



1. INTRODUCTION

The barn owl occurs throughout much of Great Britain, the Isle of Man, and Ireland. It is absent as a breeding species from the Highlands of Scotland, the Outer Hebrides, Orkney and Shetland. Barn owl populations have undergone a long term decline during the last 100-150 years (Blaker, 1933, 1934; Shawyer, 1987; Gibbons *et al.*, 1993; Toms *et al.*, 2001, Toms *et al.*, 2003), thought to be linked to the loss of hunting habitats and nest sites associated with agricultural intensification (Shawyer, 1987; Taylor, 1994; Taylor & Walton, 2003). The Scottish population appears to have increased in recent years (Shaw, 2007). British and Irish populations, and those in mainland Europe, are largely sedentary, although the natal dispersal distances of continental individuals tend to be greater (Toms, 2002b). Young barn owls from eastern Europe (the dark-breasted race *guttata*) occasionally reach Britain and Ireland but may also escape from captivity. There is no clear size difference between the sexes but they can usually be separated by plumage; most females are darker than males and also have a greater degree of flecking on their underparts (Taylor, 1994; Barn Owl Trust, 1989a). Most barn owls start breeding during their second calendar year. Once fledged, young birds cannot be separated from older birds in the field.

For further information on the biology and ecology of this species, Taylor (1994), Shawyer (1998) and Martin (2008) provide comprehensive accounts. The Barn Owl Trust (www.barnowltrust.org.uk) also provides a range of information on barn owl ecology and conservation.

Annual cycle

Breeding Activity	Peak Period	Range	Duration (days)
Occupation of home range		All year	
Territorial display		February to April	
Courtship		Early February (in mild weather), usually March to April	
Egg laying	Early April to late May	First clutch: March to July Second clutch: (infrequent) June to August (birds that laid their first clutch early in the season only)	6 to 21
Incubation	Early April to late June	March to August	29 to 34
Hatching	Early May to late June	April to August	
Young in nest	Early May to early August	April to November	50 to 70
Fledging	Mid-June to early August	June to November	
Juvenile dispersal		September to November	

2. HABITAT, HOME RANGE, NESTS AND BREEDING

2.1 Habitat

Barn owls are found in a variety of open farmland habitats and in young conifer plantations. In a survey across Britain and Ireland (Shawyer, 1987), 92% of the recorded breeding sites were below 150 m a.s.l., where snow cover in winter was 15 days per annum or less. In areas with a higher snowfall, breeding barn owls were rare. In southwest Scotland, most barn owls bred between 75–175 m a.s.l., with only a few pairs at higher altitudes in forestry plantations (Taylor, 1994). Regular breeding at higher altitudes (over 200 m and up to 310 m a.s.l.) has been recorded in southeast Scotland and on Exmoor, Devon.

2.2 Home range

Barn owl home ranges are not exclusive. They may defend the immediate area around the nest (the nesting territory) but evidence for other territorial behaviour is weak (Taylor, 1994). Outside the breeding season, birds are known to forage up to 3 km, and occasionally up to 5 km, from their nest site, which equates to a home range size of up to 5,000 ha. In contrast, during the breeding season, the foraging range of breeding barn owls normally extends up to a kilometre from the nest: an area of up to 350 ha (Cayford, 1992; Taylor, 1994). Barn owl home ranges generally include areas of rough, tussocky grassland with a deep litter layer (optimum vole habitat) but the species may also occur in areas with little or no rough grassland within a kilometre of the nest site (Taylor, 1994; Ramsden, 1995; Shawyer, 1998; McGhie, 2000). In enclosed pastoral farmland in southwest Scotland, breeding barn owls were found to require at least 9–10 km of grassy woodland edge within a 1 km radius of a nest site (Taylor, 1989). Studies in areas of England, Scotland and Wales found that barn owls needed varying amounts of rough grassland within 2 km of the nest in order for local populations to be sustainable, as follows: 14–21 ha in arable areas; 31–47 ha in pastoral areas; and 17–26 ha in mixed farming areas (Askew, 2006).

2.3 Nest sites

Barn owls nest in large cavities in trees, buildings, bale stacks, and in fissures in rocks, as well as nest boxes. They prefer dry, dark nest sites with a floor surface greater than 0.3 m by 0.3 m (Taylor, 1994). Nationally, about a third of barn owl nest sites are in trees but a big dry cavity is required so generally only old trees are suitable (Shawyer, 1987; Toms *et al.*, 2000). In the west of Britain, barn owls use buildings more frequently than in the east, which appears to be due to the lack of suitable tree sites (Toms *et al.*, 2000). They tend not to use buildings that are frequently used by people (Bunn *et al.*, 1982; Shawyer, 1987; McGhie, 2000) and the conversion of many derelict rural buildings and farm steadings into modern houses has restricted the availability of sites for barn owls; with others lost as they deteriorate into unusable ruins (Petty *et al.*, 1994; Ramsden, 1998; Toms *et al.*, 2000). However, where nest sites such as old barns are converted into dwellings and provision for the owls is incorporated, they will often continue to nest with humans living directly below them (Ramsden, 1995). Birds that can remain out of site when at the nest are much less likely to be flushed and can tolerate all kinds of activity close to the nest (Barn Owl Trust, 2002). In the most recent survey of barn owls across Britain and Ireland in 1995–1997, the commonest trees used for breeding were ash and oak, the species most likely to develop sufficiently large cavities, although elm, sycamore and willow were also used (Toms *et al.*, 2000). Nest holes in trees are predominately in a cleft or cavity in the main trunk (Bunn *et al.*, 1982), at an average height of about 5 m from the ground. Trees used for breeding are generally located near the edge of large blocks of woodland (McGhie, 2000).

Barn owls will readily use nest boxes (Shawyer, 1987; Johnson, 1994) and barrels placed on trees in a coniferous forest can increase the local population size (Shaw, 1994b; Petty *et al.*,

1994). Provision of nest boxes can be used as a conservation management tool in areas where the availability of nest sites in buildings and hollow trees is declining (Taylor & Walton, 2003).

2.4 Nests

Barn owls do not build a nest but may scrape a slight hollow if the nest site has a soft substrate.

2.5 Clutch size and incubation

Barn owls lay 2–9 eggs (Shawyer, 1998), with occasional clutches of up to 12 eggs. The BTO Nest Record Scheme records the average clutch size as 4.9 (n=485). The eggs are normally laid at intervals of 2–3 days. Greater gaps, often associated with poor weather (extremely low temperatures, snow or prolonged rain), of 3–7 days have been recorded (Taylor, 1994). Egg laying occurs later when small mammals are scarce or when spring weather is cold, and young females lay later than older birds (Taylor, 1994). In Britain and Ireland, clutch size varies significantly with habitat and decreases as the breeding season progresses (Taylor, 1994). Smaller clutches are laid in years when there are fewer small mammals and, in such years, a greater proportion of pairs will not lay (Taylor, 1994). Second broods are more frequent in years when small mammals are highly abundant. Incubation begins with the first egg and lasts for 29–34 days (Bunn *et al.*, 1982), with most eggs hatching after 30–32 days. Only the female incubates, leaving the nest for brief spells (5–10 minutes) around three times a day. The male begins feeding the female about one month before laying and provides all her food (at the nest site) during incubation. In southwest Scotland, prey-delivery rates were measured at 19 nests using automatic nest recorders (Langford & Taylor, 1992). Average daily rates (from 12:00h one day to 12:00h the next) of 16.4 items were recorded during laying and 8–11 during incubation. These high delivery rates, similar to those recorded during the nestling period at the same nests (see Section 2.6 below), resulted in the caching of surplus food at most nests, probably as an insurance against food shortage once chicks had hatched.

2.6 Brood size and fledging

Hatching is asynchronous. As a result, the chicks in a large brood are of widely differing ages. The female broods for the first 10 days, after which she hunts in addition to the male (Cramp, 1985). Maximum daily delivery rates (from 12:00h one day to 12:00h the next) of 14–16 items during the nestling period were recorded in southwest Scotland about 30 days after the hatching of the first chick, with a steady decrease thereafter (Langford & Taylor, 1992). One pair was recorded bringing 17 prey items to the nest in two hours (Bunn *et al.*, 1982). The young can fly after 50–55 days (Cramp, 1985) but their flight feathers are not fully developed until 70–75 days after hatching and they return to the nest until they are 11–14 weeks old (Taylor, 1994). They become independent 3–5 weeks after leaving the nest, and normally leave the parental home range within a few weeks (generally between September and November). Juvenile dispersal is largely completed within the first four or five months after fledging (Toms, 2002b). The abundance of small mammals influences chick survival and the number that fledge: 45% of chicks may die in years with low populations of small mammals compared to only 5–10% in years when they are abundant (Taylor, 1994).

3. SURVEY TECHNIQUES

CAUTION *Barn owls can be sensitive to disturbance at the nest site, particularly early in the nesting cycle, from prelaying through to hatching (Shawyer, 1987; Percival, 1990; Ruddock & Whitfield, 2007), so special care should be taken during these stages of the breeding cycle.*

However, nest inspections should not have a detrimental effect if carried out carefully at all stages of the breeding cycle (Taylor, 1991, 1994). Barn owls should not be flushed from nests or roosts in daylight because they may be mobbed by other birds and will be reluctant to return, which may affect their survival particularly in the winter months. If it is necessary to look inside a confined space for a nest site, it is strongly recommended that goggles or full face protection is worn, particularly if there is a risk of a more aggressive tawny owl being present. If searches for nest or roost sites and nest inspection visits require visits to old buildings and/or climbing, then appropriate health and safety precautions should be taken (see Section 7.10 of Introduction).

3.1 Breeding season visit schedule

The species is listed on Schedule 1 in Great Britain, Northern Ireland and the Isle of Man, and Schedule II in the Republic of Ireland (see Section 7.1.1 of Introduction). This is a difficult species to survey accurately because it is largely nocturnal and thinly distributed over a wide geographical area; compared with other owl species it is not particularly vocal nor does it defend a clearly defined territory (Toms *et al.*, 2001). The survey methodology described here follows that used for the 1995-1997 UK survey (Toms *et al.*, 2001), allowing for additional visits to monitor breeding success. To establish occupancy (which for barn owls requires the location of active nests, see below), two visits are required – Visit 1 and one additional visit between May and August (Visit 3 or 4). Two further visits are required to measure breeding performance (Visit 2 and Visit 3 or 4). If there is any uncertainty over the stage in the breeding cycle, Visit 2 should be delayed so as not to disturb birds during laying. Late visits in October may be necessary if birds have attempted a successful second brood.

Visit 1	November to January	To check for suitable nesting sites and signs of occupancy
Visit 2	April to June	To locate active nests with eggs. Note CAUTION about timing of visits
Visit 3	May to June	To check for young and late/second clutches
Visit 4 (Two or more visits may be required)	July to August (October)	To check for fledged young and late nests/second clutches

3.2 Signs of occupancy

Given that the home ranges of barn owls are not mutually exclusive, the only definitive way to assess the numbers in a study area is to locate nest sites. Barn owls can be almost completely nocturnal but, in many areas, they are crepuscular. They can be seen hunting in the early morning shortly after dawn or in the evening about an hour before sunset or even earlier in winter (Bunn *et al.*, 1982). If a barn owl is feeding young, it will carry prey directly back to the nest site and its direction of flight can be used to help locate the nest. Not all owls hunt in daylight, however, so fieldworkers should not depend on observing barn owls when locating nest sites.

3.2.1 Locating home ranges

Information on barn owls can be obtained from local people but pairs can exist in an area without people knowing, so systematic searching is always required. Male barn owls may make advertising calls from their roosts (typically in the 6-7 weeks before laying but also prior to second clutches), and display flights (flying steadily over the territory, repeatedly changing direction and calling; Cramp, 1985), which may assist in identifying areas that are occupied and hence require subsequent systematic checking.

Study areas should be intensively and systematically searched for the presence of potential nest sites in winter (November to January), when deciduous trees are leafless and there is

minimal risk of disturbance to early-breeding tawny owls. All suitable sites should be mapped or recorded as six figure map references, including farm buildings, tree cavities away from the centre of a wood, nest boxes, cliffs (including quarries) and bale stacks. If it is suspected that a barn owl is present at a particular location, then it should not be flushed; simply record the site at this stage. A barn owl disturbed in daylight may be mobbed by other birds and will be reluctant to return to the site, which may affect survival in the winter months.

To establish occupancy, all of these potential nesting sites must be visited again between May and August (Visit 3 or 4); this timing maximises the likelihood of finding breeding birds or evidence of breeding and early failure, while avoiding disturbing birds early in the nesting cycle. An earlier visit (Visit 2) can be made to check for nests with eggs, taking care to minimise disturbance, and two (or more) visits may be made between May and August to assess productivity. Later visits may be required if a pair of barn owls has attempted a second brood.

The sight of birds carrying food into a site can be taken as evidence of breeding and there is no need to approach the nest site any closer, unless checking the nest contents for a specific purpose. Watching a potential nesting area from a distance for an hour before sunset until an hour after sunset on a cloudless, still evening gives a 97% chance of observing a visit from a barn owl, if the site has an active nest (Toms *et al.*, 2000).

Some barn owls may also be located by listening for their 'song', which is described as a loud, drawn out, hissing scream 'shrrreeeee', with a marked gargling or tremulous effect (Mikkola, 1983). Screeching by males begins in mild weather in February. The calls are made shortly after dusk or as the male leaves the nest site or roost (Bunn & Warburton, 1977). The fieldworker should listen for these calls around dusk and plot the locations on a map, before returning and searching the area for roosts and suitable nest sites at the appropriate time. Some barn owls may also respond to broadcast calls, but they do not do so consistently enough for this to be used for survey purposes.

Later in the season, indirect signs may be more obvious around an active nest site, with downy feather extensions from the young becoming snared on foliage (surveyors should be careful not to confuse these with tiny moulted feathers from adult birds), and pellets deposited below the nest entrance of tree cavity sites. On warm days, flies attracted to discarded prey often provide a clue to the location of a nest site, and a smell of ammonia may emanate from the site. Some nest sites may remain clear of white splashings and other signs until the young start to climb about, however, so 'clean' sites do not necessarily mean that there are no barn owls breeding.

3.2.2 Locating roosts

Barn owls can have a number of daytime roosts. Both the male and female will roost at the nest site before and during egg laying but the male will move to roost at nearby sites, often a paired nestbox if there is one, after the clutch is complete. The female will move to a separate roost once the oldest owlet is about four weeks of age (Toms *et al.*, 2000). Care must be taken not to count roosts as additional occupied nest sites. Roosts can be located by systematically searching suitable buildings, trees and crags. They can be identified by an accumulation of pellets, feathers and white streaking (Section 3.2.3). In coniferous plantations in southwest Scotland, barn owls seldom roost during the winter in nest boxes that are subsequently used for breeding, being seen on less than 5% of visits to these boxes. Faecal droppings showed that they regularly visit these nest sites, however, as four out of five nest boxes that contained fresh droppings in winter were subsequently used for breeding. Any roosts or nest sites located should be recorded as a six figure map reference with a description of the site.

3.2.3 *Recognition of signs*

When searching for barn owls, watch out for pellets and feathers on the ground, on bales, or on ledges in buildings, and for long white streaks of droppings on beams, walls or tree trunks (Barn Owl Trust, 2002). Before entering a building, look for holes in the outside walls which a barn owl could use (a minimum of 75 mm wide) and check these for droppings or other signs (Barn Owl Trust 1989b). Fresh barn owl pellets are characteristically glossy black, fading to dark grey as they dry (Shawyer, 1998; Barn Owl Trust, 2002). Hence, with experience, it is possible to use the condition of pellets to ascertain how recently sites have been occupied (see Barn Owl Trust, 2002, for photographs of pellets of differing age, from one day to thirty months old). The pH of barn owl stomachs is higher than that of many other predatory birds and there is less digestion of skeletal material (Smith & Richmond, 1972). Hence barn owl pellets are harder and more compact than those of other owls and contain most of the bones from their prey. They tend to be wide relative to their length, with a size range of 30-83 mm long by 15-40 mm (Shawyer, 1998; Brown *et al.*, 2003). Barn owl feathers are distinctive and highly variable and some individual owls can be recognised by the differences in pattern (Taylor, 1994).

3.2.4 *Evidence of occupancy*

Finding occupied roost(s) indicates that barn owls are present in an area but the location of an active breeding attempt (observations of food being brought to a nest site) is necessary to confirm occupancy.

3.3 Evidence of breeding

3.3.1 *Locating active nests*

See Section 3.2.1 for information on finding nest sites and determining whether they are occupied. If it is necessary to look inside a confined space for a nest site, it is strongly recommended that goggles and some sort of face protection (e.g. a fencing or welding mask) is worn. Talk quietly, to warn the barn owl of your presence so that it can depart carefully, but do not make a lot of noise as this may alarm the bird. In tree hole sites, be very careful of tawny owls, as these can be much more aggressive. Nest checks should be done as close to dusk as possible to avoid flushing adults during daylight.

3.3.2 *Evidence for fledging*

Fledged barn owl chicks should be located by checking the nest site. As hatching is asynchronous, a large brood of young in the nest will be at a variety of ages. In buildings, the whole brood may be visible after fledging as they roost during the day. This is not so with tree nests where regular visits will be required to record the fledging of each chick. Barn owl young can easily hide and the immediate area around the nest site should be searched thoroughly. In buildings, the chicks can hide under the eaves, between hay bales and in any available crevice or hole. Fledged young can also be located by listening for their food calls (Cramp, 1985).

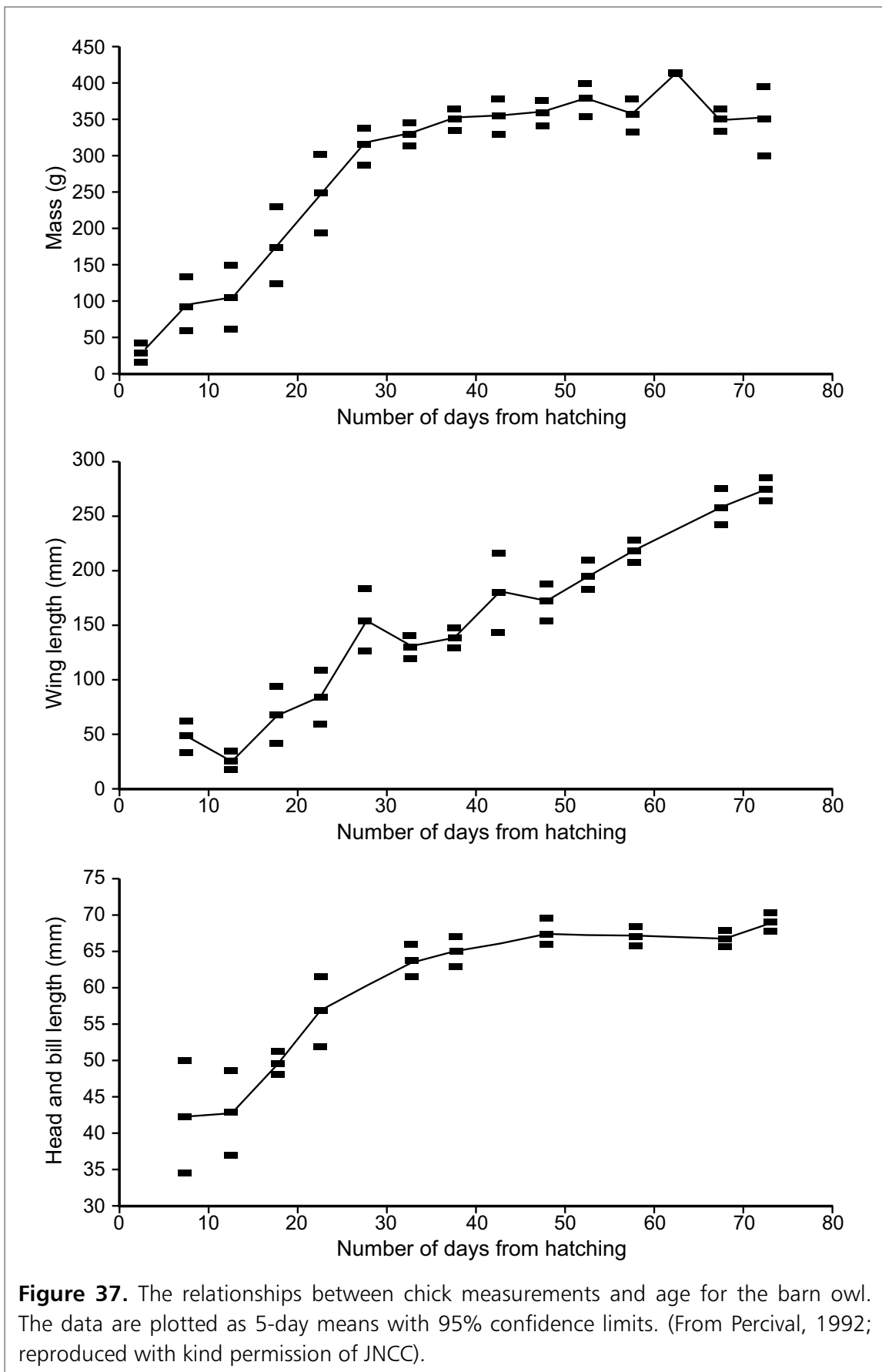
3.4 Evidence for non-breeding

Under extreme conditions of food shortage, female barn owls may not lay (Taylor, 1994); this tends to occur in the decline and low phases of vole population cycles. If a pair of barn owls is known to be occupying a home range but no active nest or fledged young are found during visits at the appropriate times, this provides evidence for non-breeding.

3.5 Ageing and sexing young

Growth curves showing changes in body mass, wing length and head and bill length have been produced for British barn owls (Percival, 1992; Figure 37). These measurements in combination can be used to give at least an approximate estimate of the age of young. Mass should not be used on its own to estimate age, as this may vary in relation to a number of

factors, including the foraging conditions for the parents, condition of the young, brood size, how recently a chick has been fed and the time of day (Taylor, 1993). Wing length is thought to be the best predictor of age (Taylor, 1994) and wing growth is linear after 20 days, so that



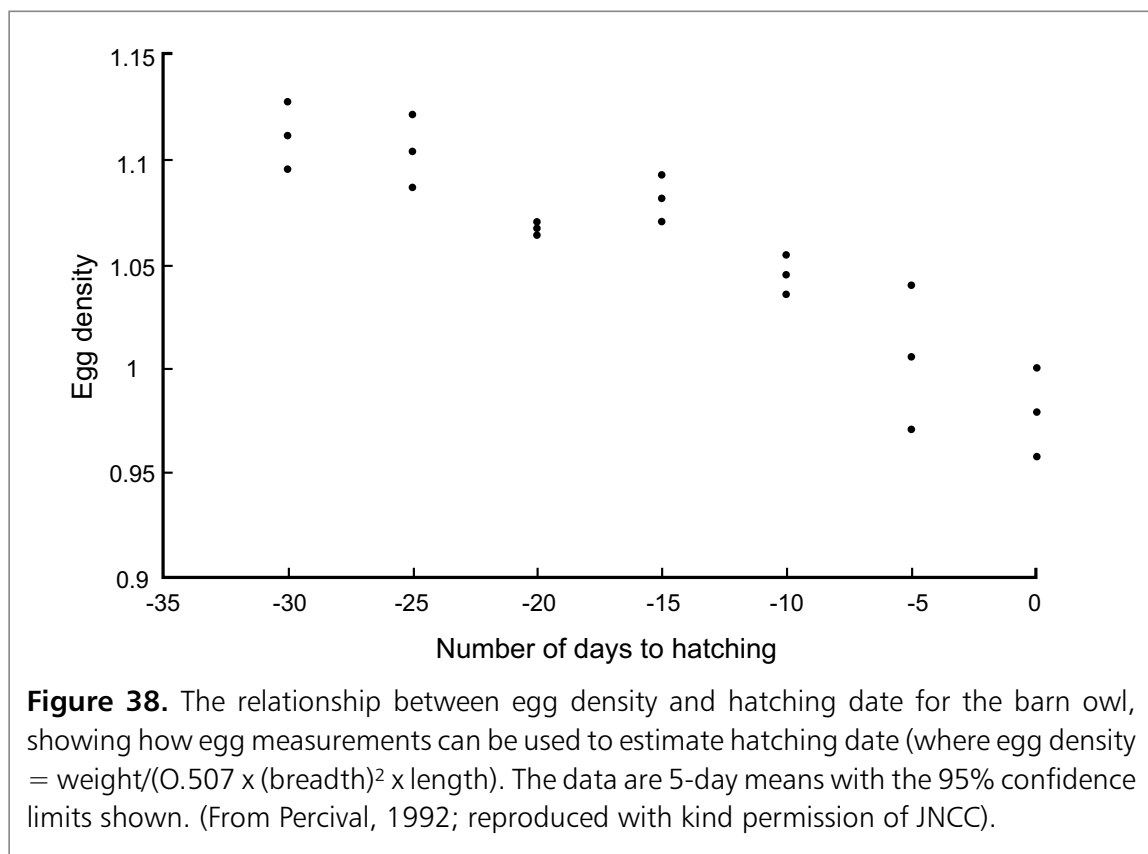
chick age can be estimated from the following equation:

$$\text{Age (days)} = (\text{wing length (mm)} + 22.3)/5.1 \quad (v)$$

Shawer (1998) describes the growth of the wing feathers in owlets and use of the length of the emerging quill of primary seven to age nestlings. The majority of chicks can be sexed from the age of 40 days by the amount of flecking on the underbody (Taylor, 1994). Chicks with no flecking on the underbody (an underbody fleck score of 0) can be reliably sexed as males, while those with heavy flecking (underbody fleck scores of 3 or 4) can be sexed as females. Intermediate birds (underbody fleck scores of 1 or 2) cannot be sexed reliably. Some female chicks also have a generally richer brown wash to their upper body and more pronounced black wing bars than male chicks.

3.6 Use of egg density measurements

Information on British barn owl eggs is available from which hatching dates can be estimated from measurements of egg density (Percival, 1992; Figure 38; see also Section 6.5.1 of Introduction). Further data collection is likely to be required before hatching dates can be predicted with precision but the data available can be used as an approximate guide to the period over which hatching will occur and visits to check on young might be made.



4. SURVEYS OUTSIDE THE BREEDING SEASON

Surveys outside the breeding season are likely to be incomplete, as roosting sites can be smaller and better hidden than nesting sites, and therefore easily missed. The variability of behaviour with respect to time of day (or night) between birds also means that observations of hunting or calling birds will provide only minimum estimates of the barn owl population in a study area.