

# Studies of West Palearctic birds★



## 195. Eurasian Woodcock *Scolopax rusticola*

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The Eurasian Woodcock *Scolopax rusticola* is an elusive bird which has evoked a sense of awe and mystery amongst naturalists for centuries. Even today, many birders regard it as a mysterious species and are intrigued by its peculiar roding flights and calls. The Eurasian Woodcock (henceforth referred to simply as Woodcock) is rarely seen on the ground owing to its cryptic plumage, and when disturbed in woodland it quickly disappears by means of a zig-zag flight. For most of the year, the Woodcock is solitary and silent, the obvious exception being during periods of roding at dawn and dusk in spring and early summer. The species has long been hunted in Britain and Ireland in winter, and much has been written in sporting literature about the arrival of migrant birds and the habitat associations of Woodcocks in winter. Until recent decades, however, the Woodcock was probably the British-breeding wader about which least was known of its behaviour and breeding biology.

When seen at close range, the two most arresting features of the Woodcock's appearance are its long tapering bill (67-80 mm, about 20% of its total length) and its large dark eyes set back in the crown of the head. The sexes are similar in

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\*This paper, and others in this long-running *British Birds* series, will be published in a forthcoming HarperCollins book.

plumage and morphology and are impossible to tell apart in the field other than by their behaviour during the breeding season. Even in the hand, there is as yet no definitive method of distinguishing males from females, although males tend to have marginally shorter bills and longer tails than females (Clausager 1973a). Although still a rare occurrence, Woodcocks with noticeably short bills (40–55 mm) have been recorded with increasing frequency during the last 20 years or so. The cause of this abnormality has yet to be determined, but in most cases the birds are apparently in good condition and seem to survive as well as do normal individuals.

Martin (1994) has demonstrated that Woodcocks are unable to see the tips of their bills and concluded that they do not forage visually. In common with that of other scolopacid waders, the tip of the Woodcock's bill contains many sensitive nerve endings and it seems that Woodcocks rely on tactile and chemical cues when feeding. Their food consists of soil invertebrates, primarily earthworms, beetle larvae and fly larvae, which are obtained mainly by probing. The unusual position of the eyes enables the Woodcock to see the entire hemisphere above and behind its head, an ability which is undoubtedly important in predator avoidance.

### Distribution, habitat and migration

There is a total of six species within the genus *Scelopax*, of which *S. rusticola* is the only one inhabiting the Western Palearctic. The American Woodcock *S. minor* is found in the Nearctic, whilst *S. saturata*, *S. celebensis* and *S. rochussenii* are limited to Indonesia and New Guinea, and *S. mira* is confined to the Ryukyu Islands. The breeding range of the Eurasian Woodcock probably comprises the entire temperate and boreal Palearctic and, apart from some scattered southern populations, the distribution limits lie between the July isotherms of 12°C in the north and 24°C in the south.

In Norway the northern distribution limit lies at 70°N, in Sweden and Finland at 66°N, and farther east it goes down to 64°N. In Siberia, the northern distribution is believed to coincide with that of the Siberian Fir *Abies sibirica* (Vaurie 1965). Island populations in the Azores, Madeira and the Canaries, as well as in Corsica, form the southern limit to the Woodcock's distribution. The southern limit on the mainland is less certain because, in this area, only high-altitude regions are inhabited. The limit runs through northern Spain (Pyrénées), the mountainous parts of southern France and northern Italy and then south into the Tuscan Apennines. It then follows the southern edge of the taiga at about 50°N as far east as southern Japan.

About one-third of the global Woodcock population breeds in Europe and by far the largest numbers are found in the former USSR and Fennoscandia, with over 90% of the European population occurring in these regions (Piersma 1986). These populations are migratory, wintering throughout western and southern Europe, but particularly in France, Spain, the United Kingdom and Italy. The breeding populations of northwestern Europe are largely sedentary.

Although related to snipes *Gallinago*, sandpipers *Tringa/Calidris* and curlews *Numenius*, Woodcocks are rarely found in coastal habitats except on migration and are generally associated with woodland. This is reflected in the bird's German and French names of *Waldschnefpe* and *Bécasse des bois*, meaning 'Snipe of the

Woods' and 'Long-billed bird of the Woods', respectively. The preferred breeding habitat is deciduous or mixed woodland (Clausager 1972), but conifer plantations are used up to the thicket stage (Shorten 1974; Marchant *et al.* 1990), as are large patches of Bracken *Pteridium aquilinum* in upland areas. Clausager (1972) concluded that, even in deciduous forests, the younger stands (aged 1-20 years as opposed to 21-100 years) were more densely populated. Where still present, coppice Hazel *Corylus avellana* probably provides good habitat for breeding Woodcocks. Data from the British Trust for Ornithology's National Sites Register suggest that in Britain there is a higher incidence of breeding in large woods (>80 ha), and that woods of less than 10 ha are rarely used (Fuller 1982). Clausager (1972) reported that in Denmark the minimum size of woods frequented by Woodcocks was 20-30 ha. Kalchreuter (1983) has suggested that, in many cases, increased disturbance by Man in small woods is probably the limiting factor rather than woodland size itself.

In Scotland, Woodcocks breed in sparse woods of scattered birch *Betula*, but show a preference for dense patches of naturally regenerating saplings (Hoodless 1994). In mature deciduous woodland, an understorey of brambles *Rubus*, Hazel, Holly *Ilex aquifolium* or Bracken provides cover from avian predators (Hirons & Johnson 1987). Nevertheless, breeding Woodcocks have also been found on treeless islands off the Irish coast (Shorten 1974), and I have found nests in Heather *Calluna vulgaris* on Scottish moorland. Earthworm-rich soils are chosen by Woodcocks for feeding areas during the breeding season, and, in lowland mixed deciduous woodland, Hirons & Johnson (1987) found that Woodcocks fed almost exclusively in stands dominated by Sycamore *Acer pseudoplatanus*, Ash *Fraxinus excelsior* or Pedunculate Oak *Quercus robur* and avoided areas of Beech *Fagus sylvatica* and mature conifers owing to their low densities of soil invertebrates. Wide rides and small clearings (1-3 ha) are important to provide easy access and flight paths in large woods (Shorten 1974).

The habitat requirements are less specific in winter, and patches of Gorse *Ulex europaeus*, willow *Salix* and Rhododendron *Rhododendron ponticum* often hold Woodcocks during the day. This is probably because, in winter, Woodcocks become nocturnal and frequent nearby fields to feed. Consequently, areas with permanent pasture or long-rotation grass leys within about 1 km of woods are preferred, as these types of field support high densities of soil invertebrates (Hirons & Bickford-Smith 1983; Granval 1988).

The Woodcock's breeding distribution in Britain and Ireland has changed little during the twentieth century, with absences only from Devon, Cornwall and south and west Wales (Witherby *et al.* 1940; Sharrock 1976; Gibbons *et al.* 1993). The reason why there are no breeding Woodcocks in these areas is still unclear. They each, however, support very high densities of Woodcocks in winter, and possible explanations for the absence in the breeding season are local extinction owing to high shooting pressure or increased overwinter mortality as a result of density-dependent effects when large numbers of migrant Continental Woodcocks are present. Breeding Woodcocks are currently most abundant in the north of England (Yorkshire, Co. Durham, Cumbria and Northumberland) and the lower-lying areas of Scotland (the Borders, eastern Tayside and the area between Inverness and Nairn). The highest numbers in southern England occur in Kent, Sussex and Surrey. Densities never seem to be particularly high,

however, even in prime habitats. Hirons' (1983) estimate of 18-23 individuals per km<sup>2</sup> during his study at Whitwell Wood in northeast Derbyshire is probably typical of the densities to be found in the best lowland deciduous woodland sites in England.

There was probably some expansion of range in southern Scotland, Wales and East Anglia during the 1950s and 1960s owing to the planting of large areas of new conifer forest (Parslow 1967), but the extent to which these were used by Woodcocks was never investigated. It seems likely that these forests are less suitable for Woodcocks now because they have reached the age where the canopy is closing. The size of the breeding population in Britain and Ireland is very difficult to estimate, but is believed to be about 36,000 individuals (10,250-26,000 'pairs'; Gibbons *et al.* 1993).

Migrant Woodcocks originating mainly from Fennoscandia and the former USSR visit Britain in winter. The first of these usually arrive in northern Britain during the second week of October and those in the south about ten days later (Hoodless & Coulson 1994). The influx of overwintering migrants continues until late December and is such that the British wintering Woodcock population may number 800,000 individuals (Hirons & Linsley 1989). This means that, if there are equal numbers of young and adult British Woodcocks in winter, Continental Woodcocks comprise approximately 91% of the wintering Woodcock population in Britain.

Woodcocks winter in all counties of Britain and Ireland, but generally avoid high ground in both Scotland and northern England (Lack 1986). They are thought to be more numerous on the British east coast and in southern and western England and Wales (Tapper & Hirons 1983). Densities often reach 30 per km<sup>2</sup> in Cornwall, with its mild climate and predominance of dairy farms, but densities of eight to 12 per km<sup>2</sup> are more typical in the largely arable areas of central and southern England. On higher ground farther north, such as in North Yorkshire and Co. Durham, densities tend to be about six per km<sup>2</sup> (Hoodless 1994).

Using information on the size of breeding Woodcock populations on the Continent and the proportion of ringed individuals recovered in Britain, I have estimated the proportions arriving from each country as 37% from the former USSR, 25% from Finland, 12% from Sweden and 10% from Norway (Hoodless & Coulson 1994). Comparison of the mean recovery latitudes of foreign-ringed and British-ringed Woodcocks and the proportions recovered in different areas of the British Isles indicates that by far the largest numbers of Continental migrant Woodcocks winter in southern England and Wales (Hoodless & Coulson 1994). The majority of these Continental Woodcocks depart during late February and March, but ringing has revealed that some are present in Britain until mid April. There are no records of any remaining to breed.

### Breeding system

Woodcocks are most conspicuous during the spring and early summer, owing to the distinctive roding flights performed by males at dawn and dusk. Flights average six to eight minutes and individuals generally make two to five flights per evening (Hirons 1978; Ostermeyer & Ferrand 1979). During the course of these flights, the males periodically reduce their wing-beats and give two to four frog-like croaks

followed by a series of sharp 'tizik' calls. Some individuals may rode for up to an hour in a single 24-hour period (Hirons 1983). They tend to rode for longer periods at dusk than at dawn, but roding may continue sporadically for most of the night during the full-moon periods. Study of sonagrams has revealed that, within the basic call, each male has his own distinguishable voice pattern (Hirons 1978).

Until the late 1970s, the Woodcock was believed to be monogamous, and roding flights were thought to delimit the boundaries of exclusive territories (Steinfatt 1938; Tester & Watson 1973), although promiscuity had been suggested by a few observers (von Zedlitz 1927; G eroudet 1952; Bettmann 1961). During the last 15 years, thanks to radio-tracking, great advances have been made in our understanding of the breeding behaviour of the Woodcock. In a large deciduous wood in Derbyshire, Hirons (1983) found that most first-year males did not rode and that the roding areas of the older males overlapped. Males will occasionally chase one another and very rarely three or even four individuals may be involved. Hirons concluded that a dominance hierarchy was established, resulting in a few males roding the longest and obtaining all the matings with females. He later demonstrated that males roded longest over the patches of best nesting habitat (Hirons 1988a).

To prove the existence of the male hierarchy, Hirons captured the two males which he believed to be most dominant in his study population and subsequently monitored the intensity of roding by the remaining radio-tagged individuals. He found that for two days following the removal of the dominant males the general intensity of roding was reduced, but then previously sub-dominant males started to rode for longer and within seven days the intensity of roding was back to its original level. When one of the original dominant birds was returned to the population, the level increased still further (Hirons 1983).

The female remains on the ground near clearings or rides and probably calls the male down. She often runs in circles, displaying the brilliant white tips of her tail, before allowing the male to copulate. Occasionally, the pair may make short low-level flights together. The pair bond usually lasts for only three or four days, during which time the male does not rode but follows the female closely. The male then resumes roding and does not revisit the female (Hirons 1980). It has also been shown that dominant males may fertilise up to four females in a season (Hirons 1980). The mating system of the Woodcock is generally now referred to as one of successive polygyny.

The age of first breeding by females has been reported as 12 months (Ostermeyer & Ferrand 1979; Hirons 1980), but it is not clear whether all females or only a proportion breed at this age. The gonads of first-year males are well developed by February-March (Stronach 1983), but the proportion of first-year males roding in a particular area seems to depend on the number of older males present. In Britain, only a small proportion of first-year males are thought to rode (Hirons 1980), whereas in countries such as Sweden, where older males are removed by spring shooting, up to 50% of roding males may be first-years (Marcstr om 1988).

Recaptures and recoveries of ringed birds indicate that a high proportion of breeding adults return to the same breeding site in subsequent years (Hoodless 1994).



**Plate 203. Woodcock *Scolopax rusticola*, Norfolk, March 1986 (Roger Tidman)**



**Plate 204. Concealed Woodcock *Scolopax rusticola* on nest in snow, Nottinghamshire, March 1974 (J. Ellis).** The bird's eye is dead centre in photograph, just to the right of the bole of the tree, with the bill pointing towards the right.

### Breeding season and productivity

The breeding season in Britain is generally considered to extend from early March to mid July. Two of the earliest recorded instances of roding in Britain or Ireland were on 3rd February in West Sussex (des Forges 1975) and on 15th February in Surrey (Raynsford 1959). I reckon to see roding Woodcocks in Hampshire and Dorset by about 20th February. Roding activity usually peaks in mid May and ceases by mid July. The earliest Woodcock clutch found in Britain was on 2nd March (Vesey-Fitzgerald 1946), although the nest observed by des Forges (1975) was probably completed on 2nd March. The latest clutch was found on 9th September (Savage in Glutz von Blotzheim *et al.* 1977). In Denmark, 43% of clutches were found prior to 7th April in years when the mean March temperature was 0.5°C or more above average and only 13% were found before 7th April when the mean March temperature was 0.5°C or more below average (Clausager 1973b).

The mean first-egg date from all BTO nest record cards up to 1989 was 18th April, but egg-laying commenced significantly later in the north of England (17th April) than in central and southern England (13th April) and was later still in Scotland (24th April) (Hoodless 1994). It may initially seem odd that the peak of roding activity is later than the main period of nesting, but this is probably because the dominant males quickly find mates during March and April, whereas in May and June, when most females have nests or young, they have to rode for longer before finding a receptive female.

The nest is little more than a flat hollow, measuring 13-15 cm in diameter, usually lined with dead leaves or dry grass. The clutch generally consists of three or four eggs, exceptionally two or five, and the mean clutch size from nest record cards is 3.9 eggs (Hoodless 1994). The eggs are usually laid on consecutive days or, less frequently, on alternate days. The incubation period ranges from 17 to 24 days, the average being 22 days. The female alone is responsible for incubation and the caring of the young (Shorten 1974; Hirons 1980).

During a prolonged watch of a Woodcock nest, des Forges (1975) found that the female left her nest on average four times a day during daylight hours, at intervals of about 2½ hours. The periods of absence lasted for 14-40 minutes. During the two days immediately preceding hatching, the absences were less frequent, with the female leaving the nest only twice a day. Woodcocks do not usually leave the nest at night. Time off the nest is spent feeding, and des Forges found that the female usually walked to her feeding area, which was never more than 30 m from the nest. Occasionally she walked only a few metres from the nest and then flew to her feeding ground.

Nest record cards have revealed that only 44% of nests survive from the day the first egg is laid until hatching, whilst in my intensive study at Whitwell Wood the proportion was 50%. Many Woodcocks will, however, re-nest after the loss of a clutch, but probably attempt to do so only once. Occasionally, the female will re-nest in the vicinity of the first nest, but usually she leaves the wood and selects another site up to 10 km away (Hirons 1983). Assuming that each female can make two nesting attempts, but that each will raise only a single brood per year, I have estimated that 65-71% of the females alive in mid April produce a brood of chicks.

Desertion is the cause of almost as many nest losses as predation, and previous authors have noted that the Woodcock seems particularly prone to desert its clutch (Shorten 1974; Kalchreuter 1983; Nethersole-Thompson & Nethersole-Thompson 1986). Desertion is often the result of accidental flushing of sitting birds by walkers and dogs or disturbance caused by forestry activities. Inevitably, in some cases, however, apparent desertion is due to predation of the female away from the nest, and Eurasian Sparrowhawks *Accipiter nisus* and Tawny Owls *Strix aluco* are known to kill adult Woodcocks. The main egg predators are Eurasian Jays *Garrulus glandarius* and Carrion Crows *Corvus corone*, although Wood Mice *Apodemus sylvaticus*, Grey Squirrels *Sciurus carolinensis* and Hedgehogs *Erinaceus europaeus* will also occasionally take Woodcock eggs. Red Foxes *Vulpes vulpes* and Stoats *Mustela erminea* are important nest predators, usually taking both the female and the eggs.

Egg fertility is high and, excluding eggs which are taken by predators during incubation, an average of only 7% are addled or are damaged by the parent bird. The chicks weigh 16-20 g at hatching and their bills are about 17 mm long (Marcström & Sundgren 1977; Hoodless 1994). They remain in the nest cup for only two to three hours before being led away by the female. The chicks remain in contact with the female by means of short, shrill calls, but she generally makes no attempt to feed them. Varga (1968) saw a female turning over leaves for the chicks, and Workman (1954) saw an adult feeding a chick bill to bill, but these observations are probably exceptional. Wilson (in Cramp & Simmons 1983) followed the movements of 14 broods, but never saw the female help the chicks to feed, and this was the case with the few broods that I observed during the period shortly after hatching. Woodcock broods do not generally wander so far as those of other waders (Nethersole-Thompson & Nethersole-Thompson 1986) and often remain within 250 m of the nest during their first ten days.

In the event of danger, the female performs an impressive distraction display, flying away from the chicks with laboured wing-beats and a depressed tail (Lowe 1972). She then circles the potential predator at a distance of about 20 m and will occasionally drop to the ground and feign a broken wing. Much has been written about Woodcocks carrying their young, a subject of considerable controversy. In some instances, observers have clearly mistaken the laboured distraction display for the female carrying a chick. Nevertheless, there are now several records from observers who have managed to follow the female to the point where she drops and have then found a chick (Alexander 1946; Nethersole-Thompson & Nethersole-Thompson 1986). It must be concluded that Woodcocks will occasionally carry their young, but do not do so in every instance when they are disturbed.

The chicks are able to fly after 20 days (Hirons 1983), by which time they weigh 130-160 g (about 50% of the adult weight) and their bills are about 45 mm long. They become independent of the female shortly afterwards, but are not fully grown for at least another 20 days. Mean chick survival until fledging at Whitwell Wood was 45%, but the rate of chick mortality varied greatly from year to year (Hoodless 1994). During the summers of 1989 and 1990, which experienced average rainfall, 60% of chicks survived to fledging, whereas during the very dry summers of 1991 and 1992 only 32% of chicks fledged. The reason for the poor chick survival in years with dry summers is thought to be that



earthworms are less available. Hirons (1988b) found that in northern England there was a correlation between the ratio of adult to young Woodcocks shot by hunters in winter and the amount of rainfall the previous summer.

It has been suggested that the Woodcock is double-brooded (Alexander 1946; Clausager 1973b), but there are only two proven instances of this, where Woodcocks incubating eggs were seen surrounded by a brood of chicks (von Zedlitz 1927; Jensen in Pay 1937). It is possible that the prevalence of double-brooding might vary regionally and seasonally according to the prevailing weather (Kalchreuter 1983). Further information from a marked population, preferably containing radio-tagged individuals, is required before any firm conclusion can be drawn.

### Diet, winter behaviour and mortality

Woodcocks take their food from the ground surface, from under leaf litter and by probing. They eat a wide range of invertebrates, including earthworms, adult and larval beetles, caterpillars, sawfly larvae, spiders and harvestmen, ants, millipedes, woodlice, earwigs, fly larvae and small snails. Vegetable matter generally comprises only a small component of the diet and consists of seeds of buttercups (Ranunculaceae), spurge (Euphorbiaceae), sedges (Cyperaceae), peas (Leguminosae) and grasses (Gramineae) (Glutz von Blotzheim *et al.* 1977). Kiss *et al.* (1988) found vegetable matter in Woodcock stomachs in autumn, winter and spring, but the proportion relative to animal matter was highest in spring. There appears to be great regional variation in the relative proportions of invertebrate prey items, but, when the ground is soft enough to allow probing, the proportion of adult beetles, earwigs and millipedes tends to decrease in favour of earthworms (Glutz von Blotzheim *et al.* 1977). In spring and summer in northern England and Scotland, earthworms, spiders, millipedes and woodlice are the groups taken most frequently by both adult Woodcocks and chicks. Adults, however, also select beetle larvae more often than expected from their availability, whilst chicks exhibit a particular preference for spiders (Hoodless 1994). The greatest variety of prey items is taken during autumn migration. In mild winter conditions, earthworms and leatherjackets (Diptera larvae) are by far the most important components of the diet (Hirons & Bickford-Smith 1983; Granval 1988).

During the breeding season, Woodcocks feed in woodland by day and remain in cover to roost at night. In autumn, however, their behaviour changes, and throughout the winter and early spring Woodcocks are nocturnal and leave the woodland at dusk to feed on nearby fields. They return to cover approximately half an hour before dawn (Hirons & Bickford-Smith 1983) and roost during the day. It is thought that this change occurs because invertebrate food becomes relatively more available in fields in the winter (Hirons & Owen 1982). It may, however, also be due in part to the fact that Woodcocks foraging in open, mainly leafless woodland by day would be especially vulnerable to avian predators, which

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Plates 205-207. Woodcocks *Scolopax rusticola* on nests. Top, Norfolk, April 1985 (Roger Tidman); centre, with eggs, Nottinghamshire, May 1991 (J. Ellis); bottom, with chick, Nottinghamshire, June 1992 (Gerald M. Hall)



are known to constitute an important threat in the breeding season, when there is more cover than in winter (Hirons & Johnson 1987).

The Woodcocks select permanent pastures and grass leys in preference to plough or fields of winter cereals (Ferrand & Gossmann 1988; Hoodless 1994), even in areas where the proportion of grass fields is very low (Hirons 1983). In grass-dominated farmland, they feed on the permanent pastures with the highest densities of soil invertebrates, and the same individuals often return to the same field each night for up to a month (Hoodless 1994). During cold spells when Woodcocks are unable to feed at night, they will often frequent streams during the day (Hirons & Bickford-Smith 1983), although I have seen them on fields at night even when the ground was frozen.

On the basis of the mean Woodcock hunting bags per county during a mild winter (1979/80) and a cold winter (1980/81), Tapper & Hirons (1983) have suggested that there is a redistribution of Woodcocks within Britain during cold winters. If this is the case, it probably involves only the Continental migrants, as there is no evidence from ringing recoveries that British Woodcocks move farther from their natal or breeding sites in cold winters or cold spells within winters (Hoodless & Coulson 1994). It seems plausible that the resident and the migrant Woodcocks might follow different strategies in cold weather, since the resident birds will probably benefit from remaining in the same place owing to familiarity with the site, but the migrants have little to lose by moving and may have a better chance of finding an unfrozen feeding area elsewhere.

Woodcocks can generally withstand four or five days of freezing conditions, but they are believed to experience higher mortality in exceptionally cold winters owing to all of their feeding sites becoming frozen (Baillie *et al.* 1986; Marchant *et al.* 1990). During the severe winter of 1962/63, unusually large numbers of Woodcocks were concentrated in the southern and western counties of England and Wales and significant numbers were among the many dead birds reported (Ash 1964; Dobinson & Richards 1964). There is no direct evidence that more Woodcocks move to Britain from the Continent in cold winters, but there is a suggestion of this from increased numbers of sightings of Woodcocks on the coast (Dobinson & Richards 1964; Marchant 1982; Cramp & Simmons 1983).

The annual adult survival rate of British Woodcocks has been calculated from 342 ringing recoveries as 58%, while first-year survival has been estimated from 426 recoveries as 47% (Hoodless & Coulson 1994). The main natural predators of adult Woodcocks are Eurasian Sparrowhawks, Tawny Owls, Red Foxes and Stoats, although Northern Goshawks *Accipiter gentilis*, Peregrine Falcons *Falco peregrinus*, Golden Eagles *Aquila chrysaetos* and Common Buzzards *Buteo buteo* are also known to take them (Nethersole-Thompson & Nethersole-Thompson 1986). Woodcocks found dead have generally fallen into wire fences or overhead cables, or collided with vehicles.

### Status and population pressures

The state of the British breeding Woodcock population is very difficult to assess because there is no simple way to census the species. Woodcock nests are notoriously difficult to find and, although counts can be made of roding males, these are of questionable value because of the species' polygynous mating system

and the fact that only a proportion of the males rode. The BTO's Common Birds Census (CBC) index suggests a progressive decline in the British Woodcock population, which has become steeper since 1980 (Marchant *et al.* 1990). The CBC is, however, not particularly suited to crepuscular species such as the Woodcock which do not hold breeding territories, and it is not clear how reliably the CBC monitors the Woodcock population. In addition, the CBC data are biased towards southern England and it is now clear that Woodcocks are more numerous and have fewer gaps in their breeding distribution in northern England and Scotland (Gibbons *et al.* 1993). Nevertheless, the difference in the records of breeding Woodcocks between the BTO breeding-bird surveys of 1968-72 (Sharrock 1976) and 1988-91 (Gibbons *et al.* 1993) clearly points to a reduction in the size of the British breeding Woodcock population.

Woodcocks are still highly prized by sportsmen, who can legally shoot them between 1st October (1st September in Scotland) and 31st January. The impact of hunting on the Woodcock is very difficult to assess, but it is likely that shooting claims only a small proportion of the total overwintering population. There was no significant difference between the annual adult survival rates of ringed individuals that were shot and that were found dead (Hoodless & Coulson 1994), and recent evidence suggests that there has been a decline in hunting pressure on Woodcocks in Britain and Ireland, together with most other European countries, since the 1960s (Henderson *et al.* 1993). Hunting statistics provide an indication of changes in the numbers of wintering Woodcocks from year to year, but yield no information on the British breeding population because of the large influx of Continental migrants. Game Conservancy Trust figures suggest that the size of the wintering population has remained relatively constant since 1960 (Tapper 1992).

Forestry practice in Britain clearly affects the Woodcock population by altering the amount and type of habitat available to the species. Habitat loss is caused by the closing of forest canopies, conversion of mixed stands to pure conifer stands and clear-felling. In the south of England, there has been a net loss of woodland and covert since the 1930s owing to the felling and fragmentation of old woodlands and the dissolution of former sporting estates (Marchant *et al.* 1990). There has also been an 82% decline in managed coppice in Britain since 1950 (Warren & Key 1991). These losses may have been offset to some extent by the creation of large areas of new conifer forests during the 1950s and 1960s mentioned earlier. Information is still required, however, on the extent to which conifer plantations of different ages and different species composition are used by breeding Woodcocks.

Because Woodcocks feed primarily on farmland in the winter and early spring, their fortunes may fluctuate in relation to changes in agricultural practice. The single factor most likely to account for the widespread decline in the number of resident Woodcocks is probably the large-scale conversion of pasture to tillage in Britain since the 1950s. There has also been a vast increase in the range and quantity of pesticides applied to farmland, and the effects of some of these chemicals on the soil-invertebrate food of birds are still poorly known. It has been shown recently that some molluscicides and fungicides are directly poisonous to earthworms and some other classes of soil invertebrates (Wiltshire & Glen 1989). The cattle anthelmintic *Ivermectin* has also caused concern because it inhibits the



larval development of certain Diptera and dung-beetles (*Aphodius*) (Madsen *et al.* 1990). Earthworms are known to adsorb pesticide residues readily, and Woodcocks may therefore be contaminated by accumulation of these residues. Such an effect was demonstrated in the case of the American Woodcock during the early 1960s, which accumulated lethal doses of heptachlor epoxide that was applied in the Gulf States to control the imported Fire Ant *Solenopsis saevissima* (Stückel *et al.* 1965a, b). Another potential problem is the recent occurrence of the New Zealand flatworm *Artiosthia triangulata* in some parts of Britain and Ireland. This flatworm feeds upon earthworms, and the Woodcock is one of many birds and mammals likely to be affected adversely if the flatworm becomes established widely and abundantly in the soil here (Hancocks 1995).

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