The Pheasant

A Special Report by
The Game Conservancy Trust

Sponsored by Hiscox Underwriting Limited

Contents

Preface

The pheasant, though not indigenous, is a highly significant species in Britain. Its value as a sporting quarry has made it one of the most common birds and it accounts for over 80% of gamebirds harvested through shooting. It is one of the most important gamebirds, not just in this country, but throughout Europe and North America.

Despite being reared and managed for shooting, pheasants are not just an artificial part of Britain's countryside. There are significant wild populations: if management for shooting ceased, they would remain in many areas, albeit at much lower densities.

Because of the importance of shooting in our rural economy, the pheasant's presence – through management – has helped to shape the very countryside itself. The majority of British shoots depend on reared pheasants to ensure adequate sport and they therefore provide one of the few tangible incentives for farmers to manage their land with wildlife in mind. Often it is only the revenue generated from pheasant shooting which makes conservation on lowland farms a viable proposition.

While this Report is primarily concerned with the wild pheasant in Britain, its biology, management and habitat, at no time do we forget the importance and impact of reared pheasants on the conservation of the countryside as a whole.

History of the Pheasant in Britain

Although intensively managed since the middle of the 19th Century, pheasants were introduced to this country much earlier – by the Normans, or possibly even the Romans.

The first record of an introduction in Europe comes from Greek mythology when Jason and the Argonauts were said to have brought the pheasant back from the valley of the River Phasis in the Colchis region of Georgia after their Golden Fleece search. The pheasant's Latin name, *Phasianus colchicus* reflects this story. There is also evidence that the pheasant was present in Britain during the Roman occupation: recipes survive and pictures of pheasants have been found in mosaics. The Romans kept them as cage birds for food, but it is unlikely that there was a wild population in the UK until after the Norman conquest.

THE MOSAIC AT WOODCHESTER (AD325) CLEARLY DEPICTS A COMMON PHEASANT

Pheasants were certainly breeding in the wild during the late 15th Century. They reached Scotland and Ireland in the 16th Century and Wales soon after. By the early 19th Century they were firmly established and ranged throughout the kingdom, with the exception of the Scottish Highlands and offshore islands.

Origins of the Pheasant and its Distribution

The pheasant is amazingly adaptable and has become naturalised in wide-ranging countries with diverse habitats. It can be found in arid, almost desert climates; mid-continental prairies where the winters are long and temperatures can plunge to –40C; to temperate climates with mixed agriculture and forest habitats. There are, however, common elements which govern the pheasant's range and historical distribution. It is a species of temperate agricultural ecosystems, requiring shrubby vegetation such as woodland edge and agricultural land.

THE MIXED AGRICULTURE AND FOREST HABITAT OF CHINA IS FAR REMOVED FROM BUT NO LESS APPEALING TO PHEASANTS THAN THE MID-CONTINENTAL HABITAT OF NORTH DAKOTA.

The pheasant's natural range extends from the Caucasus, along the Black Sea and east across Asia to Korea, Manchuria, China, Taiwan and, in the case of the Green Pheasant, Japan. This natural range has dramatically expanded due to introduction by man. As a result the bird is naturalised throughout most of the temperate regions of Europe and North America, though in the latter it was not successfully established until the 1880s, with stock imported directly from China.

Figure 1

Pheasants harvested in Britain

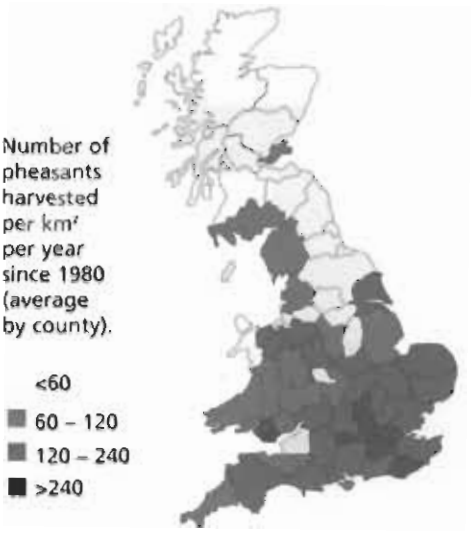
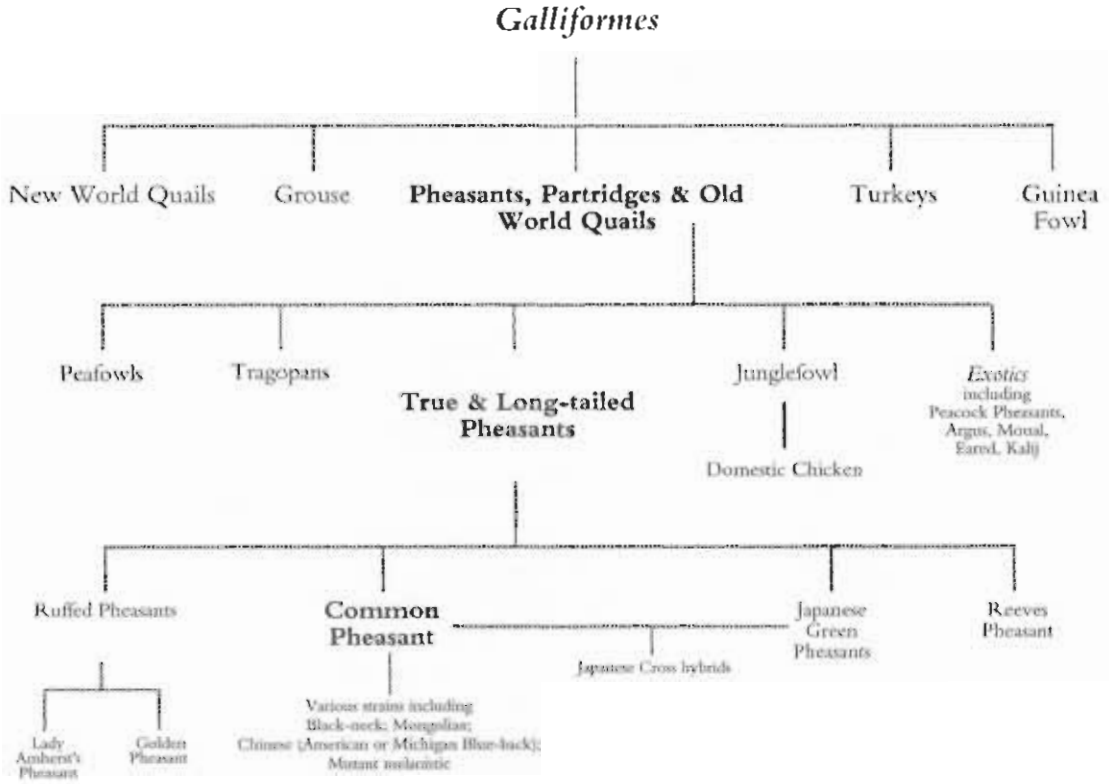


Figure 2

Wild pheasant habitat

The species and its relatives



In Britain, the extent and density of the pheasant's range can be illustrated well by the number of pheasants harvested, see Figure 1. It is also interesting to compare this with the most suitable wild pheasant habitat in Britain, see Figure 2.

The Species and its Relatives

The Common Pheasant is a member of the order Galliformes, a group distributed globally. This order also includes groups such as partridges, quail, grouse, turkeys and guinea fowl.

The Common Pheasant is one of 47 different pheasant species. The other 46 include Peafowls, Tragopans, Junglefowl and exotic pheasants such as the Argus, Monal, Eared, Kalij, Ruffed and Long-tailed. There are a large number of sub-species of Common Pheasant defined mostly by geography and the colours of the male's plumage. Sub-species introduced outside their native ranges have freely interbred with each other and with the closely related Japanese Green (*P. versicolor*).

Of the 47 species of pheasant, the Peafowls are the largest and perhaps the most striking as the males carry the magnificent tail feathers used for courtship. The males of the less well known Argus also have exquisite tail feathers used for display. Another group, the Peacock pheasants, are small and secretive with grey or brown plumage but marked with shimmering metallic eyes, or ocelli, like those of true peacocks. The Monal pheasants of Asia's high mountain ranges are superbly coloured – some males of other species have 'bibs' under their chins which they inflate during courtship and their flank feathers are marked with eye spots. Also among this list of pheasant species is the Junglefowl, the ancestor of the domestic chicken. The Eared pheasants are large birds with feather tufts which give them their name. The Kalij pheasants have laterally compressed tails and brightly coloured wattles.

The group of true and long-tailed pheasants includes the Common Pheasant (referred to throughout the remainder of this Report as the 'pheasant') and similar species such as the Reeves Pheasant which has one of the longest tails of any bird (up to two metres long). Finally, the Ruffed pheasants include only two species: the Golden and Lady Amherst's. Both these species originated in China but have been successfully introduced to Britain.

Definitions: 'Wild' and 'Reared'

There are many different ideas about what is classified as a 'wild' pheasant. This has created a great deal of confusion. The following definitions are those used by The Game Conservancy Trust.

Hand-reared: Pheasants which were reared in captivity and then released.

Wild-reared: Any pheasants which were reared in the wild by hens which were themselves hand-reared.

Naturalised: Any pheasants which were hand-reared, and have survived to their second breeding season.

Wild: Any pheasants reared in the wild by hens which were also reared in the wild.

THIS COCK PHEASANT HAS A TYPICAL BRONZE PLUMAGE SHOWING A PARTIAL WHITE NECK RING AND RED FLESHY WATTLES

Distinguishing Characteristics of the Common Pheasant

Pheasants are fairly large birds, with males weighing around 1.3 kg and females around 1 kg. Males typically have a bronze plumage marked with black, a dark metallic blue head and a long barred tail. They also have bright red erectile wattles around each eye and tufts of feathers behind each ear known as 'pinnae'. The females are drab in comparison, with a fairly uniform light brown plumage, a shorter tail and no wattles or pinnae. Since the selective breeding of strains in Britain by game farmers, there is now a range of colours from black or dark brown through to pure white. Many males have a white neck ring of varying width and white or blue coverts on the wings. Interbreeding of different strains has occurred to such an extent in Britain that the original population, known as 'Old English Blacknecks' are found only in certain areas. Illustrations of the range of varieties appears on page 25.

Pheasants and Other Wildlife

We cannot talk about pheasants in isolation: they are part of a whole ecosystem in the British countryside. While managing habitat and controlling predation pressure for pheasants, the other birds and wildlife which share that ecosystem are also affected.

For example, the management of woodland for pheasants, particularly the establishment of a coppice shrub layer, is also likely to increase the numbers of other birds that inhabit woodland with open areas, shrubby edges and low cover. The willow warbler, spotted flycatcher, chiffchaff, song thrush, blackcap, garden warbler and nightingale are such beneficiaries.

Predation control by gamekeepers during the breeding season not only increases the number of pheasant chicks hatching, but is also likely to have a similar impact on breeding waders, songbirds and other gamebird species. Some songbirds also benefit from the abundant insect food associated with conservation strips prepared for

THE PEARL-BORDERED FRITILLARY (*BOLORIA EUPHROSYNE*) NEEDS OPEN AREAS IN WOODLAND – A FEATURE FREQUENTLY ASSOCIATED WITH PHEASANT MANAGEMENT

CHAFFINCHES ABLE TO FEED ON STUBBLES AND GAME CROPS ARE MORE LIKELY TO SURVIVE THE WINTER.

pheasants. Many seed-eating species such as yellowhammers include insects in their diets during the breeding season and these are scarce in intensively managed crops. Gamebirds, buntings and finches all feed on stubbles during the winter, so where stubbles are left unploughed for pheasants through the winter, survival rates of these species are likely to be higher. Game crops specially planted for pheasants also provide a valuable food source for finches, buntings and sparrows.

Benefits are not limited to birds. Cutting rides and 'skylights' for pheasants in areas of otherwise dark and shaded woodland has had a dramatic beneficial effect on populations of butterflies, increasing the numbers of individuals and the variety of species. Two species benefiting specifically from pheasant management are the pearl-bordered and the small pearl-bordered fritillaries. Since the demise of traditional coppicing, these two species have generally declined.

Many woodland flowers such as the now protected bluebell flourish in woods managed for pheasants. Conservation headlands benefit gamebird chicks as well as rare flowers such as the pheasant's eye, rough poppy and corn buttercups. Occasionally, intensive management for pheasants can have adverse effects on other species and the landscape. For example, some Victorian game shooters introduced invasive non-native shrubs to British woodlands. Today, indiscriminate use of straw on pheasant feed rides can sometimes damage the ground flora. Overcoming this particular problem is simple and some guidelines are given on page 22.

Deer browsing, by rapidly expanding fallow and roe deer populations, can make coverts cold, draughty and unattractive for pheasants and other wildlife. This can happen gradually without it being noticed. However, with effective deer management, the problem can be avoided.

In describing our understanding of pheasants, this Report breaks down the life-cycle of the bird into its major components. Like all other species of wildlife these are simply defined as the need to eat, the need to avoid being eaten and the need to reproduce. For pheasants we can divide the year into several periods which are dominated by particular factors. Chapters follow on each of these.

SONG THRUSHES THRIVE IN PHEASANT HABITAT WHICH PROVIDES THEM WITH OPEN AREAS AND SHRUBBY COVER FOR NESTING.

Winter

The winter is the pheasants' preparation time for breeding in spring. They remain in areas of cover during this cold season. In Britain, the winters are rarely harsh enough to cause high mortality in pheasants, although snow and ice can cause problems. Throughout the winter, the sexes are segregated, generally in loose flocks. Both young and old males remain relatively solitary, tending to space themselves throughout the available habitat, where the typical size of their home range is between 20 and 25 hectares. Males are often found dispersed in less suitable habitat such as hedgerows or small clumps of shrubs.

Cock pheasants are intolerant of each other and competition amongst them is intense, so during the winter they assess each other and develop a 'pecking order' before establishing their breeding territories in the spring. By March, they have claimed suitable breeding sites and competed for territories surrounding them.

The females, however, form stable flocks and remain in the best areas of warm woodland. They do not need to compete with each other and so can spend their time in the safety of a flock. Winter flocks of females contain a stable core mainly of older hens who can often be found together. The younger ones are more likely to drift between different flocks, but still remain in woodland areas.

A GRADUAL INCREASE IN HEIGHT OF SHRUBS AND TREES FROM THE OPEN FIELD IS A CLASSIC HALLMARK OF GOOD OVERWINTERING HABITAT FOR PHEASANTS.

Habitat

Woodland is the most common overwintering habitat for pheasants, but they can also be found in areas of rough ground, reed filled dykes, wetlands and game and arable crops left standing during the winter. Pheasants are drawn to woodland at this time of year because it provides cover, a reliable source of food and shelter. Although attracted to woodland, they spend the majority of their time during the winter within 20 metres of open ground. Adjacent cereal stubbles can be a good source of food.

Short-rotation coppice

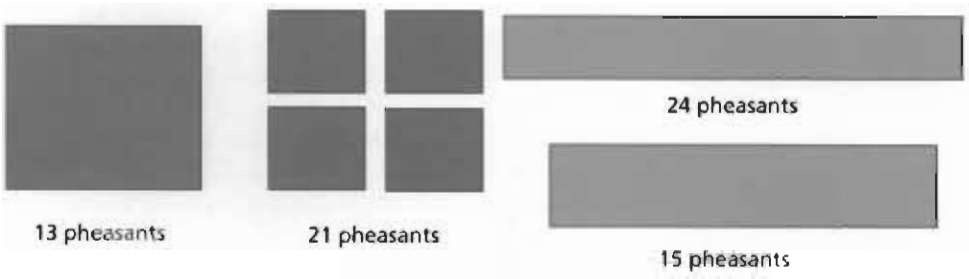
A new crop, short-rotation coppice (SRC), involves fast growing willow and poplar usually destined for energy production. SRC can make attractive winter habitat for pheasants. Sympathetically managed production plots of this woodland type can also attract songbirds and other wildlife to farmland. The incentive to plant SRC on a large scale depends on the likely economic return, not on the wildlife and game value (although this contributes), so if the crop does not provide an economic return, the potential conservation benefits are unlikely to be realised.

In addition to providing winter cover, SRC can help increase pheasant breeding densities by providing extra sites for territories. Surveys indicate that similar numbers of breeding birds use SRC compared to more traditional woodland.

For successful pheasant shooting, SRC should be carefully sited. Blocks should not be too close together, nor too close to a release wood. Ground contours should be made use of wherever possible. This must be balanced against the practicalities of harvesting the coppice. The Advisory Service of Game Conservancy Limited can provide detailed advice on a case by case basis and has over 40 years experience of designing woodland for pheasants, (Telephone: 01425 651013).

GROWN PRIMARILY FOR ENERGY PRODUCTION, SHORT-ROTATION COPPICE ALSO PROVIDES USEFUL PHEASANT COVER DURING WINTER.

Pheasant density in woodland during winter as a function of woodland shape



Each shaded area represents one hectare of woodland

The features selected by pheasants during winter and spring are broadly similar: a high proportion of woodland edge and shrubby cover, with a preference for mixed stands of different aged trees rather than uniform areas of any one type. Correctly managed woodland can increase winter densities and encourage more breeding birds in the spring.

For roosting, pheasants prefer trees which provide dense, wind-proof and fox-proof cover during the night and horizontal branches on which to perch. Trees such as larch (post-thicket) and spruce as well as mature oak and hazel, firs and western hemlock provide these features. Some of the densely branched medium height species are also good, such as field maple, wild crab, hawthorn and blackthorn – the last two being particular favourites.

Woodland edge

Winter pheasant density within woodland is related to the length of edge in a given wood. Small woods tend, therefore, to hold higher densities of pheasants than larger ones as they have a higher edge to area ratio. Woods of less than 3-5 hectares seem to be the best. Irregular shaped and narrow woods have an increased edge to area ratio and can also hold more birds, see Figure 4.

SNOW AND ICE CAUSE PROBLEMS FOR PHEASANTS, BUT IN BRITAIN WINTERS ARE RARELY HARSH ENOUGH TO CAUSE WIDESPREAD MORTALITY

Shrubby cover

The Game Conservancy Trust's data show that higher densities of pheasants are found in woods with abundant shrubby cover – woody vegetation between 0.3 and 2.0 metres high. This feature is important within woodland as an understorey beneath overstorey trees. Without it, woodland is draughty and unattractive to pheasants. Shrubby cover also increases pheasant densities at the woodland edge, where the birds spend most of their time. Gradually increasing tree heights from the open field provide more holding cover for pheasants than woodland edges where shrubs are scarce or where there is a sudden height increase to the canopy. So long as these shrubs provide suitable cover, pheasants do not seem to be particularly attracted to any specific species. Traditional woodland management such as hazel coppicing is one technique which ensures abundant shrubby cover for pheasants in winter.

Woodland rides

Woodland rides can provide alternative 'edges' for birds in large blocks of woodland and seem to increase suitable cover for overwintering. The Trust's research has shown, however, that there must be a distinct break in the canopy for there to be a pronounced edge effect. This means that a ride should ideally be between 30 and 50 metres wide. Where rides are narrower than this, they do produce a slight edge effect but remain partially shaded, so pheasants are less attracted to them.

Non-woodland habitat

Pheasants make use of a variety of habitats other than woodland. Cover crops planted for shooting often provide shelter and food for pheasants throughout the winter. A crop consisting of a single species can provide suitable habitat, but mixtures are also used and are a requirement if the crop is to be grown on Set-aside land. For example, kale mixed with quinoa provides good winter habitat. Addition of a biennial such as parsnip or teasel will maintain the mixture into the second year, as quinoa does not reseed. In the South East and East Anglia, mixtures including maize or millet are the most commonly grown game crops though not on Set-aside. They can also provide the type of cover needed by pheasants after shooting.

In the USA, the dense cover of reeds or cat-tails is often cited as very important habitat during cold winter weather. The thick layer of vegetation near the ground appears to be more important to the pheasant than the particular species. In several parts of the USA, wetland vegetation management is considered a crucial part of overall pheasant habitat management programmes. This can also hold true in East Anglia where wetland vegetation is commonly associated with pheasants.

Figure 5

Pheasant diet during winter is affected both by farming methods and by gamekeepers

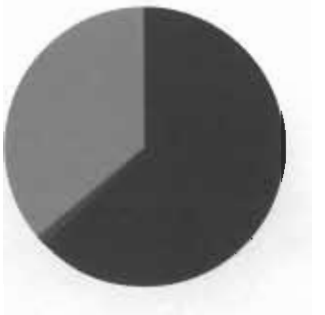
Pheasant diet during winter

Keepered Estates

- Green Shoots 45%
- Broadleaves 3%
- Wild Seeds 0.5%
- Wild Fruits 0%
- Insects 0%
- Cereal Grains (mainly provided by keepers) 51.5%

Unkeepered Estates

- Green Shoots 63%
- Broadleaves 0%
- Wild Seeds 1%
- Wild Fruits 35%
- Insects 1%
- Cereal Grains 0%



Fox control is best carried out at night using a rifle before the crops get too high

Food

During the winter, when many birds find it hard to get enough food, pheasants seem to cope without too much difficulty. In addition to cereal grains, they also feed on berries, seeds, tubers and overwintering insects found in the soil and leaf litter, see Figure 5. They can scratch up the ground with their powerful feet and dig down to buried roots up to 40 cm underground.

If food is ever in short supply, for example if cold weather makes food inaccessible, pheasants may retire to their roosting sites and sit it out rather than try to find food. They can sit motionless for days without apparent detriment.

Pheasants prefer areas rich in beech and mature oak and hazel as these provide more mast during the winter. The Trust's research indicates that they also prefer woods surrounded by arable land to those surrounded by grass.

Feeding

Over much of Britain, where pheasants are managed, gamekeepers provide supplementary feed, usually grain, to ensure a higher density of pheasants for shooting. Supplementary feeding usually takes place throughout the autumn and winter and takes three typical forms: gamekeepers spreading grain daily along straw covered woodland rides; providing grain in hoppers throughout the wood; and dumping piles of grain spoil. Although supplementary feeding is usually done to hold and redistribute pheasants for driven shooting, it also helps to mitigate some of the losses of natural foods caused by modern agriculture.

Predation

Winter mortality from predation is generally not excessively high. However, foxes do kill pheasants during severe weather conditions when snow cover can make the birds more vulnerable to predation.

Lamping at night with a powerful rifle is an effective and humane way of controlling foxes. It is best carried out from late winter/early spring until the crops get too high to see properly. Snaring can be important when the cover is too high or in areas with thick undergrowth.

Survival of adults

Pheasants are not long-lived birds in the wild even when not subject to shooting. The annual survival rate of pheasants after maturity is between 30 and 50 per cent. The average life expectancy is only one year and a bird that reaches three or four years old can be considered very old. The oldest recorded pheasant in the wild, however, was 13 years old.

In February, the males start to compete for breeding territories between one and five hectares in size. Not all males are successful – often the younger or smaller males fail to secure breeding sites and remain non-territorial.

During March and April, the successful males display to attract females into their harem and to defend their territories. The females remain in dense cover during the daytime, coming out into the open only at dawn and dusk to feed. While they feed, the males guard them from predators, intruding males and from other dangers.

As part of his territorial display, the cock pheasant puffs up his feathers, inflates his wattles and raises his ear-tufts. He then braces himself with his tail and gives the characteristic 'kok-kok' call followed by a rapid wing-beat. Each male has a distinctive call, which with practice can be individually identified. It is highly likely that pheasants recognise each other this way.

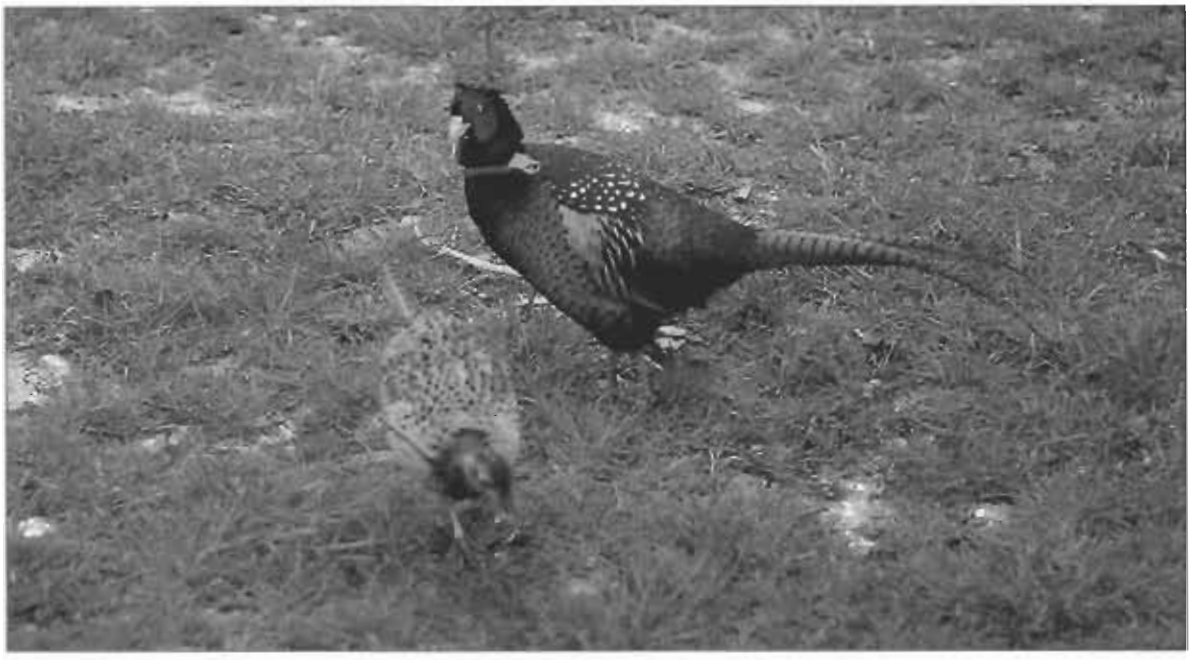
This display by the cock is also a sexual advertisement to attract hens to his harem. Crowing is an energetic activity and only good quality males can crow regularly, so hens tend to be attracted to the cocks which crow the most. Females are also attracted to a territorial male's red wattles surrounding his eyes, which when inflated cover the side of his face.

These displays are used by non-territorial males to a lesser extent and all males at any time of year will make crowing noises, but it is only the breeding males on their own territories that will manage the full-blown 'kok-kok'.

Pheasants are one of the few British birds with a polygynous mating system, where one male breeds with a number of different females in the same year. The precise breeding strategy used by pheasants, known as 'territorial harem defence', is the rarest breeding strategy of any bird. In Britain, it is the only bird breeding in this way. The strategy requires that the male contributes nothing to the next generation but his genes!

A territorial male may have a harem of up to a dozen hens, although in Britain, where shooting occurs, the

A COCK PHEASANT'S RAPID WING BEAT IS A SIGN THAT HE IS DEFENDING HIS TERRITORY.



Territorial males and their harems feed on open land adjacent to woods at dawn and dusk.

average is two or three. The ratio can be as high (in captivity) as 50 hens to one cock before there is any loss in fertility. This mating system allows harvest of a greater percentage of males without impacting the productivity of the population.

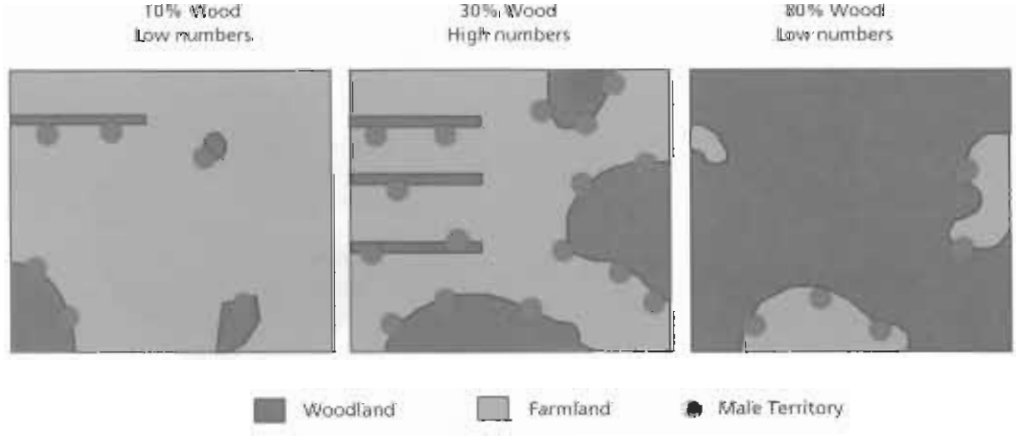
It is vital that during the breeding season the hens put on weight in readiness for nesting and rearing chicks and do not waste valuable energy in avoiding dangers. The male must therefore ensure that his hens can fill their crops as quickly as possible without risking predation or harassment from other males.

Once mating has taken place, the hen moves away from the male's territory and begins egg laying. When off the nest, or if she loses the nest, she may well return to the male to feed. Sitting hens often use the territorial male as protection from other males while feeding, showing similar wing hunching and behaviour to that which bantams display when off the nest, yet not requiring the attention of the dominant male.

A territorial male's red wattles are used to attract females. When inflated, they cover the side of his face.

Figure 6

Territorial male density as a function of the amount of woodland



Habitat

Male pheasants will establish territories along hedgerows, ditches or in areas of rough ground, and along woodland edges. Woodland edges are the most popular areas because hens use the woodland cover during the daytime and come out to feed in open arable at dawn and dusk. see Figure 6 on page 13.

Early in the breeding season, cocks often show a preference for setting up territories along the edges of Set-aside fields. Set-aside contains more food for hens than other crops and so is particularly beneficial during the period before eggs are laid. The Game Conservancy Trust's research has confirmed that the hatching success and survival of chicks is improved where hens forage in *managed* Set-aside in the pre-laying season, although Set-aside does not increase the number of nesting attempts or the clutch size.

The amount of shrubby cover in the woodland edge adjacent to breeding territories is also important. As hens need this during the day, harem sizes along woodland edges rich in shrubby cover are significantly larger than in areas with low levels of cover.

Narrow woodland rides do not contribute extra woodland edge and therefore do not provide suitable conditions for breeding territories unless they are at least 70 metres wide.

Once all territory sites are occupied, additional males are forced to become non-breeders. The number of territories therefore remains relatively constant while total pheasant numbers vary due to other factors. Territorial male density does not reflect the total population, but the number of suitable territory sites, and therefore the quality of the habitat determines the breeding potential of a particular piece of countryside. The critical aspects of the habitat are some dense cover adjacent to open habitat – which should have some food value. Populations can therefore be easily increased through improved habitat.

Food

During the spring, harsh conditions can exist, with little natural food and low temperatures. During March and April, hen pheasants need high quality food because of all the nutrients required for egg-laying. They also need fat reserves to carry them through incubation. But modern agriculture does not leave much wasted grain for pheasants in spring (see Figure 7), so they are likely to use up body reserves before the breeding season, rather than putting on extra fat.

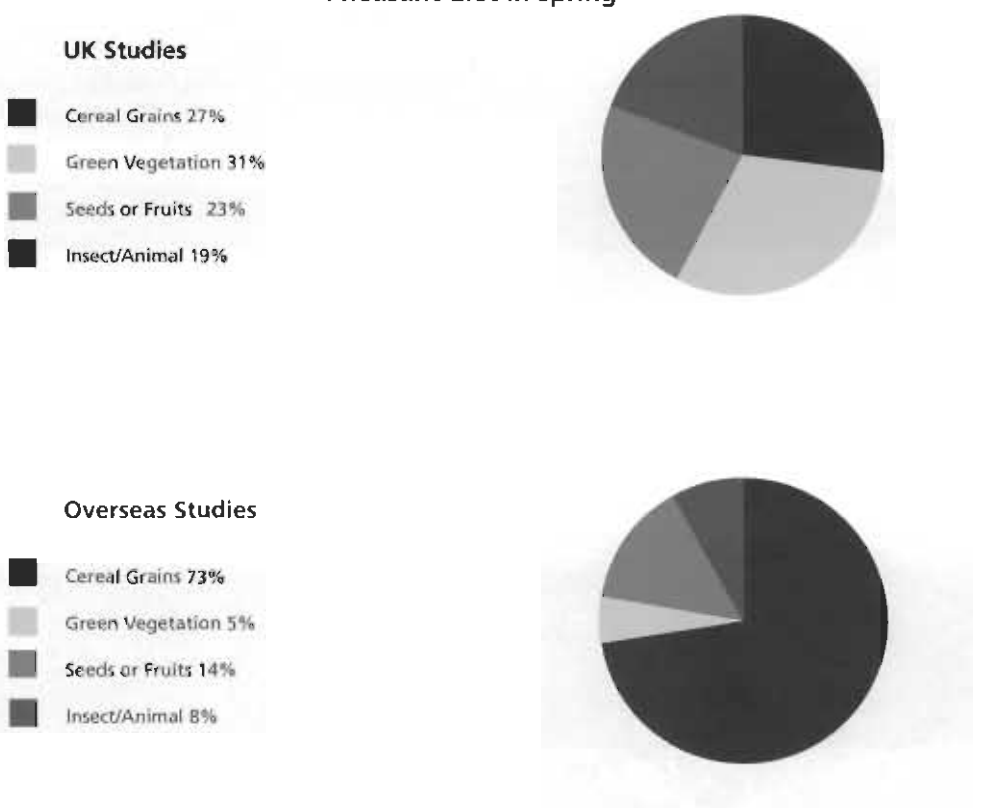
Once they are laying eggs and incubating, the hens feed less often and begin to use their reserves. Spring food is important in determining hen condition and therefore chick production.

Feeding

While many gamekeepers feed their pheasants until early April, few continue beyond this. However, the Trust's research shows that supplementary feeding in late spring

Figure 7

Pheasant diet in spring



Compared with many studies of pheasant diet abroad, in Britain pheasants appear to be short of the wasted cereals coming in elsewhere.

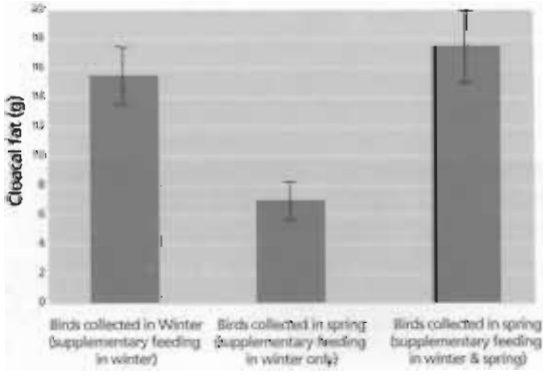
In the spring pheasants prefer to feed on the woodland edge. It is important to site hoppers accordingly.

from hoppers in breeding territories allows hens to increase their fat reserves in readiness for breeding (see Figure 8). In our experiments, hens with access to supplementary food were seven times more likely to re-nest and produced three times as many chicks as unfed hens.

Although in the winter pheasants are generally fed from large hoppers within the wood, it is important during the breeding season to move feeding sites out of the woods and into breeding territories. A larger number of small hoppers enables more birds to take advantage of this resource at a time when they will not form large flocks around a small number of feeding outlets.

Figure 8

Cloacal fat comparisons of spring and winter feeding



Comparisons of cloacal fat reserves in hen pheasants. All birds collected during winter had been fed, but during spring, some birds had been fed while others continued to be fed.

Predation

Pheasants are particularly vulnerable to predation at different times during the spring and summer breeding period. During territory establishment and harem formation in spring, non-territorial males are chased away from the breeding sites on the woodland edge by the territorial males. As a consequence they spend a greater proportion of time further from cover in more open areas of farmland than territorial males (an average of 65 metres for non-territorial males compared with 28 metres for territorial males). This makes them more conspicuous and vulnerable to both mammalian and avian predators. They therefore tend to associate together in the centre of fields where the combined vigilance of a group increases their safety.

Territorial males are at their most spectacular during the spring and while this is successful in obtaining a territory and attracting hens, it inevitably draws the less welcome attentions of predators. However, since one of their main concerns is to protect their hens, they are continually on the look-out for all potential threats.

The female's main concern at this time is to select a mate and to build up sufficient energy reserves to ensure the production of good eggs and to enable her to withstand the rigours of incubation. Feeding out in the open obviously brings increased risk of predation, but being part of a territorial male's harem can reduce the risk. Females benefit from the extra vigilance of the male because he gives them early warning of predators, and enables them to feed almost continuously, thereby reducing the total length of time they need to spend out in the open. A radio-telemetry study of hen pheasants estimated their survival during March and April, ie prior to incubation, to be around 60-64%.

Nesting

By the end of April the mated hen pheasants begin to disperse and select nesting sites. Nest sites are usually chosen close to but not in the breeding territory of the male. The males, meanwhile, remain faithful to the central 'parade' area of the territory until approximately the end of June. The sitting hens know where to find the cocks and will use them for protection and re-mating after nest failures. The males then move into the growing crops where they stay for the remainder of the summer in small groups of two or three birds. Males take no part in nest building, incubation or rearing chicks.

Pheasants are ground nesting birds, although they have been found in a range of locations including in tree holes, on walls and in old squirrel dreys. Nests rarely consist of more than scrapes on the ground with a lining of grass.

The nests can contain as many as 32 eggs, although more typically 8 to 13. The earlier nests contain more eggs on average than the later ones. Eggs are variable in colour, ranging from dark brown, through the most common olive green, to sky blue. But each hen tends to lay eggs of a similar colour and shape.

Producing eggs consumes less energy for the hen than incubating and rearing young. To take advantage of this situation, pheasants often lay their eggs into the nests of other hens. Dumping their eggs or 'brood parasitism' can produce more chicks at less cost to the hen. Many of the larger nests, particularly those containing over 15 eggs, are likely to be the efforts of more than one hen and this can be seen by the range of colours and shapes of the eggs – although not always. Pheasants do not just dump eggs on their own species, they will regularly use nests of other ground-nesting birds such as partridges, mallard, woodcock, and gadwall. One partridge hen was found with 12 pheasant eggs and 16 of her own. Needless to say, such cross-species dumping often results in poor production.

Hens which lose their first nests can re-lay up to three more times. If the first clutch hatches and is reared successfully, the hen will not re-lay. Each hen, therefore, will rear no more than one clutch per season. Potential for re-nesting depends on both the hen's condition and the time of nest loss. She is unlikely to re-nest after a late loss.

A hen will lay about two eggs every three days. She does not sit on the eggs until all have been laid. As none of the embryos will begin developing until she incubates, she can synchronise their development so that all will hatch on the same day.

The hen incubates by sitting on top of the eggs to keep them warm and encourage their development. She loses an area of feathers from her breast to form a brood patch which allows the blood vessels to transmit her body heat more efficiently to warm the eggs. Incubation takes about 25 days, during which time the hen spends nearly 23 hours in the day on the nest. In the brief periods she spends away from the nest she must feed and defecate before the eggs start to chill. As a result, sitting hens produce exceptionally large droppings (clocker droppings) which can be a sign that a hen is incubating in the vicinity.

Pheasant nests contain around 12 eggs. Larger numbers than this often indicate the efforts of more than one hen.

Habitat

Hens often choose to nest on the edges of woods or in hedgerows where they can find tall herbaceous vegetation containing tussocky grasses or beds of nettles, see Figure 9 opposite. Later nests and re-nests are often found in cereal fields, as by then these contain more cover.

The Pheasant is a ground nesting bird and its nests are little more than lined scrapes on the ground.

(far right) Pheasant nests are well camouflaged beneath the undergrowth in areas with dense ground cover.

Predation

Predation by foxes is almost always the cause of death of hens during the nesting season. Although well camouflaged, hens are particularly vulnerable to predation during the nesting period. Evidence from The Game Conservancy Trust's research suggests that many hand-reared hens are in poor physical condition during the lead up to nesting in spring, possibly causing increased vulnerability. Certainly the mammalian predators which hunt by smell, such as foxes, find more nests once hens are sitting on the eggs. The nesting period is thus an important time to control foxes by lamping or by snaring.

Stoats, though not large, are capable of killing game-birds several times larger than themselves. Pheasants are most at risk during incubation when stoats have been observed rolling eggs away from the nests. They will also take growing chicks and will indulge in surplus killing if they get into a rearing pen. Gamekeepers trap stoats during the nesting season to reduce this predation.

Corvids (crows, magpies, rooks and jays) do little damage to pheasants before egg laying. Once the eggs are laid, however, corvids are responsible for severe losses.

One effective control measure to reduce egg losses is to introduce Larsen traps into corvid territories. A live decoy bird is placed in one half of the trap, enticing the resident bird to defend its territory. Once captured in the other half of the trap, the resident bird can be dispatched humanely.

More than at any other time of year, protection from predators during the pheasant nesting period is paramount. Where gamekeepers control predators, losses are far fewer, because predation is the primary reason for nesting failure.

Predation is not the only reason for nest failure, however. A significant number of nests are destroyed by agricultural practices such as silage cutting. More recently, the Set-aside rules required destruction of valuable pheasant habitat at peak nesting time. Happily, these rules have now changed. Abandonment can account for a large number of losses. If a hen is disturbed during laying and incubation, particularly in the early stages, she may abandon the nest and try again.

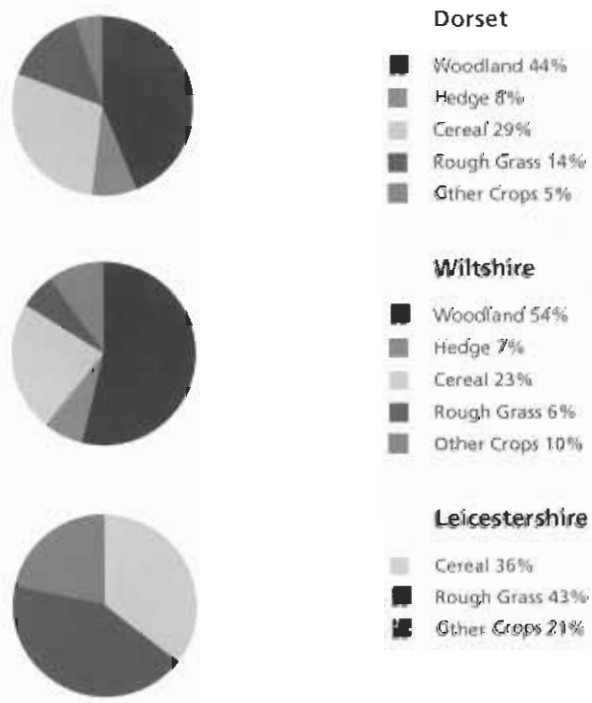
As corvids take eggs, the Larsen trap is a particularly effective control method when used in the spring.

Both nests and nesting hens can be destroyed by silage cutting.

Percentage of different habitat used for nesting on three areas in England.

Figure 9

Pheasant nesting habitat



Brood-rearing

EVEN AT A FEW DAYS OLD THE CHICKS ARE VERY MOBILE.

If a nest reaches the end of incubation despite all the hazards on the way, the unhatched chicks begin to call each other and to the sitting hen who clucks back. These calls strengthen the bond between hen and chicks and also synchronise development of the chicks. This ensures that all the chicks hatch within a few hours of each other.

In order to hatch, the chicks peck around the inside of the egg using a special 'egg tooth' on the end of their beaks and eventually push off one end. About one in 10 eggs fail to hatch. The successful chicks are kept warm by the hen and soon dry. They leave the nest within three or four hours and move into brood cover.

The First Three Weeks

After hatching, an average brood contains about 10 chicks. As soon as they dry after hatching, the chicks are independent, being able to run and feed themselves although they do not need to feed immediately. Their large stomachs contain the remains of the yolk sac which nourished them during incubation. As this depletes, they search out their own food. The hen does not feed them. Instead she leads them to an area rich in insects where they can forage for themselves.

During the first week or two the chicks need the hen to keep them warm because they are unable to generate enough heat for themselves. They thrive in warm weather as there are more insects and they can forage

SMALLER (AND SCRUFFIER) THAN THEIR MOTHER, POULTS CAN FLY WELL AND REMAIN IN THEIR FAMILY GROUPS.

longer without being brooded. During cool weather, on the other hand, they need more attention from the hen, spending less time feeding.

The hen keeps watch for danger, responding in a variety of ways when she encounters it. Sometimes, though rarely, she gives a 'broken wing' display, feigning injury to draw a potential predator away from the chicks. A more common response is to give a short alarm call which makes the chicks scatter and then crouch. After the danger has passed, the hen clucks to draw the dispersed chicks back to her. Sometimes hens will even attack a potential predator.

At a few days old, the chicks' wing feathers grow, enabling them to make short fluttering flights as early as two weeks of age. At this point, they lose their fluffy appearance and look like smaller scruffy versions of the adult hen; they are then called **poults**.

CONSERVATION HEADLANDS MAKE IDEAL BROOD HABITAT FOR PHEASANTS AS THEY CONTAIN A PLENTIFUL SUPPLY OF LARGE INSECTS SUCH AS SAWFLY LARVAE.

Habitat and Food

When chicks hatch, they need the protein supplied by abundant insect populations, with a high percentage of caterpillars, true bugs and sawfly larvae, if they are to survive (see Figure 10 opposite). The hen leads them to insect-rich areas, often cereal crops, woodland rides, young plantations or newly cut coppice.

Radio-telemetry studies at Loddington, The Game Conservancy Trust's farm in Leicestershire showed that hens take their broods into cereals and specifically designed and well managed Set-aside (especially Wild Bird Cover Option).

Plentiful insect food is the main determinant of good brood-rearing habitat. Cereals, Set-aside and cereal field boundaries are insect-rich and therefore provide the most popular brood-rearing areas. The best brood-rearing cover consists of cereals mixed with other crops and some broad-leaved weeds as it provides insect-rich vegetation which is easily penetrated at ground level by chicks, but with a canopy to make them feel safe from predators.

Meanwhile, the adult birds concentrate on eating young shoots, grain and insects. They make little use of the woodland during the late spring and summer.

Off shoots where wild birds make a contribution to the bag, establishment of brood-rearing cover is well worthwhile. Conservation headlands are one way of providing good brood-rearing cover.

Conservation Headlands

These are six metre wide strips between the crop edge and the first tramline. They are areas of crop treated with selective pesticides to control grass weeds, cleavers, virus vectors and diseases whilst allowing most broad-leaved weeds and beneficial insects to survive. They are good for young gamebirds because the crop provides a canopy under which the chicks can safely forage on the abundant insects.

Large clutches of eggs ensure that the species can survive even though the chances of individual chicks surviving is slim.

On some estates, Set-aside may be preferred to conservation headlands, as it does not interfere with farming operations. On heavy soil, cereal-based mixtures for brood-rearing cover are best sown in the autumn. The Advisory Service of Game Conservancy Limited can supply all the details a shoot manager may need.

Chick Mortality

The survival rate of pheasant chicks generally runs between 20 and 40 per cent. Early losses through starvation, chilling and predation soon reduce an average pheasant clutch of 10 chicks to about four, even in a good year. Even after chicks leave the care of the hen at 8-10 weeks old, they continue to suffer substantial losses. Only the large clutch size of the pheasant ensures that the species can survive these losses.

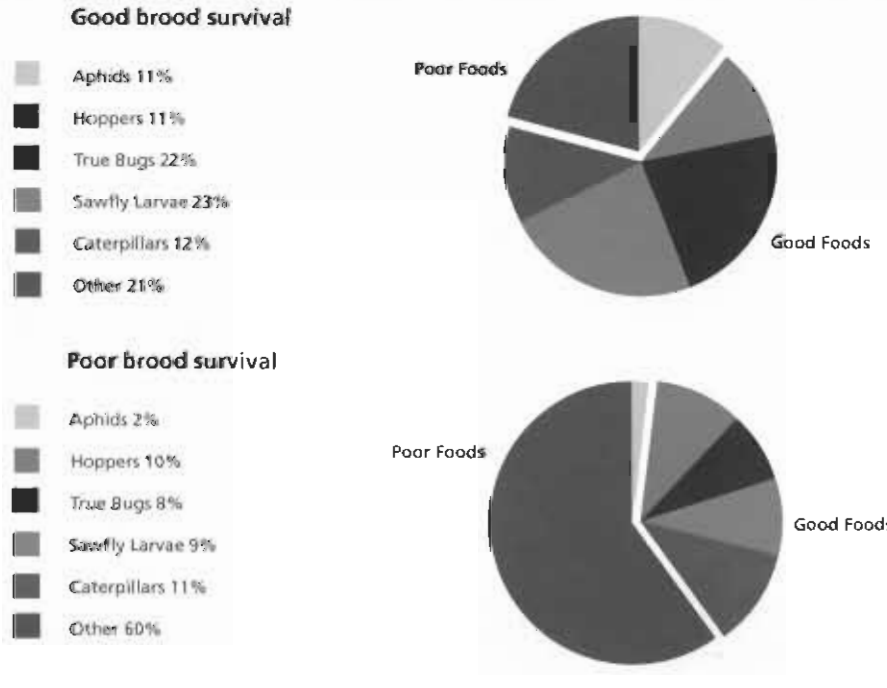
It is the quantity of insect food available during their first 10 days which is the crucial factor affecting chicks' survival. In areas rich in insects, chicks are likely to survive well, but if they have to wander a long way searching for food they are unlikely to survive. The young chicks feed on large slow-moving arthropods found close to ground level, particularly sawfly larvae, heteropteran bugs, ground beetles, rove beetles and spiders. As they grow, they start to eat an increasing number of plant seeds, particularly those of grasses.

Many of the important insects live on weeds among crops or prey on weed-living insects. Pheasant chick survival rates are often highest in the weedier corners of fields. But with modern agricultural practices these areas are increasingly rare. Intensive use of herbicides and insecticides have made cereal fields inhospitable to hungry pheasant chicks and their chances of survival have declined. Previously common flowers such as charlock and corn marigold have practically vanished from farms and gamebird chick survival has fallen to levels insufficient to sustain many wild populations. It is important to note here that although cold wet weather can have a major impact on chick survival, good habitat management can mitigate those effects over which we have no control.

Predation

Predation could be responsible for causing high mortality amongst chicks, but this is difficult to document. Large numbers of mammalian and avian predators will certainly take chicks of all ages.

Figure 10



Pheasant chick diet in areas of poor brood survival compared with areas of good brood survival. Larger numbers of important chick foods such as sawfly larvae, caterpillars, true bugs and hoppers can make a great improvement in chick survival.

IF WOODLAND IS DESIGNED CORRECTLY, THE PHEASANTS FLY HIGH MAKING TESTING TARGETS FOR THE GUNS

The pheasant is the most numerous gamebird in Britain and comprises over 80% of all quarry shot. Although many pheasants are wild, particularly in the south and east of the country, about 90% of pheasants shot each year are in fact hand reared. In Britain, over 20 million pheasants are reared and up to 12 million pheasants are shot annually. Probably more money is spent on pheasant management than on looking after all our other wild bird species put together. Estimates put the amount of private money spent on game management at ten times that spent by the Government on funding nature conservation, most of it going directly on employment.

Rearing and Management

Typically, reared birds are raised from captive breeding stock by a gamekeeper, or purchased from a game farm. These days, they are often hatched in large mechanical incubators. During July and August, at about six weeks old, the poults are placed in large, open-topped release pens in woodland. The juvenile feathers of one wing are sometimes clipped to restrict flight, but as their feathers regrow the poults leave the pens in August and September and disperse into the surrounding habitats. By October they are fully grown and adapted to life in the wild.

Most released birds are shot within two kilometres of their pen and about 40% of birds released each summer are shot during the following winter. Some of the rest will have died between release and the start of shooting, although many do survive to increase the size of the following spring's breeding population. Approximately 6% are shot in the second winter following release.

Pheasant Shooting and Conservation

In Britain, the landowner has an incentive to manage pheasants, fundamentally because the freedom to undertake this work rests with him or her. Management often includes rearing. To support the type of driven shooting traditionally practised, high densities of birds must be present. Input-intensive programmes such as rearing and hunting predation pressure have to be cost-effective.

LARGE OPEN-TOPPED RELEASE PENS GIVE THE JUVENILE REARED PHEASANTS SAFETY FROM PREDATORS UNTIL THEY ADAPT TO LIFE IN THE WILD

Pheasant shooting creates an incentive for landowners to plant and manage woodland for wildlife

Shooting is a popular pastime in Britain. Overall, 58% of agricultural properties and 88% of those larger than 400 hectares maintain pheasant shooting. The rights to shoot pheasants on an area rests with the landowner, although these rights are frequently sold in return for a sporting rent. Rent levels vary substantially depending on quality of woodland, topography, proximity to urban areas and density of game. On prime pheasant shoots, rent can exceed the value of standing timber, illustrating just how important pheasant shooting can be to the economies of the countryside.

In this country, there has been considerable documentation of the beneficial effects of habitat management associated with pheasant shooting, particularly its positive effect on woodland planting and management. The practice of rearing is fundamental to British game shooting and its attendant conservation benefits.

A postal survey of 712 landowners of predominantly lowland estates was conducted by Dr Graham Cox, together with Dr Charles Watkins and Dr Michael Winter in 1996. The study revealed complex motivations for shooting - generally a mix of commercial and personal considerations. According to the survey, estates releasing pheasants were more likely to incorporate beneficial management into their land use. Among estates where pheasants were released, 61% had planted new woodlands compared with only 21% where pheasants were not released. Although non-shooting estates had fewer woodlands, less than 10% of these carried out any form of woodland management. The study showed that many positive landscape features such as hedgerow management, coppicing, and wetland developments were being undertaken as a direct result of the shooting interest. In addition, the authors summarised various estimates of income and suggest that figures of about £22 million to £26 million per year was derived from shooting. This results in the employment of about 2,600 gamekeepers and equivalent of 1,600 to 2,800 full time beaters. It seems clear, therefore, that without the incentive of the pheasant harvest, far less woodland would be planted or managed for conservation.

The Shoot

Pheasant shooting is popular almost everywhere, and shoots range from the very formal affairs with substantial bags, to rough walked-up shoots with just a few birds at the end of the day.

The shooting season in Britain runs from 1 October to 1 February, although few birds are shot before November. On a typical formal pheasant shoot a line of beaters flush the birds from a wood or other area of cover, over a line of standing Guns. Each wood or area of cover is called a 'drive' and usually about seven or eight areas are driven per shoot day. On consecutive shoot days the drives are varied so that each one is only shot over occasionally.

Early in the season, most estates shoot both cocks and hens, although as the season progresses, fewer hens are shot so that their numbers are left high for the breeding season. Because of their polygynous breeding system, the population can easily sustain a large number of cocks being shot. On purely wild bird shoots up to 90% of the males and 20% of the females can be shot without any long-term detriment to the population. With releasing, this figure becomes less relevant because more birds can always be released to compensate for heavy shooting. Pheasant shooting must be properly conducted, in a sustainable way and in sympathy with other countryside activities. Detailed guidance is contained in the *Code of Good Shooting Practice*, produced by The Game Conservancy Trust in conjunction with others.

Holding and Driving Pheasants

Pheasants are easy birds to rear but in order to produce good shooting, there needs to be plenty of holding cover and a well-designed set of drives to show birds to their full advantage. Wooded hillsides are ideal, and broken wooded landscapes with intersecting valley bottoms where Guns can be placed make the best pheasant shoots. Areas not suitable for wild bird production are more reliant on reared birds. The Quantocks, the Weald and the Chilterns are examples of regions with an emphasis on pheasant rearing to produce quality shooting.

Rides and open spaces in woodland help for flushing purposes. Flushing points can also be created by increasing plant density in desired areas. Fast growing poplars planted beyond the flushing zone can help produce rising areas. Again, the Advisory Service of Game Conservancy Limited can advise.

Avoiding Conflicts

Pheasant shooting has come under political pressure in a number of other European countries. Rearing and releasing gamebirds is now banned in the Netherlands, and restricted in Germany, Belgium and Denmark. Issues raised during public debate in these countries have centred on welfare aspects of the rearing process, the perceived negative impact of rearing on species of conservation interest and the effects on wild gamebird stocks.

Certain forms of pheasant management for shooting do cause conflicts with other nature conservation interests. It is important, therefore, that managers are aware of the conservation value of an area and that they manage it sympathetically to avoid conflicts. If well thought out, game management will be highly beneficial and the negative aspects overcome.

The main conservation issues relate to siting of woods, pheasant release pens, the use and treatment of woodland rides, and the provision of straw bales or planting of non-native species for cover.

While planting new woodland for pheasants normally increases the conservation value, they should not be sited in areas which already have a high wildlife value, for example, downland, wildflower meadows or traditionally open habitat. Instead, new woods should be planted on sites with previously low conservation value.

Existing woodland, particularly ancient semi-natural woodland (originating before 1600AD) has a high conservation value because it normally contains more native trees and shrubs than newer woodland. Game management plays a role in preserving this habitat, particularly if a rotation of coppicing, if appropriate, and sympathetic ride management is used to help retain diversity.

Release pens can cause weed species, such as nettles, to increase and characteristic woodland flowers, such as wood-sorrel, to become scarce, particularly if pheasant density within the pens is too high, or if the same area is repeatedly used over a long period. These problems are easily avoided if pens are sited in newer forest plantations rather than within older native woodland. Larger pens, with lower pheasant densities help to minimise nutrient enrichment of the ground and soil erosion, and also represent good pheasant management practice.

Disease in Pheasants

A number of diseases considered 'traditional' in pheasants affect both wild and reared populations. These include gape worms which, in the adult stage, lodge in the wind pipe and typically affect reared birds shortly after release. However these worms are found in wild populations and are carried by bird species other than pheasants.

Intensive pheasant rearing has seen the spread of a number of less well-known diseases which can be just as damaging and often not easily treated. These include Hexamatiasis, Coronovirus and Rotovirus.

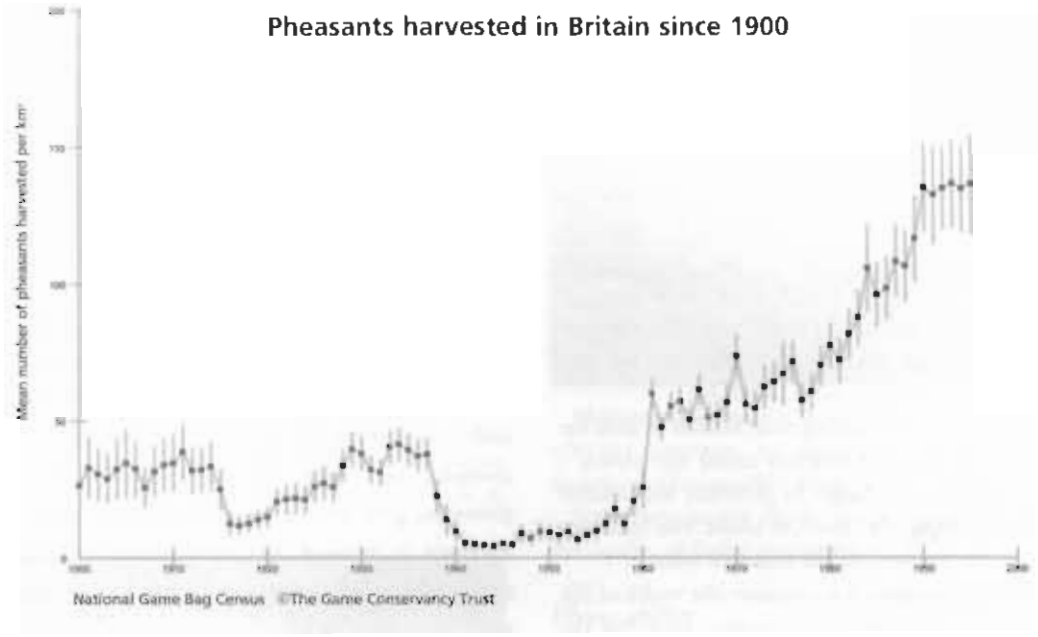
How these and other diseases move between reared pheasants and pheasants in the wild is virtually unknown. However, diseases which are easily treated in captivity can have a devastating effect on birds in the wild. We are finding that even some parasites once thought to have a minimal effect on pheasants might be much more important. The importance of disease and parasites for pheasant management is expanding to include not only those diseases causing obvious mortality, but those which negatively impact population dynamics while not actually killing the birds.

For example, pheasants can be poisoned by slug pellets used on fields adjacent to their release pens, pesticide spraying, etc. Disease in reared birds is sometimes the result of bad management techniques and therefore can frequently be avoided. With the trend towards lesser availability of drugs to treat parasites and disease, good management becomes paramount.

The Code of Good Game Rearing Practice, produced by The Game Conservancy Trust and others provides a clear standard, not only for reared birds but also for a wide range of management practices in the wild. The main points are:

- Be tidy - do not leave waste where birds can get access to it.
- Be clean - always use properly cleaned, serviced and disinfected equipment.
- Feed properly - always provide a good supply of properly formulated food for the type and age of birds reared.
- Give fresh water - do not be tempted to skimp on quality or regularity of supply.
- Do not overcrowd - always allow plenty of room for the numbers of birds you keep.

More information on pheasant disease is detailed in our Green Guide *Diseases of Gamebirds and Wildfowl* available through Game Conservancy Limited's Sales Centre.



Numbers of pheasants harvested per km² in the 20th Century. The influence of rearing is especially obvious after 1960.

Laying straw on woodland rides for supplementary feeding can sometimes damage the woodland flora and fauna. It is generally better to feed from hoppers, especially small ones in clusters rather than a single large one. Spreading food onto the natural leaf litter can work just as well as straw, but does not have the same damaging effect. If straw must be used, it is best to avoid herb-rich areas. Raking up the straw at the end of the shooting season allows the plants underneath to grow and seed.

Increasing the shrubby cover along the woodland edge is beneficial to conservation generally, but it is better to choose native species. Although they may take longer to establish, they will provide similar benefits for pheasant shooting in the end. It is always worth avoiding invasive species such as rhododendron and snowberry.

Using straw bales as temporary shelter along woodland edges and in rides can cause dense shade and mulching, which can lead to the loss of ecologically important plant species. Restoring hedges and coppicing the outer rows of existing shrubs and trees are suitable alternatives to straw bales. If bales must be used, they are best placed in adjacent fields rather than inside the woodland edge.

Negative effects of game management are frequently the result of bad practice and so can usually be avoided. Game management techniques should always be sympathetic to conservation interests.

Game Book Data

Game book data are proving to be important because they can offer a historical perspective that allows us to compare today's information trends with the past. They can show us the geographical spread of the species over time; long-term patterns of changes in numbers which can only be detected over extended periods of time; and trends in abundance which may not be obvious unless looked at on a national or regional scale over a long period.

Data from game books have shown that the development of more efficient rearing techniques, demands for larger numbers of birds for driven shooting, the increased cost of labour (eg for gamekeepers), and changes in farming, have resulted in less effort being expended on wild game management. This inevitably leads to less wild game. But the net result of these changes is that the number of birds which can be shot on a piece of ground, and therefore be expected to be seen on driven shoots, has increased substantially.

The Game Conservancy Trust's National Game Bag Census has shown an average bag of about 25 pheasants per 100 hectares in 1900, rising to almost 50 by the late 1930s. The Second World War and a feeding ban after the war meant that pheasant bags dropped dramatically, so that by 1960 the bag per 100 hectares was about the same as in 1900. There was then another rapid expansion during the 1980s and bags rose to almost 150 pheasants shot per 100 hectares by 1990. There is now considerable evidence to suggest a stabilisation of bag throughout the 1990s (see Figure 11).

The pheasant is clearly the most successful gamebird of our generation. It has always been an important gamebird, but its predominance over the last three decades is obvious. The primary reason for its success is that it is easy to rear using modern equipment. Its habitat requirements also make it less susceptible to agricultural pressures than other species and, of course, it does possess sought-after sporting qualities. However, releasing pheasants without managing habitat and controlling predation can lead to shrinking wild populations.

Ageing Pheasants

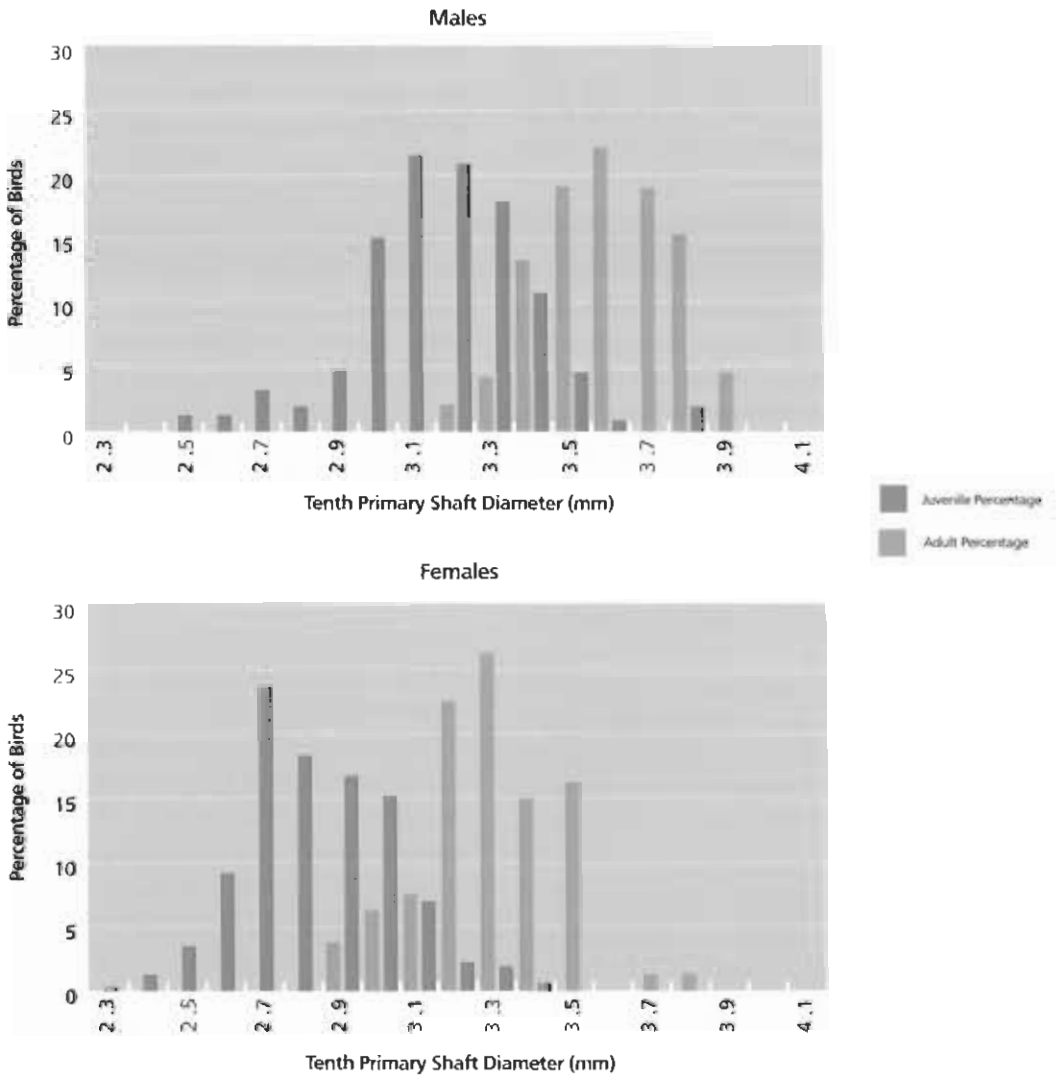
Unlike many of our gamebirds, accurately ageing a pheasant is difficult, although various characteristics can provide a rough guide. Once they have grown their adult plumage, it is impossible to separate old from young from a distance by sight. On closer examination, you can see that young cock pheasants have smaller, rounded spurs on their legs, while older birds have long, sharp ones. By the late winter, the spurs of the young birds have finished growing, so this method alone is unreliable.

Another technique for ageing dead birds is to look for the small sac (Bursa of Fabricius) inside the cloaca – typically it is 10mm or larger in juveniles and smaller than 5mm, or completely closed, in adults. This structure is thought to be involved in the immune system.

An easier way, however, is to measure the width of the base of the tenth primary wing feather (counting the flight feathers in from the wing tip). Because young birds develop their adult plumage when only half grown, their feathers tend to be smaller than those of adults. Measuring the diameter of this feather at the point where the first filaments develop enables most birds to be separated into age groups. Adult male pheasants have shaft diameters of over 3.1mm; males with diameters below this are juveniles as are females with measurements of less than 2.9mm. However, for both sexes there is an overlap between adults and juveniles (see Figure 12.) Even these measurements, therefore, give only a rough indication. When better accuracy is needed, biologists often use additional measurements of feathers and bird size to distinguish adults from juveniles.

Figure 12

Diameters of the tenth primary shaft feathers



Pheasant Strains

The Common Pheasant and closely related Japanese Green Pheasant comprise 32 and two sub-species, respectively. These are mainly separated by the colours of the male's plumage and by geographical isolation.

Old English Black-necks: Derived from the sub-species from the vicinity of the Black Sea. It is, however, not the only sub-species to lack the white neck-ring.

Scandinavian: Not easily distinguished from standard mixed-strain pheasants. They are generally ring-necks (unlike the 'Old English' black-neck), although the neck ring is usually narrower than that of Chinese birds. A batch of birds should be fairly even in colour.

Chinese, Michigan blue-backs, Americans: Effectively Chinese ring-necks. The male has pale grey wing coverts, with a fairly wide neck ring and a blue-grey rump. There is usually a white stripe on either side of the head.

Japanese Green: Most birds released of this strain are only a quarter-cross. Their plumage characteristics are not reliable, but they tend to be dark with little or no neck ring. They are greener than the 'Old English' strain. Pure Japanese greens have an iridescent green appearance (compared with the purple/blue of 'Melanistic' pheasants) with paler blue/green rump and wing coverts.

Fen pheasants: In some areas reared birds are rarely introduced and artificial feeding is uncommon. These resulting wild birds look very much like Scandinavian pheasants and are typically small and light-weight. They survive on a diet of vegetable waste, for example carrots and potatoes and also sugar-beet pieces readily dug up from the chiefly light peaty soils.

Old English Black-neck

Mutants (Melanistic, Bohemian, etc): Derived from selective practices in captivity. The unusual colour variations often quickly disappear in the wild.

Some new strains developed in captivity may impact the quality of flying performance.

Flying ability

Our research suggests that flying ability is a complex interaction of genetics, management and perception. The quality and layout of the woodland or cover, management techniques, and how shooters perceive flying ability, all seem to be more important than genetic strain differences and the condition of the birds. This does not suggest that genetics plays no part in flying ability, but that shoot management needs to be perfected before any real differences between the performance of different strains can be detected.

Scandinavian

Japanese Green Cross

Wild vs reared

The survival of reared pheasants in the wild is consistently lower than for wild birds, as is their breeding success. If hand-reared birds were as good at predator avoidance as wild ones, then their resulting breeding success could double the population within a year. Wild types spend more time on alert, are 'flightier' and more prone to disturbance. But predator evasion and raising a brood are not dictated by genetics alone. It is possible that the absence of a parent contributes to poor predator recognition and avoidance in hand-reared chicks and a combination of rearing methods, early experience, exposure to parasites and genetics accounts for the better chances of survival and breeding of 'wild' pheasants.

Michigan Blue-Back

Scientific Methods

Scientists use a number of techniques to acquaint themselves with pheasant biology and behaviour. One of the best tools is the ability to identify individual birds. This is relatively easy with cock pheasants as they can be distinguished by their plumages, but hen pheasants are more tricky to identify being fairly uniform in colour.

Tagging: Numbered tags called 'ponchos' large enough to see from a distance help surmount this problem. Leg rings and wing tags help to provide information on survival and dispersal, but tell us less about behaviour because the numbers are not visible except at close quarters.

Radio-telemetry is probably the biggest breakthrough in studying wild animals. By fitting the birds with small battery-powered transmitters which emit radio signals, scientists can locate the bird in any cover at any time of day or night. Using this method, we can collect detailed information from individual birds about where they live, what they eat, who they mate with and so on (see Figure 13). This information is far more detailed than direct observation alone could provide.

THOUGH GENETICS MAY PLAY A PART IN FLYING ABILITY, RESEARCH HAS SHOWN THAT THE QUALITY AND LAYOUT OF WOODLAND COMBINED WITH MANAGEMENT TECHNIQUES ARE EQUALLY IMPORTANT TO FLYING ABILITY.

PHEASANT WITH 'PONCHO'

Dead birds also provide useful information. Pheasant shoots are ideal for examining large numbers at a time of year when they are otherwise hard to study. We can collect data on body weight, health, diet and age in this way.

Spring and autumn counts: Pheasants, like many of our game species, undergo large population fluctuations both within years and between years. An understanding of these changes and the size of the population can give us a better handle on understanding those factors influencing change and, for those involved in managing pheasant shooting, a better tool for setting shooting pressure. We use two different counts to provide the basic data on populations and productivity. To look at populations of pheasants going into the breeding season, we take advantage of the relatively structured mating system to obtain counts of both males and females (see Figure 14). The breeding territories set up by males and already explained previously in this report encompass open habitat. This is because the male wants to be seen. We have found that males will generally ignore vehicles on most places because they regularly see them during

HEN WITH RADIO TRANSMITTER.

farming operations. By counting males on blocks of habitat we can get a very good estimate of the populations. Consistently, we have found that after three surveys we can locate about 85% of the breeding males on a particular piece of ground. We can also locate about 70% of the hens. This information tells us not only the population density of both breeding males and females, but also the sex ratio and numbers of non-territorial males.

In autumn we can then repeat the counts to get estimates of brood survival and overall productivity of the populations (see Figure 15). However, this tends to be more difficult than similar surveys of grey partridge because pheasants tend to spend more time in thick cover and the poults are much more likely to leave the brood at an early age. It is also much more difficult in areas with late harvested crops such as sugar beet.

Long-term pheasant monitoring programme: Although The Game Conservancy Trust has been collecting population data on individual estates for some 20 years, we have never had a co-ordinated effort to document populations and productivity. Therefore in 1996 we launched the long-term monitoring programme. This is aimed at farms and estates where wild pheasants are managed or where productivity from left-over reared pheasants is desired. By collecting population data in a standardised way from a large number of sites over a long period of time, we hope to be able to look at the problems of pheasant management in the greater landscape – simply another tool to help us understand and therefore better manage pheasants.

Radio-locations of a single hen during the spring and summer of 1993

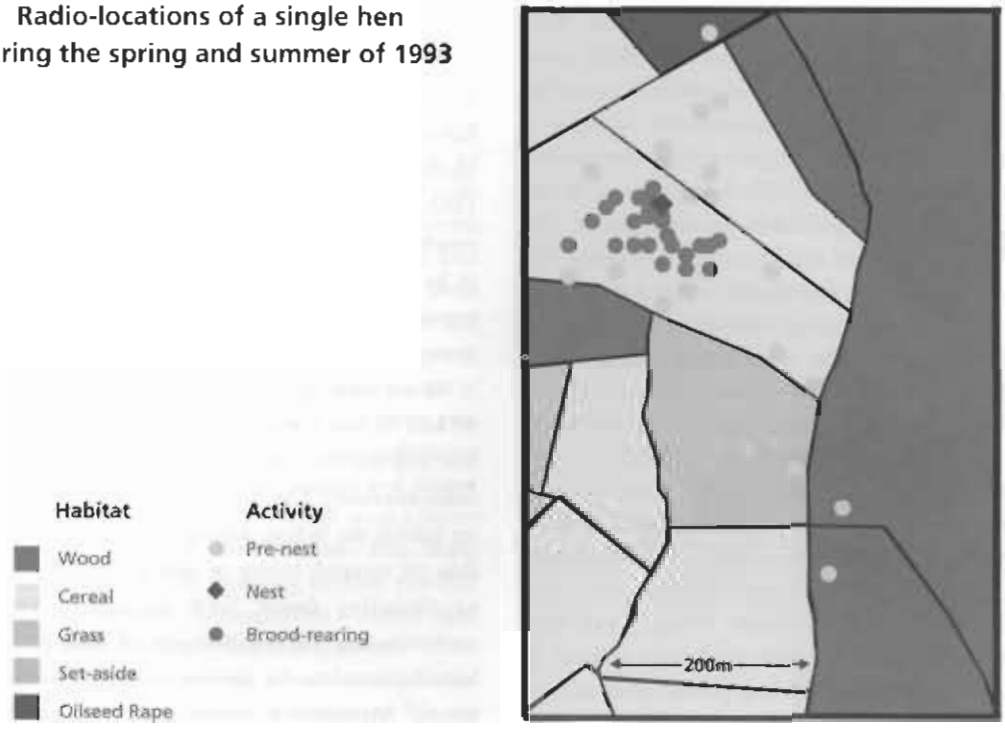
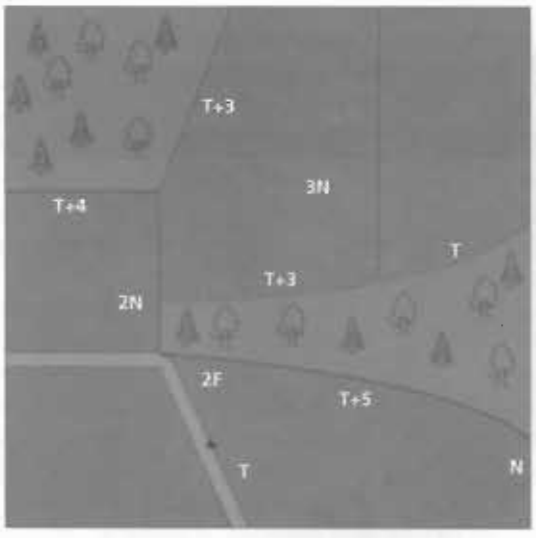


Figure 14

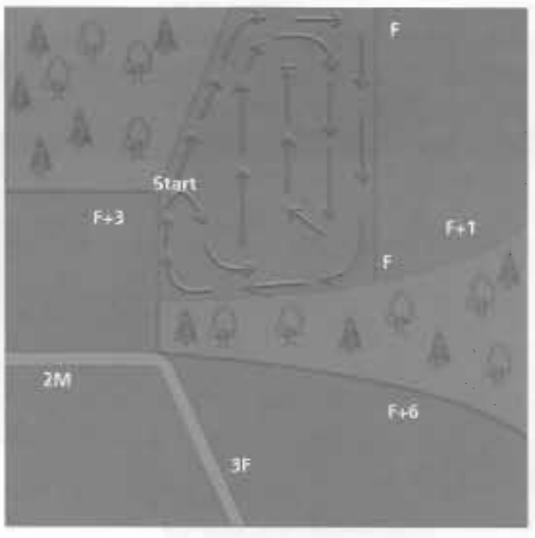
Spring pheasant counts



T = Territorial Male
T+4 = Territorial Male plus 4 Females
F = Female
N = Non-territorial Male

Figure 15

August pheasant counts



2M = 2 Males
3F = 3 Females Together
F+6 = Adult Female with 6 Young
→ Example of route to drive through field

(FAR LEFT) PHEASANT COUNTS IN SPRING REVEAL THE NUMBERS AND LOCATIONS OF THE BREEDING BIRDS.

AUGUST PHEASANT COUNTS REVEAL THE BROOD SURVIVAL AND PRODUCTIVITY.

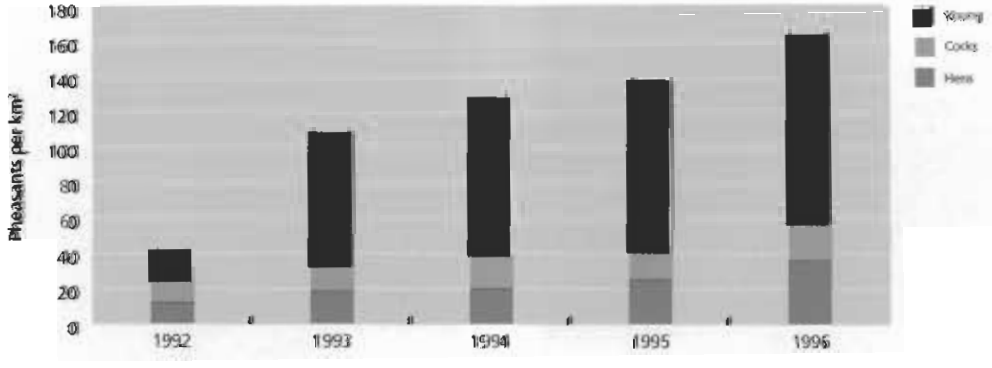
Wild pheasants are being studied as part of the Loddington project, started in 1992. This project, situated on the 333 hectare (825 acre) Loddington Estate in Leicestershire, which is owned by the Allerton Research and Educational Trust, is a demonstration and research project where management for wild game and other wildlife is carried out in the context of a modern, profitable farming system. The farm is mainly arable but also has a flock of around 220 ewes. The soil type is predominantly clay, and arable land is down to a winter cropping rotation of wheat, barley, oilseed rape and beans. The estate is well provided with non-crop habitats such as woodland, hedgerows, ponds, and ditches. Habitat management on the farmland includes provision of conservation headlands, beetle banks and wild bird cover on Set-aside strips. The Set-aside strips form a network across the farm and are sown with a variety of mixtures providing brood-rearing and winter cover. Woodlands and hedgerows are also managed to increase their habitat value. A full time gamekeeper is employed and predation control is rigorous throughout the breeding period (February to July). No gamebirds are released on the estate.

During the first four years of active management, autumn pheasant numbers increased from 126 (42/km²) to 490 (165/km²), see Figure 16. In 1992, no changes were made to previous management to provide baseline monitoring information. In 1993, when conservation management began, the number of young birds produced was four times the number produced in 1992, and productivity has continued to rise each year since, as illustrated by the purple bars in Figure 16. An annual harvest is taken by shooting mainly cock birds, and the number shot has increased fourfold from 53 birds in 1993/94 to 213 in 1996/97. However it should be emphasised that the Loddington project is not intended to be a 'model shoot' but a demonstration of how wild populations can be conserved through appropriate management on productive farmland.

We are running a research project in which between 50 and 70 hen pheasants are fitted with radio tags each year and followed throughout the breeding season using radio-telemetry. This has provided valuable information on habitat use before, during and after nesting as well as data on survival, causes of mortality and emigration to neighbouring farms. Such information is vital in understanding the requirements of wild pheasants and how habitats can be further improved to satisfy their needs. Maximising productivity is essential if a population of wild pheasants is to be sustained and provide the returns needed to cover the costs involved. This ensures that the additional conservation benefits for other forms of wildlife which accrue from management for pheasants can be realised.

Figure 16

Autumn pheasant populations at Loddington



Conclusion

While we have extensive knowledge of pheasants, provided from a wealth of data from our own scientific projects and others, we still have much to learn.

At The Game Conservancy Trust, we are in a position to influence decision makers by providing information based on solid scientific data which will promote an understanding of the conservation issues associated with pheasants. But there are many questions which remain unanswered. The Trust is working hard to get more data on wild pheasants and reared pheasants in the wild. Both directions are important for pheasant conservation and conservation of our lowland habitats.

We need much better data on the interaction of habitat and predation risk. Recent research suggests pre-breeding condition is much more important in pheasants than previously realised. Impacts of parasites and disease are again coming to the forefront. We also need a better understanding of harvest management. For these questions and others, we are trying to develop practical solutions for pheasant management within the constraints of modern countryside management.

We are currently investigating the role of parasitic nematodes on pheasant population dynamics. We are also studying the impact of modern agriculture on availability of food for pheasants during the spring. Preliminary evidence suggests that waste cereal grains and other seeds are not available in modern agricultural fields. This reduces the ability of hens to put on fat reserves for the rigours of egg-laying and incubation. Some experimental data now suggests that this results in lower chick production. We are developing research to test the effects of spring feeding on pheasant productivity on a wide range of estates. A sign of increased interest and respect for wild pheasant management has been the establishment of a Wild Pheasant Group in East Anglia. This follows on from some very successful partridge groups. We encourage those interested in forming such groups in other pheasants of Britian to contact us.

Funding is always the constraining factor in our research and more projects are needed into the future of pheasant management. Conservation depends on a better understanding of problems faced by pheasants as we approach the next millenium. Our monitoring programmes provide a wealth of information but they are difficult to maintain - requiring funding year in and year out. Over the next few years we would like to initiate an intensive study of wild pheasants, which will require much larger funding levels than are currently available.

You can help us by providing data for our long-term population studies or by providing study sites for specific projects. If you do not have access to specific sites or data, there are many opportunities to fund or contribute to our research projects. More than 50% of our research and monitoring programmes are raised through grants and donations.

Aebischer, N.J. & Robertson, P.A. (1992).
Practical aspects of compositional analysis as applied to pheasant habitat utilization. In: *Wildlife Telemetry: Remote Monitoring and Tracking of Animals*. Eds.: I.J. Priede & S.M. Swift. Ellis Horwood, London. 285-293.

Baxter, D.A., Sage, R.B. & Hall D.O. (1996).
A methodology for assessing gamebird use of short rotation coppice. *Biomass & Bioenergy* 10: 303-306.

Bealey, C.E. & Robertson, P.A. (1992).
Coppice management for pheasants. In: *Ecology and Management of Coppice Woodlands*. Ed.: G.P. Buckley. Chapman and Hall, London. 193-210.

Beer, J.V. (1990).
Gamebird diseases in Great Britain. In: *Pheasants in Asia 1989*. Eds.: D.A. Hill, P.J. Garson, & D. Jenkins. World Pheasant Association, Reading. 265-274.

Clarke, S.A. & Robertson, P.A. (1993).
The relative effects of woodland management and pheasant Phasianus colchicus predation on the survival of the pearl-bordered and small pearl-bordered fritillaries *Boloria euphrosyne* and *B. selene* in the south of England. *Biological Conservation*, 65: 199-203.

Dowell, S.D. (1990).
Differential behaviour and survival of released hand-reared and wild grey partridges in the United Kingdom. In: *Perdix V: Gray Partridge and Ring-Necked Pheasant Workshop*. Eds.: K.E. Church, R.E. Warner, & S.J. Brady. Kansas Department of Wildlife and Parks, Emporia, Kansas. 230-241.

Dowell, S.D. (1990).
The development of anti-predator responses in grey partridges and common pheasants. In: *Pheasants in Asia 1989*. Eds.: D.A. Hill, P.J. Garson, & D. Jenkins. World Pheasant Association, Reading. 193-199.

Draycott, R.A.H., Hoodless, A.N., Ludiman, M.N. & Robertson, P.A. (1997).
Effects of spring feeding on body condition of hand-reared ring-necked pheasants. In: *Journal of Wildlife Management*.

Hill, D.A. (1985).
The feeding ecology and survival of pheasant chicks on arable farmland. *Journal of Applied Ecology*, 22: 645-654.

Hill, D.A. (1986).
The Pheasant. In: *The Atlas of Wintering Birds in Britain and Ireland*. Ed.: P. Lack. T. & A.D. Poyser, Calton. 166-167.

Hill, D.A. & Edwards, J. (1986).
The compatibility of pheasant management and woodland conservation with emphasis on southern England coppice. In: *Proceedings of the Symposium on 'Lowland Woodland Conservation and Access'*. Recreation Ecology Research Group, Wye College, Wye. 1-17.

Hill, D.A. & Rands, M.R.W. (1986).
The ecology and adaptability of the pheasant (*Phasianus colchicus*) and grey partridge (*Perdix perdix*) in relation to changing land use in Britain. In: *Proceedings of the Third Symposium of the World Pheasant Association*. World Pheasant Association, Reading.

Hill, D.A. & Ridley, M.W. (1987).
Sexual segregation in winter, spring dispersal and habitat use in the pheasant (*Phasianus colchicus*). *Journal of Zoology*, London, 212: 657-668.

Hill, D.A. & Robertson, P.A. (1988).
The Pheasant: Ecology, Management and Conservation. Blackwell Scientific Publications, London. pp 278.

Hill, D.A. & Robertson, P.A. (1988).
Breeding success of wild and hand-reared ring-necked pheasants (*Phasianus colchicus*). *Journal of Wildlife Management*, 52: 446-450.

Hill, D.A. & Robertson, P.A. (1988).
A population model as an aid to pheasant management. In: *Pheasants: Symptoms of Wildlife Problems on Agricultural Land*. Eds.: D.L. Hallett, W.R. Edwards, & G.V. Burger. North Central Section of the Wildlife Society, Bloomington, Indiana. 149-163.

Hill, D.A. & Robertson, P.A. (1990).
Breeding success of wild and hand-reared ring-necked pheasants. In: *Pheasants in Asia 1989*. Eds.: D.A. Hill, P.J. Garson, & D. Jenkins. World Pheasant Association, Reading. 173.

Hoodless, A.N., Draycott, R.A.H., Ludiman, M.N. & Robertson, P.A. (1997).
Ring-necked pheasants (*Phasianus colchicus*): foraging behaviours and diet in spring: An experiment and a review. In: *Proceedings of Perdix VII International Gamebird Symposium*.

Kenward, R.E., Robertson, P.A., Coates, A.R., Marcström, V., & Karlbom, M. (1993).
Techniques for radio-tagging pheasant chicks. *Bird Study*, 40: 51-54.

Lister, S.A., Beer, J.V., Gough, R.E., Homes, R.G., Jones, J.M.W., & Orton, R.G. (1985).
Outbreaks of nephritis in pheasants (*Phasianus colchicus*) with a possible coronovirus aetiology. *Veterinary Record*, 117: 612-613.

Ludolf, I.C., Robertson, P.A., & Woodburn, M.I.A. (1989).
Changes in the ground flora and butterfly populations of woodlands managed to encourage pheasants. In: *Biological Habitat Reconstruction*. Ed.: G.P. Buckley. Belhaven Press, London. 312-327.

Pennycott, T.W. (1996).
Effect of four therapeutic agents on *Trichomonas phasiani* carriage in pheasants. *Veterinary Record*, 139: 214-215.

Potts, G.R. (1982)
Conservation of pheasant habitat in Asia and a possible role for hunters and aviculturalists. In: *Pheasants in Asia 1982*. Ed.: C.D.W. Savage. World Pheasant Association, Reading. 109-114.

Pyke, K.L. (1989).
Assessment of a technique to measure pheasant chick feeding rate with special reference to set-aside land. Unpublished M.Sc. Thesis, Imperial College, London.

Ridley, M.W. & Hill, D.A. (1987).
Social organisation in the pheasant (*Phasianus colchicus*): harem formation, mate selection and the role of mate guarding. *Journal of Zoology*, London, 211: 619-630.

Robertson, P.A. (1985).
Habitat selection and the relative distribution of wild and released pheasants as determined by winter trapping. *Journal of the World Pheasant Association*, 10: 87-99.

Robertson, P.A. (1985).
Ageing Irish pheasants by measurement of their proximal primaries. *Irish Birds*, 3: 71-74.

Robertson, P.A. (1988).
Pheasant management in small broadleaved woodlands. In: *Wildlife Management in Forests*. Proceedings of the Institute of Chartered Foresters. Ed.: D.C. Jardine. Institute of Chartered Foresters, Edinburgh. 25-33.

Robertson, P.A. (1988).
Survival of released pheasants, *Phasianus colchicus*, in Ireland. *Journal of Zoology*, London, 214: 685-695.

Robertson, P.A. (1990).
The effects of releasing hand-reared birds on the British pheasant population. In: *Pheasants in Asia 1989*. Eds. : D.A. Hill, P.J. Garson, & D. Jenkins. World Pheasant Association, Reading. 233-236.

Robertson, P.A. (1991).
Estimating the nesting success and productivity of British pheasants *(Phasianus colchicus)* from nest record schemes. *Bird Study*, 38: 73-79.

Robertson, P.A. (1992).
Woodland Management for Pheasants. Forestry Commission Research Bulletin, No. 106. HMSO, London. pp.18.

Robertson, P.A. (1993).
The Pheasant & The Golden Pheasant. In: *The New Atlas of Breeding Birds in Britain and Ireland: 1988-1991*. Eds. : D.W. Gibbons, J.B. Reid, & R.A. Chapman. T. & A.D. Poyser, Calton. 140-143.

Robertson, P.A. (1993).
Managing Woods for Pheasants. In: *Management of Small Farm Woodlands*. Ed. : D.A. Greig. Institute of Chartered Foresters, Edinburgh. 73-82.

Robertson, P.A. (1995).
Pheasants and fragmentation: positive effects of landscape interspersion. In: *Fragmentation in agricultural landscapes*. Proceedings of the 3rd Annual IALE (UK) Conference, Ed. : J.W. Dower. Colin Cross Printers, Garstang. 169-175.

Robertson, P.A. (1996).
Does nesting cover limit abundance of ring-necked pheasants in North America? *Wildlife Society Bulletin*, 24: 98-106.

Robertson, P.A. & Carroll, J.P. (1989).
Observations on the autumn density of Chinese ring-necked pheasants *(Phasianus colchicus karpowi)* in Shanxi Province, People's Republic of China. *Journal of the World Pheasant Association*, 14: 101-106.

Robertson, P.A. & Dowell, S.D. (1990).
The effects of hand-rearing on wild gamebird populations. In: *The Future of Wild Galliformes in the Netherlands*. Eds. : I.T. Lumeij & Y.R. Hoogeveen. Gegevens Koninklijke Bibliotheek. The Hague. 158-171.

Robertson, P.A. & Hill, D.A. (1986).
The role of predation in pheasant release. In: *Proceedings of the Third Symposium of the World Pheasant Association*. World Pheasant Association, Reading.

Robertson, P.A. & Hill, D.A. (1992).
A bird in the bush is worth four in the hand : hand-rearing and the productivity of pheasants in the wild. *Global Trends in Wildlife Management*, 2: 305-309.

Robertson, P.A., Hill, D.A., & Raw, K.A. (1985).
Variations in body weight and tarsal dimensions of English and Irish pheasants with notes on ring sizes. *Ringing & Migration*, 6: 119-121.

Robertson, P.A. & Hillgarth, N. (1994).
Impact of a parasite *Heterakis gallinarum* on the body condition and breeding success of pheasants *Phasianus colchicus*. In: *Proceedings of the 21st Congress of the International Union of Game Biologists. 2*. Ed. : I.D. Thompson. Canadian Forest Service, Halifax, Nova Scotia. 77-82.

Robertson, P.A. & Kenward, R.E. (1990).
Trapping, marking and radiotagging. In: *Pheasants in Asia 1989*. Eds. : D.A. Hill, P.J. Garson, & D. Jenkins. World Pheasant Association, Reading. 153-166.

Robertson, P.A., Wise, D.R., & Blake, K.A. (1993).
Flying ability of different pheasant strains. *Journal of Wildlife Management*, 54: 778-782.

Robertson, P.A. & Woodburn, M.I.A. (1993).
Introduction. In: *The Pheasant : The New Fur, Feather and Fin Series*. Ed. : C. McKelvie. Signet Press, Lockerbie.

Robertson, P.A., Woodburn, M.I.A., & Hill, D.A. (1988).
The effects of woodland management for pheasants on the abundance of butterflies in Dorset, England. *Biological Conservation*, 45: 159-167.

Robertson, P.A., Woodburn, M.I.A., & Hill, D.A. (1993).
Factors affecting winter pheasant density in British woodlands. *Journal of Applied Ecology*, 30: 459-464.

Robertson, P.A., Woodburn, M.I.A., Neutel, W., & Bealey, C.E. (1993).
Effects of land use on breeding pheasant density. *Journal of Applied Ecology*, 30: 465-477.

Sage, R.B. & Robertson, P.A. (1994).
Wildlife and game potential of Short Rotation Coppice in the U.K. *Biomass and Bioenergy*, 6: 41-48.

Sage, R.B, Robertson, P.A., & Wise, D.R (1997).
Survival and breeding success of different pheasant strains released into the wild. *Cahier Faune Sauvage*.

Sotherton, N.W. & Robertson, P.A. (1990).
Indirect impacts of pesticides on the production of wild gamebirds in Britain. In: *Perdix V: Grey Partridge and Ring-Necked Pheasant Workshop*. Eds. : K.E. Church, R.E. Warner, & S.J. Brady. Kansas Department of Wildlife and Parks, Emporia, Kansas. 84-103.

Sotherton, N.W., Robertson, P.A., & Dowell, S.D. (1993).
Manipulating pesticide use to increase the production of wild gamebirds in Britain. In: *Quail III : National Quail Symposium*. Eds. : K.E. Church & T.V. Dailey. Missouri Department of Conservation, Jefferson City, MO. 92-101.

Woodburn, M.I.A. (1986).
Habitat selection and woodland management for pheasants on an estate in Dorset. Unpublished M.Sc /DIC Thesis, Imperial College of Science and Technology.

Woodburn, M.I.A. (1991).
Gamebirds and woodland edges. In: *Edge Management in Woodlands*. Forestry Commission Occasional Paper, 28. Ed. : R. Ferris-Kaan. The Forestry Commission, 35-41.

Woodburn, M.I.A. (1992).
Managing woods for pheasants. In: *Report of the 4th Annual Conference of the National Small Woods Association* : Management of Open Ground in Woodland. Ed. : R. Ferris-Kaan. National Small Woods Association, Northampton. 12-20.

Woodburn, M.I.A. (1993).
Monitoring pheasant populations. In: *Pheasants in Asia 1992*. Ed. : D. Jenkins. World Pheasant Association, Reading. 122-127.

Woodburn, M.I.A. (1997).
Comparative breeding success of wild and reared ring-necked pheasants *(Phasianus colchicus)* in southern England. In: *Proceedings of Perdix VII International Gamebird Symposium*.

Woodburn, M.I.A. & Robertson, P.A. (1990).
Woodland management for pheasants: economics and conservation effects. In: *The Future of Wild Galliformes in the Netherlands*. Eds. : I.T. Lumeij & Y.R. Hoogeveen. Gegevens Koninklijke Bibliotheek, The Hague. 185-198.

Zhang, Z.W., Ni, X.J., Liang, W., Zhou, X.Q., Li, Y., Liu, Z.Y., & Robertson, P.A. (1996).
Studies on the aggregating behaviour of wild ring-necked pheasant. *Acta Zoologica Sinica*, 42: 112-118.

Zhang, Z.W., Niv, F.L., Sun, Q.A., & Robertson, P.A. (1993).
Ecology of the Chinese Ring-necked Pheasant. In: *Pheasants in Asia 1992*. Ed. : D. Jenkins. World Pheasant Association, Reading. 91-94.

Code of Good Game Rearing Practice. The Game Conservancy Trust, et al.

Code of Good Shooting Practice. The Game Conservancy Trust, et al.

(1986) *Game in Winter: Feeding & Management*. Advisory Service of Game Conservancy Limited.

(1993). *Egg Production and Incubation*. Advisory Service of Game Conservancy Limited.

(1993). *The Pheasant*. The New Fur Feather & Fin Series. Signet Press.

(1994). *Gamebird Rearing*. Advisory Service of Game Conservancy Limited.

(1994). *Predator Control*. Advisory Service of Game Conservancy Limited.

(1994) *Game and Shooting Crops*. Advisory Service of Game Conservancy Limited.

(1996). *Gamebird Releasing*. Advisory Service of Game Conservancy Limited.

Beer, J.V. (1988). *Diseases of Gamebirds & Wildfowl*. Advisory Service of Game Conservancy Limited.

Carroll, J. & Robertson, P. (1997). *Integrating Pheasant Management and Woodland Conservation*. Game Conservancy Limited.

Delacour, J. (1977). *The Pheasants of the World*. Spur Publications & World Pheasant Association.

Hill, D. & Robertson, P. (1988). *The Pheasant: Ecology, Management & Conservation*. Blackwell Scientific Publications.

Howman, K.C.R. (1993). *Pheasants of the World: Their Breeding & Management*. World Pheasant Association & Hancock House Publications.

Hudson, P.J. & Rands, M.R.W. (1988). *Ecology of Gamebirds*. BSP Professional Books.

McCall, I. (1988). *Woodlands for Pheasants*. Advisory Service of Game Conservancy Limited.

McCall, I. (1990) *Your Shoot*. A & C Black (Publishers) Ltd.

Parkes, C. & Thornley, J. (1994). *Fair Game: The Law of Country Sports and the Protection of Wildlife*. Pelham Books.

Prior, R. (1987). *Deer Management in Small Woodlands*. Advisory Service of Game Conservancy Limited in association with the British Deer Society.

Robertson, P.A. (1988). *The Pheasant*. Shire Publications.

Robertson, P.A. (1992). *Woodland Management for Pheasants*. Forestry Commission Bulletin 106, HMSO, London.

Robertson, P.A. (1997). *A Natural History of the Pheasant*. Swan Hill Press.

Tapper, S. (1992) *Game Heritage*. Game Conservancy Limited.

Fordingbridge
Hampshire
SP6 1EF

First Published 1997
ISBN 1 903369 01 3
Designed by Ptarmigan Design Publishing & Print Ltd
Printed by James Byrne Printing Ltd
Front picture: Bridgeman Art Library