



Goshawk

Accipiter gentilis

1. INTRODUCTION

The Goshawk (northern goshawk) stopped breeding regularly in Britain and Ireland in the 1880s. Breeding became regular again from the mid 1900s, as a result of deliberate (unauthorised) and accidental releases of falconers' birds (Holloway, 1996; Petty, 2002). Numbers increased slowly at first, but populations in some areas increased rapidly from the late 1980s (Petty, 2002), and since then there have been over 200 pairs breeding in Britain (Gibbons *et al.*, 1993; Ogilvie & RBBP, 2004; Holling & RBBP, 2008). Goshawks have been breeding in Northern Ireland since the early 1990s and a few pairs have been recorded in the Republic of Ireland in recent years (www.goldeneagle.ie). The success of these populations is variable and, in some, growth is thought to be limited by persecution (Marquiss *et al.*, 2003). Adult goshawks are sedentary in Britain and Ireland (Petty, 2002). Juveniles disperse from their natal areas in late summer. Populations breeding in northern Europe are partially migratory, and some individuals may reach Britain from Scandinavia (Petty, 2002). Care must be taken in separating goshawks from sparrowhawks. In particular, female sparrowhawks often look much larger when they are flying with a slow wing flap, and may be confused with goshawk. The larger female goshawks can be separated from males in the field. Immature birds are distinguishable from adults by their browner plumage and heavily streaked breasts. Goshawks can breed at one year old.

Kenward (2006) provides a comprehensive reference, covering goshawks globally, but with a focus on Europe. Bosakowski (1999) and Kennedy (2003) also provide useful reviews, especially for North American populations.

Annual cycle

Breeding Activity	Peak Period	Range	Duration (days)
Occupation of home range		All year	
Territorial display		March to April	
Nest building		September to late April	
Egg laying	Early April	Mid-March to early May	3 to 12
Incubation	Early April to mid-May	Mid-March to early June	35 to 39
Hatching	Mid-May	Mid-April to mid-June	
Young in nest	Mid-May to early July	Mid-April to late July	38 to 46
Fledging		Late May to late July	
Juvenile dispersal		June to early August	20–40 days after fledging

2. HABITAT, HOME RANGE, NESTS AND BREEDING

2.1 Habitat

Goshawks are tree nesting raptors, which normally breed in large mature forests but can be found in smaller woods (20–50 ha) and even in wooded parks in some central European cities (Petty, 1996). They hunt over both open areas and within woodland.

2.2 Home range

Goshawks defend only the nesting territory and hunt within large overlapping home ranges. They may breed in the same locality for a number of years; for example, goshawks (although not necessarily the same individuals) have been recorded using similar nesting areas in commercial forestry for at least 10 years (Petty, 1989). Home range sizes and nest densities vary with the availability of suitable prey and woodland (Kenward, 1982, 2006); in suitable habitats, nest sites are regularly spaced (Petty, 1989). In lowland Britain, the distance between adjacent nests in woodland blocks varied from 1–3.7 km (Anon., 1989). More recently, nests have been found 750 m apart where there is no line of sight; the closest nests, where there is line of sight, have been 1,200 m apart. In contrast, in one area in Sweden, nests were 6 km apart (Widén, 1985). In southeast Alaska, home ranges of females and males during the breeding season averaged 4,153 and 4,785 ha, respectively (Hanley *et al.*, 2005).

Nesting ranges, which are generally less than 5 ha in extent (Petty, 1996), are normally found in large blocks of mature forest. They can occur in woods smaller than 3 ha (Marquiss & Newton, 1982) but usually only where there is a lack of more extensive woodland. In one area of lowland Britain, woodland (of all types including restock) was found to comprise an average of 68% of the habitat within 750 m of 40 nest sites, ranging from 89% to as little as 17% (with the remainder of habitat predominantly farmland). Less wooded sites were used after core forest sites were filled.

2.3 Nest sites

Nest sites are usually placed in areas with a high density of mature trees and well developed canopy cover (Bosakowski, 1999), surrounded by relatively open woodland (Petty, 1996). In two goshawk breeding areas in Britain, nests were found in stands of trees between 2.4–3.8 m apart in an area of coniferous trees, and 2.5–8.0 m apart in an area with coniferous and broad-leaved trees (Newton, 1986). Trees as low as 12 m have been used (Marquiss & Newton, 1982) but the average height is often above 20 m (Anon., 1989). Trees used for nesting tend to be larger than the surrounding trees (they need to support the goshawk's substantial nest) and conifers are used in preference to broadleaved trees in Britain (Anon., 1989). Larch is frequently used, as its branches provide both good support for nests and excellent nest building material. Marquiss & Newton (1982) suggest that the characteristics of the site are in fact more important than the tree species. Good flight access is required because courtship, feeding and roosting activities take place below the tree canopy, and fledglings need an open nursery area in which to practice their aerial skills (Petty, 1989). In closed canopy conifer plantations, nests are often found near openings, tracks, rides or areas of windblown timber (Petty, 1989), allowing access to the nest. In older, more open stands, where access is less restricted, nesting may occur anywhere. Old, very open stands with no secondary canopy development tend to be avoided for nesting unless there are no alternatives. The nests from different years are often clustered within a small area, and individual nests may be used many times. The birds may move up to 2.5 km to another nest site, for example, if the site is disturbed early in the season, with some pairs having up to four different nesting areas within their nesting range (Petty & Anderson, 1996).

2.4 Nests

Goshawks build large untidy nests from branches and twigs, lined with green fronds and sometimes bark and pine needles (Cramp & Simmons, 1980). New nests may seem surprisingly small (75–90 cm in diameter) compared with old goshawk nests that have been re-used, but they are always larger than sparrowhawk nests in the same tree species. In a lowland British population, most pairs had only a few extant nests and re-use was common; only a minority of birds built new nests if existing nests were still usable. In northern England, several instances have been recorded of goshawks building a new nest but not using it, and instead moving to refurbish an old nest within 70 m. Conversely, an old nest may be refurbished before a new one is built. Goshawk nests cannot be separated from buzzard nests as there are similarities in construction; goshawk nests are usually larger but buzzards may take over old goshawk nests. In conifers, goshawk nests tend to be built in the whorl of branches just below the base of the green crown at the top of the tree (Petty, 1989). In deciduous trees, nests are built in a stout fork usually about three-quarters of the way up (Anon., 1990). The height of the nest from the ground varies from 12–29 m, depending on tree age and height (Anon., 1989).

2.5 Clutch size and incubation

Breeding tends to be earlier in southern Britain than in northern Britain. Goshawks lay clutches of 2–5 eggs (Anon., 1990), with an average of 3.8–4 for different altitudinal ranges in Britain (Marquiss & Newton, 1982; Anon., 1990). Clutch size in one British population has declined from an average of four eggs, 1980–87 (Anon., 1990), to 3.5 eggs in recent years. Eggs are laid at 2–3 day intervals and incubation is carried out mainly by the female (Cramp & Simmons, 1980). Incubation was reported to start with the second egg, and the average incubation period measured as 37 (± 2) days from laying of the second egg to hatching of the first chick, in a study in lowland Britain (Anon., 1990). Replacement clutches may be laid 15–30 days after egg loss (Cramp & Simmons, 1980). Evidence for only one replacement clutch, laid in the same nest as a clutch that failed (after the disappearance of the male), was found for 57 breeding attempts where eggs were known to have been laid, 1980–87 (Anon., 1990). In northern England, a post-mortem of an adult female found dead with developing eggs inside her suggested she was attacked by another goshawk, possibly the immature female that replaced her and went on to lay a clutch of eggs.

2.6 Brood size and fledging

Goshawk eggs hatch over a 2–3 day period. The female generally broods the young for the first 8–10 days and remains close to the nest for at least 16 days, longer if the male brings sufficient food (Cramp & Simmons, 1980). The young typically move onto branches in the nest tree at 35–41 days from hatching (Petty, 1989; Anon., 1990); they make their first flights to adjacent trees at 38–46 days, with the smaller males fledging before the females. They remain within 300 m of the nest until 65 days old, when feather growth is complete, and typically disperse 65–90 days after hatching (Kenward *et al.*, 1993; Marquiss *et al.*, 2003). The average brood size at fledging has been recorded as 3.0 in Britain (Marquiss & Newton, 1982). In one British population, brood size at fledging has declined from an average of 2.8 between 1980–87 (Anon., 1990), to less than two in recent years. In Fennoscandia, the average brood size varied from 3.7 in years of favourable prey abundance to 1.9 in poor years (Sulkava *et al.*, 1994).

3. SURVEY TECHNIQUES

CAUTION *Care should be taken to avoid disturbing goshawks during nest building and early incubation, as some pairs are prone to desert. It is recommended that nests are viewed from*

distances of 300 – 500 m (Ruddock & Whitfield, 2007; Whitfield *et al.*, 2008b). Obviously when searching for nests in woodland it will be necessary to approach potential nest sites more closely, but care should be taken to minimise disturbance. Visits to check use of known nests should take no more than 5–10 minutes (Visit 2), and searches for new nests should be delayed until young are likely to have hatched (Visit 3). If nest inspection visits require tree climbing, then appropriate health and safety precautions should be taken (see Section 7.10 of Introduction). Nest visits should be avoided after chicks reach the age of 30 days as they may fledge prematurely.

3.1 Breeding season visit schedule

The species is listed on Schedule 1 in Great Britain, Northern Ireland and the Isle of Man (see Section 7.1.1 of Introduction). Boyce *et al.* (2005) reviewed methods used to detect occupancy of goshawks in North America and recommended three visits using foot searching or four visits for call broadcasting. Here, based on searching, four visits are recommended to confirm occupancy and breeding, even if no signs of occupancy are found during the earlier visits. Use of call playback for surveying is also described.

Visit 1	March to April	To check for occupancy and (until mid-March) the presence of new nests
Visit 2	Late April to May	To briefly view known nests for activity
Visit 3	June to early July	To check for young at known nests and search for additional active nests
Visit 4	Late July to early August	To check for fledged young

3.2 Signs of occupancy

3.2.1 Locating home ranges

Goshawk nesting ranges can be used over many years but alternative nesting ranges used by the same pair may be up to 2.5 km apart. Repeated surveys of known nesting ranges may suggest a population decline if search effort is not widened to allow for such large-scale movements. For this reason, regular searches of all woodland blocks within a study area are recommended. In northeast Scotland, fieldworkers surveying goshawks first check all known nesting ranges and then widen the search around those that are apparently unoccupied until an occupied nesting range is found or the nesting territories of adjacent goshawk pairs are reached. This requires that extensive areas are covered but ensures that population estimates are comparable between years.

Before surveying new areas, it is recommended that fieldworkers collect old breeding records from ornithological sources and local people (Bosakowski, 1999). Forestry workers and gamekeepers sometimes know areas where goshawks have bred in the past, or are frequently seen. Areas of mature trees that could support breeding goshawks can be identified using OS maps, or preferably forestry stock maps that give the year of planting and tree species by compartment. All suitable areas should be systematically searched for signs that birds are present. The most obvious may be the nest (Petty, 1989) but it is also important to check low feeding perches (e.g. roots and stems of fallen trees) and the ground for pluckings, feathers and white faeces. Plucking points with evidence of more than one prey item are usually found within 200 m of active nests; on sloping ground they are normally uphill of the nest, giving the adults a clear flight-line to the nest. Moulded flight feathers and down are also found in

occupied nesting ranges. In larch and broadleaf stands, searches should be made when nests and feeding perches are more obvious before leaves appear in the spring (Petty, 1989, 1996; Bosakowski, 1999).

Marquiss *et al.* (2003) describe the use of old nests to derive the history of newly discovered nesting territories by examining the layers of material. If nest lining and moulted feathers were present, it was assumed that eggs had been laid and incubation started. Nests were classed as successful if the top layer contained copious amounts of nestling down, faeces and the bones of prey, and unsuccessful if these signs were absent. Such signs were discernable up to three years after a breeding attempt.

Occupied nesting ranges can also be located by observing forests from vantage points that give a clear view over several square kilometres of forest. High-circling displays by single birds or pairs can be seen throughout the year but goshawks display more intensely over the canopy close to the nesting area in March and early April; these displays, performed by both males and females, are more frequent early in the morning in fine weather at the start of the breeding season. The full sky-dance involves: high-circling, flapping and soaring in tight spirals; undulating and slow flapping flight (gradually losing height); sometimes further circling to regain height; and plunging from a height of up to several hundred metres into the nesting wood with wings held towards sides (Cramp & Simmons, 1980). Wailing calls may be made just before, or during, the performance.

The presence of birds, especially single birds displaying, may not be linked to an occupied nest site, however. Marquiss & Newton (1982) recorded five areas where displaying birds were seen regularly but no evidence of breeding was obtained despite intensive searches.

Goshawks can also be more obvious during the two periods of the year when they call more frequently (Petty, 1989): during courtship in March and early April; and in July, after the young fledge, when they call incessantly when hungry. Prior to laying, the female is often found in the nesting area and she sometimes calls when observers approach. There is much vocalisation between the pair members at this time, particularly during bouts of nest building, copulation and prey delivery, and especially for 2–3 hours around dawn (Penteriani, 2001). Nesting areas can be located or occupation confirmed during courtship with low risk of disturbing birds by listening for these calls around dawn at the edge of suitable habitat.

The playback of calls has been used to locate goshawks (Kennedy & Stahlecker, 1993; Penteriani, 1997; Bosakowski, 1999). Response rates vary with the stage of breeding, with maximal responses reported during the prelaying and post-fledging periods. Surveys using broadcast calls during brood rearing only will however miss pairs that have failed earlier in the breeding cycle because the adults become less territorial post-failure. Appropriate separation distances between broadcasting stations and transects depend on the power of the speaker system, topography, tree density and the presence of running water (for example Kennedy & Stahlecker (1993) recommended broadcast stations 300 m apart on transects 260 m apart, whereas Bosakowski (1999) used a more powerful signal that could be heard 400 m away, allowing for greater distances between transects). Areas close to loud rushing streams or rivers can be omitted as goshawks tend to avoid these areas for breeding (Reynolds *et al.*, 1982; Spieser & Bosakowski, 1987). If the broadcast stations can be watched from about 20 m away, birds may be observed approaching the speakers, ensuring a higher detection rate (Bosakowski & Smith, 1998).

3.2.2 *Locating roosts*

Active roosts can be found during systematic searches of nesting ranges and can be identified by the presence of fresh faecal droppings, pellets and moulted feathers (Section 3.2.3). They are generally close to the nest site.

3.2.3 *Recognition of signs*

Feeding perches with white faeces, plucks and carcasses may be found on tree stumps, up-turned roots, large branches or old nests. Goshawk pellets and plucks cannot be separated reliably from those of buzzards, however, and identification must be confirmed by other signs (e.g. moulted feathers, active nests). Moulted feathers should be collected if found, as they can be used to identify individual birds (Bijlsma, 1997).

3.2.4 *Evidence of occupancy*

Sightings of adult goshawks in combination with signs, such as moulted feathers and the remains of several kills, provide evidence of occupancy. Sightings on their own, even if birds are seen in the same area on a number of occasions, do not provide sufficient evidence.

3.3 Evidence of breeding

3.3.1 *Locating active nests*

Nests can be found by searching nesting ranges in early spring (Visits 1 and 2), when the active nest will be built up with fresh branches. In thick, coniferous woodland, splashes below a female's preferred perch may be a good pointer to nest location. Such perches are usually within 40-50 m, uphill of the nest and with a good flight line. Care must be taken, however, to avoid excessive disturbance during nest building and early incubation, as some pairs may desert easily at this time (Anon., 1989; Petty, 1996; see *CAUTION* above). At some nests viewed from the ground, the incubating female's tail feathers are visible. Later, active nests have moulted down around the rim or on neighbouring branches, which can be seen with binoculars. A sketch and/or digital photograph of the location of the nest should be made as well as a record of its location (at least a six figure map reference). If, after the likely hatching date, a nest has no white faeces beneath but has fresh green vegetation and (especially) down shed by an incubating female, this may represent breeding failure. Fieldworkers should be aware also that a pair may have moved to an alternative site within the nesting range if a new or refurbished nest is abandoned. Any climbing to check for remains of broken or unhatched eggs should be delayed until late June, to avoid disturbing a site where incubation has been delayed (e.g. through relaying).

3.3.2 *Evidence for fledging*

Large feathered young (at least 30 days old) in, or close to, the nest are evidence of successful fledging. Records of brood size are most reliable if well-feathered young can be counted in the nest, by climbing or observation from a suitable vantage point. Beware of climbing to nests when young are likely to be 30 or more days old (with very little or no down on the head) however, as chicks (particularly males or undernourished individuals) may jump. After hatching, the nest cup is likely to be covered with new nesting material (fresh twigs) and if chicks have fledged successfully the nest cup can rarely be seen at all. Searching beneath this material may reveal any unhatched eggs or the remains of dead chicks in the nest cup. Recently fledged young that are not yet strong on the wing can be located by their begging calls and the number estimated, but this approach is unreliable when young can fly strongly and may scatter over 200 m from the nest.

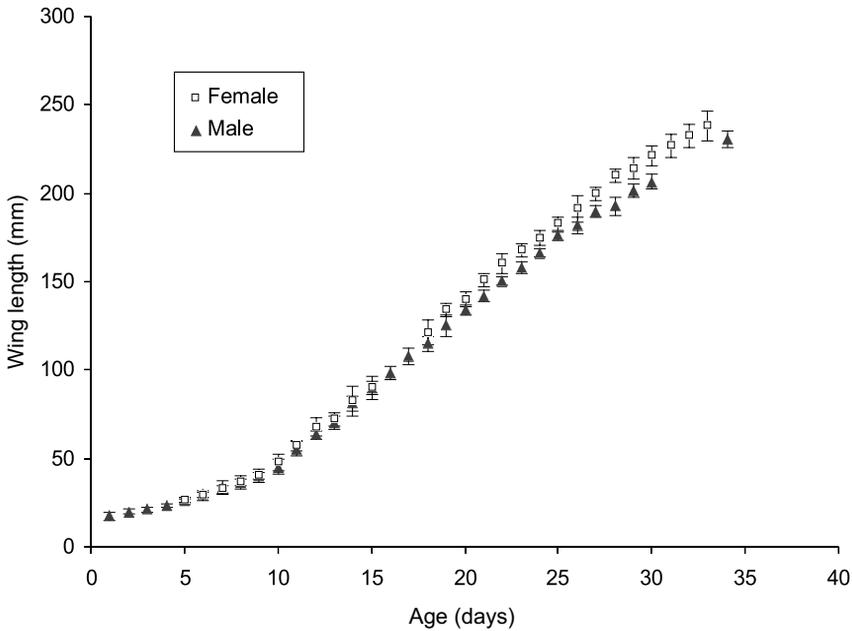


Figure 17. Change in the mean wing length (with 95% confidence limits) of goshawk chicks with age. Data from 2–44 nests per year over eight years and two study areas; each point based on measurements from 5–21 male and 5–13 female young (from Bijlsma, 1997).

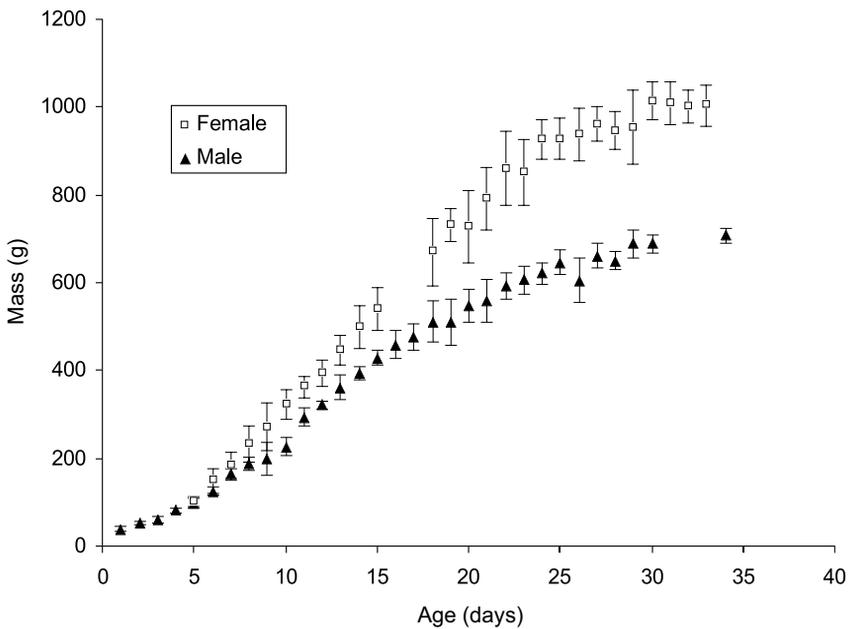


Figure 18. Change in the mean mass (with 95% confidence limits) of goshawk chicks with age. Data from 2–44 nests per year over eight years and two study areas; each point based on measurements from 5–21 male and 5–13 female young (from Bijlsma, 1997).

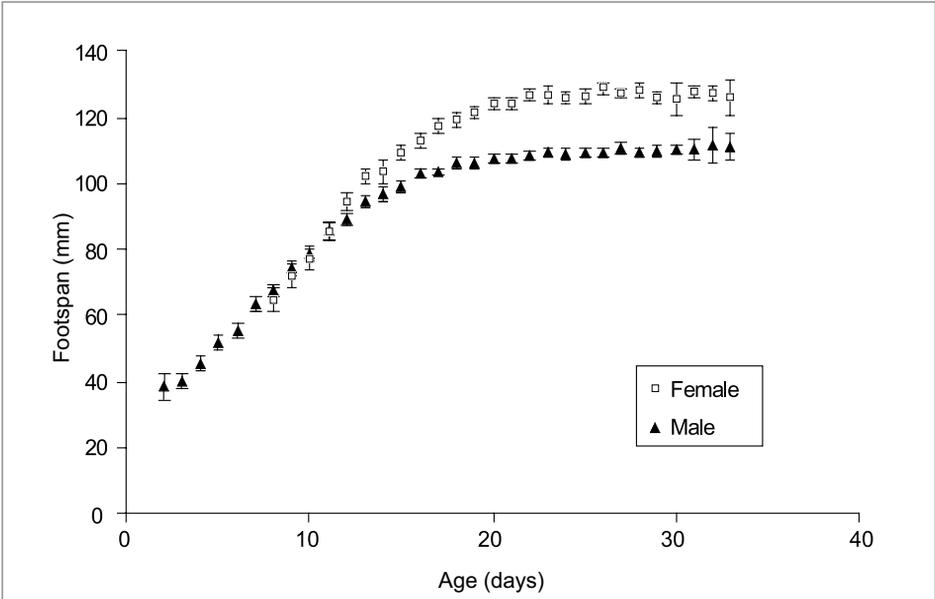


Figure 19. Change in the mean foot span (width of span including claws, with 95% confidence limits) of goshawk chicks with age. Data from 2-44 nests per year over eight years and two study areas; each point based on measurements from 5-34 male and 5-20 female young (from Bijlsma, 1997).

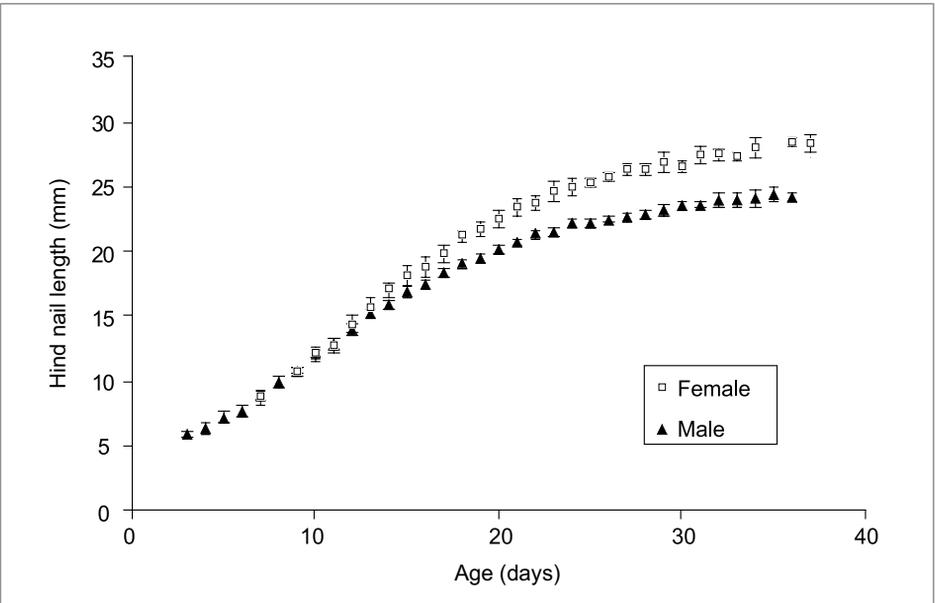
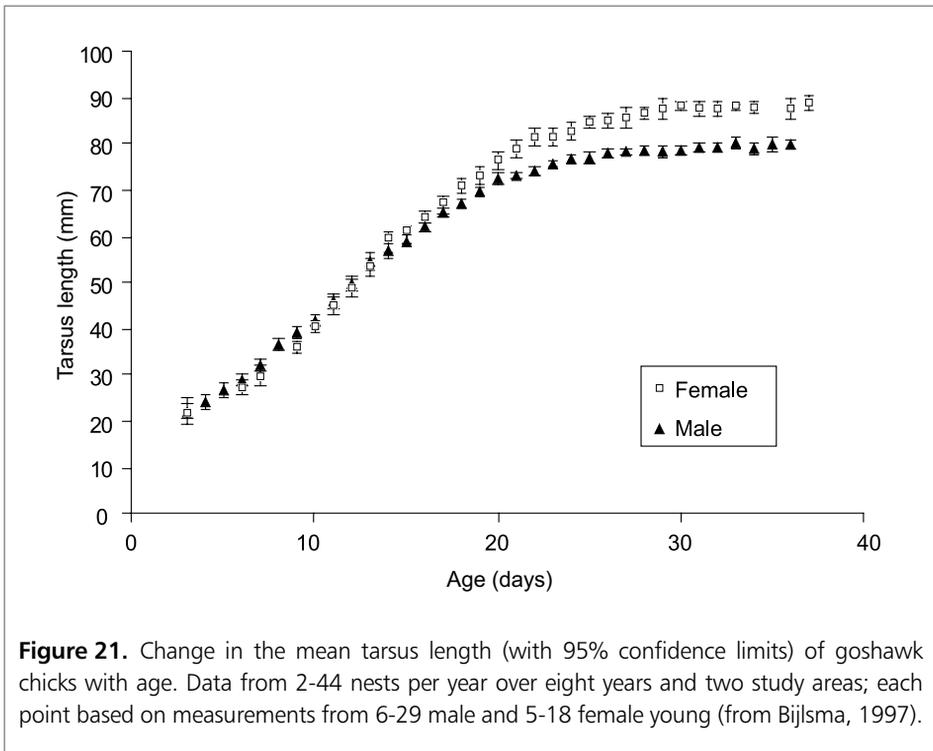


Figure 20. Change in the mean length of the hind claw (with 95% confidence limits) of goshawk chicks with age. Data from 2-44 nests per year over eight years and two study areas; each point based on measurements from 6-28 male and 5-19 female young (from Bijlsma, 1997).



3.4 Evidence of non-breeding

If displaying birds and other signs are seen regularly in a given location but no evidence of an active nest or fledged young is found subsequently, despite extensive searches at the appropriate visit dates, this suggests occupancy but non-breeding (Marquiss & Newton, 1982).

3.5 Ageing and sexing young

Goshawk chicks can be aged approximately by measuring their wing length (Bijlsma 1997; Figure 17). Sexing should be possible visually based on foot and tarsus size from day 15 or 16 onwards, and often from age 12 to 13 days. Sexing should be confirmed by taking measurements, however, by first ageing young using wing length and then sexing using a combination of mass (which is thought to be quite a reliable indicator of sex in this species; Figure 18), foot span (Figure 19), hind claw (Figure 20) and tarsus length (Figure 21), in that order of priority. Based on measurements of Dutch birds, the foot spans of the sexes do not overlap after the age of 16 days (wing length > 99 mm; Figure 19), when females have a span larger than around 111 mm and males less than 105 mm (Bijlsma, 1997). Growth of foot span is complete by 21 days of age, when males have a span less than 116 mm and females equal to or greater than 119 mm. Similarly, measurements of Dutch birds suggest that both hind claw length (Figure 20) and tarsus length (Figure 21) differ significantly between the sexes after about 18–20 days of age and these can provide additional criteria for sexing (although they are more prone to individual variation in measurement by observers). On Gotland, only two of 87 males over 28 days of age (wing length > 200 mm) had a minimum tarsus width (with callipers squeezed tight momentarily) greater than 6.5 mm and only one of 82 females less than this (Kenward *et al.*, 1993).

Goshawks (of the nominate race *gentilis*) increase in size with latitude, with larger birds breeding in Scandinavia. Some Goshawks breeding in northern Britain are descended from these larger northern birds (Marquiss & Newton, 1982), so that the measurements given above should be used with caution in Britain and Ireland; further measurements of young goshawks from populations in Britain and Ireland are required before young can be aged and sexed reliably. For one British population, mass is reported to be the best predictor of sex, with small variations between males and females in foot span, hind claw and tarsus length.

4. SURVEYS OUTSIDE THE BREEDING SEASON

There is no established method for surveying goshawk populations outside the breeding season. An index of wintering abundance might be obtained by carrying out counts of birds observed from defined survey routes (preferably randomly selected or at least representative of habitats in the area to be covered). Observers walking fixed survey routes in a set time span, several times each winter, and recording observations of goshawks and their approximate distance from the transect line, could generate data of use for indexing changes in numbers between years. Such survey work should be undertaken at similar times each year, between mid-November and late February, to exclude possible influxes of immigrants during passage periods (Wernham *et al.*, 2002).