



1. INTRODUCTION

Short-eared owls are widely distributed across upland areas of Great Britain (Gibbons *et al.*, 1993), and small breeding populations also exist in saltmarshes and other rough grassland in lowland areas. Small numbers breed on the Isle of Man, but short-eared owls are scarce in Ireland. Short-eared owls are opportunistic wanderers (Glue, 2002b), and the numbers breeding in a given area can vary significantly between years. This latter variation has been linked to cyclical changes in the abundance of voles (Korpimäki & Krebs, 1996; Petty *et al.*, 2000), which are their principal prey in Europe. British short-eared owls disperse from their upland breeding haunts to lower altitudes in winter, and some movement westwards to Ireland probably also occurs (Glue, 2002b). Populations breeding in northern mainland Europe are strongly migratory, while those breeding in mid-Europe are partially migrant. Birds from these populations have been recorded in Britain in winter, although the size of the winter influx is thought to be highly variable (Glue, 2002b). The sexes are similar in size and plumage, although males generally have paler faces and underparts and are less heavily streaked. After fledging, the young are darker than the adults, until they moult in the autumn (Cramp, 1985). Short-eared owls can breed at one year old (Glutz von Blotzheim & Bauer, 1980) if there is sufficient prey.

Annual cycle

Breeding Activity	Peak Period	Range	Duration (days)
Occupation of home range and courtship		March to April	
Egg laying	Late April (varies with vole population and weather)	Late March to early May (earlier laying in good vole years); occasional second or repeat clutches in June/July	
Incubation	Late April to late May	Late March to late July/August	24 to 29
Hatching	Mid-May	Mid-April to June; occasionally into late July/August for second clutches	
Young in/near nest	Late May to late June	Late April to August/September	12 to 17
Fledging		Late May to June; occasionally August/September for second clutches	At 24 to 27 days old
Juvenile dispersal		Late June to September	

2. HABITAT, HOME RANGE, NESTS AND BREEDING

2.1 Habitat

In the breeding season, short-eared owls require an extensive tract of open land, with an adequate small mammal population. Habitats used include heather moorland, rough grassland in upland and lowland areas, young forestry plantations, bogs, and sand dunes and salt marshes near the coast (Glue, 2002b). In winter, they occupy similar habitats at lower altitudes, though not necessarily as extensive in area.

2.2 Home range

In years when voles are abundant, short-eared owls are thought to defend exclusive home ranges (Clark, 1975; Mikkola, 1983) and hunt within this range. When the food supply is poor, however, and when they are feeding young, they will hunt outside of this defended area (Cramp, 1985). Studies in Scotland and Wales have reported home ranges of 18–875 ha with a similar range of sizes reported from Europe and a larger area (4,600 ha +) from a study in Idaho (Cramp, 1985; Calladine *et al.*, 2005). Breeding density of short-eared owls varies between years with high densities associated with years of high vole abundance. In Britain, breeding densities of at least 5 pairs per 10 km square of suitable habitat were estimated for years of plentiful food supply by Gibbons *et al.* (1993). An analysis of short-eared owl records collected during the 2004 hen harrier survey suggested respective densities of 1–1.5 and 2–3 apparently occupied territories per 10 km square in Scotland and Wales respectively (Calladine *et al.*, 2005). Home range occupation by short-eared owls is likely to be weather dependent and may be delayed by snow or by prolonged periods of rain.

2.3 Nest sites

Short-eared owls nest on the ground. The nest is usually placed in heather, tall rushes, grass or bracken, and may be located under a tussock, next to a boulder, or under a fallen or young tree. They are widely reported as nesting within young plantations. A one-year study in southwest Scotland (Shaw, 1995) found that both first and second rotation plantations were occupied, with first rotation plantings supporting breeding short-eared owls for up to 12 years after planting. The highest densities were found amongst 3–7 year old plantings. The smallest occupied coup for second rotation planting was 62 hectares. In mainland Europe, short-eared owls also breed in cereal fields when vole numbers are high.

2.4 Nests

The short-eared owl is the only Palearctic owl to build a nest regularly. The nest consists of a shallow scrape, roughly lined with pieces of short (3–6 cm) vegetation (Mikkola, 1983; Cramp, 1985). Of a sample of 33 nests in Perthshire, Scotland, however, two were built (to 6 cm high) and contained sticks up to 12 cm long. Clark (1975) watched a female making a scrape and then lining it. There is no evidence that the male helps to build the nest.

2.5 Clutch size and incubation

Clutch size may be greater in years when voles are abundant. The normal range is 2–8 eggs (Cramp, 1985), with exceptional clutches of up to 14 in good vole years (Adair, 1892). In Perthshire, Scotland, however, good vole years appear characterised by an increased density of breeding owls rather than larger clutches (with clutch sizes consistently 5–7 eggs). The BTO Nest Record Scheme gives an average clutch size of 5.4 (n=56). Incubation starts with the first egg and lasts for 24–29 days (average 26 days) for each egg (Mikkola, 1983). Eggs are laid at daily intervals. The female incubates and broods small chicks, whilst being fed by the male (usually at the nest, with the first feed delivered around nightfall; Roberts & Bowman,

1986). Laying occurs earlier in good vole years than poor ones (Mikkola, 1983). Short-eared owls will relay as late as June if a first clutch fails. Second broods have occasionally been assumed (nests with eggs as late as July) in good vole years but an intensive study in Perthshire (including two exceptional vole years) has found no evidence for double broods.

2.6 Brood size and fledging

The eggs hatch asynchronously and the larger first-hatched chicks have a better chance of survival than the others. Cannibalism among siblings may occur if food is scarce (Mikkola, 1983; Cramp, 1985). Once they are about a week old, the young may be fed during the daylight hours, although one study on moorland in Wales suggested that most feeds occurred after 17:00h and before 08:00h (Roberts & Bowman, 1986). At a nest with young in Scotland, activity peaks were recorded 2-3 hours after sunrise, early in the afternoon, and 0-2 hours after sunset; with visits continuing throughout the night (Cramp, 1985). The provisioning rate has been recorded as 2.1–3.9 voles per day per chick (Cramp, 1985). Once brooding is complete, the male and female feed the young. The chicks will leave the nest and hide in surrounding vegetation at 12–17 days old (Witherby *et al.*, 1940); when they may scatter and move up to 100 m away. The young continue to be fed by the parents until they fledge at 24–27 days old (Witherby *et al.*, 1940) and start to disperse from the nesting area some weeks later.

3. SURVEY TECHNIQUES

CAUTION *Short-eared owl nests should not be visited in cold, wet weather. It is recommended that vantage points for viewing short-eared owls are situated at least 500 m from areas of activity / nests to minimise the risk of disturbance. Surveys in 2006 and 2007 from fixed vantage points found that the detection distance of owls increased from about 500 m in the first year to just over 700 m in the second, suggesting that some owls may have shifted their centres of activity further from observers in the second year of the study (Calladine *et al.*, 2008). Further evidence from the same study of a potential deterrence effect of observers was suggested by the fact that owls rarely came within 200 m of fieldworkers. It is therefore recommended that surveyors working on this species strive to be as unobtrusive as possible.*

3.1 Breeding season visit schedule

The species is listed on Schedule 1 in Northern Ireland and the Isle of Man and on Schedule II in the Republic of Ireland (see Section 7.1.1 of Introduction). Given the difficulty of surveying this species to establish occupancy and the presence of a breeding pair, it is recommended that all four visits are made (as detailed below). Broods that have fledged early may start to disperse by late June.

Visit 1	Early March to mid-April	To check for occupancy [but see 3.2.1]
Visit 2	Mid-April to May	To locate active nests
Visit 3	June	To check for young (dispersed or still in nest)
Visit 4	July	To check for fledged young and any late nests

Short-eared owls are difficult to survey. There may be large year-to-year variation in the numbers of breeding birds present in an area, the adults may be visible for only a small proportion of the daylight hours, and nests are hard to locate.

Short-eared owls can be active at any time of the day or night although the proportion of diurnal, crepuscular and nocturnal activity may vary throughout the year. In a study involving a small sample of short-eared owls on Orkney, adults were found to synchronise their hunting to three-hourly cycles of activity shown by Orkney voles throughout the day (Reynolds & Gorman, 1999), although daylight hunting was conspicuous only in the spring and summer. Intensive fieldwork in three study areas in Scotland and across two breeding seasons (Calladine *et al.*, 2008) showed that adult owls were visible for less than 5% of the daylight hours from March to July, and that the most reliable times to detect the owls varied with stage of breeding (see 3.2.1 below). The chances of seeing short-eared owls may also be higher after prolonged periods of heavy rain.

3.2 Signs of occupancy

3.2.1 Locating home ranges

Observations should be made from suitable vantage points overlooking the area to be surveyed. To cover an area comprehensively, no part of the area should be more than 750 m from a vantage point (Calladine *et al.*, 2008). On the first visit to a new survey site, areas unsuitable for hunting and breeding can be usefully marked on a map and excluded from further survey (Gilbert *et al.*, 1998).

From March to mid-April (the settling period), encounter rates during the daylight hours are likely to be very low: in an intensive study, adult owls were only visible for 1-2 minutes per hour of watching (Calladine *et al.*, 2008). Hence in order to detect pairs that do not go on to lay, many hours of observation or night vision equipment may be required. From mid-April to May (the incubation period), short-eared owls are most detectable in the four hours before dark or (to a lesser extent) in the four hours after first light. Two 2-hour watches from each vantage point in the four hours before dark are recommended in order to have a 75% chance of detecting breeding owls during incubation. In June (the main chick rearing period), short-eared owls are more visible throughout the daylight hours; two 2-hour visits in the morning (up to 8 hours after first light) or evening (from 4 hours before dark) are recommended to maximise the likelihood of detection. In July, when most broods fledge, adults are most active 2-8 hours after first light and less so in the evenings (Calladine *et al.*, 2008).

The male short-eared owl carries out an elaborate display which may last up to an hour (Clark, 1975). It involves rapid ascent flights in tight circles with rhythmic wing beats (wings appearing to pause momentarily at the end of the downstroke and 'bounce back up' into the upstroke), interspersed frequently with 'wing-clapping', during which the bird loses height and may appear to 'drop like a stone' (Mikkola, 1983). As the bird gains height, it may wing-clap less and soar or hover, giving a characteristic advertising call. It may descend with shallow glides, each ending in a wing-clap before the ascent begins again. Such a display culminates in a near vertical stoop, with 'rocking-flight' (rolling from side to side with wings held in a deep 'V' shape). Displaying short-eared owls may not always go on to breed. Two birds flying parallel, showing 'wing-clapping', 'V-flying' or talon-locking may indicate males from two separate territories.

In Welsh moorland, few short-eared owls were seen actively hunting within 500 m of nests (Roberts & Bowman, 1986), whereas in young coniferous plantations in Dumfries and Galloway they generally remained within the coup used for nesting (Shaw, 1995).

For the purposes of estimating the number of territories in a given area, it is recommended that fieldworkers plot their observations of flightlines and behaviour (in particular behaviours indicative of territory holding or breeding, see 3.2.4 and 3.3 below) on large scale maps (Calladine *et al.*, 2008).

3.2.2 Locating roosts

The daytime roosts of breeding short-eared owls are found in deep vegetation close to the nest. To avoid unnecessary disturbance, searches for these roosts are not recommended.

3.2.3 Recognition of signs

Short-eared owl pellets may be found below posts and prominent features in the landscape (boulders, knolls). They are generally rounded at one end, tapered at the other and grey in colour (length = 22–82 mm; width = 11–32 mm; Glue, 1977b; Mikkola, 1983; Brown *et al.*, 2003). They are similar in size to those of long-eared owls and cannot usually be separated reliably, although in open habitats, well away from trees (with the exception of very young trees in plantations), any pellets found are likely to be from short-eared owls.

3.2.4 Evidence of occupancy

Occupation of a home range by short-eared owls and evidence for breeding (3.3 below) can be determined from behavioural observations as follows, representing ascending evidence (modified from Shaw, 1995; Gilbert *et al.*, 1998; Calladine *et al.*, 2008):

Possible territory / breeding

- (a) Owl(s) seen in flight in transit (not hunting).
- (b) Owl(s) seen using an area for hunting.

Probable territory/ breeding

- (c) Owl(s) seen perched.
- (d) Owl(s) carrying prey.
- (e) Courtship display (wing-clapping).

Confirmed territory/breeding

- (f) Owl(s) giving alarm calls or mobbing potential predators.
- (g) Owl(s) repeatedly carrying prey into an area.
- (h) Active nest located.
- (i) Recently fledged young owl(s) seen.

Owls perched on moorland or posts in the open between March and May may be male birds in close proximity to females during the egg-laying or early incubation period (Calladine *et al.*, 2008).

3.3 Evidence of breeding

Observations equivalent to categories (f) to (i) in Section 3.2.4 above provide evidence for confirmed breeding (Calladine *et al.*, 2008).

Behaviours indicative of territory holding and / or breeding may be seen relatively infrequently: of 464 sightings of short-eared owls over two breeding seasons, 162 (35%) involved such observations (Calladine *et al.*, 2008). Of these, 53% involved birds sitting in the open for more than 30 minutes during daylight hours between March and May, 20% mobbing of predators, 17% birds carrying prey, 7% wing clapping and 3% fledged juveniles.

3.3.1 Locating active nests

Areas over which short-eared owls have been observed (in particular areas where behaviours indicative of a confirmed territory have been recorded) should be watched from suitable vantage points that give a clear view of any possible nesting areas. During incubation, male short-eared owls may feed the female twice during daylight hours. There may be a higher

chance of sightings during the evening as the male may only feed the female in the morning if hunting the previous night has not been sufficiently productive (see 3.2.1 above).

During watches, hunting short-eared owls should be located and followed. When they catch prey, short-eared owls dive straight down into the vegetation. If a bird rises quickly, then it may have failed to make a kill and will resume hunting. If a kill has been made, the bird will often remain on the ground for several minutes. The prey will either be eaten or carried back to the nest (in the bill or feet).

Males carrying food fly directly towards the nest, usually at a greater height than usual. They normally deliver prey to the female at the nest although the prey may be dropped on the nest or, occasionally, the female may fly to the male to receive the food (Clark, 1975; Mikkola, 1983). As the male approaches the nest, he will usually land about 100–200 m away, apparently checking for the presence of potential predators such as corvids or other hazards (including people). The female may call from the nest encouraging the male to feed her. The male will then fly and/or walk to the nest, usually disappearing completely into the tall vegetation and rising quickly without the prey. Sometimes a male that has been hunting will make a high, direct flight and a 'gentle shiver'. If this behaviour is seen, the nest may be located directly beneath. It may be used by males that have been unsuccessful at hunting to alert the female that they are still around. The 'gentle shiver' is not the vigorous 'wet spaniel shaking itself' used in courtship but a briefer action, although still obvious when seen through binoculars.

Hunting male owls may also cache prey. In this case, the male will be on the ground for a few minutes — longer than a rapid nest visit. Laying a cache of surplus food close to the nest may be a means of controlling juvenile cannibalism when prey is abundant (Ingram, 1959). Both adults may cache prey once the female stops brooding the young.

Based on visits by the male and/or sightings of a female, the likely position of a nest in relation to at least three local features should be carefully recorded by taking a digital photograph and/or making a sketch map. A search can then be made. Female short-eared owls will not flush easily when incubating or when brooding small young.

Both parents feed the young once the female has stopped brooding and after they have left the nest. As the chicks grow, the frequency of feeds increases and they will occur later in the morning and earlier in the evening than during incubation.

Adult short-eared owls may also reveal the location of a nest or fledged chicks by hovering above a visiting fieldworker and vocalising ('barking').

3.3.2 Evidence for fledging

It is difficult to obtain accurate counts of brood size and the number of fledgings for short-eared owls, because the young hatch asynchronously and leave the nest about 10 days before they fledge. Counts of young before they disperse from the nest (to record brood size) can be made if the nest is found during incubation, by making a series of visits 2–3 days apart. Young often die shortly after hatching however, and it cannot be assumed that small chicks will survive and disperse.

Dispersed young can be counted by observing the adults feeding them during a single evening or morning watch. They attract the attention of the adult carrying food with a 'begging display' (Clark, 1975), which involves calling, ruffling the body feathers, and vibrating wings close to

the body. The young may also rotate and flap their wings to expose the more conspicuous underwing (Cramp, 1985), and may make a hissing call (not unlike the sound of cold water falling onto a hot stone). The adults either drop the food directly to the chick or land beside it and pass the food. These displays are very obvious and often mean that several chicks can be located as they respond to the adult. The position(s) of young should be carefully noted during the watch, in order to assess the minimum number present. The extent of down and the degree of development of flight feathers should be recorded as these can be used to estimate how soon an owlet is likely to fledge.

Brood size at fledging can only be estimated by counting flying young hunting over the home range shortly after they fledge. This gives a minimum figure because it is unlikely that all the fledged young will be observed, particularly if the home range is extensive.

3.4 Evidence for non-breeding

Non-breeding is common in short-eared owls, and is particularly associated with years of low vole abundance. Distinguishing between breeding and non-breeding in this species where behaviours indicative of breeding are observed infrequently (see 3.3 above) is particularly difficult. If a pair of short-eared owls is recorded occupying a home range, and no evidence of breeding is obtained despite several visits involving watches of sufficient duration at appropriate stages of the season, then it is possible that breeding has not taken place. If this is the case, territorial and courtship behaviour will decrease and the owls may disperse before the end of May.

3.5 Ageing and sexing

Limited data on ageing nestlings are available for a small sample of birds (two male and three female chicks) from a single brood of French birds reared in captivity (Arroyo *et al.*, 2000). These data suggest that nestlings up to 15 days old can be aged approximately, regardless of sex, from the equation:

$$\text{Age (days)} = (\text{Mass (g)} + 15.6) / 18.2 \quad (\text{vii})$$

and chicks older than 15 days can be aged, regardless of sex, by measuring wing length, from the equation:

$$\text{Age (days)} = (\text{Wing length (mm)} + 30.1) / 7.6 \quad (\text{viii})$$

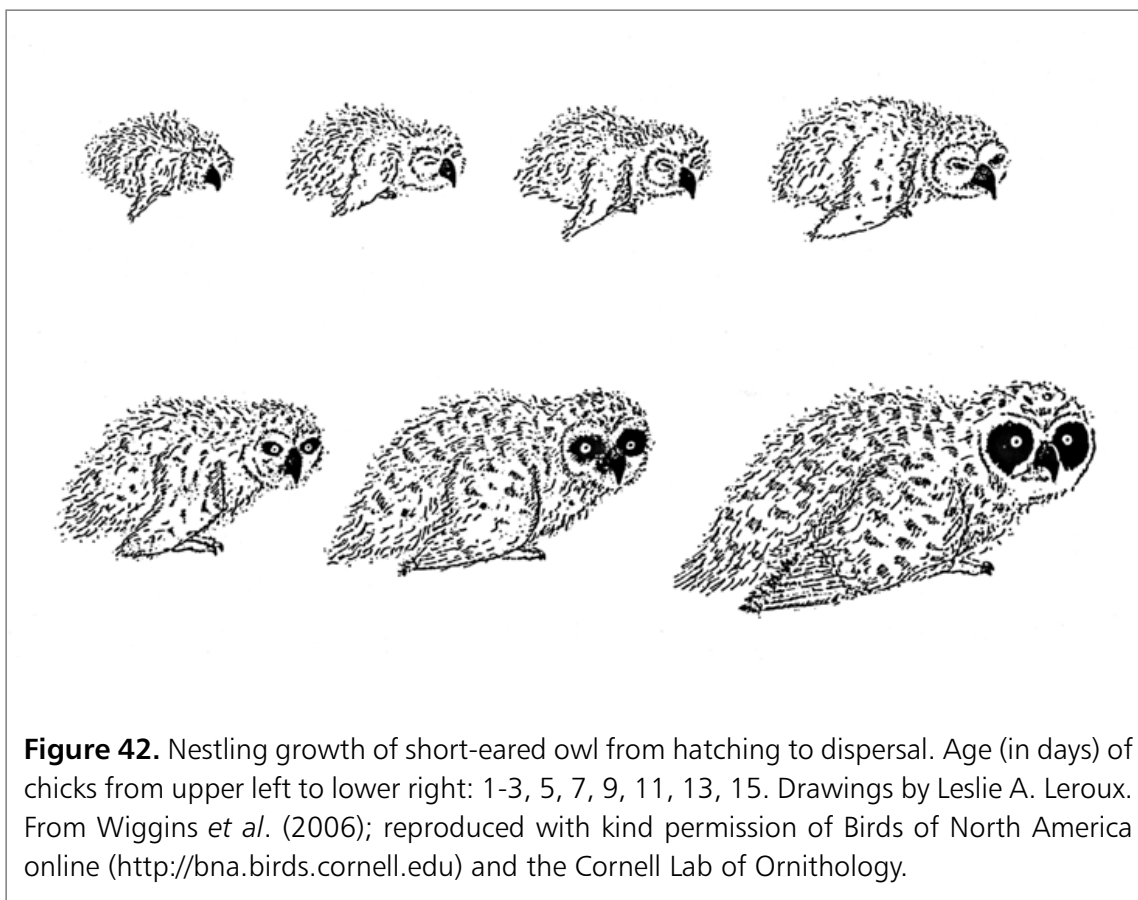
From a larger sample of young, including nestlings measured in the field, Arroyo *et al.* (2000) demonstrated differences in growth rate between males and females, concluding that males and females should be aged separately if their sex can be determined (see below). Based on the same small samples of young (two males and three females), they provide the following equations for ageing chicks of more than 15 days old:

$$\begin{aligned} \text{Female age (days)} &= (\text{Wing length (mm)} + 42.2) / 7.9 & (\text{ix}) \\ \text{Male age (days)} &= (\text{Wing length (mm)} + 28.6) / 7.9 & (\text{x}) \end{aligned}$$

These data require corroboration with a larger data set to confirm their generality but might be used to age young approximately.

The degree of development of body feathers and the presence of down can also be used to estimate the age of nestlings. The plumage development of short-eared owl nestlings prior

to dispersal from the nest is shown in Figure 42. A brood of three short-eared owl chicks of varying ages is shown in Plate 79.



From 10–15 days old, some chicks and juveniles can be sexed by examining the markings on the secondary feathers (Arroyo *et al.*, 2000). The underwing of males is paler with fewer thinner, dark transverse lines than that of females (Figure 43). In males ($n=7$), the average number of transverse lines per secondary feather was 2.4 ± 0.5 (SD) with a range of 2–3, while the females ($n=9$) had an average of 3.7 ± 0.7 (SD) with a range of 3–5. Transverse lines were also thinner on males and did not reach the edge of the feather (Arroyo *et al.*, 2000; Figure 43).

The upper side of the secondary feathers is also distinct. Males show a clear contrast between the pale ochre bands on the outer web and the pure white of the inner web. Females have a darker inner web: near the rachis, the colour is similar to the ochre of the outer web and fades to dirty white near the edge of the feather. In addition, the white tips of the secondary feathers are much larger in the male (Figure 43).

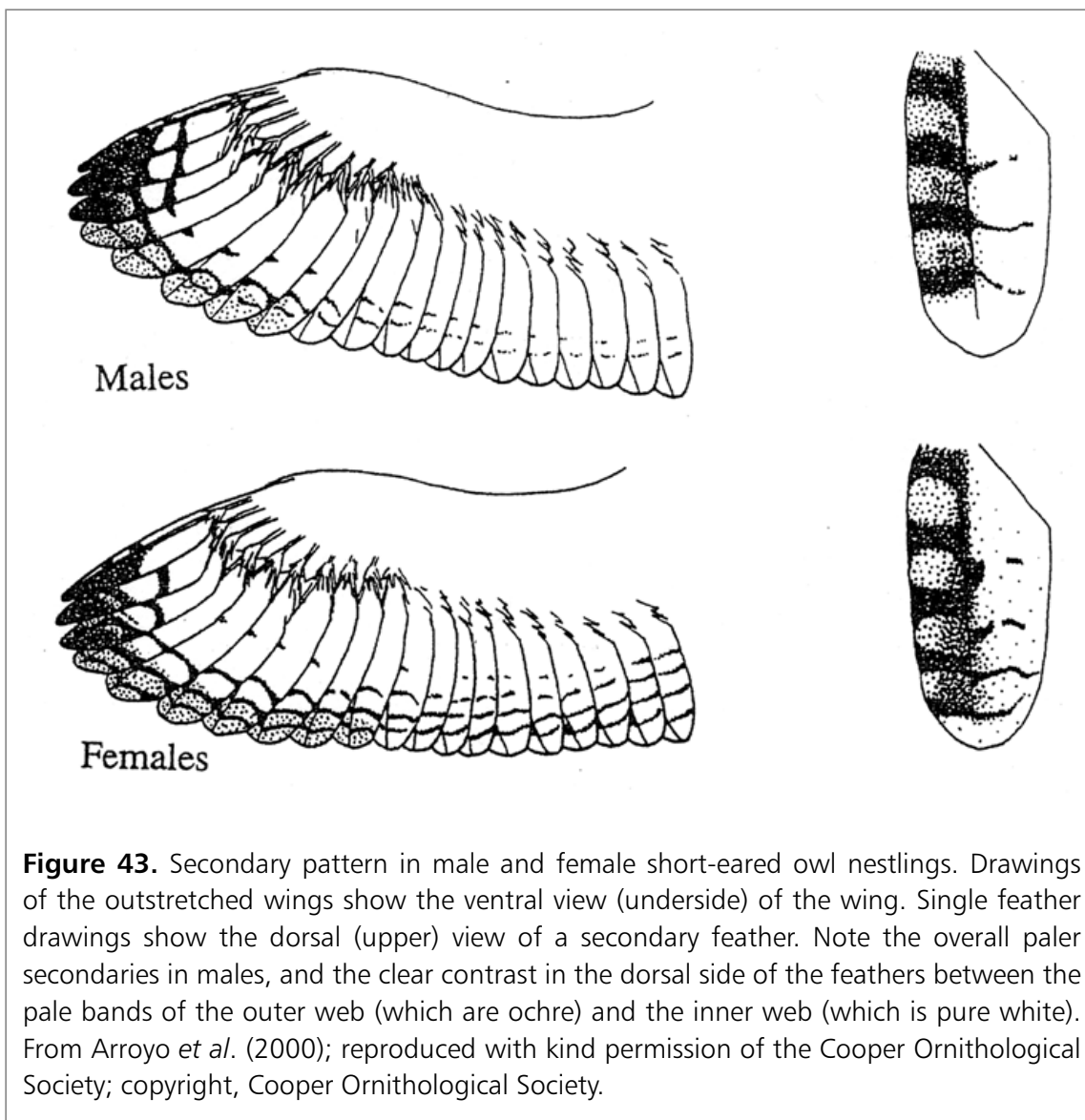


Figure 43. Secondary pattern in male and female short-eared owl nestlings. Drawings of the outstretched wings show the ventral view (underside) of the wing. Single feather drawings show the dorsal (upper) view of a secondary feather. Note the overall paler secondaries in males, and the clear contrast in the dorsal side of the feathers between the pale bands of the outer web (which are ochre) and the inner web (which is pure white). From Arroyo *et al.* (2000); reproduced with kind permission of the Cooper Ornithological Society; copyright, Cooper Ornithological Society.

4. SURVEYS OUTSIDE THE BREEDING SEASON

Short-eared owls may roost communally outside the breeding season (Glue, 1977b). Numbers vary considerably from year to year but individual roosts can hold as many as 30–40 birds (Clark, 1975). Typical roost sites overlook the surrounding hunting ground and have been found in grass-covered seawalls, in clumps of small trees or shrubs, in coarse grasses in recently afforested ground or sheepwalk, in deep heather and in reeds (Glue, 1977b). Short-eared owls may use the same roosts as hen harriers (Dickson, 1992). Wintering short-eared owls are primarily crepuscular and nocturnal (Bosakowski, 1987). They normally leave their roost after sunset but earlier departures tend to occur on heavily overcast days. The locations of roosts can be found by watching for concentrations of short-eared owls returning in the early morning or leaving in the evening; and numbers of birds using roosts can be counted by watching from a suitable vantage point as they leave the roost in the evening (Bosakowski, 1987).