Ecology and Conservation of European Forest-Dwelling Raptors

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Effective field methods for surveying breeding goshawks

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Introduction

A crucial factor in population studies is the collection of rapid, inexpensive, and unbiased population estimates. Accounting for individuals that are present but not detected is a particularly challenging issue (Thompson, 2002). When surveying birds it is important to use methods that are adjusted to the life-history traits of the species of interest; moreover, biases associated with unadjusted methodologies are exacerbated if inappropriate survey locations or sampling units are chosen. The ability to produce reliable population estimates is dependent on maximization of the probability of detecting all individuals.

The goshawk *Accipiter gentilis* is a good example of a species that has the potential to be rather difficult to detect because of forest-dwelling characteristics and associated low visibility. However, the bird can be relatively easy found if survey methods appropriate to particular aspects of the goshawk's breeding cycle and behaviour are used. Here, I describe a general framework for conducting surveys of goshawk breeding populations. The two major aims are: (1) to provide essential and practical information of use in future goshawk (and, more generally, forest bird of prey) surveys; and, (2) to demonstrate a fast and efficient survey technique developed through a sound knowledge of the main behavioural traits of the species. In all such undertakings it is important to be aware that local factors affect the probability of detecting individuals, as emphasized by Thompson (2002), and that many of these factors are not constant within a species or habitat, and may indeed vary over time.

A brief overview of goshawk monitoring techniques

From an anthropocentric perspective the goshawk is commonly considered to be a *secretive* species. The fascination with this 'ghost' of the forest, and the management and conservation implications for forestry (*e.g.,* Penteriani & Faivre, 2001; Beier *et al.*, 2008; see also Hargis & Woodbridge, 2006) have resulted in extensive (but perhaps unjustified) research devoted to development of rapid and effective methods for detecting goshawk nest sites. The most common survey techniques include: (1) broadcasting of recorded goshawk calls (*e.g.,* Kimmel & Yahner, 1990; Cerasoli & Penteriani, 1992; Kennedy & Stahlecker, 1993; Joy *et al.*, 1994; Watson *et al.*, 1999; Roberson *et al.*, 2005); (2) listening for dawn goshawk vocalizations during the courtship period (Penteriani, 1999; Dewey *et al.*, 2003); and, (3) searching for nests on foot. Other methods used more sporadically have included: (4) aerial surveys from helicopters or aircraft (*e.g.,* Doyle & Smith, 1994; Younk & Bechard, 1994); (5) observations of goshawk behavioural events including aerial displays and food calls of young (*e.g.,* Anonymous, 1989; Petty, 1989; Kostrzewa & Kostrzewa, 1990); and, (6) visual searching for signs of goshawk presence (*e.g.,* whitewash, moult feathers, prey remains, or pellets; Petty, 1989; Penteriani, 1997). An optimal goshawk monitoring technique would have an efficacy of nearly 100% (*i.e.,* allowing detection of all goshawk breeding sites in any given area), with consideration of the speed of nest detection, temporal (daily and annual) applicability, and cost. I argue that the combined application of some of the methods

Juvenile female goshawk eating on a recently hunted rabbit. Vincenzo Penteriani.

noted above in a temporal sequence determined by the breeding cycle of goshawks and their life history can approach the threshold of 100% efficacy. Dewey *et al*. (2003) reported that a combination of dawn surveys, direct nest site searches, and broadcast surveys, can be effective. It is important to stress that when using acoustic survey methods (which are the most common), the period of the longest and most numerous vocalizations is the courtship stage; the greatest number of daily vocalizations, the longest series of calls, and the most complex calls within each sequence, all occur during this period (Penteriani, 2001). In addition, the vocalizations of young birds in the nest increase until the 10th day after fledging. Vocalizations then diminish and cease about 40 days after the young have left the nest, or approximately 80 days after hatching, when dispersal from the nesting area typically occurs (Kenward *et al.*, 1993a). This decrease in vocalizations close to the nest after fledging may be because juveniles may fly as far as 1 km from the nest (Kenward *et al.*, 1993b) prior to dispersal. Additionally, if juveniles are heard when far from the nest, nest searching can be seriously biased.

The ideal sequence of search techniques is:

1. Listening for dawn and morning vocalizations during the 3 months prior to egg laying;
2. Broadcast surveys using the adult chattering call (Penteriani, 2001) during the month prior to egg laying;
3. Broadcast surveys using the adult chattering call during the beginning of the nestling period;
4. Broadcast surveys using the juvenile food/location calls (Schnell, 1958; Penteriani, 2001) from the end of the nestling period to the end of the first month after fledging.

Several other techniques can be used alone, or in combination with other methods (*e.g.,* noting of aerial displays during the courtship period or at the beginning of autumn; visual searching for signs of presence), depending on specific needs (*e.g.,* random nest location, rapid surveys, or true censuses) and local conditions (*e.g.,* large woodlands *vs.* small patches of trees; coniferous *vs.* deciduous forests), but the applications and effica-

Vincenzo Penteriani surveying goshawks.

Adult male goshawk controlling his hunting area from a perch. Julen Zuberogoitia.

cies are often rather limited and these approaches will not be discussed further here.

However, the importance of foot searches for breeding sites during both the nestling period and in winter needs to be emphasized. Foot searches are indispensable for finding active nests following detection of goshawks in a stand of trees using indirect methods, such as call displays. As a method for locating new goshawk breeding sites in areas never before prospected, foot searching is very time-consuming, but has the potential to be quite effective in several specific scenarios.

First, at a point midway through the nestling period, a goshawk breeding pair has already spent several weeks in the breeding stand in close proximity to the nest. As a consequence of their daily activity, and that of the young birds, numerous signs of their presence (e.g. white faeces, plucking sites on higher spots like stones or stumps) are detectable and can help identify occupied nests in areas that have not been previously prospected. Some birds are relatively aggressive, and the presence of a breeding pair can be revealed by alarm calls as searchers approach an occupied nest. *Second*, the appearance of deciduous forests changes markedly in winter, and nests become very visible. Although some areas may be under snow, foot searches have the advantage of enabling detection of goshawks several months earlier than other methods. However, the owners of nests found under such conditions may be in doubt, although, amongst forest-dwelling species, goshawks generally build one of the largest nests, but other species including buzzards and booted eagles can frequent similar (*i.e.,* old- growth) stands and also construct large nests, especially those which are used over a number of years. In such instances a rapid survey during the breeding period will allow the presence of goshawks to be confirmed. In practice, this means that there is an interval of approximately 5 months (from late November to early April) during which it is relatively easy to detect raptor nests in deciduous forests. During the remainder of the year, the presence of leaves makes detection more difficult. Depending on local conditions, the winter searching method can be very useful, especially if concentrated in the most mature portions of forested areas. As goshawks may breed in a very small patch of old trees within a relatively young forest stand (Penteriani & Faivre, 1997, 2001; Penteriani *et al.*, 2001, 2002a; Kenward, 2006), winter foot

searches should be concentrated on those stands that are likely to be selected by this species. Examination of aerial images is useful as this enables the most mature portions of forest to be readily identified, and, hence, many likely goshawk breeding stands can be detected before ground searches commence. However, if the aim of the survey is to study breeding habitat selection or the location of all goshawk breeding sites within a given area, foot searches beyond mature stands will be necessary during the breeding season. Failure to search forest areas apparently lacking the appropriate structure, age, and/or slope orientation can lead to incorrect conclusions on the relationships between habitat and bird populations. *Third*, foot searches are one of the fastest methods by which to prospect confined goshawk breeding areas, including urban gardens or small patches of trees isolated within open landscapes.

Moving to the field…

Listening for dawn and morning vocalizations during the 3 months prior to egg-laying

WHEN. The duration of goshawk breeding vocalization events peaks from late winter (approximately 3 months before egg-laying) and early spring (the beginning of courtship, when call duration is longest) to the beginning of egg incubation, at which time the duration of calls decreases (Penteriani, 1999, 2001). Therefore, listening sessions should commence at the beginning of the third month before egg-laying and should increase in frequency 1.5 months before the start of incubation.

The first call in the courtship period can occur up to 45 min before sunrise, and vocal event duration peaks from 1–3 h after sunrise (Penteriani, 1999, 2001). Also, additional listening sessions should start at least 15 min before sunset and continue for 3 h after sunset. At this time of the day goshawks always vocalize in the immediate vicinity of the nest that will be used during spring, and it is thus very important to establish the direction and distance of the calls if the active nest site is to be quickly found. However, because this time bracket has been only tested in central and southern Europe, no information is available on how the goshawk vocal activity may be affected by the peculiar light conditions of the northernmost countries, where dawning takes more time (i.e. the sky is lighter earlier before dawn than in southern latitudes).

WHERE. As the species has a generalized preference for nests on slopes with a northerly orientation (Penteriani, 2002), stands on such slopes in uneven study areas should be surveyed first. Although altitudinal ranges are related to local factors, it is usually preferable to conduct initial searches on low- and mid-altitude slopes; this is a recommendation that holds true for all methods (see also Fig. 31).

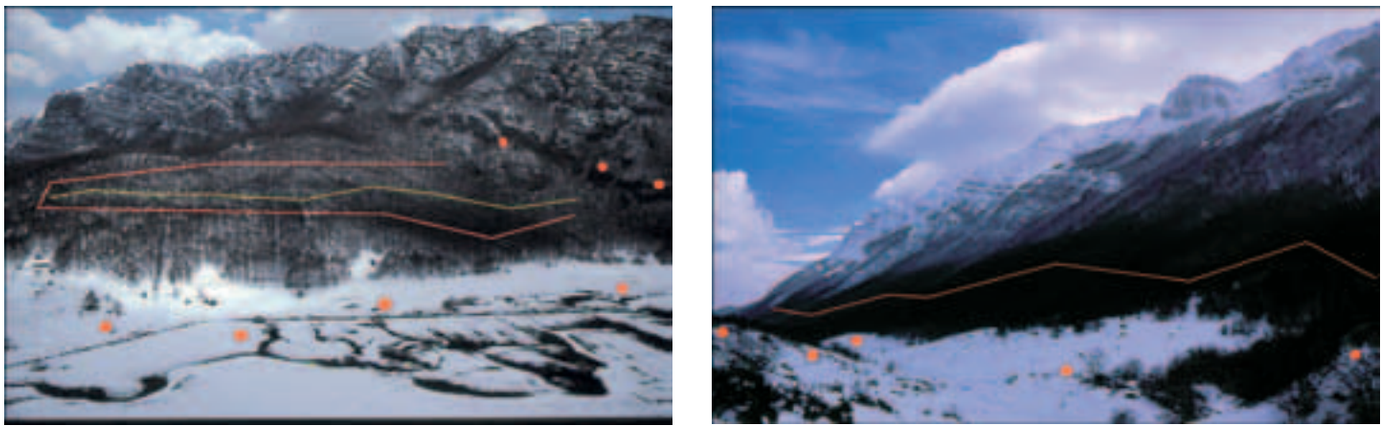

Figure 31. *Examples of appropriate locations and transects for listening and broadcast surveys for both adult and juvenile calls in a remote mountain area of central Italy (Penteriani, 1997). For large expanses of forested area (A), survey transects such as that shown in red are recommended as they increase the possibility of encountering an active nest, and consequently eliciting a response (see the text for more details). If complete surveys are not required, or if there are time restrictions in locating breeding pairs of goshawks, a good option is that represented by the yellow transect in (A) and the red transect in (B). These cross the intermediate layer of the forested area, where most of the goshawk nests are likely to be located. In both figures the red spots represent the best listening stations for detecting dawn and morning vocalizations. Their location, predominantly away from the tree cover or in substantial open, dominant sites within the forest, facilitate effective call listening (also when from far) and visual location of the source of vocalizations, as well as increasing the possibility of sighting display flights during calling.*

Adult male goshawk in a perch. Vincenzo Penteriani.

HOW. Although in this period it is possible to hear the entire vocal repertoire of goshawks, the two main goshawk call types are (1) a guttural, chattering *"kek-kek-kek…";* and, (2) a plaintive, wailing *"whee-oo…whee-oo… whee-oo…"* (food-begging call; Schnell, 1958; Penteriani, 2001).

Sites can be considered unoccupied by nesting goshawks if no vocalizations are heard in the interval from approximately 30 min before sunrise to 5 min after sunrise, during two listening sessions in the month most remote from egg-laying, or after a single session in the 2 months closest to egg-laying. During the 200 min fol-

lowing sunrise, no listening session at any site should exceed 90 min. Sites where no vocalizations are heard in two consecutive sessions (possibly separated by a 1-month interval) can be considered to be unoccupied by a breeding pair (see also the minor local modifications of the original method in Dewey *et al.*, 2003).

Depending on the monitoring site, as a general rule each listening station can be considered to cover a minimum radius of 500 m if the listening position is outside the forest (better if possible), and 250 m if the listening position is inside the stand. These values represent the minimum distances for detecting vocalizing goshawks; with particularly favourable listening positions, and sound and weather conditions, a calling goshawk can easily be heard at a distance of more than 1 km by an experienced observer. Listening stations can be distributed along transects and should be separated by about 300 m if inside the forest, or about 500 m if outside. Transects are also useful for checking nest site fidelity between years. As breeding sites may include more than one nest, some of which may be separated by tens of meters to > 1 km (see also Dewey *et al.*, 2003), multiple listening points within the same breeding site allow assessment of the largest (and the most difficult to detect) displacement of a breeding pair. Days with strong wind and intense precipitation are usually not suitable for use of survey methods based on spontaneous or elicited (*i.e.,* broadcast survey) vocalizations.

It is advisable to arrive at listening stations well before dawn, as sunrise is one of the best times to listen for goshawks.

MAIN STRENGTHS. As dawn and morning calls are a natural, specific, and regular feature of goshawk behaviour, listening sessions at these times offer a high chance of detection success. In fact, goshawk vocalizations are regarded as a strategy complementary to mate-guarding (Møller, 1987; Penteriani *et al.*, 2002b), and are particularly frequent in the morning, when most copulation occur (Møller, 1987; Squires & Reynolds, 1997). Dewey *et al.* (2003) also reported that intense chattering bouts by both adults heard during listening sessions are usually accompanied by frequent acts of copulation.

This method contrasts with the broadcast survey technique, which depends on a response to an external stimulus (*i.e.,* a broadcast call), and the distance of the broadcast source from the responding individual. Responses are highly dependent on individual variability and gender, as well as the presence of at least one breeder in the nest vicinity (see also Roberson *et al.*, 2005). During the courtship period (but also well before, in the case of nonmigrant populations; Penteriani, 2001) goshawks have most of their nocturnal roosts in the proximity of or within their nesting core area or nest, and will naturally vocalize early in the morning.

Understanding this behaviour provides a very effective tool for locating breeders well before they start incubation. This information can also be extremely valuable in the case of goshawk pairs that fail to reproduce during the incubation or early nesting period, when in general (a) both males and females remain quite silent (also if stimulated), and, (b) nest sites are less frequently checked by researchers. In practice this means that nesting sites that are extremely difficult to find later in the breeding cycle can be located. Moreover, the relatively short time needed at a listening point means that an observer can move to other listening locations during the same morning, and consequently survey relatively large areas each day. In addition, this method becomes useful when broadcast techniques are less so (Kennedy & Stahlecker, 1993; Roberson *et al.*, 2005), and has the advantage of being non-invasive as it does not interfere with the regular activities of breeders. Finally, early morning vocalizations are generally made close to the nest and thus indicate nest location, whereas broadcast techniques can elicit responses from individuals well away from their nests, or influence movement of breeders towards the broadcast source. Although the response of goshawks commonly indicates the presence of a breeding site near the calling post, the birds can approach for several hundreds of meters toward the broadcast source, which can increase the time needed for and the difficulty in locating the nest tree.

MOST IMPORTANT LIMITATIONS. The major constraint of this method is the time at which it is effective, which is confined to dawn during winter and early spring. In many goshawk areas this period coincides with the heaviest snowfall and lowest temperatures, and extreme weather can make it difficult to reach listening stations in the dark. In addition, following the publication of this method (Penteriani, 1999) a North American researcher called attention to the fact that, in the USA, the dawn listening period can be very dangerous because this corresponds to the time of grizzly bear *(Ursus arctos)* activity. Combined with darkness, this method may thus involve serious risks of close encounters with bears by those searching for goshawks.

As noted by Dewey *et al.* (2003), dawn and morning vocalization surveys can miss lone breeders if call rates are influenced by the presence of a mate. However, single goshawks in a breeding area are difficult to detect with any other survey technique.

Although listening for dawn and morning vocalization was successfully tested by Dewey *et al.* (2003), the cited authors found that a small percentage of sampled nesting areas were incorrectly identified as unoccupied. This happened because "The differences in accuracy rates may be a reflection of differences in migratory status, … some birds possibly had not yet returned to their nest areas from their wintering areas, … most goshawks in our study area probably are partial migrants", and "goshawks used alternate nests widely separated from the surveyed site". Clearly birds not yet present cannot be detected, but the observations cited above emphasize the importance of a sound knowledge of goshawk winter behaviour, and life cycle timing.

Broadcast surveys using the adult chattering call during the month prior to egg laying

WHEN. "Goshawks are active throughout the day so the time of day in which surveys are conducted is not an issue, …" (Wyoming High Plain District, 2009). This statement is not necessarily the best basis on which to plan an effective survey. Daily activity patterns do not reflect spatial patterns of individuals. In other words, goshawks do not spend the entire day in the proximity of their nest. Again, information on the behavioural features of any species can contribute to work on survey techniques for other species. Although there is a lack of detailed information on the daily occurrence of goshawks in core breeding areas, records of call behaviour at nest sites show that goshawks frequent the nest area in the early morning and around sunset (Penteriani, 2001). During incubation, nestling, and fledgling periods, the daily distribution of vocalizations is more irregular. This suggests that broadcast surveys have the potential to be more effective if performed close to sunset and sunrise and, consequently, at least one survey should be performed at these times, even though the method is successful during the entire day (Kennedy & Stahlecker, 1993). Because goshawks increasingly frequent the area of the nest in the few weeks before egg-laying, broadcast surveys should be concentrated in the month before the start of incubation. This is the optimum time for use of this technique; in earlier months, listening for spontaneous dawn and morning calls is preferred. When quantifying the relationship between distance and probability of detection, and thus the effective area surveyed per broadcast station, Roberson *et al.* (2005) showed that the detection rates for breeding goshawks over all distances were highest during courtship. The cited authors also reported that the use of broadcast surveys during the courtship stage

Goshawk nest with green branches before laying. Iñigo Zuberogoitia.

results in greater accuracy in assessment of population densities and habitat preferences than did surveys conducted later in the breeding season. One of the most important results from the very detailed cited study on rates of goshawk detection was that higher rates were observed during courtship, which contrasts with the earlier data of Kennedy & Stahlecker (1993) for the courtship period. The former study used calls broadcast in the morning, when goshawks are more frequently close to their nest; this emphasizes that the effectiveness of survey techniques is fundamentally affected by knowledge of species behaviour and local breeding phenology.

HOW. The process described here is derived from integration of the early recommendations of Kennedy & Stahlecker (1993) with the recent experience of Roberson *et al.* (2005) and personal field experience (Penteriani, 1997; Penteriani *et al.*, 2001). (a) Use the main adult call (*kek-kek-kek*), recordings of which are commercially available from many sources. It is important to note that recorded calls simulate an intrusion into a breeding territory. As call features send a message to conspecifics on the characteristics of the 'intruding' individual (Penteriani *et al.*, 2002b), the efficacy of recorded calls in eliciting a response from known breeding pairs should be tested. A poorly explored relationship seems to exist between the characteristics of broadcast calls on the one hand, and the elicited response, and decisions by territory owners to attack, on the other (Penteriani & Delgado, unpublished data). Thus, it is possible that projecting the call of an individual with a dominant phenotype might decrease the probability of a response from breeders. (b) Playback stations should be established 300 m apart. (c) In large forested areas where more than one transect is necessary, parallel transects at least 300 m apart should be established over the survey area (but see also Roberson *et al.*, 2005). (d) A minimum of three visits to a survey area, one of which should be at sunset/sunrise, is necessary to confidently assess the presence/absence of goshawks (Boyce *et al.*, 2005). At least 7–10 days should elapse between surveys at a given site.

Adult male goshawk in the study area. Iñigo Zuberogoitia.

Although in many reports this method has been unnecessarily complicated by factors including very intricate broadcast procedures, considerations of wind speed, precise distances between playback stations, and angles of loudspeaker rotation during broadcast, the simplest and most commonsense procedure will produce the best results. Moreover, although it has been frequently reported that the gender of calling individuals can be determined by vocalizations (*i.e.,* that females have lower and more powerful calls), such discrimination is very difficult in the field and is rarely useful during surveys.

It is preferable to stop for approximately 5 min at each calling station, alternating about 30 sec of broadcast and 1 min of listening for responses. Moreover, after the last broadcast, the observer should look and listen in all directions for about 5 min before moving to the next station. Hand-held megaphones and a portable minidisc recorder are very useful for projecting calls in multiple directions from each call station. For example, information on MONACOR equipment is available at http://www.monacor.de/typo3/index.php?id=70&typ=full&nutzerkennung=&spr=EN&L=1&versuche=10&suche=Megaphone; see in particular the TM-27), and the Sony MD Walkman (http://www.sony.co.uk/product/paw-minidisc---net-md-walkman) can also be used. Although several suggestions on broadcast levels have been made, common sense suggests that the volume should be adjusted to account for prevailing noise levels, topographical condition and so on.

Broadcasting during incubation is not really useful because goshawks are less likely to respond during this period (Speiser & Bosakowski, 1991; Roberson *et al.*, 2005) and breeders are generally quieter at this time than during other phases of the breeding cycle (Penteriani, 1999, 2001).

Last but not least, time can be lost completing field records of questionable importance including other wildlife present, habitat types, previous vegetation thinning, concentrations of coarse woody debris, household weather reports (partly cloudy, sunny day), wind speeds calculated on the basis of worthless tables (simply remain at home on windy days and when raining…), and the presence of water. It will be a pity that you lose a silent goshawk approaching you while writing that you are broadcasting inside a pine forest under a clear sky!

MAIN STRENGTHS. This method allows large areas to be surveyed because the time spent at each broadcast station is relatively brief.

MOST IMPORTANT LIMITATIONS. Because this technique is most effective early in the morning, broadcast transects that have not detected goshawks during other periods of the day need to be revisited close to sunrise.

It is also important to be aware that the Eurasian jay *(Garrulus glandarius)* in Europe, and Steller's jay *(Cyanocitta stelleri)* and gray jays *(Perisoreus canadens)* in the USA (*e.g.,* Kennedy & Stahlecker, 1993; Watson *et al.*, 1999) can mimic the goshawk quite well, representing a source of bias if observers are not familiar with the goshawk vocal repertoire. The main call of the green woodpecker *(Picus viridis)* calling at a distance may also pose a similar problem for inexperienced observers.

Broadcast surveys are strictly dependent on individual variability, season, topography, broadcast equipment, characteristics of calls, and on distance between the breeder and the broadcast location. Moreover, some individuals can atypically respond when far from their nest (*e.g.,* when in their hunting area; P. Kennedy, personal communication), resulting in searches for a nest that does not exist.

Finally, it has also been argued that dense vegetation and topography can increase attenuation of broadcast calls and reduce their detection by goshawks (Watson *et al.*, 1999).

Broadcast surveys at the beginning of the nestling period using the adult chattering call

WHEN. It is useful to recommence broadcasting several days after egg hatching, and to use the chattering call only during the first 3 weeks of the nestling period. When the nestlings are quite large (*e.g.,* 1 week before fledging), broadcast surveys using the juvenile food/location calls are most effective.

HOW. As suggested by Kennedy & Stahlecker (1993) and Bosakowski & Vaughn (1996), the chattering call should be broadcast during the nestling period. The protocol is the same as described in the previous chapter.

MAIN STRENGTHS. This broadcast technique can be useful when other survey methods fail or are ineffective. Most of the signs of a breeding pair and their young, which are helpful in detection of active nests by foot searches, increase during the nestling period. In other words, little faeces and few plucked prey remains are evident just after hatching. In addition, the calls of young nestlings responding to broadcasts are generally audible when the observer is very close to the nest.

MOST IMPORTANT LIMITATIONS. In addition to the limitations associated with broadcasting adult calls, described above, it is also important to appreciate that territory owners who have failed to reproduce do not respond to broadcasts.

Broadcast surveys using the food/location calls of juveniles from the end of the nestling period to the first month after fledging

WHEN. It is preferable to use this method when nestlings approach fledging, and during the first month of the post-fledgling dependence period, when young goshawks begin to venture 300 m from the nest (Kenward *et al.*, 1993a; Kennedy & Ward, 2003). Because juvenile goshawks tend to vocalize throughout much of the day at the end of the nestling phase and during the post-fledgling dependence stage (Penteriani, 2001), and as the birds are always in the vicinity of the nest and vocalize differently from their parents, broadcast surveys using the juvenile call can be performed at any time of the day in these periods.

HOW. As suggested by Kennedy & Stahlecker (1993) and Bosakowski & Vaughn (1996), the juvenile food-begging call *(whee-oo…whee-oo… whee-oo)* should be broadcast following the same protocol as that for broadcast surveys using the adult chattering call during the month prior to egg-laying.

As juveniles remain in the vicinity of the nest (except in the last days before dispersal) this technique is applicable throughout the day. This is a crucial period when prospecting for successful breeding pairs, because it is possible to cover very large areas from sunrise to sunset, and the absence of snow or mud at this time usually allows easy access to the most remote areas. Roberson *et al.* (2005) suggested that broadcasts should cease 2 h prior to sunset, to minimize the possibility of attracting nocturnal predators to fledglings, and this recommendation is strongly supported.

MAIN STRENGTHS. Nestlings and fledglings respond more readily and frequently than do their parents, and, consequently, the potential of locating these birds is

greater than for adults. Moreover, because juveniles respond from the vicinity of the nest, their vocalizations act as a direct guide to the nest location.

MOST IMPORTANT LIMITATIONS. Breeding failures.

To conclude…

As stated at the outset it is very difficult to establish a common survey procedure for the entire range of situations, and generalizing is even less appropriate if the species has a Holarctic distribution but can breed anywhere from isolated patches of trees in an urban setting to remote and pristine areas. I have thus sought to synthesize my personal experiences and the many research reports on this topic, focusing on those techniques that are most generally applicable, simple, useful and effective. Many studies have recommended complicated protocols that are quite impossible to reproduce in the field. In 30 years of surveying goshawks across many European countries, the most important lesson I have learned in the field is that the harder a species is to locate, the more important it is to develop simple ways to locate it. Searching for goshawks is amongst the most exciting and fascinating field experiences in raptor research, particularly when many days of searching are rewarded with the sight of one of these 'ghosts' hidden in a beautiful portion of the forest. Even after having located more than 100 breeding goshawk pairs and several hundred nests, each time I have the opportunity to go to the field to survey goshawks I experience the same excitement and pleasure as on my very first survey, because of the possibility of discovering a new 'treasure' hidden deep in the forest.

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Female goshawk looking after her offspring. Carlos González.