

SURVEY PROTOCOL FOR THE LITTLE OWL (*Athene noctua*)

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October 2007 version

Suggested citation:

David H. Johnson, Dries Van Nieuwenhuysse, & Jean-Claude Génot. 2007. Survey Protocol for the Little Owl (*Athene noctua*); October 2007 version. Global Owl Project. 19 p. [unpublished report]. (www.globalowlproject.com).

Summary: This document reflects a standardized protocol for conducting nocturnal surveys on Little Owls (*Athene noctua*) across the range of the species. This protocol recommends use of the broadcast (playback) technique for surveying owls in demographic study areas as well as for general distributional and ecological studies. The broadcast method described in this document exploits the vocal responses of territorial Little Owls to conspecific calls. 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 two minute track played three times, with each broadcast track separated by silent periods of one minute each. Broadcast is stopped as soon as a Little Owl responds. The observer waits 5 minutes after the last sequence, and records the positions of all responding owls on a field map. Thus a maximum of 13 minutes is spent at each survey station. The recommended pre-recorded calls are those of territorial calls (Hardoin 2002). The tape recording used to provoke Little Owl response was obtained from the CD “*Tous les Oiseaux de l’Europe*,” part 3, “*Coucou – Hypolais*” by Jean C. Roché (WildSounds, Norfolk, UK). The “ghuk” sounds at 63 and 78 seconds are used. 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. For demographic studies, we recommend 4 visits across each of the survey routes (and associated survey stations) to gain responses from 90-95% of the territorial owls there. For general distributional surveys, we recommend 3 visits to each of the survey routes. 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. We anticipate that this protocol will be updated from time to time, and that the updates will be published and distributed following a normal scientific peer-review process. In particular, we expect that additional research will clarify the *detection probability* of territorial owls, and provide clarification as to the number of visits needed to accurately determine the numbers of owls present in a given area.

Outline of this Survey Protocol

The outline of this survey protocol follows the structure of *Essential Elements of Protocols* (Oakley *et al* 2003), with components added to reflect demographic aspects of owl studies:

I. Background and Objectives:

1. Background – history, resources being addressed
2. Rationale – justification of selecting a given resource to inventory or monitor
3. Objectives – list of measurable tasks

II. Sampling Design:

1. Site selection – criteria for site selection; defining boundaries or “populations” sampled; procedures for selecting sampling locations; stratification, spatial design

2. Sampling Frequency and replication – recommended number and location of sampling sites; frequency and timing of sampling; level of change that can be detected for the amount/type of sampling
- III. Field/Office Methods:
1. Setup – field season preparations and equipment setup (including permitting/compliance procedures).
 2. Events sequence – sequence of events during field season or during preparation of a monitoring plan
 3. Measurement details – details of taking measurements, with examples of field forms
 4. Sample processing – post-collection processing of samples (e.g., lab analysis, preparing voucher specimens)
- IV. Data Handling, Analysis and Reporting:
1. Metadata procedures – descriptions of fields and sizes; sample collection information; site description; quality assurance procedures
 2. Database design – overview of database design illustrating table relationships
 3. Data entry – data entry procedures; verification and editing of data
 4. Data summaries – data summaries and procedures for conducting statistical analyses
 5. Report format – report format with examples of summary tables and figures
 6. Trend analysis – recommended methods for trend analysis
 7. Archival procedures – data archival procedures
- V. Personnel Requirements and Training:
1. Responsibilities – roles and responsibilities
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I. Background and Objectives

Background - 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. 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.

Survey Methods for other Athene owls – Due to the similar ecological niches with the other *Athene* owls, we offer a summary of the survey methods being employed for them.

Spotted Owlet (*Athene brama*) – This is a generally common nocturnal species within its southeast Asia range, and is often found in village and urban areas. The primary method for surveying Spotted Owlets is by night time "call counts" (listening stations) along transects, as these birds become very vocal during dusk and dawn. This technique works effectively during their main breeding season (January to April). It is believed that the call broadcast of territorial calls will also work; nests are located by examining possible nest cavities (F. Ishtiaq pers. comm.). The species nests in cavities (e.g., tree, crevices in buildings), and December to June is the overall breeding season for the species in India (Kumar 1985).

Forest Owlet (*Athene (Heteroglaux) blewitti*) – Observations by Jathar and Rahmani (2004) reveal that broadcast of territorial and song calls is not sufficient to determine presence or absence of Forest Owlets, but that direct searching (on foot) is required. This is a diurnal species, and January and February are the best seasons to conduct surveys because there are increased chances of getting pairs with fledglings. The fledglings constantly emit food begging calls that are audible from 100-150 m. The species nests in tree cavities in semi-open woodlands. The overall breeding season is October to May (Ishtiaq et al 2002, Ishtiaq & Rahmani 2004). This is a critically endangered species, only found in some five locations in central India.

Burrowing Owl (*Athene cunicularia*) – As their name implies, Burrowing Owls nest in unused animal burrows. The use of recorded calls can significantly increase Burrowing Owl detections, particularly males (Haug & Didiuk 1993). A standardized range-wide roadside survey using call broadcast has been recommended by Duxbury & Holroyd (1998) and Conway et al. 2003. This method gave a detection probability of 80% in detecting Burrowing Owls using a 15 minute period (5 min listening, 5 min broadcast, 5 min listening), in early morning and in the early breeding season (Duxbury & Holroyd 1998). Conway et al. 2003, found a detection probability of 64% using roadside point-count surveys alone; and only a 37.5% detection rate using driving surveys; the use of broadcast surveys in combination with point-count surveys increased the detection rate to 86%. Because of low nest reoccupancy rates, long-term monitoring of abundance should not be based solely on surveys of historical breeding sites (Lehman et al 1998). Nesting season surveys should be conducted during the peak of the breeding season, between April 15 and July 15 (western North America). A protocol for surveying

Burrowing Owls can be found at:

<http://www2.ucsc.edu/scpbrg/PDFFiles/surveyprotocol.pdf> A strong array of scientific publications on Burrowing Owl demographics have been published in recent years (see Lincer & Steenhof 1997, Wellicome & Holroyd 2001, Gorman *et al* 2003). The species is found in western North, Central, and South America.

Rationale - The Little Owl *Athene noctua* is a territorial species distributed in Palearctic regions across 80 countries. It is a small raptor 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. The Little Owl population has been recognized as declining in significant portions of its 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. To date, no formal survey protocol for the Little Owl has been published.

Objectives – There are typically three primary objectives in surveying for Little Owls:

- 1) Documentation of presence/absence
- 2) Estimating numbers of owls (density, absolute or relative abundance), or
- 3) Assess population dynamics (size, distribution, trends in abundance over time).

In this survey protocol we are focusing on surveying to assess population dynamics. This is the most rigorous of the three objectives; documentation of owl presence and estimating the numbers of owls can also be determined using this protocol. In modeling habitat preference, determining the absence of owls is as important as determining their presence.

II. Sampling Design

We make two basic assumptions in the use of this survey protocol. First, we assume that the species will answer territorial calls consistently. Second, 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.

Site selection – The geographic focus of this protocol is surveys that are conducted on Little Owl *Vital Sign* demographic study areas. However, this protocol can also be used in other research and general survey applications within the range of the Little Owl.

Sampling Frequency and Replication – Annual surveys, occurring during the breeding season, are recommended for determining the population dynamics (or presence/absence) of Little Owls. More specifically, for *demographic study areas*, we recommend a “4-visit” sampling frequency. In demographic studies, we are trying to locate 90-95% of the territorial owls. For *presence/absence surveys*, we recommend a 3-visit sampling frequency. In presence/absence surveys, we are trying to locate any territorial owls. This latter sampling method can be used to model Little Owl presence (but not density) with logistic regression analysis, since presence/absence data are less sensitive to sampling bias than those of density (Green 1979).

III. Field/Office Methods

Setup – 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 (see Equipment List below), 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 so as to assure 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 Nieuwenhuysse 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.

For areas outside of demographic study areas, we suggest that observers establish 2 x 2 km survey areas (after Van Nieuwenhuysse & Leysen 2004; Figure 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-km² UTM square is divided into 4 squares of 25 ha (500 by 500m) 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 (Figure 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 (Figure 2). 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 or Leapfrog Surveys (described below).

During field surveys, observations of Little Owls are located using a compass, reflecting the compass bearings between the broadcasting point and indication of simultaneous observations (Figure 3).

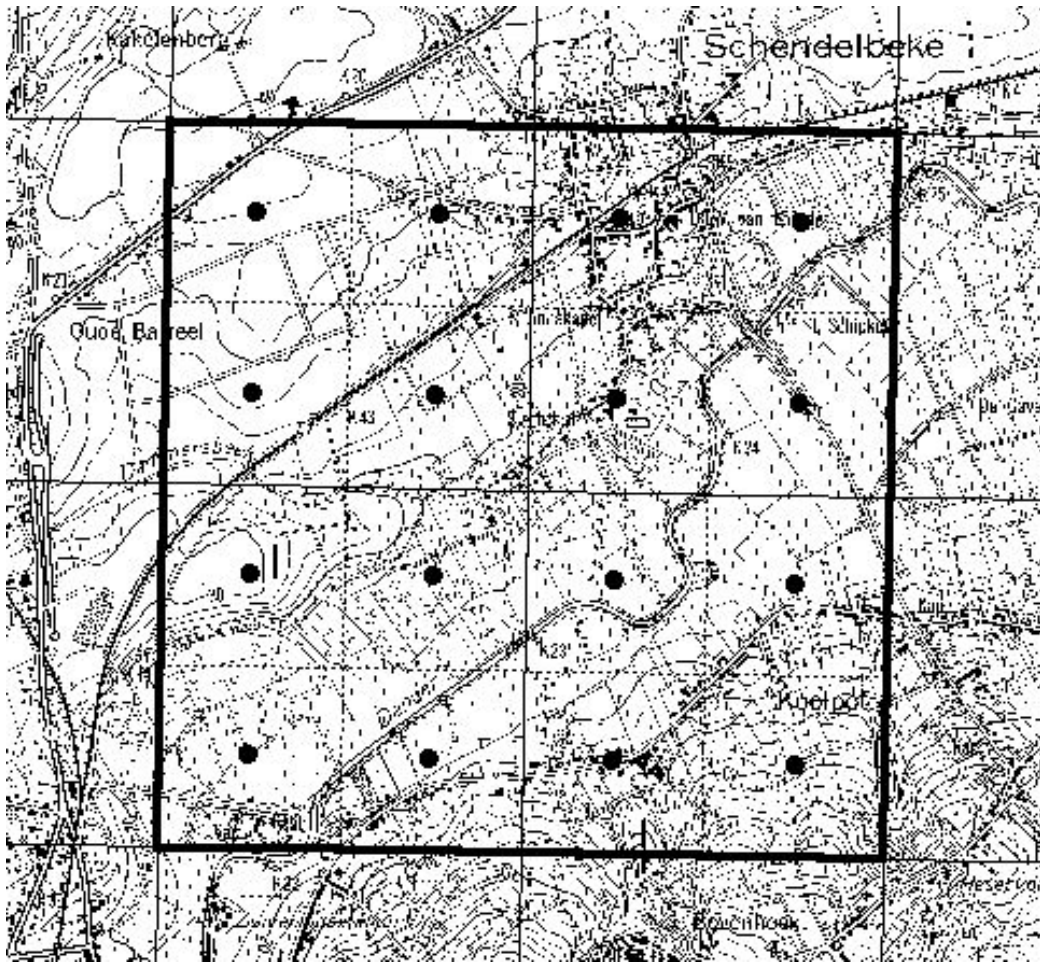


Figure 1. Survey units (2 by 2 km) divided into sixteen squares of 25 ha, with theoretical broadcasting points indicated (after Van Nieuwenhuysse & Leysen 2004).

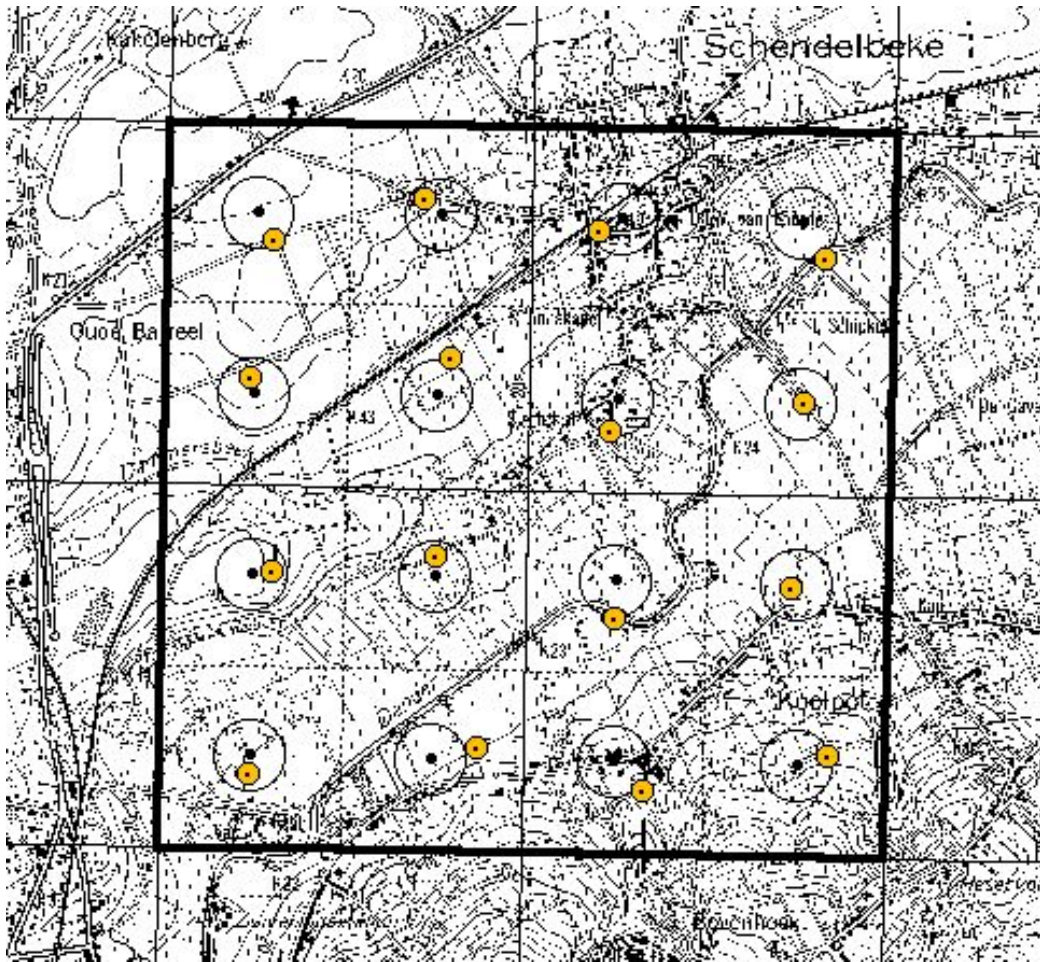


Figure 2. Survey units (2 by 2 km) divided into sixteen squares of 25 ha, with theoretical (black spots) and actual broadcasting (**yellow** spots) points indicated (after Van Nieuwenhuysen & Leysen 2004).

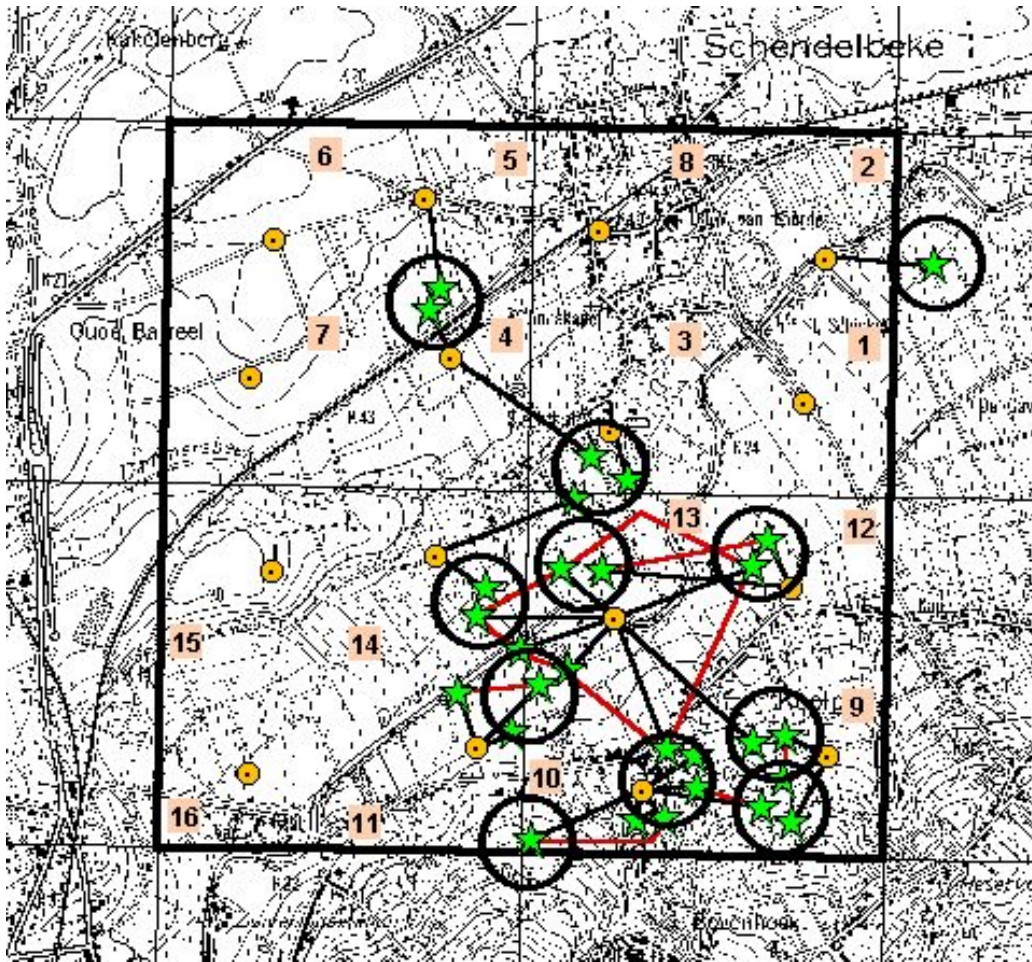


Figure 3. Registration of observations (**yellow** dots are broadcasting points, stars are observations, black lines connect the observation point with the broadcasting point, red lines indicate simultaneous calling individuals) (after Van Nieuwenhuysse & Leysen 2004).

Events sequence

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.

For demographic surveys and general surveys, 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.

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 (J. Navarro pers. comm.), 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 (J. Navarro pers. comm.).

Measurement details

The tape-recorded call sequence consists of a two minute track played three times, with each broadcast track separated by a silent periods of one minute each. Broadcast is stopped as soon as a Little Owl responds. The observer waits 5 minutes after the last sequence, and records the positions of all responding owls on a field map. Thus a maximum of 13 minutes is spent at each survey station. The recommended pre-recorded calls are those of territorial calls (Hardoin 2002). The tape recording used to provoke 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 at 63 and 78 seconds are used. 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.

We strongly recommend the use of triangulating on responding owls, 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. This will serve to pinpoint the location of the responding owl. Observers will 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.

Sample processing

Note on Detection Probability and Response Rate – Surveys efforts are ultimately aimed at determining the total number of *territorial* owls (paired and unpaired) present on 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 behaviors (e.g., hunting). It requires energy from the owls to respond to territorial intruders, and the owl must balance its energy expenditure in territorial defense against its other nightly and seasonal activities. Non-territorial ("floater") owls seldom respond, as vocalizations from them will cause the territorial holder to respond aggressively to them (and actively chase them from the territory).

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 the broadcasted 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 3 broadcast visits were needed to have an 87% chance of obtaining at least one reply from territorial owls.

The **detection rate** is a summary of the number of owls that were recorded across a given area, e.g., (number of individuals heard)/(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.

Observations in areas with high densities of Little Owls: In areas having high densities of Little Owls, observations suggest that the owls both respond more readily, resulting in the observers' ability to hear and record a higher percentage of the territorial owls present (Exo & Hennes 1978, Zuberogoitia and Campos 1998, Pirovano & Galeotti 1999).

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 km² 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* the calls of the 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 location, but rather mapped the approximate location of the responding owls; as this process was done by each of the volunteer teams working simultaneously, owls were double-counted.

IV. Data Handling, Analysis and Reporting

Metadata procedures – The demographic parameters of interest for the meta-analysis are *sex-specific survival, female fecundity, and population rate of change*. Therefore, in the interest of data consistency, researchers from each study area will be 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; and
- 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 – see sections VIIA, B, C, and D of this protocol, below.

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 databases supplied by

the respective study-area researchers. Ten records will be randomly drawn from the capture-history database from each study-area and 10 from the reproductive 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.

Data summaries – For examples of detailed demographic analyses using mark-recapture data on owls, see Franklin et al 2004, Ganey et al 2004, and Forsman et al 1996.

Report format – For examples of detailed demographic analyses using mark-recapture data on owls, see Franklin et al 2004, Ganey et al 2004, and Forsman et al 1996.

Trend analysis – For examples of detailed demographic trend analyses using mark-recapture data on owls, see 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.

V. Personnel Requirements and Training

Responsibilities – For the majority of demographic studies, it is anticipated that there will be a Project Manager and one or more field crew surveyors. 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.

Qualifications – Project Managers are expected to have at least 2 seasons of field experience with owl surveys (any species). All field personnel are expected to have adequate hearing (as determined through hearing exams).

Training availability, locations, timing, and procedures- At this point, no formal training programs have been identified for the Little Owl protocol; there may be organizationally-based programs on owl surveys. In the future, the International Little Owl Working Group is likely to make some training available on this protocol.

VI. Operational Requirements

Workload and schedule - We anticipate that each 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. Project Managers will begin in December/January, and Field Surveyors will begin about 1 week in advance of the formal survey season.

Equipment needs – office space; crew vehicles, field survey equipment, cassette tapes, head lamps and other torches, data forms, computer, writeable CDs, rings, traps, nets or other gear for capturing owls.

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.

VIIA. Gathering Data on Occupancy and Reproduction in Little Owl Demographic Studies

The following sections provide both general and specific direction for implementing demographic field surveys for the Little Owl, as part of the Monitoring Plan. All areas will be surveyed according to the methods described herein. Any deviations from these methods must be approved through the International Little Owl Working Group.

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

Survey Methods - The intent of the survey is to obtain complete 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 and survey routes must be established to achieve complete coverage of the area. Calling stations should be spaced 500 m apart (Finck 1990, Exo 1992), depending on topography. 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 behavioral 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 centers 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.

* 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).

* Do not survey under inclement weather conditions, such as high winds (>10 km per hour) rain, or high noise levels (stream noise, machinery, etc.), which could prevent hearing a response that would be heard under better conditions.

* Systematically survey the area of interest until an owl responds, or if no response, until a minimum of four complete night visits are conducted each year. Survey effort should be spread

out over 2 to 3 months to avoid survey efforts concentrated in a short timespan (for example, in a 3-week period at the first of the survey season).

* Where survey seasons are restricted (because of snow, mud, bridge failures, etc.), the survey period may be adjusted to fit the conditions.

* Owl calls should be played on a cassette tape (or CD), 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. Follow the survey methods listed below. Whatever method used, be certain to cover all potential areas within the study area.

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 10 minutes at each point, more if the topography prevents you from hearing birds that might respond from the previous calling point (for example across a major ridge). If the topography lends itself to fewer prominent calling points, spend more time at each point.

Continuous walking or leapfrog surveys - Walk the designated route, stopping at frequent intervals to call and listen for responses. If two people are involved, use a leapfrog method, where one person conducts the broadcast and listening at one station, while the other person continues on to the next station.

* If Little Owls are heard during a survey:

Estimate the original and final location of the owl(s). The best method is to triangulate on the owl's calls, taking compass bearings from two or three locations. 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.

* If an owl responds at any point, record the data as required. If no response is heard, proceed to the next calling point. Continue until the defined survey area is completely covered.

* If an owl responds at night, return to the area during the day as soon as possible (followup visit) to verify status as described below.

* When a bird responds, record the data and continue with the survey route for the remaining points. Completing the route will provide an opportunity to detect any other owls in the area.

Occupancy Status - Determination of non-occupancy – A minimum of three 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, the three nighttime visits would be part of the normal survey coverage of the area. Additional visits are permissible, but three 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 center. 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 as 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 two 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.

Positive 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 molting 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 or under a nest.

Confirmation of non-nesting status - Confirmation must take place before May 15. The 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 protocol 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 split up and become difficult to locate.
3. Females observed roosting for 30 minutes 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.

Number of Young Produced - This measure of reproduction is the most important measure we take, because it is the basis for estimates of fecundity. The number of young produced is averaged for **all** females, whether they are paired or not. The measure of reproduction is the number of young that leave the nest. It is not permissible to count “branchers” (young birds sitting on branches in the nest tree) unless you are certain that there are no other young hidden in the nest. The concern with counts of branchers is that young hidden in a nest not be overlooked.

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 protocols for determination of nesting status (refer to criteria above).
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

behavior 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 followup 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 followup visit to confirm the number of young fledged should take place at least 3 days later to make sure that all young have 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.

VII B. Estimating Reproduction Rates at Sites Historically Occupied by Little Owls - Quantifying Site-Specific Reproduction

This is an analytical protocol for combining reproductive data sets and does not apply to or amend protocols for conducting occupancy and reproduction surveys in demographic studies. The index is to be calculated for only those sites occupied by a pair in at least one year during the study period. Pair status will be defined by using the definition found in Part IIIA. Include values for all years of the study (including years prior to first pair status confirmation) for each site included.

1. A nine (9) will be entered when the following “unknown” status conditions occur:
 - a. Less than three visits were attempted and no reproductive determination could be made. Daytime follow-ups do not constitute as additional visits.
 - b. When a pair is detected and protocol was not followed or met when attempts were made to ascertain the number of young produced (see item 5, (b) below, for exceptions to this rule).
 - c. Owls fitted with tail-mounted or backpack-style transmitters can be included in calculations for the entire time that the devices are attached.
 - d. Data are not available to make a reproductive determination.
2. An eight (8) will be entered for sites surveyed for occupancy status at least three times (1 March to 30 June) and the site was “unoccupied” because:
 - a. No owls responded.
 - b. A pair or resident single could not be confirmed.
3. A seven (7) will be entered for years when sites meet “resident single” status. Resident single status is established by the response of a single owl on two or more visits within the season, with no response by an owl of the opposite sex after three complete visits. In cases where a “known-sex” owl responds and subsequent “unknown-sex” responses occur, attribute all responses to the known-sex bird. A single response or observation of a ringed owl will serve to meet resident single status in cases where the three-visit minimum is met and the observed owl was previously confirmed on the site.
4. A six (6) will be entered in cases where “resident single” status is met for one owl and where there was also a response(s) from an opposite sex individual but pair status could not be confirmed.
5. A zero (0) will be entered for “pairs” that do not produce young if:
 - a. Owls were visited and non-nesting or no-young-produced determination, or both, was made.
 - b. Sites meet pair status, but do not meet standards for reproductive determination, and at least two visits were made to relocate the owl(s) after the initial detection.

6. Numeric values (for example, 1, 2, or 3) will be entered when young are produced and observed at the site.
- The maximum number of live young counted at any time during the season will be entered in the matrix.
 - Fledglings must leave the nest tree alive to be counted.
 - Young found dead are not counted. But, if fledglings are known to have been killed after being previously located (out of the nest tree) alive, then they are counted.

VIIIC. Estimating Occupancy Rates at Sites Historically Occupied by Little Owls - Quantifying Site-Specific Occupancy

The codes, listed below, have been developed for combining data sets and do not apply to or amend individual study area protocols for conducting demographic studies. Definitions of “pair,” “resident single,” and minimum survey effort required for inclusion of data will be the same as outlined in the protocol for site-specific reproduction (see Part IIIB). The index is to be calculated for sites with pairs or resident singles for at least 1 year in the history of the site. Birds carrying transmitters may be included in this index. Additionally, it might be wise to include data on sites surveyed to protocol (three visits or more) but never occupied during the course of your study (if you have those data).

The codes are as follows:

- 1 = A pair or two resident singles of opposite sex
- 2 = Resident single male
- 3 = Resident single female
- 4 = Resident single of unknown sex
- 5 = Resident single male with female response
- 6 = Resident single female with male response
- 7 = Male and female detected, pair status unknown, and neither individual meets “resident single” status
- 8 = Detection of male, female, or unknown sex not meeting resident single status (floaters)
- 9 = Unoccupied
- 0 = No data or insufficient survey

Make a judgment call for those cases where the same bird or birds occupy more than one site in a given year. This is such a rare event that it is probably irrelevant.

VIIID. Estimating Turnover Rates at Sites Historically Occupied by Little Owls - Quantifying Site-Specific Turnover

The codes, shown below, have been developed to track site-specific turnover of individual owls. This parameter will be tracked with separate fields for male and female owls.

- 1 = The presence of the previously marked owl is confirmed by direct observation.
- 2 = Replacement by another owl at the site with no observation of the previously marked owl (see note (E), below).
- 3 = Re-observation of the marked owl at a different site (that is, the marked owl is known to have moved away from the original site for at least 10 months).
- 4 = Recovery of the carcass of the owl or other confirmation of death.
- 5 = Failure to verify the presence of the marked owl for a period of 2 or more years using the standards for status surveys (three or more visits). Note: The site does **not** need to be vacant (see note (B), below).

6 = This number is used for the first year when a bird cannot be positively identified. If the bird is not identified in a subsequent year, then this code is changed to code 5. In cases where this code is followed by codes 2, 3, 4, or one or more 7's, then the code should be an x. By using this code we can (1) better document the year in which events actually occur, and (2) reserve the option to calculate annual turnover rates for study areas (if we ever wish to do so in the future) because we can later decide which year-interval to assign these turnover events to.

7 = Any cases where a determination of the events occurring between the two years could not be made are classified as undetermined (that is, use this code for all cases not meeting any of the other codes).

9 = Nines will be entered in year fields before the initial ringing or initial identification of a ringed bird of that sex at that site.

The following guidance should be used in assigning the codes listed above.

A. Anytime a bird is relocated after a period (of any length) of years when its presence at the site could not be verified, then the bird will be assumed to have been present in all interim years; code 1 will be filled in retrospectively for those years. This may underestimate instances where birds move from the site for one or more years and then return.

B. For birds "missing" for two sequential years record the turnover (code 5) for the first year the bird was "missing."

"Missing" means that the site was surveyed (three-visit minimum) and either (1) no bird of that sex was detected, or (2) a bird of that sex was detected but not identified.

Occasions will arise when we search a site for a particular bird for two years and detect a bird of that sex at the site in one or both years but fail to identify it. In cases where the detected bird really is the same bird as previously marked, this methodology will cause us to incorrectly classify it as a code 5 turnover. This problem is rare in occurrence and will be partially corrected for by note (A), above. This makes tabulation of turnover much easier and more straightforward (for example, any time a site is surveyed for two subsequent years after initially identifying a marked owl and no owl can be positively identified for both years, the site gets a code 5).

C. For occasions when a bird is found dead and is replaced by another bird in the same year, record the event as a mortality and not a replacement (that is, code 4 supersedes code 2).

D. For occasions when a bird is known to have moved and is replaced by another bird in the same year, record the event as a movement and not a replacement (that is, code 3 supersedes code 2). Also see (L), below, for additional information.

E. A two (2) should only be used when a replacement event is used to document the turnover of the previous bird. Do not use code 2 when a new bird occupies a site known to have been vacated by the previous bird (that is, the previous bird moved, died or disappeared, (3, 4, or 5, respectively)).

F. For instances when a bird is identified in a given year and is then known to have been replaced (2), moved (3), or died (4) within the same year, treat the event as though it happened at the end of that season; for example, a male is ringed in 2002 and then found dead on a subsequent visit during the 2002 season. Record the mortality in the record.

G. When a bird moves and then returns (with no replacement in the interim), the first year it returns should be coded with a seven (7) and not a one (1).

H. For analysis, fields with codes = 1, 2, 3, 4, 5 will be tallied as "owl-years" (codes 7 and 9 are nondata codes).

I. For analysis, fields with codes = 2, 3, 4, 5 will be considered "turnovers."

J. For birds wearing a backpack-style transmitter, add a value of ten (10) to the code.

K. For birds wearing a tail-mount transmitter, add a value of twenty (20) to the code.

L. In cases where a ringed owl is missing (not confirmed) for two or more years and then is reobserved at a new site, the following rules apply:

(i) If there has been no replacement and a turnover has already been coded with a five (5) in the first year that the owl was not confirmed, then change the five (5) back to a six (6) and code the

turnover as a movement by placing a three (3) in the column for the year that the owl was reobserved.

(ii) If there was a replacement before the original owl was relocated at the new site, code the turnover as a movement by placing a three (3) in the column for the year that the replacement owl was first observed.

These rules are in keeping with (D), above (code 3 supersedes code 2) and also help to code the movement or turnover as accurately as possible with respect to the year when it occurred.

VIII. References

- Centili, D. 2001. Broadcast and Little Owls *Athene noctua*: preliminary results and considerations. *Oriolus*, 67 (2-3): 84-88.
- Conway, C.J., and J.C. Simon. 2003. Comparison of detection probability associated with Burrowing Owl survey methods. *Journal of Wildlife Management* 67(3):501-511.
- Duxbury, J. & G.L. Holroyd. 1998. Testing a possible standardized, road-side survey technique for Burrowing Owls. Abstract and notes. Second International Burrowing Owl Symposium, Ogden, Utah.
- Exo, K.M. 1992. Population ecology of Little Owls *Athene noctua* in Central Europe: A review. In, C.A. Galbraith, I.R. Taylor, and S. Percival (eds.): *The ecology and conservation of European owls*. Pp 64-75. Peterborough, Joint Nature Conservation Committee. (UK Nature Conservation, N° 5).
- Exo, K.M. & R. Hennes. 1978. Empfehlungen zur Methodik von Siedlungsdichte-Untersuchungen am Steinkauz (*Athene noctua*). *Die Vogelwelt* 99:137-141.
- Fuller, M.R. and J.A. Mosher. 1987. Raptor survey techniques. Pages 37-65 in B.A. Giron Pendleton, Millsap, B.A., Cline, K.W. and Bird, D.M. (eds). *Raptor management techniques manual*. National Wildlife Federation, Washington, D.C.
- Finck, P. 1990. Seasonal variation of territory size with the Little Owl (*Athene noctua*). *Oecologia*, 83:68-75.
- Galeotti, P. 1989. Tavola rotunda: metodi di censimento per gli strigiformi. Pp. 437-445 In M. Fasola (ed), *Atti II Seminario Italiano Censimenti Faunistici dei Vertebrati*. Suppl. Ric. Biol. Selvaggina, XVI.
- Gorman, L.R., D.K. Rosenberg, N.A. Ronan, K.L. Haley, J.A. Gervais, & V. Franke. 2003. Estimation of reproductive rates of Burrowing Owls. *Journal of Wildlife Management* 67(3):493-500.
- Haug, E.A. & A.B. Didiuk. 1993. Use of recorded calls to detect Burrowing Owls. *Journal of Field Ornithology* 64:188-194.
- Ishtiaq, F. & A.R. Rahmani. 2004. The Forest Owlet *Heteroglaux blewitti*: vocalization, breeding biology and conservation. *Ibis* 147(1):197-205.
- Ishtiaq, F., P.C. Rasmussen & A. R. Rahmani (2002). Ecology and behaviour of the Forest Owlet. Pp. 80-88 In I. Newton, R. Kavanagh, J. Olsen, and I. Taylor (eds). *Ecology and Conservation of Owls*. CSIRO Publishing, Australia.
- Kumar, T.S. 1985. The life history of the Spotted Owlet (*Athene brama brama*, Temminck) in Andhra Pradesh. Monograph No. 4. Raptor Research Centre, Hyderabad, India. 241 p.
- Lincer, J.L. & K. Steenhof. 1997. The Burrowing Owl, its biology and management including the proceedings of the first international Burrowing Owl symposium. *Journal of Raptor Research Report* 9. 170 p.
- Lint, J., B. Noon, R. Anthony, E. Forsman, M. Raphael, M. Collopy, E. Starkey. 1999. Northern Little Owl effectiveness monitoring plan for the Northwest Forest Plan. General Technical Report PNW-GTR-440. Portland, Oregon. U.S. Department of Agriculture, Forest Service. 43 p.
- Oakley, K.L., L.P. Thomas, & S.G. Fancy. 2003. Guidelines for long-term monitoring protocols. *Wildlife Society Bulletin* 31:1000-1003
- Sará, M. & L. Zanca. 1989. Considerazioni sul censimento degli strigiformi. *Rivista Italiana di Ornitologia* 59(1-2):3-16.
- Wellicome, T.I. & G.L. Holroyd. 2001. The second international Burrowing Owl symposium: background and context. *Journal of Raptor Research* 35(4):269-273.
- Zuberogitia, I. and L.F. Campos. 1998. Censusing Owls in large areas: a comparison between methods. *Ardeola* 45(1):47-53.