

PHEASANT SHOOTING IN BRITAIN

The SPORT and the INDUSTRY in the 21st CENTURY

By Peter Robinson, Consultant Ornithologist, Member of the UK Panel of Expert Witnesses, Fellow and past Principal of the Institute of Professional Investigators

Preface

This report summarises a desktop study of the current state of the British Pheasant shooting industry and its impact on the countryside, its fauna and flora and on the British people. It differs substantially from recent industry studies in that it examines most of the issues involved from another perspective, something rarely if ever done to this level of detail. As a consequence many people may find that its conclusions conflict with their own perceptions or understandings, and therefore may find them difficult to accept. It is also true that some findings are based substantially on calculation and extrapolation, but usually only because the industry lacks reliable or current information on what are extremely important questions for the British countryside.

A list of the scientific names of species mentioned in the text appears in Appendix I and a comprehensive, but by no means complete list of references consulted appears in Appendix II.

Summary

During the 1900s, gamebird shooting evolved from a sport into a billion-pound industry which, like other industries, gives importance to profitability. With the exception of agriculture, few industries interact as closely with the natural environment, and it may be difficult separating agriculture from pheasant management in any event. Perhaps the single most important factor in UK gamebird management is the industry's reliance on maintaining gamebird populations at unnaturally high densities, normally far in excess of natural carrying capacity. This is a fact usually ignored in any debate on shooting or management issues. Managed pheasant densities range from 10 to 12 up to 20 birds per hectare or more, compared with around 0.1 for unmanaged populations.

Distressingly little information is available centrally on numbers of gamebirds released, shot and sold (including UK Red Listed species; that is, species seriously in need of conservation help) even though most estates keep records. The currently quoted figure of 20 million pheasants released annually is derived from early 1990s data, at which time releases were doubling every five years. Furthermore there are no statutory controls on these releases, and the industry forecasts a 400 per cent growth in game sales by 2001. As much as 70 to 90 per cent of the winter pheasant population may be shot annually on some shoots.

Despite industry claims that game production benefits wildlife, populations of the extensively managed, formerly abundant grey partridge, together with other common farmland birds, declined by up to 80 per cent over the most recent period of industry growth. The pheasant too may now be destined for extinction as a truly wild bird. Captive-reared pheasants experience particularly poor breeding success, and their productivity declines further as the percentage of released individuals in the

population rises. Released pheasants suffer higher than normal spring mortality rates when they cease receiving supplementary feed and start breeding. Between-year survival expectations for released birds are half those for wild birds.

Both avian and mammalian predators are attracted to these unnatural concentrations of naive hand-reared birds, who lack natural behavioural responses to attack. Thus in order to protect these hand-reared birds, estate managers subject predators to unnecessary and unreasonable controls. The industry remains firmly in the 19th century in its attitude towards predators. Science is frequently challenged on grounds of tradition or superstition. Substantial gamebird losses are also caused by other factors, such as disease, which are inadequately addressed. A recent multi-agency report concluded that the number of pheasants killed by predators away from release pens was acceptable in the context of the overall number of birds released. It also expressed concern about the lack of research into non-lethal means of solving predation problems at release pens. Little or no work has been done on conditioning captive-reared gamebirds to cope with natural predators.

Many within the industry have a poor understanding of predator-prey relationships within the wider environment, and recent attempts to justify predator control on game estates in order to benefit songbird populations are biologically inept. Farmland songbird declines are irrefutably linked to the same agricultural policies and practices that have reduced grey partridge numbers, with no provable link to predator activity. The biomass (weight) of the spring pheasant population accounts for 30 per cent of the total UK avian biomass, whereas the total early winter pheasant biomass probably exceeds that of all other bird species by as much as 600 per cent.

Perhaps 5 million or more wild birds and other animals are legally killed each year in the name of gamebird management. Important protected birds of prey and mammals also killed illegally, though in much smaller numbers. Some 2,300 birds of prey were reported killed to the Royal Society for the Protection of Birds (RSPB) during 1990-1997. In one year, 118 incidents involved poison misuse and 174 involved shooting and other prohibited means. As a consequence, hen harriers face extinction in England. In 1997 alone, the number of specially protected birds killed included eight red kites, nine Peregrine falcons and one golden eagle. Twenty-eight common buzzards were also killed.

Each year about 12 million pheasants may be crippled during shooting over and above those that are bagged, and about 75,000 metric tonnes of lead shot are discharged annually into the countryside. The number of birds of prey and gamebirds that die from the effects of ingesting spent lead shot is unknown. Few gamebird population are free of an increasing variety of diseases and the industry is experiencing difficulty coping with this situation. Some medicines used to treat captive gamebirds pose a threat to consumers and, presumably, to other wildlife.

About 55,000 landowners control between 60 and 80 per cent of the British countryside, much of it used for game management. The public is denied access to most of their own countryside as a consequence. If implemented, current government proposals will enact long overdue recommendations for public access to common or open land. Claims that the number of shooters will increase are not supported by the number of shotgun licences issued. A day's pheasant shooting costs around £1,000 per

person, and the cost of purchasing a shotgun may be £2-3,000. Pheasant shooting remains largely dominated by class and social distinctions.

Introduction

Depending in no small part on one's social position, the management and shooting of gamebirds as currently practised in Britain is either: 1) a noble ancestral sporting tradition and the salvation of the countryside at a time of major conservation loss; or 2) the anachronistic, environmentally inarticulate and selfish exploitation of Britain's wildlife heritage by an over-privileged, often arrogant minority in pursuit of personal gain, who exclude about 90 per cent of the population from their native countryside. Such is the gap in our perceptions of the gamebird industry and its impact on the natural environment.

Fundamental, too, is the degree of mutual misunderstanding involved in the use of such key words as conservation or countryside. The gamebird industry has a tendency to confuse the management of greatly overstocked gamebird populations, such as pheasant, with far broader conservation issues affecting all other wildlife occurring at natural densities.

Surprisingly, no truly comprehensive study of the gamebird industry appears to have been undertaken, with most authors concentrating largely on economic and social aspects (15, 22, 33). Truly environmental considerations have been largely ignored in industry studies, with some authors even considering the wider natural environment as subsidiary to game management.

According to one writer, the evolution of life weaves itself beyond efficient analysis (32). So if we truly wish to understand complex interactions between gamebird management and present-day natural, economic and social environments, a detailed understanding of the processes from which they evolved may prove difficult. But without this, it becomes impossible to make rational judgements. Most writers consider today's landscape the product of the last 1,500 years, and all agree on how little the countryside changed up to the late 19th century and how great have been the changes (and the losses) since then (54, 86).

Administration of society requires social leaders but, according to some writers, what makes Britain unique is the way leadership has become associated with class. This also has land-ownership implications. Norton-Taylor (76) draws attention to the interesting conundrum whereby if you own land, you presume — or are presumed — to be better fit to rule, to hold power and responsibility. It also presumes that if you have successfully climbed the political and industrial ladder, you should own land. Added to that is the belief, peculiar to Britain, that the aristocracy and landed gentry enjoy a kind of enlightened, though frequently arrogant, conviction that they are the backbone of Britain. With this goes the frequent, but nonetheless mistaken belief that land ownership conveys automatic understanding of the complexities of wildlife ecology (10, 59, 77).

The Common Pheasant

Originally from Asia, most authorities credit the Romans with introducing pheasants to Britain, though successive introductions make modern stocks an inevitable blend of geographical races (31, 62, 94, 114). Primarily a bird of woodland edge and rough

ground, pheasants flourish in a range of habitats, including grassland, cultivation and reedbeds (25). Now inextricably linked to lowland agriculture (94), many see the pheasant as a symbol of our 'traditional' countryside. Recently assessed as the 13th most common breeding bird in Britain (42) both in numbers and distribution, the pheasant is now also the most important gamebird in Britain (114) and among the most significant in virtually all of Europe and North America (94).

A range of natural environmental population controls mean natural pheasant densities are normally insufficient to support modern commercial demands for driven shoots. Therefore where such shoots occur, autumn populations are substantially augmented by releases of captive-reared birds, the numbers of which may double every five years (69, 114). Importantly, the currently quoted figure of 20 million annual releases was for the early 1990s. In 2000, the true number involved could easily exceed 35 million, if one considers a 1990s forecast of a 400 per cent increase in game-meat sales in 10 years and the doubling of populations every five years.

By 1989 the calculated pheasant population for England, Scotland and Wales combined was 850,000 territorial males, 650,000 non-territorial males and 1.6 million females, for a total of 3.1 million birds (93). Importantly, though, this took into account only the spring breeding population and ignored released captive-reared birds (17, 69, 114). Like the now red-listed grey partridge, the population of truly 'wild' pheasants may be in decline. It could be as low as 10 per cent of the total number of birds at liberty (114). With so few shoots now reliant on wild stocks, the British pheasant population would probably collapse without captive releases (93,105, 114).

In terms of total combined body weight, the 1989 spring pheasant population of some 3 million birds accounted for 30 per cent of the total avian biomass. However, if one also takes into account the 20 million or more birds now being released in autumn, pheasant biomass exceeds that of all other bird species combined by perhaps 600 per cent (26). The effects of this gross environmental imbalance have yet to be examined properly.

Pheasant Management

The demands of introducing and maintaining naive hand-reared gamebirds in an 'alien' wild environment differ significantly from those of rearing domestic poultry. Gamebirds must be hardy, have high levels of immunity to disease, be able to survive in the wild and avoid natural predation (8). They must also 'perform' well over the guns and still comply with subsequent commercial demands of both the game dealer and consumer.

Mounting economic restraints have forced game managers to maintain gamebird populations at ever greater and increasingly unnatural densities. Inevitably, these concentrations of a potential food source heighten conflicts between game managers and natural bird and mammalian predator populations. Critical to this debate is that most within the industry no longer view managed gamebird populations as unnatural, with far too many advocating predator elimination as the primary management objective. This is despite the fact that this is an annually renewable problem and that total predator elimination is a near impossibility, as well as being both morally and scientifically questionable. Recent industry research is directed mainly at demonstrating levels of potential loss to the rural economy from any political attack

on game shooting (15, 17, 33), even though a search for fuller integration with the natural environment might prove more rewarding to both the industry and the environment. Illustrating this point is that among the numerous bird species suffering agriculturally-related declines of up to 80%, is the grey partridge (40, 98), the former mainstay of the British lowland gamebird industry.

This same in-house research (17) criticised the industry's failure to collate and publish meaningful details on the numbers of birds released, shot and sold annually (15, 16, 17). Were these statistics generally available, they would be of considerable conservation and management importance. Because such data are probably already held by most shoots (114), there seems no obvious justification for this omission.

Shooter and Keeper Numbers

By mid the 1990s, about 57,000 people (0.1 per cent of the population) shot live quarry on 52,000 agricultural holdings throughout England, Scotland and Wales (15). The area of agricultural land involved totalled 4.5 million hectares (42 per cent) in England and Wales, and 2.2 million hectares (40 per cent) in Scotland. While the proportion of land involved in pheasant shooting is unknown, it usually accords with the total area of agricultural holdings (15).

The numbers of gamekeepers employed on all types of gamebird shoots peaked at over 23,000 around 1911. Since then they have declined to perhaps 5,000 (114). But it would be wrong to assume this reduction in personnel reflects a decrease in the volume of shooting overall, even though recent industry claims of increased numbers of people participating in game shooting appear not to be supported by what limited data are available (1, 15).

Stocking Densities and Cropping Statistics

Despite its popularity as a lowland gamebird, even by 1900 the pheasant comprised only 15 per cent of the annual take, with the grey partridge forming the bulk. However by the 1980s, pheasants accounted for 55 per cent of shot gamebirds, with a 500 per cent increase in numbers killed between 1960 and 1983 (114) being directly attributable to captive rearing (Table I). By the mid-1990s, 21 million gamebirds of seven species were shot annually, including 18 million pheasants (85 per cent). Of those, 11 million (61 per cent) were sold for human consumption in Britain and elsewhere (15, 16, 114). Thus, the total number of pheasants shot exceeded the then estimated 3.1 million wild bird population by some 600 per cent, with the disparity largely attributable to the enormous volume of released birds. We must, however, bear in mind that this calculation is based on 10-year-old data and takes no account of industry predictions of as much as double the number of birds released and a 400 per cent increase in income from the sales of game meat by 2001 (69, 114).

Table I
Known and Projected Totals for Numbers of Pheasants Released, Shot and Sold

Year	Released	Shot	Sold
1983	?	8,400,000	5,000,000
1992	20,000,000	17,000,000	10,200,000
1997	?	18,000,000	11,000,000
2001	(40,000,000+)	(36,000,000+)	(22,000,000+)

Compared with 'wild' birds, captive-reared pheasants suffer greatly increased mortality (from various sources), and because their between-year survival is only half that of wild birds, comparatively few survive to breed. This increasing reliance upon released birds to produce the shootable requirement lowers incentives to retain wild breeding stock. Where released birds do survive to breeding age, they have lower breeding success, which means that as the proportion of released birds increases, the population productivity declines (93). Unlike in some parts of North America (J Massie pers com), there is no requirement to ring or otherwise mark British cohort groups prior to releases in order to monitor long-term survival, and no structured voluntary marking scheme. Thus, little wide-scale information is available on between-year survival of released birds or on recruitment into the 'wild' population.

In typical unmanaged habitat, the average pheasant breeding density is around 0.039 territorial males and 0.073 females per hectare (0.112 birds per hectare) (93). On managed shoots, pheasant density is largely determined by habitat manipulation and the volume of released birds (93). This results in numbers of birds greatly exceeding the natural carrying capacity. On average, releases of up to 10 to 12 birds per hectare are claimed to cause no conservation problems and higher numbers may be possible, though national advisory groups advise that densities above 20 birds per hectare may have negative ecological effects (113).

Captive Rearing

Eggs for artificial incubation (formerly by domestic fowl - now typically in electrical incubators) are either purchased from game farms or acquired from the mix of previously released and wild birds present on the shoot. In the latter case, adults are either caught-up and penned prior to laying, or eggs are collected from natural nests, with females left to hatch and rear repeat clutches. A more costly alternative involves purchasing hatching eggs or newly hatched or older birds from commercial game farms, with a substantial and increasing proportion of eggs involved originating outside the UK (2 million eggs from the French company GIBÍRETZ in 1998). Even by 1983 (the most recent figures available), 140 game farms annually supplied 9 million newly hatched birds for rearing and shooting, plus 30 million or more hatching eggs (15). Currently, some farms rear 800,000 young pheasants annually.

Young pheasants are initially reared under cover, but at six weeks they are moved to 'release pens', permanently positioned in or close to the intended shoot area. Here the pens are uncovered, and the birds escape to nearby managed woodland where they are provided with supplementary food. In their initially naive state, young pheasants are vulnerable to a range of hazards, including avian and mammalian predators, who are attracted by these unnatural concentrations of accessible prey.

Reporting in February 2000 on the results of a five-year study, the UK Raptor Working Group (UKRWG) concluded that, in the context of overall pheasant numbers, losses to predators are 'minimal' (119). Nevertheless there were some concerns. Losses at some release pens of as much as 10 per cent were considered the main problem. Some reports claimed losses of up to 46 per cent. Even so and despite extensive research, Lloyd (61) was unable to confirm that avian (rather than mammalian) predators participate in mass kills. As an extension of Lloyd's study, multi-agency recommendations for non-lethal means of reducing predator impacts at

release pens were published in 1985 (6), and the UKRWG found that these were being followed by 68 per cent of keepers. There remained concern over the number still making no effort to limit predation.

The UKRWG also saw the current lack of effort aimed at exploring the effectiveness of 'non-lethal' deterrents at release pens as the most important predator-related issue facing the lowland gamebird industry at this time. The group called for urgent research and recommended that all conclusions be widely disseminated to interested parties.

Debeaking, Anti-peck Bits and Wing Brailing

The switch to intensive hand-rearing of huge numbers of pheasants during the 1900s was paralleled by increases in a number of diseases and behavioural problems previously of only limited significance. One is the tendency for concentrations of confined birds to indulge in serious feather pecking. To prevent this, birds are fitted with a small, commercially available plastic or light metal 'bit', preventing full closure of the beak and commonly held in place by two small projections fitted into the exterior nasal cavities. Bits are fitted when the birds are around three weeks of age and removed before they are transferred to release pens, at age six or seven weeks. Bits may need replacing with a larger size as the birds grow.

Inevitably, birds fitted with bits experience feeding difficulties for at least a few days, after which they apparently adjust to the device. Allegations of birds subsequently unable to feed are presumably ill-founded, if only because this defeats the prime objective of rearing well-fed, healthy gamebirds. Nevertheless a period of temporary stress is presumably involved as birds adjust to the sudden need to feed using a bill that no longer closes fully.

Additionally, as a further aid towards reducing antisocial behaviour in captive birds, small plastic 'spectacles' have been fitted to interrupt birds' straight-line vision. In the past, these were usually held in place by a pin driven through the nasal orifices, a method that is now illegal. The extent to which these pin-type specs continue in use is unclear (30).

Birds should not be released with bits or spectacles in place and game managers normally adhere to this rule, though inevitably some escapes do occur. While as many as 40 million pheasants are now reared and released annually, the percentage fitted with bits is unclear.

Another approach to feather pecking is to remove an anterior portion of the beak from all the birds when they are about 10 days old - a process known as 'debeaking' (30). Comparatively little appears to have been published on the practicalities of solving the feather-pecking problem by improving rearing conditions, though presumably cost becomes an issue.

In order to prevent captive adult pheasants in open-topped laying pens from flying free, birds may be fitted with lightweight straps, or 'brails', which fit around and restrict the closed wing. As with bits, brails must be removed before the bird is freed. The use of brails has been criticised for the presumed stress inflicted on birds unable to stretch a wing or preen for perhaps weeks, and the likelihood of associated muscle

damage. Fitting pens with netting covers obviates the need for brailing but, again, the extent to which these are still used is unclear.

Release Pens

Typical pheasant release pens are built with two-metre-high wire netting on timber poles positioned within managed woodland. Most incorporate defences against attacks by foxes, but owing to the need for pheasants to fly from the pen once they are able, few have roofs to protect against avian predation. Thus, penned young birds remain vulnerable to avian predators, particularly sparrowhawks, common buzzards and tawny owls. A recent industry survey showed that 51 per cent of all alleged raptor predation incidents involving gamebirds occurred at release pens (nearly all holding pheasants), with the three named avian predators involved in (36, 20) and 17 per cent of incidents respectively (119).

Previously, researchers examined 489 pheasant release pens, finding that the average pen size was 0.63 hectares (1.56 acres) and contained 568 birds at a density of 901 per hectare (365 per acre) (63). However, a smaller number of pens visited averaged only 0.47 hectares (1.16 acres), but contained 2,128 birds per hectare (861 birds per acre). In fact, the study revealed a wide range of pen densities, with some containing over 6,000 birds per hectare (10 times the recommended 600 birds). Fifty-eight per cent of release pens were stocked above recommendations. Meanwhile in an entirely unrelated survey, researchers found 1,000 birds per hectare was not unusual (105).

A sensible approach can minimise conflicts between game management and the wider environment. Careful positioning and good design of pens can reduce both predation (61, 119) and environmental impacts on the pen's immediate surrounding, particularly in woodland. The age of surveyed pens ranged from one to 20 years. The amount of tree cover above a pen does not significantly affect predation, but pens with 60 per cent or more internal herb cover suffered 50 per cent less predation than pens with less cover. However, removal of tree cover can significantly alter natural plant communities in the pen's proximity (63).

Sadly, pens with little or no internal cover are all too common and, as such, are particularly vulnerable to predation. Fox predation from release pens can be further reduced by a combination of placing pens in smaller woods (less than 50 acres) and by totally confining the structure within the wood itself (63). Releasing older birds, e.g. at seven weeks, also helps reduce predation, as does releasing them later in the season.

Supplementary Feeding

Supplementary feeding of released hand-reared pheasants is the norm in order to increase survival and prevent the birds from wandering onto adjoining land (94). Activities associated with feeding, e.g. straw-covered rides*, or removal of tree cover, may adversely affect local plant communities. (*The straw is used to increase the woodland edge effect and to serve as a firebreak.

According to Robertson (94), artificial feeding is vital for released pheasants to improve their chances of survival. However, the same author draws attention to substantial difficulties faced by birds that have never foraged for themselves. This is particularly true following the annual spring withdrawal of such food, just at the time

when the birds' energy demands are increasing in preparation for breeding. Although trials showed substantial improvements in the condition of female pheasants where feeding continued into spring, it remains unclear why 'un-fed' birds suffered poorer condition. Among the possible explanations are: 1) an inability to adjust to natural foods; 2) the possible inadequacy of natural foods given the serious adverse effects of recent agricultural practices on other farmland birds, e.g. skylark and corn bunting; or 3) possible higher parasite levels in released birds. Females reared in spring-fed areas occurred in greater numbers, produced 60 per cent more nests and hatched 40 per cent more chicks than those left unfed. This leads us to assume that the continuation of artificial feeding into spring has the potential to reduce adult losses and improve productivity, both of which might help balance alleged predation losses.

The Market in Shot Birds

Controls on the sale of dead game are complex and extremely outdated. Income from British retail sales of game meat doubled between 1983 and 1992, and according to Game Marketing Executive (GAME) (69) they were destined to increase by 300 to 400 per cent between 1992 and 2001. If true, this increase was presumably accompanied by at least some increase in the numbers of released birds. Even a 100 per cent increase would mean annual releases of 40 million pheasants by 2000, with some 36 million birds being shot annually. Industry expansion of this magnitude also seems guaranteed to intensify conflicts with the broader conservation need and to magnify difficulties within the industry itself, e.g. increase levels of disease among captive-reared birds and thus further escalate use of medicinal controls.

Particularly worrying is GAME's assertion that the commercial non-availability of dead game during seasons when shooting is not allowed, creates gaps in consumer awareness that depress meat sales (47). Amending the Game Acts to allow year-round sales of dead game would have serious implications for enforcement, including weakening statutory closed periods through the creation of a market for illegally taken birds.

Game dealers normally collect shot gamebirds from estates prior to evisceration and many carcasses reach retail outlets in this condition. In this respect, the gamebird industry offers itself as a target for change by a government apparently dedicated to seeing all domestic poultry eviscerated at source, as elsewhere in Europe (104).

Predators Conflicts and Predator Control

Though the point is usually grossly understated, the primary function of gamebird management is to produce the maximum numbers of individual birds for shooting. To achieve this, particularly in Britain, game managers have evolved methods of maintaining gamebird stocks at densities greatly exceeding natural carrying capacities. This deeply artificial situation is heavily dependent upon varying amounts of habitat manipulation, substantial annual releases of captive-reared birds and extensive and systematic 'lethal' predator control. The whole process is driven primarily by profit, with gamebird shooting and associated activities now best viewed as part of the agricultural livestock industry.

In Britain 20 million captive-reared pheasants were said to have been released annually by the early 1990s. That figure could since have doubled, though regrettably there are no current data available (16, 69,114). This requirement for game managers

to release apparently limitless numbers of domestically reared birds overrides government and public concerns for the natural environment and magnifies conflicts with predators and other natural processes.

Avian and mammalian predators form an inseparable part of the biological mass, and predation is widely believed to have shaped every aspect of the life histories of birds and other wild animals (14, 18). Nonetheless substantial misunderstandings and prejudices over the part played by predators within the natural environment remain widespread among landowners and employee game managers, as demonstrated by the recent headline 'Moorland keepers launch attack on science' (4, 27).

An increased predator presence can be anticipated around any concentration of prey, whether natural or unnatural. Predators are attracted to pheasant release pens, in the same way that grey herons or great cormorants are attracted to fishponds or blue tits to garden nut feeders. However, substantial moral and ecological questions are associated with the persistent, long-term suppression of biologically important predators within these artificial conditions, especially when such conditions are financially motivated and lack either broader ecological considerations or effective monitoring controls (14, 27, 119).

Results of world-wide research into non-gamebird populations suggest caution when comparing the ecology of birds occurring naturally with those managed at unnaturally high densities. Studies show that, on balance, 75 per cent of songbird nests are subject to natural predation, and there is no evidence that ground nests fail more frequently than those above ground (18, 57). Furthermore, unless predators have been introduced artificially to an area, there are few documented cases where population declines are unequivocally attributable to predation alone (18). Declines usually result from the loss or alteration of breeding or feeding habitat (as with the British farming industry recently). Predation is merely an exacerbating factor.

Nevertheless, of all the causes of gamebird mortality, including climate and disease, many game managers still consider predation to be the most serious. It is also the only influence capable of being dealt with quickly and easily (72). This contradicts the logical path to long-term preservation of gamebird stocks which lies in managing habitat, controlling disease and, in the case of pheasants, researching protective, 'non-lethal' control measures at release pens (14, 18, 93, 119). So blinkered is the industry's approach to dealing with the predation problem that little or no research has been conducted into the possibility of training captive reared birds to be more alert to predators. An example of such a programme is being carried out with reintroduced houbara bustards in Saudi Arabia (121).

This systematic persecution of avian and mammalian predators is one of the more controversial aspects of gamebird management (3, 99, 100). Evidence suggests that many within the industry still have a poor understanding of basic biological principles of predator-prey relationships. Most worrying is the number of specially protected rare birds and other animals that are still killed illegally (a situation recently described by the Secretary of State for Scotland as a 'national disgrace' (3)). Added to this are ongoing industry demands for legislative changes that would allow the destruction of these same biologically important creatures (27). Of equal concern is the lack of any central monitoring of the numbers of specially protected mammals, including pine

martens, otters and pole cats, that are accidentally destroyed during routine trapping of other species, such as stoats or American minks (113).

The extent to which wholesale destruction previously caused population declines, range retractions and even national and local extinction in predatory and other birds and animals is a matter of public record (13, 114, 116, 117). Much of this killing was associated with so-called game preservation. Even today an estimated 1.5 million birds and 3 million mammals are legally destroyed on lowland shoots each year (Table II) in the name of game-management (114). The true total is undoubtedly greater. To this we must add the lesser, but arguably more important, number of rare birds of prey killed illegally, several of whom receive special legal protection (13, 97, 99). Virtually all game managers continue to destroy at least some predatory species, often with an enthusiasm out of step with modern understandings of complex predator-prey relationships. As a consequence, predators pay an enormous penalty for being just one of a range of readily identifiable factors impacting upon these artificial gamebird populations.

American research into the effects of predator removal on breeding gamebirds and waterfowl occurring at natural density, shows that the short-term gains of such removal programmes can be impressive. Nonetheless predator control provides no long-term population benefit by way of increased breeding or post-breeding adult population size (18). This is because predator removal normally extracts an expendable surplus, without affecting population size. Thus culling replaces rather than augments annual mortality. Meanwhile, as with human attempts to control natural predators, a substantial proportion of predated gamebirds come from that portion of the population normally lost to natural wastage. In addition to which, predators refill spatial vacancies left by culled animals and are biologically 'programmed' to increase population size during times of local prey abundance (18, 71).

Long-term studies disprove suggestions that the recovery of the woodland sparrowhawk population caused recent reductions in songbird numbers. Some woodland songbirds actually increased in conjunction with the number of sparrowhawks. Most songbird declines occurred among farmland and not woodland species, illustrating unequivocal links to changes in agricultural practice. Likewise, claims that changes in magpie distribution and abundance have caused reductions in small bird populations, have been proved false.

In fact, the evidence reveals an important lack of correlation between the spread of these two species and declines in songbird populations (73, 74, 115). In its recent landmark report, the UKRWG found no published evidence that avian predators have sustained effects on the size of songbird breeding populations. Fourteen studies into the declines of European farmland species pointed out that none was attributable to predation, and all were attributable to changes in farming practices (119).

In this respect, recent attempts by the Game Conservancy Trust to suggest that songbird populations are enhanced by predator control programmes, are biologically spurious. They also perpetuate the medieval philosophy that the presence of predators is harmful to other wildlife. Publication of a one-year study by the conservancy into alleged findings that songbirds benefitted from a control programme, was premature,

and lacked a long-term perspective, a prerequisite of population ecology studies (85, 109, 110).

Arguably this philosophy of total predator elimination leads ultimately to a world devoid of known population regulators, and therefore vulnerable to an unimaginable array of opportunistic replacement organisms.

The UKRWG also found that the illegal killing of birds of prey remains widespread. Reports of 720 confirmed incidents during 1990-1997, involving at least 834 individuals representing 15 species, probably represented a 'very small' proportion of the likely total (119). The group concluded that such activities limit the national distribution and numbers of red kites, hen harriers, common buzzards, golden eagles and peregrine falcons, to a level below that which might naturally be expected. Impact is greatest on the hen harrier, who risks extinction in England as a consequence. During the same period, over 2,300 reported incidents of bird of prey persecution and poisoning came to the notice of the Royal Society for the Protection of Birds (RSPB). The average annual rate was 118 poisoning incidents and 174 involving shooting or other prohibited forms of destruction, such as trapping (99).

Although not all were thought to be game-related, the majority occurred on land used for shooting, or used jointly for shooting and agriculture (RSPB pers com). Birds killed illegally in 1997 included 10 diurnal raptor species and two owls. Of the raptor species, eight were red kites, nine were Peregrine falcons and one was a golden eagle. All are specially protected. Twenty-eight common buzzards also died, and there were 11 incidents of bird of prey nests being destroyed.

TABLE II
Estimated Minimum Annual Totals for Five Bird and Nine Mammal Non-Game Species Destroyed in Furtherance of Game Management³

<u>Species</u>	<u>Mean per km2*</u>	<u>Total</u>
Hedgehog	0.75	50,342
Weasel	1.25	83,903
Stoat	1.75	117,463
Polecat ¹	0.03	336
American Mink	0.23	15,438
Wildcat ²	0.04	887
Fox	2.3	154,380
Grey Squirrel	40.0	2,684,880
Brown Rat	7.0	469,854
Total – 3,107,629 mammals		
Magpie	2.3	154,382
Carrion/Hooded Crow	3.5	234,930
Rook	5.0	335,615
Jackdaw	2.0	134,246
Jay	1.1	738,353
Total – 1,597,526 birds		

Combined Total 4,705,191 birds and other animals

* 1989 figure – Tapper 1992

¹ 25% of England/Wales total area

² Scotland only

³ excluding non-agricultural upland, e.g. moorland

One important recommendation in the UKRWG report calls for the enhanced enforcement of existing legislation to prohibit the illegal killing of birds of prey. Such enforcement would underpin efforts to encourage game managers and others to pursue only legal options of enhancing game stocks. Allegedly the percentage of

shoots that engage in illegal predator destruction is now small, but it is difficult to be sure. For one thing, the RSPB figures don't account for incidents dealt with by the police or the three national agricultural ministries without reference to that organisation.

For obvious reasons, incidents involving shot birds are difficult to attribute to individuals, or even particular estates or farms. The same is often true of poisoning incidents. Not so, however, the use of the barbaric and long-outlawed pole-trap, which kills birds of prey by catching and breaking their legs and is typically set around pheasant release pens. Five incidents in 1997 involved pole-traps, while in a further two, otherwise legal, spring-traps were used improperly (99).

Benefits of Gamebird Management to Other Wildlife

Industry claims of substantial benefits to other wildlife arising from gamebird management may have foundation, but if so, little research has been done to demonstrate this and even less has been published. Moreover, industry-commissioned studies suggest landowners and game managers are apt to let their own, somewhat narrow, re-prioritised definition of 'conservation' obscure the broader, more comprehensive picture (15, 105). As demonstrated by the reference to 'conflicts between game management and other land uses such as public access, wildlife conservation and commercial timber production' (105). It's important to note, too, that virtually all industry studies concentrate on the economic and social aspects of shooting, to the near exclusion of true conservation considerations. The industry also fails to quantify these alleged conservation benefits or to specify exactly which species are involved. At the same time, it neglects to address the equally important question of which species might be adversely effected, e.g. birds of prey or predatory mammals.

In the case of woodlands, the argument for wildlife benefit rests substantially on the claim that, particularly in lowland Britain, considerable woodland loss would follow wide-scale reductions in game management. Though this may be true, it seems equally probable that modern statutory conservation controls on woodland clearance would now prevent it.

Regrettably the same cannot be said for agricultural land, which remains inextricably associated with pheasant and 'partridge' shooting. Indeed recent marked declines in the populations of many classic farmland species, including up to 80 per cent of skylarks, lapwings, corn buntings as well as many types of mammals, plants and insects, mean suggestions that game management helps preserve other wildlife may be substantially flawed (41, 98, 111). This is reinforced by the fact that included among these substantial declines is that of the formerly abundant and intensively managed grey partridge, a bird now scarce and threatened enough in conservation terms to be Red Data listed (40).

It is now broadly accepted that these alarming declines in formerly abundant species are directly attributable to changes in agricultural policy and practice, which, in turn, are driven by international agricultural and trade agreements, among others. Advances in technology also play their part. These largely monetary pressures on farmers manifest themselves in hedgerow removal, clinical monocultures, improved agro-chemical control and 'tidier' farms, with an associated loss of habitat diversity and a

lower tolerance for natural competitors.

True, the particular habitat demands of pheasant management result in a desirable pattern of small woodlands of about two ha or less, with additional sub-division producing the necessary extensive edge effect. Pheasant management also demands a beneficial range of tree age-classes and retention of under-story, plus the continuation of less common tree management practices, such as coppicing (51). But though this type of management may benefit some woodland passerine communities, woodcock, and some small mammals, other species may be harmed. Furthermore, natural predators are actively discouraged throughout shooting areas. The requirements of woodland pheasant management conflict with commercial timber production, and the demands of supplementary feeding and beater access may limit under-storey density, thereby adversely affecting small bird, mammal, insect and some plant populations.

Admittedly, most landowners and game managers are genuinely offended by suggestions of environmental misunderstanding, and the issue is largely one of differing perceptions. The problem is perhaps not unconnected to the somewhat arrogant and largely class-related view that mere ownership of land provides automatic understanding of complex ecological relationships. It is also not helped by the associated belief that gamebirds score highest in the ecological order.

The Game Acts

Various statutes aimed at protecting game species and controlling trade are known collectively as the Game Acts. Many are now archaic. Seventeen Game Acts have an average age of 106 years, with the oldest being two centuries. Eleven (64 per cent) are older than 100 years, and four of the remaining six apply solely to deer. These statutes protect just five or so mammals and seven gamebird species, two of whom (pheasant and red-legged partridge) were introduced and one (capercaillie) re-introduced. These seven gamebirds comprise just 1.3 per cent of all bird species on the British List (12).

These Game Acts have almost nothing in common with modern conservation legislation, e.g. the 1981 Wildlife & Countryside Act, and were primarily implemented by Parliament on behalf of landowners with the express intention of preventing poaching (a form of theft) and sale of illegally taken game. Although free-living game is not property in the excepted legal sense, these Game Acts come close to treating it as such.

Modern criticisms of these anachronistic laws include:

- The lack of variability in the event of marked population changes, as with the grey partridge, the shooting and sale of whom remains unregulated despite its precarious national status following a population decline of some 80%;
- The lack of any conservation intent. Conservation legislation provides for the ability to limit shooting during prolonged bad weather. Game Acts do not. They also fail to address habitat requirements or long-term species' needs (witness again the decline of the grey partridge in the face of practical game management);
- The frequent use of archaic language and imprecise and now meaningless species names, e.g. 'muirfowl' or 'black game'. In cases of legal disputes, the 1981 Act requires the use of scientific names;
- The granting of medieval-style enforcement powers to gamekeepers employed by

so-called 'privileged' classes, e.g. royalty, lords of the manor, stewards of the crown or manor, who may seize dogs or poaching equipment. These powers include the ability to exercise powers of arrest otherwise restricted to police officers. Seized dogs and other property may become the possession of the landowner. Gamekeepers may also deputise their powers to others.

Following marked population declines or range retractions in many species, some gamebirds covered by the Game Acts are now Red Data Listed (40). Data on two of those species, the grey partridge and the capercaillie, should be available from shoot managers, but managers do not have much such information available. The 20 million 'partridges' shot in 1995 included an unknown proportion of grey partridges, at a time when all parties involved are being urged to monitor populations and shooting pressures (15, 16, 17), Biodiversity: The UK Steering Group Report, Volume 2: Species Action Plans.

By empowering privately employed gamekeepers with enforcement capabilities, Game Acts are out of step with current Parliamentary practice. In effect, they make them special constables. They also fly in the face of recent political refusal to grant similar statutory authority to conservation managers charged with protecting threatened and rare species of fauna and flora.

Additionally, by bestowing increased enforcement powers on gamekeepers, these Game Acts perpetuate a two-tier, medieval system of justice that legally, politically and democratically, is out of step with the 21st century. A full review of the Game Acts is overdue, especially when they could easily be incorporated into modern species and habitat-based conservation legislation. The continued existence of these Acts accounts in large part for the continued separation of gamebird management from mainstream conservation, as well as the view that the management of gamebirds is in some way detached from the more diverse requirements of the wider natural environment.

Conditioned Taste Aversion

The concept of 'educating' predatory birds and other animals to ignore specific prey types uses a process known as Conditioned Taste Aversion (CTA). It is gaining increasing support in Britain. The principle capitalises on our ability to influence learned behaviour in wild animals, thereby causing them to avoid what would otherwise be natural prey, e.g. gamebirds. Treating the prey with volatile but tasteless substances produces an immediate and dramatic response from study predators, who in some cases avoided future contact with that particular prey for more than a year (58, 91, 92).

This form of predator control promises a biologically acceptable alternative to far less acceptable and often illegal methods of lethal predator control still utilised by many British shooting estates and farmers. The use of CTA may be particularly appropriate in the case of foxes and other territorial animals, given that removing such animals, as is currently done, merely provides space for new individuals to occupy. CTA allows territory holders to continue deterring interlopers at the same time as it limits predation (18).

Crow Cage-trap

Farmers and game managers are permitted to kill a small minority of wild birds. However, the ways in which they may kill these birds are severely limited and, in general, the use of cage traps is not allowed. This restriction does not apply to the taking of crow species (Corvidae), but centuries of active persecution make these birds difficult to trap or shoot. Recent government-controlled experiments into catching corvids with cage traps suggested that such traps are particularly efficient if a live call-bird is used as well (34, 90, 114). This method has since been approved under an Open General Licence, though the use of live decoys is limited to the five common corvid species — carrion/hooded crow, magpie, rook, jay and jackdaw. These are also the only species of corvids that may be trapped.

Trials showed that traps containing live call-birds caught over five times more magpies than traps without them. Carrion crow decoys caught three times more birds. The number of captures of both species per trap/day with decoys was substantially greater than without them, and the numbers rose even higher when multiple decoys were used.

Of the 10,500 trial captures, only one per cent reported capture of non-target individuals. These individuals represented 14 species, but not surprisingly, over half were owls or diurnal birds of prey. The likelihood of avian predators entering traps to attack live call-birds seems unavoidable. Therefore the possibility of them being used either to reduce predator numbers or capture birds of prey illegally must be a concern of conservation organisations and anyone charged with enforcing conservation legislation (99). This point was not lost on the UKRWG. It recently recommended that appropriate authorities review licensing procedures covering crow cage traps in order to 'eliminate those conditions that might facilitate the abuse of this legal technique of pest control' (119).

The exemption of crow cage traps from the normally stringent statutory restrictions that apply to cages used to keep other bird species is controversial and impossible to justify. Similarly, obligatory welfare considerations that normally apply to live call-birds — for example, the provision of water and shelter — do not apply to trapped birds. Given animal welfare legislation that requires such traps be visited at least once a day, this is difficult to justify.

Public Access to Game-Management Areas

In England and Wales 50,000 members of the Country Landowners Association (CLA) own and manage 60 per cent of the countryside 21, while in Scotland 3,500 members of the Scottish Landowners Federation (SLF) own and manage an unspecified area (thought it is often quoted as 80 per cent - SLF pers com). In Britain as a whole, about 1,700 individuals are said to own one third of the entire country (76). A substantial proportion of this 'private' land is used for gamebird shooting or, certainly in lowland areas, for gamebird shooting and agriculture.

But as the Government recently acknowledged (March 1999), even after 50 years of statutory commitment to improving public access and an even longer history of co-ordinated political and social pressure, public access remains limited to just 193,000 kilometres of 'rights of way' (9, 44).

Although landowners remain noisily opposed to suggestions of statutory access, they claim that they accept the principle of greater public involvement in the countryside. They have conditions, however. They will allow such involvement only after locally negotiated agreements have been drawn up, and they demand appropriate financial compensation should the public cause any damage. The sum would be based on a combination of lost time and lost income (19). A recent Scottish study (23, 24) suggested that managed estates suffered average annual losses of £731. Farmlands suffered average losses of £136. None reported losses of up to £5,000.

Using these average figures, the likely combined annual costs to Scottish landowners, many of whom presumably manage substantially larger estates than their English counterparts, would be about £2.5 million. This is considerably less than the somewhat inflated costs advanced by the landowners themselves.

Though game managers prefer to treat the public access debate as a conservation issue, they should see it as a conflict between recreational pursuits. But recent industry research found no evidence of conflict on those particular grounds and no evidence of danger to the public from gamebird shooting (105). Nonetheless disturbance to gamebirds during both breeding and shooting seasons presents game managers with potential financial loss. Larger estates are perhaps better able to balance these two interests. Interestingly, a study of red grouse ecology on managed moorland found no evidence of reductions in either breeding productivity or shooting totals following increased public access (82).

The continued illegal destruction of birds of prey and other predators on an unknown percentage of game management areas may also partly account for the landowners' reluctance to allow public access. However, an increased public presence may help reduce this problem.

Recommendations of both the 1958 Royal Commission on Common Land and the 1986 Common Land Forum to extend public access to include all common land (10) continued to be opposed by a minority moorland land-owner group. Despite recent substantial public support and the initial backing of the Government, Ramblers Association proposals for a statutory right to roam appeared destined to fail (87, 88). Consequently, the Government's somewhat unexpected acknowledgement (February 1999) that voluntary agreements had no realistic chance of resolving this issue was welcomed by almost everyone except landowners (20).

More recently, the Government published its intention to allow unrestricted public access to all common or open land for the purpose of 'open air recreation' (Countryside and Rights of Way Bill ñ March 2000). It failed, however, to extend this right to either farmland or private estates.

Shooting Crippling Rates

There is a marked absence of data available on numbers of gamebirds shot but not killed outright - the so-called 'crippling rate'. But it has been suggested that pheasant kills occur at ratios as high as one bird for every five shots fired (5:1) to as low as one bird for every 30 shots fired (30:1) (45). What we don't know are how many shots are fired, what percentage of shots injure birds, what percentage of injured birds are dispatched on site, and within what time-scale.

Averaging the above figures suggests that about 17.5 shots are fired for every pheasant killed. Averaging the above figures suggests that about 17.5 shots are fired for every pheasant killed. Given a likely 2000 pheasant kill of some 36 million birds, this indicates a total shot discharge of around 945 million cartridges. Using these figures, if you consider a nominal and probably low crippling rate of just two per cent (that is, two birds for every 100 shots fired), you're left with a crippled bird total of around 12 million. In other words, one for every three birds known to have been killed.

Upon initial examination, a suggestion that 315 million shots may have been fired at gamebirds in 1992 may seem excessive. However Cobham estimated pre-1983 cartridge sales of 120 million, half of which, he thought, were used for gamebird shooting (15). Intriguingly, if the number of shot birds doubles every five years, as the industry said it would, and if you start your calculations with figures for 1980, you arrive at a number extremely close to 315 million by 1992. The number is that much greater if you take into account the substantial increases in the number of shot birds predicted by industry since 1990.

The percentage of crippled birds recovered and dispatched immediately after being shot will be greatest where trained 'gun dogs' are employed. It will be lowest where pheasants fly high and fast into woodland areas away from the immediate shooting area. It is also likely to be higher at driven shoots than where game is 'walked up'. It may also vary according to the skill of shooters, weather, topographical features and the height of birds over the guns.

North American authorities assessed numbers of shot ducks and geese left unrecovered to be around 15-20 per cent (78), but presumably this included both crippled and dead birds. We also know that mammalian predators, e.g. foxes and, to a lesser extent, avian predators, systematically and efficiently clean up areas regularly providing carcasses (102), probably making it difficult to assess gamebird crippling rates based on numbers of dead or injured birds found after shooting. Other studies suggest most crippled birds die within one to 14 days if they are not taken by predators beforehand and unsurprisingly wing fractures figured prominently (120).

A Royal Society for the Prevention of Cruelty to Animals (RSPCA) study decided that although instantaneous death from shooting is commonly regarded as involving little or no pain, shooting injuries and associated loss of function are likely to cause severe pain and stress. It concluded that suffering, and therefore cruelty is likely where 1) an animal's death is for any reason protracted or 2) if the animal escapes or is allowed to go free after incurring injuries of such a nature that recovery from them will be either unlikely or slow (66).

In a European study of pink-footed geese, 25 to 36 per cent of all birds examined carried lead shot in their body tissues as a result of past encounters with hunters. Birds carrying lead shot had lower survival rates overall, and survival was unrelated to the numbers of pellets carried. Approximately 0.7 geese were found to have been wounded for every bird killed (75). Similarly, a study of wildfowl and wader species recorded a crippling rate of more than 80 per cent (67). North American crippling rates ranged from 4.5 to 20 per cent for ducks, and 36 to 41 per cent for geese (2,

107).

Applied to shot pheasants, the pink-footed geese data suggest that over 6 million birds were injured annually (not all of them may have been 'crippled') at early 1990s shooting levels. Whilst this might seem excessive to some, it sits comfortably with the nominal two per cent crippling rate calculated above. Though geese may appear to present a larger target than gamebirds, they are more wary, fly higher and require a heavier shot load. Even so, these figures help to indicate the percentage of gamebirds crippled annually, particularly among those shot away from driven shoots.

Unlike many other countries, Britain has no statutory system for training and testing people who shoot wild birds and other animals. The industry claims that shooting standards in Britain are higher than elsewhere. It also believes that voluntary training schemes offer the most practicable means of ensuring publicly acceptable shooting standards.

Lead Shot Deposition and Lead-induced Mortality

Lead is a broad-spectrum metabolic poison producing toxic results in animal tissue. It attacks immune, behavioural, and reproductive systems, and it can kill. Though the toxic effects of ingested spent lead shot on waterfowl have been understood for over a century, the problem of ingested lead in other bird species was only recently appreciated, with both diurnal birds of prey and gamebirds at risk (78).

It is now accepted that significant numbers of wild birds die every year from ingesting spent lead shot deposited as a by-product of sport shooting. An estimated 10 to 20 million waterfowl died annually in North America prior to the phasing in of non-toxic alternatives in the 1980s. Though not normally toxic, lead shot in the body tissue of prey species may result in secondary poisoning of predatory birds and other animals, and may increase the possibility of death in lead-carrying individuals.

By the 1980s, an estimated 3,000 tons of spent lead shot were deposited annually on North American wetland areas by wildfowl shooters; 14,000 tons were dumped on 'upland' hunting areas. Researchers also found lead shot densities of 2,000 to over 860,000 tons per hectare on some farmland, with densities up to 3.7 billion pellets per hectare for target ranges. This offered the possibility of substantial commercial rewards for their recovery (55).

If we consider that by 1983, 120 million cartridges were sold in Britain each year (15), we can say that at that time the amount of lead deposited from gamebird shooting significantly exceeded the American combined upland and wetland totals. That's because 120 million cartridges translates into an estimated 38,400 metric tonnes (37,795 imperial tons) of lead annually discharged into the British countryside, with about half (19,200 metric tonnes or 18,897 imperial tons) resulting from gamebird shooting alone (15). Moreover, the number of shot gamebirds was doubling every five years at that time, and was forecast to increase by 400 per cent by 2001. Taking into account these figures, the volume of lead shot deposited in Britain from gamebird shooting could already be in the region of 75,000 metric/imperial tonnes/tons, regardless of recent voluntary small-scale moves towards the use of lead alternatives.

Although lead residues of up to 250 parts per million or more are commonly recorded in bird tissue, levels as low as three ppm may prove fatal, with death often resulting from ingestion of a single pellet. Bird of prey studies show death normally follows lead accumulations of more than five ppm in soft tissue (78). Predatory bird species currently known to be significantly affected world-wide include the California condor, the golden and bald eagles, and the Eurasian marsh harrier. In separate studies in North America and Norway, 70 per cent of bald and golden eagles examined regurgitated food pellets containing lead shot. In France, 31 per cent of Eurasian marsh harriers tested showed significantly elevated lead blood levels, and 14 per cent had concentrations indicative of clinical poisoning (55, 64, 79).

Game and other bird quarry species shown to be adversely affected by lead ingestion include pheasant, woodpigeon and 'partridges' (UK), and pheasant, ruffed grouse, turkey, scaled and bobwhite quail, and mourning dove (America) (55, 96). One American pheasant contained 29 lead shot pellets in its gizzard.

It is probable that high lead-shot densities occur on British gamebird shoots, especially in the vicinity of fixed shooting positions, such as grouse butts. On uncultivated areas in particular, such lead may persist near the surface, and presents a long-term clinical threat to foraging gamebirds in search of grit. This could influence mortality rates in local gamebird populations.

Until 1995, just six countries had either implemented or considered legislative bans on the use of lead shot for hunting over wetlands, with a further four imposing bans in parts of their territory. Three more, including the United Kingdom, introduced only voluntary bans, though they were widely resisted by UK shooters. European statutory bans on the use of lead shot are hindered by several factors, including concern over the increased cost of alternative materials, the possible inferior killing capability of such materials, and the damage to existing guns caused by alternative shot loads. But these difficulties have not prevented other countries, notably the U.S., from adopting these materials.

Britain's reluctance to change must be viewed against the marked increases in the amount of deposited lead from gamebird shooting already referred to, as well as continually increasing anthropogenic pressures on natural habitats. Over a decade ago, Parliament saw fit to introduce a statutory ban on the sale and import of lead fishing weights in order to limit the threat of lead pollution on waterfowl and other aquatic birds. More recently there has been an increasing move towards the voluntary use of alternative shot materials, which are becoming more readily available from manufacturers. Even so, they continue to face opposition from the game-shooting sector.

The Government has finally implemented legislation prohibiting the use of lead shot, but only over wetlands and certain other sites. It is also important to appreciate that gamebird shooting is not affected by the ban, and that the risk to birds of prey posed by both dead and live shot-carrying individuals remains. It must be noted, too, that enforcement of these controls is primarily a police matter, even though the police rarely venture into the areas most affected.

Disease, Health and Hygiene in Pheasants and Other Gamebirds

Managed gamebirds, especially captive-reared stock, are prone to attack from a range of recurrent, widespread and virulent diseases, often directly related to conditions of confinement (49). All or most of these diseases recur annually on a national basis and in the case of captive-reared birds, may be caused by a variety of factors, including inadequate management, immediate environmental conditions, or nutritional disorders. Diseases caused by infectious agents, such as virus, bacteria, fungi, parasitic worms and, especially, protozoa, are of particular concern (81). Inevitably many such cases result in death of the individual, particularly where infection occurs after release. Little appears to have been published on the manner of these deaths, but we can assume it varies according to the ailment. It very probably renders the sick bird substantially more liable to predation. Some diseases attack the respiratory system, while others affect internal organs such as the liver and gut, inevitably causing death, if only by reducing the bird's ability to survive in a demanding environment. In some outbreaks large proportions of local populations succumb.

Moreover it is often difficult to differentiate between infectious agents and exterior influences, given that diseases are likely to pass more easily between birds in overcrowded or overstocked conditions. Many within the industry believe incidents of infectious diseases are increasing, but relationships between the breeding season and numbers of reported cases have yet to be fully investigated (49, 81, 84).

This rise in both the number of cases and types of diseases means a greater need for medicinal compounds, several of which have already been removed from the market owing to uncertainties over their effects on consumers, or on those using them. Even more worrying, several viruses appear to be developing immunity to particular substances. There are also growing fears that the industry may already have become over-dependent on the use of veterinary medicines and that these may become increasingly less available as a consequence. Of equal concern are growing fears that as diseases become more prevalent, complex and durable, the the variety of drugs available to combat them is reduced (49).

Industry use of the commercial medicinal feed substance Emtryl demonstrates the problem well. Claimed by game managers as the only available treatment for a number of serious gamebird diseases and widely used in Britain for that purpose, it contains the active ingredient DMZ (dimetridazole). In 1995 the European Community banned the use of DMZ as a carcinogenic substance for which no safe maximum residue levels can be set. That means it poses a risk to consumer health in whatever quantities are present (Veterinary Medicines Directorate pers com).

The EC's action was challenged by the British gamebird industry, which persuaded the then Conservative government to invoke opt-out provisions, claiming wide-scale animal suffering would follow any ban. But in April 1998 the government effected stringent veterinary controls on the use of DMZ, regulating its supply as a 'medicated feeding stuff'. There is now a statutory seven-day 'withdrawal' period between the end of medication and the release of birds for shooting. Birds also may not be treated in an uncontrolled situation, for example after release. Any additional use must be authorised by a veterinarian, and requires a 28-day withdrawal period. Its use must be recorded in a medicines record book.

If European concerns about the effects that accumulations of substances such as DMZ have on human health are justified, the same threat must surely apply to natural predators, who, as the industry constantly reminds us, also consume gamebirds. In which case a specific government-controlled monitoring programme testing for these substances in wild predators should be given serious consideration (if not already in place). Preferably the programme would be run by the government's Institute of Terrestrial Ecology, since it is part of that body's long-term responsibility to monitor accumulations of chemical pollutants in predatory birds and other animals.

The risk of diseases spreading from released gamebirds to wild bird populations (including gamebirds themselves) also needs examining, and the industry does appear to be sensitive to this possibility. Earlier Ministry of Agriculture, Fisheries & Food (MAFF) claims that outbreaks of Newcastle disease were spread by wild birds lacked supporting evidence. The possibility that the source could have been released gamebirds may not have been examined properly. Furthermore, serious declines in agriculturally linked bird species concomitant with huge increases in the number of captive-reared pheasants indicates the possibility of a relationship between the two, such as in the area of food competition. This is particularly relevant given the fact that the combined biomass (weight) of the autumn and early winter British pheasant population (including released birds) substantially exceeds that of all other breeding birds by perhaps 600 per cent.

Financial Costs of Pheasant Shooting

Two areas in which the cost of pheasant management to the shooter can be publicly examined are: 1) the retail value of the shotguns, and 2) the cost of purchasing a day's shooting, which is increasingly available through the corporate marketing sector.

Retail Gun Values

Joint mean retail shotgun values were calculated for a sample of three advertisements placed by suppliers, each offering a mix of new and second-hand shotguns in a popular shooting magazine for the month of September 1998 (Table III). Semi-automatic and pump-action weapons were excluded on grounds that their use for killing wild birds is prohibited.

TABLE III
Sample of Combined New & Second-hand Shotgun Values
 Trade advertisements - 'Sporting Gun' magazine September 1998

Advert	No Guns	Total Value	Highest Cost	Lowest Cost	Mean Cost
a	168	£273,620	£23,000	£90	£1,629
b	81	£147,680	£18,00	£90	£1,823
c	24	£136,005	£19,750	£1,100	£5,667

Shooting Costs

Advertisements for pheasant shoots appear rarely in the popular shooting press. A few estates do advertise both in magazines and on the World Wide Web, but a substantial (and perhaps increasing) amount of shooting is leased through the corporate marketing sector. While reasons for the paucity of public advertising are unclear, it's probable that most driven pheasant shoots attract their clientele from social groups who don't normally subscribe to the popular shooting press. Particularly in the case of larger, more prominent estates, it's likely that the shooting press is used mainly to dispose of vacant shoot days.

Most shooting estates prefer to entertain around eight guns per day. The cost is either calculated per individual gun (inclusive of VAT), or on the basis of cost per individual bird shot (exclusive of VAT). If the latter is used, the number of birds expected to be shot is normally provided beforehand. Eight or nine guns per day going after 250 to 350 birds in several drives is typical of many commercial shoots. Meals, drinks and estate transport are also normally provided as part of the package. They also offer the option of purchasing shotgun cartridges on site, at around £140 plus VAT per 100. Some estates will provide hire of a shotgun at a fee of around £35 per day plus VAT and if necessary will process a 'Visitors Shotgun Permit' for £25.

TABLE IV
Selection of Advertised Estate Shooting
(per individual bird per gun per day)

Estate	Species	Expectation ¹	Guns	Cost per Bird ²	Cost per Gun ³
(a)	mixed ⁴	250	8	£21.00	£771
(a)	Pheasant	275	8	£18.50	£747
(b)	Pheasant	250-350	8-9	£25.00	£787-£1141
(b)	mixed ⁴	300-350	8-9	£24.00	£1057-£1096
(c)	Pheasant	250-350	10 max	£23.00	£675-£945
(c)	Pheasant	150-200	10 max	£21.00	£370-£493
(d)	mixed ⁴	200-300	8-9	£23.00	£675-£900
(e)	mixed ⁴	250+	(8)	£24.00	£1145
(f)	mixed ⁴	300+	8	£26.00	£1145

¹ Advertised size of day's bag ² Exclusive of VAT ⁴ Pheasant & 'partridge'

³ Calculated from minimum/maximum advertised bag x minimum/maximum guns

Tables IV and V show a small selection of advertised driven Pheasant or mixed Pheasant and partridge shooting extracted from information available on the World Wide Web (1999). It is important to note that the cost of a day's shooting does not entitle the gun to remove shot birds from the estate, though the majority of shoots allow one or two brace per gun. A day's simulated Pheasant shooting on a professional Clay Pigeon range can be obtained for around £65 to £150 per person.

TABLE V
Selection of Advertised Estate Shooting
(per individual gun per day)

Estate	Species	Expectation ¹	Guns	Cost per Gun ²
(g)	mixed ³	300	8	£1,428.16
(h)	Mixed ³	300	3	£1,101.56

¹ Advertised size of day's bag ² Inclusive of VAT ³ Pheasant & 'partridge'

The Cost of Pheasant Production

In 1999, the overall cost of pheasant production to estates was £18 to £26 per bird. At least that's according to the sample of estates examined. The more recent UKRWG report suggests it may be as high as £33 per bird for a bird valued at £2.50 at the time of release (119). However, available information on the economics of commercial gamebird production is limited, and the extent to which these figures take into account the subsequent costs of, or profit from, marketed dead birds is unclear. Any variation in pricing between estates is also vague, though it seems reasonable to assume that on larger and more established shoots the pricing structure may be higher. In any event, if each bird shot earns £22 for an estate, and if 18 million pheasants are shot every year (according to the presumably now outdated mid 1990s total), the theoretical annual income from shooting is slightly under £400 million. To this one has to add income from the sales of dead birds, which by the mid-1990s involved 60

per cent of shot birds (11 million) (16, 17), thereby providing an income to estates of £1.20 each and adding a further £13.2 million to estate profits.

This too will have increased in line with any subsequent rise in the numbers of released captive-reared birds, plus of course any rise in market prices. Consequently, a likely current shooting total of 36 million pheasants by 2001, at £33 per bird shot, provides a combined return to estates of over £1 billion, with an additional income from carcass sales (at 1990's prices) of £54 million.

APPENDIX I

Scientific Names of Birds and Other Animals Mentioned in the Text

BIRDS

(Great) Cormorant	<i>Phalacrocorax carbo</i>
(Grey) Heron	<i>Ardea cinerea</i>
Pink-footed Goose	<i>Anser brachyrhynchus</i>
California Condor	<i>Gymnogyps californianus</i>
Red Kite	<i>Milvus milvus</i>
Bald Eagle	<i>Haliaeetus leucocephalus</i>
(Eurasian) Marsh Harrier	<i>Circus aeruginosus</i>
(Eurasian) Sparrowhawk	<i>Accipiter nisus</i>
(Common) Buzzard	<i>Buteo buteo</i>
Golden Eagle	<i>Aquila chrysaetos</i>
Peregrine Falcon	<i>Falco peregrinus</i>
Red Grouse	<i>Lagopus lagopus</i>
(Western) Capercaillie	<i>Tetrao urogallus</i>
Ruffed Grouse	<i>Bonasa umbellus</i>
Scaled Quail	<i>Callipepla squamata</i>
Bobwhite Quail	<i>Colinus virginianus</i>
Red-legged Partridge	<i>Alectoris rufa</i>
Grey Partridge	<i>Perdix perdix</i>
partridge	<i>Perdix perdix</i> or <i>Alectoris rufa</i>
(Common) Pheasant	<i>Phasianus colchicus</i>
Turkey	<i>Melaegris gallopavo</i>
Houbara Bustard	<i>Chlamydotis undulata</i>
Lapwing	<i>Vanellus vanellus</i>
(Eurasian) Woodcock	<i>Scolopax rusticola</i>
(Common) Wood Pigeon	<i>Columba palumbus</i>
Mourning Dove	<i>Zenaida macroura</i>
Tawny Owl	<i>Strix aluco</i>
owls	<i>Tyto, Athene, Strix</i> or <i>Asio</i> sp
Skylark	<i>Alauda arvensis</i>
Blue Tit	<i>Parus caeruleus</i>
(Black-billed) Magpie	<i>Pica pica</i>
Jay	<i>Garrulus glandarius</i>
Magpie	<i>Pica pica</i>
Jackdaw	<i>Corvus monedula</i>
Rook	<i>Corvus frugilegus</i>
Carrion Crow	<i>Corvus corone</i>
crows	<i>Corvidae</i> sp
Corn Bunting	<i>Miliaria calandra</i>
Mammals	
(Red) Fox	<i>Vulpes vulpes</i>
Pine Marten	<i>Martes martes</i>
Stoat	<i>Mustela erminea</i>
Pole Cat	<i>Mustela putorius</i>
(American) Mink	<i>Mustela vison</i>
Otter	<i>Lutra lutra</i>

APPENDIX II

Selection of Papers Consulted

- 1 ALLEN, G. (1992). **Figures show decline in number of Certificates:** Shooting News August 28-3 September 1992
- 2 ANDERSON, D.R. & K.P. BURNHAM (1976). **Population Ecology of the Mallard VI The Effect of Exploitation on Survival:** US Fish and Wildlife Service Resource Publication 128
- 3 ANONYMOUS (1998c). **Scottish Secretary aims to target raptor persecutors:** Shooting Times & Country Magazine 17th September
- 4 ANONYMOUS (1998d). **Moorland keepers launch attack on science:** Shooting Times & Country Magazine 19th November
- 5 ANONYMOUS (2000). **Countryside and Rights of Way Bill:** HM Stationary Office
- 6 British Field Sports Society, British Association for Shooting and Conservation, British Falconers' Club, Game Conservancy, National Farmers' Union, Royal Society for the Protection of Birds, Salmon and Trout Association (1985). **Predatory Birds of Game and**

Fish: British Field Sports Society, London

- 7 BATTEN, L.A., C.J. BIBBY, P. CLEMENT, G.D. ELLIOTT & R.F. PORTER. (1990). **Red Data Birds in Britain:** Poyser, London
- 8 BEER, J. (1993). **WHAT IS THE FUTURE FOR GAMEBIRD PATHOLOGY AND WELFARE?:** In *Game Conservancy Trust Review of 1992.* Fordingbridge
- 9 BLUNDEN, J., N. CURRY, T. BURRELL, G. SMART, R. SMITH & R. STEELE. (1990). **A People's Charter - Forty years of the National Parks and Access to the Countryside Act 1949:** HMSO, London
- 10 BONYHADY, T. (1987). **THE LAW OF THE COUNTRYSIDE - THE RIGHTS OF THE PUBLIC:** Professional Books, Abingdon
- 11 BRISCOE, K. (1992). **Pest culling 'good estate management':** Portsmouth News, 28 March 1992
- 12 BRITISH ORNITHOLOGIST UNION (BOU) (1992). **Checklist of Birds of BRITAIN AND IRELAND:** 6th edition: British Ornithologists Union, Tring
- 13 British Trust for Ornithology, Hawk and Owl Trust, National Trust, National Trust for Scotland, Royal Society for the Protection of Birds, Scottish Raptor Study Groups, Wales Raptor Study Group, Wildlife Trusts (UK), Scottish Ornithologist's Club, Wildfowl & Wetlands Trust, World Wide Fund for Nature WWF-UK (1997) **Birds of Prey in the UK: Back from the brink**
- 14 CAIN, S.A. (1978). **PREDATOR AND PEST CONTROL:** In *Wildlife and America 1978* (ed. H.P. Brokaw). US Government Printing Office,
- 15 COBHAM RESOURCE CONSULTANTS (1983). **COUNTRYSIDE SPORTS THEIR ECONOMIC SIGNIFICANCE:** Cobham Resource Consultants, Oxford
- 16 COBHAM RESOURCE CONSULTANTS (1992). **COUNTRYSIDE SPORTS THEIR ECONOMIC SIGNIFICANCE:** The Standing Conference on Countryside Sports, Reading
- 17 COBHAM RESOURCE CONSULTANTS (1997). **COUNTRYSIDE SPORTS THEIR ECONOMIC, SOCIAL AND CONSERVATION SIGNIFICANCE:** The Standing Conference on Countryside Sports, Reading
- 18 COTE, I.M. & W.J. SUTHERLAND (1995). **The Scientific Basis for Predator Control for Bird Conservation:** English Nature Research Report No 144, Peterborough
- 19 COUNTRY LANDOWNERS ASSOCIATION (1996). **Access 2000 - Countryside Recreation and Access Into The Next Millenium:** CLA, London
- 20 COUNTRY LANDOWNERS ASSOCIATION (1998). **ACCESS TO THE COUNTRYSIDE – THE CLA PROPOSAL Voluntary partnership works better, costs less, CLA tells Government:** CLA, London
- 21 COUNTRY LANDOWNERS ASSOCIATION (1999). **About Us:** World Wide Web Site, February
- 22 COX, G. C. WATKINS & M. WINTER (1996a). **Game Management in England: Implications for Public Access, the Rural Economy and the Environment:** Rural Research Monograph Series No 3, Countryside and Community Press, Cheltenham
- 23 CRABTREE, B. (1994). **The Cost to Landowners of Public Access to the Countryside:** In *THE HEATHER TRUST TENTH ANNUAL REPORT*, May 1994
- 24 CRABTREE, J.R., Z.E.D. APPLETON, K.J. THOMAS, W. LEE, N. CHALMERS & A. COPUS (1992). **The Economics of Countryside Access in Scotland:** SAC Economics Report 37, Scottish Agricultural College, Aberdeen.

- 25 CRAMP, S. (Ed); (1977-94). **Handbook of the Birds of Europe, the Middle east and North Africa: the birds of the Western Palearctic**: Oxford University Press, Oxford
- 26 DOLTON, C & L. de L. BROOKE (1999). **Changes in the biomass of birds breeding in Great Britain, 1968-88**: Bird Study 46.
- 27 DINGWALL-FORDYCE, A. (1998). **Langholm: just tip of the iceberg?**: Shooting Times & Country Magazine November 5
- 28 ETHERIDGE, B., R.W. SUMMERS & R.E. GREEN (1997). **The effects of killing and destruction of nests by humans on the population dynamics of Hen Harriers *Circus cyaneus* in Scotland**: Journal of Applied Ecology 34
- 29 EVANS, A., M. APPLEBY, J. DIXON, P. NEWBURY & V. SWALES (1995). **What Future for Lowland Farmland Birds in the UK?**: In *RSPB Conservation Review 1995* (ed. C.J. Cadbury). RSPB, Sandy
- 30 **FARM ANIMAL WELFARE NETWORK** (1994). **REARING PHEASANTS FOR SHOOTS – THE DISTURBING FACTS**: League Against Cruel Sports, London
- 31 FITTER, R.S.R. (1959). **THE ARK IN OUR MIDST**: Collins, London
- 32 FLEURE, H.J. (1951). **A NATURAL HISTORY OF MAN IN BRITAIN**: Collins, London.
- 33 FRAZER OF ALLANDER INSTITUTE OF STRATHCYLDE UNIVERSITY (1990). **THE ECONOMIC IMPACT OF SPORTING SHOOTING IN SCOTLAND - Summary Report**: BASC & Scottish Development Agency
- 34 GAME CONSERVANCY TRUST (1991). **LARSEN TRAPS: A SURVEY OF MEMBER'S RESULTS**: In *Game Conservancy Trust Review of 1990*. Fordingbridge
- 35 GAME CONSERVANCY TRUST (1996a). **Developments in Gamebird Disease**: In *Game Conservancy Trust Review of 1995*. Fordingbridge
- 36 GAME CONSERVANCY TRUST (1996b). **Game Predators**: In *Game Conservancy Trust Review of 1995*. Fordingbridge
- 37 GAME CONSERVANCY TRUST (1996c). **Monitoring: Accurate Counting is Crucial**: In *Game Conservancy Trust Review of 1995*. Fordingbridge
- 38 GAME CONSERVANCY TRUST (1996d). **The Pheasant: Mainstay of Game Conservation**: In *Game Conservancy Trust Review of 1995*. Fordingbridge
- 39 GAME CONSERVANCY TRUST (1996e). **Farmland: A Key Habitat**: Game Conservancy Trust Review of 1995, Fordingbridge
- 40 GIBBONS, D.W., M. AVERY, S. BAILLIE, R. GREGORY, J. KIRBY, R. PORTER, G. TUCKER & G. WILLIAMS (1996). **Bird species of conservation concern in the United Kingdom, Channel Islands and Isle of Man: revising the Red Data List**: In *RSPB Conservation Review 1996* (Ed C.J. Cadbury). RSPB, Sandy
- 41 GIBBONS, D.W., M.I. AVERY & A.F. BROWN (1996). **Population trends of breeding birds in the United Kingdom since 1800**: *British Birds* 89
- 42 GIBBONS, D.W., J.B. REID & R.A. CHAPMAN (1993). **The New Atlas of Breeding Birds of Britain and Ireland 1988-91**: Poyser, London
- 43 GJERSTAD, K.O. & I. HANSEN (1984). **Experimental lead poisoning in willow ptarmigan**: *Journal of Wildlife Management* 48
- 44 GLYPTIS, S. (1991). **Countryside Recreation**: Longman Institute of Leisure and Amenity Management
- 45 GRAY, R. (1998). **Haddeo**: Shooting Gazette, December
- 46 GREGORY, R., H. CRICK & S. BAILLIE (1996). **Birds of Conservation Concern – the new list of priority species**: in BTO News 207
- 47 GREGSON, J. (1997). **Game on**: Shooting Times & Country Magazine, 23 January
- 48 GRINDY, I. (1989). **GREED, MONEY AND MALPRACTICE**: Shooting Times & Country Magazine, 3-9 August
- 49 GRINDY, I. (1997). **Disease in mature poults and adult birds seems to be increasing on many estates**: Shooting Times & Country Magazine, January
- 50 Hawkeye Sporting (1999). **SHOOTING DAYS AVAILABLE FOR 1999/00**: World Wide Web, February
- 51 HILL, D. & P. ROBERTSON (1988). **The Pheasant – Ecology, Management and Conservation**: BSP Professional Books, Oxford
- 52 HOLLOWAY, S. (1996). **The Historical Atlas of Breeding Birds in Britain and Ireland 1875-1900**: T. & A.D. Poyser, London.
- 53 HOLMES, J., D. WALKER, P. DAVIES & I. CARTER (2000). **The illegal persecution of raptors in England**: English Nature, Peterborough
- 54 HOSKINS, W.G. (1977). **THE MAKING OF THE ENGLISH LANDSCAPE**: Hodder & Stoughton, London
- 55 KENDALL, R.J., T.E. LACHER JR, C. BUNCK, B. DANIEL, C. DRIVER, C.E. GRUE, F. LEIGHTON, W. STANLEY, P.W. WATANABE & M. WHITWORTH (1996). **AN ECOLOGICAL RISK ASSESSMENT OF LEAD SHOT EXPOSURE IN NON-WATERFOWL AVIAN SPECIES: UPLAND GAME BIRDS AND RAPTORS**: *Environmental Toxicology and Chemistry* 15
- 56 KEYMER, I.F. & R.St. J. STEBBINGS (1987). **Lead poisoning in a partridge (*Perdix perdix*) after ingestion of gunshot**: *Veterinary Record* 120
- 57 LACK, D. (1954). **THE NATURAL REGULATION OF ANIMAL NUMBERS**: Clarondon Press, Oxford
- 58 LANDA, A. & B.A. TOMMERAS (1996). **Do volatile repellents reduce wolverine *Gulo gulo* predation on sheep?**: *Wildlife Biology* 2
- 59 LEE-STEERE, G.E. (1988). **Perception of the countryside: the views of the Country Landowners' Association**: In *Public perception of the countryside* (Eds F.A. Miller & R.B. Tranter). CAS Paper 18, Centre for Agricultural Strategy, Reading University
- 60 LINDSAY, I. (1998). **Pheasant feeding and spring breeding**: Game Conservancy Trust Review of 1997, Fordingbridge
- 61 LLOYD, D.E.B. (1976). **AVIAN PREDATION OF REARED PHEASANTS**: British Field Sports Society, Game Conservancy Trust, Royal Society for the Protection of Birds, Wildfowling Association of Great Britain and Ireland
- 62 LONG, J.L. (1981). **Introduced Birds of the World**: David & Charles, Newton Abbot
- 63 LUDOLF, C., S. PAYNE & P. ROBERTSON (1989). **THE EFFECTS OF PHEASANT RELEASE PENS AND STRAWED RIDES ON ANCIENT WOODLAND GROUND FLORA**: In *Game Conservancy Trust Review of 1988*. Fordingbridge
- 64 MacDONALD, J.W., C.J. RANDALL, H.M. ROSS, G.M. MOON & A.D. RUTHVEN (1983). **Lead poisoning in captive birds of prey**: *Veterinary Record* 113
- 65 MADSEN, J. & H. NOER (1996). **Decreased survival of pink-footed geese *Anser brachyrhynchus* carrying shotgun pellets**: *Wildlife Biology* 2
- 66 MEDWAY, LORD (Chairman) (1980). **REPORT OF THE PANEL OF ENQUIRY INTO SHOOTING & ANGLING (1976-1979)**: Panel into Shooting and

- Angling, Causeway, Horsham
- 67 MELTOFTE, H. (1978). **Efficiency at intensive shooting along the coasts in Denmark. A pilot survey**: *Dansk orn Foren Tidsskr* 72
- 68 MILLER, C.K. & R.L. KNIGHT (1993). **DOES PREDATOR ASSEMBLAGE AFFECT REPRODUCTIVE SUCCESS IN SONGBIRDS?**: *The Condor* 95
- 69 MINTEL (1997). **Game and Exotic Meats**. In AN ESSENTIAL INGREDIENT for the future of your business: Game Marketing Executive (undated).
- 70 MORRISON, SIR C. (1990). **GAME 2000: A MANIFESTO FOR THE FUTURE OF GAME IN BRITAIN**: In *Game Conservancy Trust Review of 1989*. Fordingbridge
- 71 MURTON, R.K. & E.N. WRIGHT (1968). **THE PROBLEMS OF BIRDS AS PESTS (Proceedings of a Symposium held at the Royal Geographical Society, London, on 28 & 29th September 1967)**: Academic Press, London
- 72 NEWTON, I. (1979). **Population Ecology of Raptors**: Poyser, Berkhamstead
- 73 NEWTON I. & C. PERRINS (1997): **Sparrowhawks and songbirds**: *Birds* 16:5. RSPB, Sandy
- 74 NEWTON, I. L. Dale, P. ROTHERY (1997). **Apparent lack of impact of Sparrowhawks on the breeding densities of some woodland songbirds**: *Bird Study* 44:2
- 75 NOER, H. & J. MADSEN (1996). **Shotgun pellet loads and infliction rates in pink-footed geese *Anser brachyrhynchus***: *Wildlife Biology* 2
- 76 NORTON-TAYLOR, R. (1982). **WHOSE LAND IS IT ANYWAY? - Agriculture, Planning and Land Use in the British Countryside**: Turnstone Press, Wellingborough
- 77 PAGE, R. (1993). **Time To Control Our Birds Of Prey?**: THE FIELD, March 1993
- 78 PAIN, D.J. (1995). **Lead in the Environment**: In *Handbook of ECOTOXICOLOGY* (Eds D.J. Hoffman, B.A. Rattner, G.A. Burton Jr & J. Cairns Jr). Lewis Publishers
- 79 PAIN, D.J., C. AMIARD-TRIQUET, C. BAVOUX, G. BURNELEAU, L. EON & P. NICOLAU-GUILLAUMET (1993). **Lead poisoning in wild populations of Marsh Harriers *Circus aeruginosus* in the Carmargue and Charente - Maritime, France**: *Ibis* 135
- 80 PARKES, C. & J. THORNLEY (1994 revised). **Fair Game: the Law of Country Sports and the Protection of Wildlife**: Pelham, London
- 81 PENNYCOTT, T. (1997). **Gamebird Diseases: The Need for More Research**: In *Game Conservancy Trust Review of 1996*. Fordingbridge
- 82 PICOZZI, N. (1971). **Breeding Performance and Shooting Bags of Red Grouse in Relation to Public Access in the Peak District National Park, England**: *Biological Conservation* 3
- 83 POTTS, G.R. (1986). **The Partridge - Pesticides, Predation and Conservation**: Collins, London
- 84 POTTS, D. (1998). **High concern in the lowlands**: The Shooting Gazette, August
- 85 POTTS, G.R. & P.A. ROBERTSON (1994). **Game bird research in North America and Europe: The way forward, a critique and a plea**: In *Transactions of the 59th North American Wildlife and Natural Resources Conference*
- 86 RACKHAM, O. (1986). **The History of the Countryside**: Dent, London
- 87 RAMBLERS' ASSOCIATION (1995). **Draft ACCESS TO THE COUNTRYSIDE BILL**: Ramblers Association, London
- 88 RAMBLERS' ASSOCIATION (1997). **NEW SCOTTISH ACCESS LAWS - RAMBLERS REVEAL KEY AIMS**: Ramblers Association News Release, London & Edinburgh
- 89 REDPATH, S.M. & S.J. THIRGOOD (1997). **BIRDS OF PREY AND RED GROUSE**: The Stationary Office, London
- 90 REYNOLDS, J. (1990). **CROW AND MAGPIE CONTROL: THE USE OF CALL BIRDS IN CAGE TRAPS**: In *Game Conservancy Trust Review of 1989*. Fordingbridge
- 91 REYNOLDS, J. (1995). **CONDITION TASTE AVERSION UPDATE**: In *Game Conservancy Trust Review of 1994*. Fordingbridge
- 92 REYNOLDS, J. & L. NICOLAUS (1994). **LEARNING TO HATE GAMEBIRDS!**: In *Game Conservancy Trust Review of 1993*. Fordingbridge
- 93 ROBERTSON, P. (1993). **Pheasant** - In GIBBONS, D., J.B. RIED & R.A. CHAPMAN (1993). *The New Atlas of Breeding Birds in Britain and Ireland 1988-1991*: Poyser
- 94 ROBERTSON, P. (1997). **A Natural History of the Pheasant**: Swan Hill Press.
- 95 ROBINSON, P.J. (1982). **BIRD DETECTIVE**: Elm Tree Books, London
- 96 ROSCOE, D.E., L. WIDJESKOG & W. STANSLEY (1989). **Lead poisoning of northern pintail ducks feeding in a tidal meadow contaminated with shot from a trap and skeet range**: *Bulletin of Environmental Contamination* 42
- 97 RSPB (undated). **Death by Design: The Persecution of Birds of Prey and Owls in the UK 1979-1989**: RSPB (Sandy) and NCC (Peterborough).
- 98 RSPB (1996). **BIRDS of conservation concern in the United Kingdom, Channel Islands and Isle of Man**: RSPB - with Birdlife International, British Trust for Ornithology, Game Conservancy, Hawk and Owl Trust, National Trust, Wildfowl and Wetlands Trust and Wildlife Trusts
- 99 RSPB (Undated). **Birdcrime 97 - Offences against wild bird legislation 1997**: Sandy
- 100 RSPB (1998). **PERSECUTION - A review of Bird of Prey Persecution in Scotland in 1997**: Edinburgh
- 101 SAINSBURY, A.W., P.M. BENNETT & J.K. KIRKWOOD (1995). **The Welfare of free-living wild animals in Europe: harm caused by human activities**: *Animal Welfare* No.4
- 102 SCOTT, R.E., L.J. ROBERTS & C.J. CADBURY (1972). **Bird Deaths from Power Lines at Dungeness**: *British Birds* 65
- 103 Scottish Raptor Study Groups (1998). **THE ILLEGAL PERSECUTION OF RAPTORS IN SCOTLAND**: Scottish Office Central Research Unit
- 104 **SHOOTING TIMES & COUNTRY MAGAZINE** (1998). **Hanging sentence for game**: 26 November
- 105 SHORT, C., G. COX, J. HALLETT, C. WATKINS & M. WINTER (1994). **Implications of Game Management for Woodland Management, Landscape Conservation and Public Recreation**: Countryside Commission, Cheltenham
- 106 SIDAWAY, R. (1990). **Birds and walkers: a review of existing research on access to the countryside and disturbance to birds**: Ramblers Association, London
- 107 SMITH, R. & T. ROSTER (1980). **Steel vs Lead: Results from the Latest Test**: US Department of the Interior, Fish and Wildlife Service Fact Sheet. Washington DC
- 108 SPEDDING, C.R.W., A.M. HOXEY, F.A. MILLER & J.M. WALSINGHAM (1988). **The Countryside: some facts, concerns and perceptions**: In *Public perception of the countryside* (Eds F.A. MILLER & R.B. TRANTER). CAS Paper 18, Centre for Agricultural Strategy, Reading University
- 109 STOATE, C. (1995). **DOES PREDATION**

- MANAGEMENT BENEFIT SONGBIRDS?:** In *Game Conservancy Trust Review of 1994*. Fordingbridge
- 110 STOATE, C. & J. SZCZUR (1994). **GAME MANAGEMENT AND SONGBIRDS:** In *Game Conservancy Trust Review of 1993*. Fordingbridge
- 111 STONE, H.B., J. SEARS, P.A. CRANSWICK, R.D. GREGORY, D.W. GIBBONS, M.M. REHFISCH, N.J. AEBISCHER, J.B. REID (1997). **Population estimates of birds in Britain and the United Kingdom:** *British Birds* 90
- 112 SUNDAY TIMES (1990). **RAMBLERS TO STAY BARRED FROM THE GROUSE MOORS:** Sunday Times 9 August 1990.
- 113 TAPPER, S (Ed) (1999). **A Question of Balance:** Game Conservancy Trust, Fordingbridge
- 114 TAPPER, S.C. (1992). **Game Heritage: An Ecological Review from Shooting and Gamekeeping Records:** Game Conservancy Trust, Fordingbridge
- 115 THOMSON, D.L., R.E. GREEN, R.D. GREGORY & S.R. BAILLIE (1998). **The widespread decline of songbirds in rural Britain do not correlate with the spread of their avian predators:** Proceedings of the Royal Society of London, 265
- 116 TUBBS, C.R. (1974). **THE BUZZARD:** David & Charles, Newton Abbot
- 117 TUBBS, C. (1997). **MAN'S VERTEBRATE COMPETITORS:** *BRITISH WILDLIFE* Vol. 8(4)
- 118 TUCKER, G.M., M.F. HEATH, L. TOMIALOJC & F.A. GRIMMETT (Eds) (1994). **Birds in Europe: Their Conservation Status:** Birdlife Conservation Series No 3. Birdlife International, Cambridge.
- 119 UK RAPTOR WORKING GROUP (2000). **REPORT OF THE UK RAPTOR WORKING GROUP:** Department of the Environment, Transport and the Regions, Bristol & Joint Nature Conservation Committee, Peterborough
- 120 van Dyke, F. (1981). **Mortality in crippled mallards:** *Journal of Wildlife Management* 45
- 121 van HEEZIK, Y., P.J. SEDDON & F. MALONEY (1999). **Helping reintroduced houbara bustards avoid predation: effective anti-predator training and the predictive value of pre-release behaviour:** *Animal Conservation* 2
- 122 WOODBURN, M. (1993). **HOW DO PARASITES AFFECT PHEASANT BREEDING SUCCESS?:** In *Game Conservancy Trust Review of 1992*. Fordingbridge