Norfolk, UK). The "*ghuk*" sounds are found at 63 and 78 seconds; *chewing* calls are found 36, 43, and 52 seconds. An alternative call is the male advertising call "*guhk*" (Peterson Field Guide to the Bird Songs of Britain and Europe 1972) Broadcast vocalizations should be played at volume and clarity levels consistent with that of wild owls.

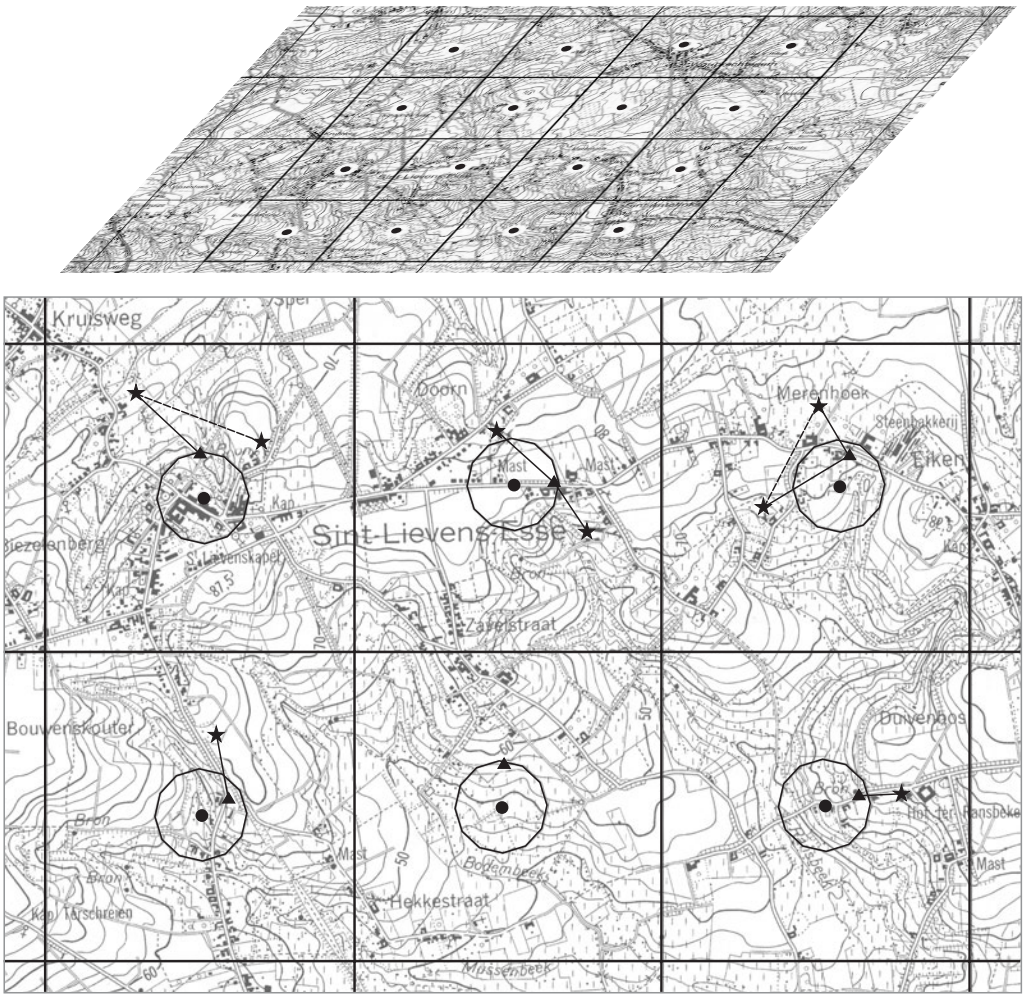

Figure 1. Top: Survey units (2 x 2 km) divided into sixteen squares of 25 ha, with theoretical broadcasting points indicated (after Van Nieuwenhuyse & Leysen 2001). Bottom: When it is not practical to survey from a theoretically-located broadcast point, observers locate a suitable survey point (triangles) within a 75-m radius of the theoretical point (circles), from which to plot calling owls (stars). Connected stars represent simultaneous locations of two owls.

The intent of the survey is to obtain coverage of the area of interest such that owls will be able to hear the surveyor and the surveyor will be able to hear the owls. Calling stations should be spaced 500 m apart (Finck 1990, Exo 1992, Van Nieuwenhuyse *et al.* 2001), depending on topography (Fig. 1). Take advantage of prominent points within the calling area when establishing calling stations. Whether owls are located or not, the following information should be recorded on a standard site visit form for each visit to a given site: (1) brief description of survey route, (2) survey start and stop time and total time of survey, (3) weather (including estimated wind speed and precipitation), and (4) survey results. Note species and number of all owl responses, regardless of species, including sex and age (if known), time of response and whether it was an audio, visual, or both. For multiple or moving owls, record and number each response or observation.

For each visit, whether positive or negative results, map (preferably on a topographic map, aerial photo, transportation map or some other high-quality map) the following:

(1) Route surveyed and stations called.

(2) For multiple or moving owls, map all response or observation locations and number each location to correspond with survey results. Characterize any behavioural observations. Make note of types of vocalizations heard, movements of owls (toward or

away from you), or situations such as one response is received and the owl is quiet thereafter. This will give the person(s) analyzing the data and determining activity centres additional information to consider.

Be especially cognizant of the possibility that you may hear other owls, and make careful notes of unusual vocalizations; record all other owl species response or observation locations.

(1) Conduct night surveys from sunset to midnight and from two hours before sunrise to sunrise. Be sure not to call the same section of a survey route at the same time on each survey effort (that is, change the start time and the end of the route).
(2) Do not survey under inclement weather conditions, such as high winds (>10 km/h), rain, or high noise levels (stream noise, machinery, roads, etc.), which could prevent hearing a response that would be heard under better conditions.
(3) Owl calls should be played on a cassette tape (or CD, MP3), with the speaker system producing a good facsimile of Little Owl vocalizations. The intent is to broadcast calls of territorial owls in a volume and quality that mimics that of wild owls.

Spot calling – Set up a series of calling points about 500 m apart along a road. When possible, select prominent points that cover large areas. Spend at least 13 min at each point.

Continuous walking surveys – Walk the designated route, stopping at frequent intervals to call and listen for responses.

If Little Owls are heard during a survey – Estimate the original and final location of the owl(s). We strongly recommend the use of triangulating on responding owls (e.g. if the owl is >100 m away), to better discern (and map) their locations. In triangulation, an observer acquires two (or three) compass bearings on the responding owl (e.g. from points that are 100 m apart), and then plots both the observers' locations (on a detailed map or aerial photograph) as well as the compass bearings to the located owl from those locations (Fig. 1). This will serve to pinpoint the location of the responding owl. Observers need to be attentive, to insure that the owl does not move between the acquisition of the 2–3 compass bearings; if it does, then a new series of bearings will be required to map its location. Be certain to record on the survey form the method used to estimate the location. Record the location on a map or photo attached to the survey form. The triangulation and accompanying map provide a way to verify the location. When a bird responds, record the data and continue with the survey route for the remaining points. If no response is heard, proceed to the next calling point. Continue until the defined survey route/area is completely covered.

Data entry – In the field, data are to be gathered on hardcopy data forms. Entry of these data into computer software programs is to be undertaken within 24 hrs of their acquisition in the field. Prior to incorporation into any population or meta-population analyses, all research groups will agree to undergo a formal data screening process to ensure quality control, to ensure that the original field data matches the data in the computer files, and to ensure that the specific criteria described in this protocol was actually followed by that study (i.e. that data collection is consistent with the protocol).

Quality control – For quality control aspects a Little Owl researcher not involved with a specific study area will be tasked with randomly selecting information from the database(s) supplied by the respective study-area researchers. Ten records will be randomly drawn from each study-area database; individual researchers will be required to provide paper copies of the associated original data forms or field notes. A comparison will be conducted, if errors are found, an additional 10 records will be checked. If errors are found during the second check, the entire database will be examined for errors.

Personnel requirements and responsibilities – The Project Manager will be responsible for data management and storage, compliance with the protocol, and oversight of the crew and logistics. Field surveyors will be responsible for compliance with accurate field work, equipment, and data entry. For the majority of demographic studies, it is anticipated that there will be a Project Manager and one or more field crew surveyors.

PART II. DEMOGRAPHIC AND DENSITY STUDIES

Of the two levels of surveys covered in this protocol, demographic and density studies are the most rigorous efforts to conduct, as the task involves locating all of the territorial owls present within the study area. The primary objective of demographic studies is to detect trends in the vital rates of the species. As part of this demographic work, there is typically the task of

annually locating all nest sites, and to mark/recapture (e.g. through ringing) all adults and young. Demographic or density efforts require complete 'wall-to-wall' survey coverage of the study area. To generate sufficient population information for mark-recapture studies, demographic areas should contain 50–100 pairs of owls (ideally, adjacent pairs). A network of 30 such demographic study areas across the range of the Little Owl has been identified in Van Nieuwenhuyse *et al.* (2008). An underlying goal of demographic studies is to correlate demographic performance with habitat conditions, to offer land managers with specific habitat features that support 'source' populations. In modelling habitat preference, determining the absence of owls is as important as determining their presence, and this requires that the study area be consistently and thoroughly searched for territorial owls. For density studies, we want to know the number of owls in a given area, and how these numbers compare to other areas. Here again, thorough and systematic surveys are required.

Sampling frequency and replication – We recommend demographic studies be conducted on a yearly basis. Density surveys can occur on a less frequent basis, perhaps once each 5 or 10 years. Survey efforts should occur during the breeding season. We recommend a '4-visit' sampling frequency, i.e. that broadcast surveys be conducted at survey stations four times during each season.

For demographic and density study areas, we suggest that observers establish 2 x 2 km survey areas (after Van Nieuwenhuyse & Leysen 2001; Fig. 1). This reflects a systematic partial sampling scheme for the selection of survey points. Once a 2 x 2 km survey unit is chosen, covering four 1-km square UTM grid cells, each 1-km^2 UTM square is divided into 4 squares of 25 ha (500 x 500 m) each. This assures unbiased coverage of both intuitively suitable and unsuitable habitats. Theoretical broadcasting points are situated in the centers of each of the 16 squares of 25 ha (Fig. 1). Prior to field surveys, the observer checks these theoretical locations in the field, and adjusts the survey point locations to best fit actual field locations. These sites are then marked on a map (and perhaps in the field as well) to allow the observer easy return to these broadcasting stations (Fig. 1).

We recommend that visits to each survey point be separated by 5–10 days. The intent is to insure that the broadcast surveys are conducted across the breeding season, to increase the probability of detecting the owls.

Gathering data on occupancy and reproduction in Little Owl demographic studies

Survey period – In general, surveys to establish the presence of territorial pairs, confirm rings of previously marked owls, and establish reproductive status between 15 February and 1 June. A later starting date (of 1 March) may be appropriate in some areas (for example, more northerly populations).

Occupancy status – Determination of non-occupancy – A minimum of four visits are required to establish non-occupancy of an area. At historical sites this normally will involve an initial nighttime survey visit to the historical core area to assess whether the owl pair is again present. In areas where owls are not recorded, or areas without previous records of occupancy, three additional nighttime visits would be part of the normal survey coverage of the area. Additional visits are permissible, but four is the minimum.

Determination of occupancy – A site will be considered occupied by a pair if any of the following occurs:

(1) Two individuals that have been paired in previous years are found alive on one or more occasions between 15 February and 30 June anywhere within a 100 m radius of the traditional site centre. There is no requirement that they be seen near each other, so long as they appear to be occupying the historical site. In cases where both pair members are confirmed alive within the historical nest core area, even in non-nesting years, we will usually classify the two members a 'pair'.

(2) In cases where birds are unmarked, birds will be classified as a pair if a male and female are heard or observed within 100 m of each other on two or more night visits (or on one or more day visits). Male and female locations do not need to occur on the same visit. For example, pair status would be assumed if a male and female were heard one night, a female was heard another night, and a male on another night. Note also that both birds must either be heard giving calls that are definitely identifiable as Little Owl calls or be seen and positively identified as Little Owls.

(3) A male Little Owl takes a food item to a female. To be called a Little Owl pair, the female must be either: (1) be positively identified by visual observation, or (2) heard giving definite Little Owl calls. Otherwise, the site should be listed as occupied by a pair of undetermined composition.

(4) A female is detected on a nest. If both she and the male are not (1) positively identified by visual

observation, or (2) heard giving definite Little Owl calls, then it should be called a pair of undetermined composition.
(5) One or both adults are seen with young. To be called a Little Owl pair, both adults must be positively identified by visual observation, or the young must be seen late enough in the season to examine their plumage.

Resident single status – Resident single status will be assigned to any location with the presence or response of a single owl within the same general area on three or more occasions during a single breeding season, with no response by an owl of the opposite sex after at least three complete surveys. Determining if responses occur within the same general area should consider topography and the locations of adjacent owl activity areas. If a single bird is detected, at least three additional visits should be conducted to determine if a pair is present during that breeding season.

Nesting status – Nesting status surveys may be conducted from 15 March to 31 May. If females are detected on the nest before these dates, those earlier visits may be counted as well. If nesting has not been confirmed earlier, at least one visit should be made during mid-April or early May, when females definitely should be incubating or brooding. To avoid missing a late nesting attempt it is important that visits not all take place in early April. If early visits do not provide evidence of nesting, at least one visit should take place after 1 May.

Confirmation of nesting – Owls will be classified as nesting if any of the following are observed:
(1) A female is detected on a nest or either a male or female carries prey into a nest on two or more occasions within the dates specified above. After 15 April, nesting may be confirmed on the basis of only one occasion where a female is observed on a nest or when a male or female carries prey into a nest. The two-visit protocol for confirmation of nesting is dropped after the specified dates, because there is little chance owls will continue to sit in the nest without actually laying eggs after the first 2 to 3 weeks of the nesting period.
(2) A female possesses a well-developed brood patch when examined in hand during April, May, and June. Presence of a small bare area or moulting feathers on the abdomen should not be counted as a brood patch. This is somewhat of a judgment call. When in doubt, use other criteria such as results of observations of roosting. Describe the brood patch, including dimensions and visual appearance of skin.
(3) Young birds are observed in the presence of at least one adult.
(4) Eggs, eggshells, or remains of nestlings are found in a nesting cavity or immediate surroundings.

Confirmation of non-nesting – Confirmation must take place before 15 May. A 1 June cutoff also may be used at higher elevations if biologically appropriate. With these cutoffs, some pairs inevitably will be classified as non-nesting when they in fact nested and failed. This means that estimates of the proportion of the population that nests may be somewhat underestimated because the estimate will include some pairs that nested and failed early in the season.

To classify a pair or a female as non-nesting, visit the site on at least two occasions and observe the male and female for evidence of nesting. If visits to document nesting are made in April they should be at least 2 weeks apart so that late nesting attempts will not be overlooked. Visits to determine nesting status in May or early June may be done at any interval, including consecutive days. One-day intervals between nesting visits are permissible later in the season, because there is little chance that a late nesting attempt will be overlooked during that period. Pairs or single females that are not checked at least twice before 1 June should be listed as '*nesting status undetermined*.' Exceptions to this two-visit non-nesting status determination are:
(1) Female does not possess a brood patch when examined in hand between 15 April and 1 June (if this occurs, non-nesting status can be confirmed based on one visit).
(2) Females believed to be non-nesting based on one visit between 1 April and 15 May, and which then cannot be located despite repeated return visits to the area. Cases like this are not uncommon in poor nesting years, when pairs briefly return to their traditional nest areas, then become difficult to locate.
(3) Females observed roosting for 30 min or more between 15 April and 15 May, showing no sign of attachment to a nest or young, may be classified as 'non-nesting' based on a single visit. Females normally should be incubating eggs or brooding young during this period. This technique should not be used for confirmation of nesting after 15 May, as it is common for females with well-developed nestlings to remain out of the nest for prolonged periods. When possible, do a second non-nesting confirmation visit to make sure.

Confirmation of nest failure – A nesting attempt may be classified as 'failed' if:

(1) A pair is initially classified as nesting, but on two or more subsequent visits, one or both pair members are absent. The two visits to confirm failure can take place anytime after nesting is first confirmed. Both visits to confirm failure need to occur before 1 June.
(2) A pair is initially classified as nesting, but neither bird can be relocated on two or more visits to the nest area after the initial confirmation of nesting. Both follow-up visits to confirm failure must take place before 1 June.

Breeding success, ringing age, and fledging age – The *number of young produced* is the most important measure of reproduction we take, because it is the basis for estimates of fecundity (in demographic studies). The number of young produced is averaged for *all* females, whether they are paired or not. The measure of reproduction that we seek (i.e. number of young produced) is the number of young that fledge. Out of practicality, young Little Owls are often ringed before they fledge (e.g. ~15 days old). However, the number of owls ringed at this stage should not be taken as the 'breeding success' or the number of young produced. Stroeken & van Harxen (unpubl. data) compared the number of young that reached *ringing age* to the number of owls that reached *fledging age* (24–30 days). After accounting for post-fledging mortality (dead owls found after >30 days), they found the number of owls >30 days old averaged 13% lower than counts of owls reaching ringing age. These data have important implications, as many field studies actually reflect the numbers of owls only reaching ringing age, and thus overestimate true breeding success. To obtain comparable results of breeding success in future studies, it is of importance to register the age of owls at the time of each observation. This will allow improved interpretations of reproductive success later. Post-fledging counts on a subset of nests (i.e. the number of young >30 days old) will provide an important control from which to better evaluate overall breeding success.

Pairs or single females – Pairs or single females will be classified as producing no young if:

(1) They are confirmed to be non-nesting based on criteria for determination of nesting status.
(2) They are visited on two or more occasions before 30 June, with no sign of young. This may include any combination of reproductive status visits and fecundity visits. For example, if a single visit in late May suggests no young produced could be combined with a single visit later that also indicates no young produced.
(3) Female is observed and designated as non-nesting on one or more occasions in April-May, but neither she nor her mate can be relocated later in the summer, despite repeated attempts (minimum of two) to relocate them. This change in the protocol is needed to address the behaviour of some non-nesting birds or birds that nest and fail; they sometimes become difficult to locate and cannot be confirmed as having produced no young.

For pairs that produce young, brood counts may take place anytime after the young fledge until 30 June. However, a determined effort should be made to count the number of young produced as early as possible after broods fledge, preferably before 1 June. The objective is to document the number of young produced before any mortality occurs. After the first occasion when young are counted, at least one follow-up visit should be made to ensure that all young were observed on the first visit. If owlets are found under a known or suspected nest tree in May, then the follow-up visit to confirm the number of young fledged should take place at least 3 days later to make sure that all young have had time to leave the nest. In all other situations, the 3-day interval between the first and second visit is not required (that is, visits can be as close as 1 day apart). To estimate the number of young produced, count the maximum number of owlets seen or heard. A visit counts for determination the number of young produced.

Data handling, analysis and reporting

Metadata procedures – For demographic studies (only), the parameters of interest for the meta-analysis are *sex-specific survival, female fecundity,* and *population rate of change*. In the interest of data consistency, researchers are requested to summarize their data in three related datasets:

(1) Survival Database: a data file with a capture-history matrix that describes the capture-recapture history of each individual owl, its ring number, its age at first capture (juvenile, adult), and its sex.
(2) Reproductive Database: a data file with annual number of young fledged (0, 1, 2, 3, etc.) for individual territorial owls, their territory, social status (paired or single owl), age of the male, and age of the female.
(3) Capture-History Database: a data file with a capture-history matrix that documents the capture-recapture history of all individuals encountered as territory holders (i.e. if an individual was first ringed as a juvenile only the territorial portion of

the history will be included), its age at first capture, its sex, and its ring number. This latter database will be used to estimate population rate of change.

Database design - The specific field headings and components for Little Owl demographic and monitoring data can be found in Van Nieuwenhuyse *et al.* 2008: 405–409, and are available by contacting the author.

Data summaries, report format, and *trend analysis* – For examples of data summaries, report formatting, and trend analyses, as based upon detailed demographic analyses using mark-recapture data on owls, we direct readers to Franklin *et al.* 2004, Ganey *et al.* 2004, and Forsman *et al.* 1996.

Archival procedures – At least one copy of the completed, error-checked digital database should be submitted to the International Little Owl Working Group by 1 November each year, for incorporation into the range-wide database on Little Owls. At least one copy of the original datasheets and a digital copy of the data will be made and filed with an appropriate organization or entity. Digital backup copies of the data should be made at least weekly. The transfer of the hardcopy and digital materials can occur as frequently as practical, but at least at the end of the given field season. The intention here is to insure that a backup copy of the data is secured against loss or accident.

Workload and schedule – We anticipate that each demographic study area will employ a Project Manager for 5–6 months, and field surveyors of 3–4 personnel for 5 months, for a total of some 26-staff months. Project Managers will begin in December/January, and Field Surveyors will begin about 1 week in advance of the formal survey season.

Budget considerations – Budgets will vary by country, based largely on staff salaries. We anticipate that larger demographic study areas will employ a Project Manager for 5–6 months, and Field Surveyors of 3–4 personnel for 5 months, for a total of some 26 staff-months.

Observations in areas with high densities of Little Owls

In areas having high densities of Little Owls, observations suggest that owls respond more readily, resulting in the observers' ability to hear and record a higher percentage of the territorial owls present (Exo & Hennes 1978, Zuberogoitia & Campos 1998, Pirovano & Galeotti 1999). This has implications for number of visits required (potentially higher detection probabilities), but also suggests care in mapping owl locations. On 19 March 2005, M. Bekaert (pers. comm.) conducted a test using 30 untrained volunteers in the Flanders region of Belgium. The volunteers conducted 1 nighttime survey visit to 36 different stations within a 9 km^2 study area. Under ideal weather conditions, and using tape broadcast, the volunteers located 47 Little Owls. Subsequently, Bekaert conducted more detailed surveys (i.e. he actually recorded and compared the calls of individual owls) and found the area to contain 41 owls. The reason that the volunteers located what appeared to be more owls than Bekaert was because they did not triangulate on the owls locations, but rather just estimated (and mapped) the location of calling owls; as this process was done by each of the volunteer teams working simultaneously, owls were double-counted.

PART III. SURVEYS TO SUPPLEMENT NEST BOX PROGRAMS

Many Little Owl researchers employ nest box programs to aid in their demographic study efforts. Nest boxes are typically checked two or more times annually, with young and captured adults ringed. A critical aspect of demographic studies is to estimate survival and reproduction rates, and this data is typically gathered by the marking and recapturing of ringed owls. However, while the majority of the owls within such study areas often nest in the nest boxes, not all do so. Thus, it becomes important to locate (and recapture) all territorial owls, each year, within the study areas. To insure that all owls are located, we recommend that researchers employ playback methods to locate owls not associated with nest boxes within the boundaries of their study areas. The intent here is to insure that all territorial owls are located (i.e. those that are not using nest boxes). The actual number of field visits may vary (from 1 to 4), depending on how readily the owls are actually located. Once a resident owl (or pair) is located, and the breeding status established, no further surveys are needed.

PART IV. PRESENCE AND REGIONAL DISTRIBUTION SURVEYS

For *presence or regional distribution surveys*, we suggest a 1-visit survey. In presence and general distribution surveys, we are trying to locate any territorial owls. While a 1-visit strategy will not detect some of the owls actually present, the outcome of this survey work will illuminate general presence and distributions of owls

and highlight areas for future work. In areas where it is not practical to set up a grid of survey points (e.g. Tibetan plateau), we recommend the use of Spot Calling, or Continuous Walking Surveys. This sampling method can be used to model Little Owl presence (but not density) with logistic regression analysis, since presence data are less sensitive to sampling bias than those of density (Green 1979). We refrain from using the terminology 'presence/absence' as true absence is very difficult to actually determine in the field.

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SAMENVATTING

Dit artikel beschrijft een protocol om op een gestandaardiseerde manier 's nachts Steenuilen *Athene noctua* te inventariseren door middel van het afspelen van de roep van de uil. Al naar gelang het doel van het onderzoek kan de nadruk van het veldwerk op twee verschillende aspecten liggen: (1) demografie en dichtheid en (2) aantallen en verspreiding. Het veldwerk is voor beide benaderingen gelijk, maar het aantal bezoeken aan het onderzoeksgebied verschilt afhankelijk van de vraagstelling. In dit artikel worden doelstellingen en definities voor beide types onderzoek aangedragen en worden er richtlijnen gegeven om te bepalen wanneer een plek door uilen bezet is, en wat het voortplantingssucces en de doorstroming in de populatie is. De aanbevolen inventarisatieperiode valt samen met het broedseizoen. Afhankelijk van de breedtegraad en hoogteligging gaat het in West-Europa om de periode februari tot en met april. In Oost-Europa, het Midden-Oosten en Azië valt de periode een maand later. Inventarisaties kunnen het best plaatsvinden van zonsondergang tot middernacht en in de twee uren voor zonsopkomst. De plekken om naar uilen te luisteren kunnen het best 500 m van elkaar liggen, langs een transect of gerangschikt in een regelmatig rasterpatroon. Op elke plek wordt 13 minuut doorgebracht. Eerst worden de uilenroepen driemaal gedurende twee minuten afgespeeld met pauzes van één minuut. Daarna luistert de waarnemer gedurende vijf minuten. De positie van elke roepende uil wordt op een kaart ingetekend. Bij voorkeur worden de geluiden afgespeeld die door mannetjes gebruikt worden als territoriumroep. Voor onderzoek naar demografie en dichtheid kan het best viermaal een bezoek gebracht worden aan de routes. Als gewerkt wordt met nestkasten waarvan de bezetting al grotendeels bekend is, kan het hier beschreven protocol gebruikt worden om het beeld van de aantallen uilen te completeren. Voor inventarisaties ten behoeve van aantallen en globale verspreiding zal een enkel bezoek aan elke plek al snel voldoende informatie opleveren. Maar meer onderzoek is gewenst naar het aantal bezoeken dat nodig is om het aantal uilen in een gebied goed te kunnen schatten.

ARDEA

TIJDSCHRIFT DER NEDERLANDSE ORNITHOLOGISCHE UNIE (NOU)

Ardea is the scientific journal of the Netherlands Ornithologists' Union (NOU), published bi-annually in spring and autumn. Next to the regular issues, special issues are produced frequently. The NOU was founded in 1901 as a non-profit ornithological society, composed of persons interested in field ornithology, ecology and biology of birds. All members of the NOU receive Ardea and Limosa and are invited to attend scientific meetings held two or three times per year.

World Owl Conference Special

Editors – David H. Johnson, Dries Van Nieuwenhuyse and James R. Duncan, in cooperation with Jouke Prop and Rob G. Bijlsma

Technical editor – Jouke Prop

Dutch summaries – Arie L. Spaans, Dries Van Nieuwenhuyse, Jouke Prop, Rob G. Bijlsma, or authors

Graphs and layout – Dick Visser

Drawings – Jos Zwarts

Cover photos - Serge Sorbi
front – Snowy Owl
back – Snowy Owl, Great Grey Owl and young Tengmalm's Owl

Production – Hein Bloem, Johan de Jong and Arnold van den Burg

Printed by Van Denderen, Groningen, The Netherlands, December 2009