

Attacks by Birds of Prey on Racing Pigeons

**A Report for the
Confederation of Long Distance Racing Pigeon Unions
of Great Britain and Northern Ireland**

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Summary

- A review of raptor predation on Racing Pigeons in Britain indicated that the three species mainly responsible were Peregrine, Sparrowhawk and Goshawk. The current breeding populations of each of these species in Britain are at their highest recorded levels. Peregrine predation on Racing Pigeons has been a source of contention since the establishment of pigeon racing as a sport in Britain, whilst the problem of attacks by Sparrowhawks and Goshawks appears to be a more recent phenomenon brought about by range expansion and population increases.
- Domestic Pigeons (in the form of Racing Pigeons, Feral Pigeons and wild Rock Doves) are the main prey of Peregrines throughout most of their range in the British Isles. The proportion of Domestic Pigeons in the diet varies in line with their availability and there is evidence that this availability may determine Peregrine breeding densities. Peregrines mainly kill Racing Pigeons in flight when they are away from the loft area and during exercise flights. Domestic Pigeons do not feature significantly in the diet of breeding Sparrowhawks and most Racing Pigeons are probably killed in the immediate loft area prior to the hawks' breeding season. The proportion of Domestic Pigeons in the diet of breeding Goshawks in Britain varies regionally and is likely to be higher in areas where Racing Pigeons are more abundant. Goshawks can take Racing Pigeons away from the loft area in a similar manner to Peregrines and at the loft in a similar manner to Sparrowhawks.
- A review indicated that the only practical form of deterrent applicable to the problem of birds of prey and Racing Pigeons were visual deterrents, with the exception of Bali bells. Visual deterrents are less effective than acoustic or chemical deterrents at repelling birds. Visual deterrents can be used at the loft area and on individual pigeons. Loft area deterrents include replica Great Horned Owls, eyespot balloons and reflective objects. On-bird deterrents include eyespot wing markings, sequins and Bali bells. There is no evidence to suggest that replica Great Horned Owls elicit an avoidance response in Sparrowhawks or Goshawks. Evidence of a consistent deterrent effect of eyespot patterns on birds was weak, as was the evidence for an avoidance response to reflective objects. The review concluded that there was little evidence to support the view that visual deterrents represent a potential solution to the problem of attacks by birds of prey on Racing Pigeons.
- In South Wales, the proportion of Domestic Pigeons in prey remains found at Peregrine breeding sites varied throughout the year. During the pigeon race season (April to September) Domestic Pigeons comprised 69% of prey remains found. Outside the race season (October to March) Domestic Pigeons comprised 25% of prey remains found at Peregrine nest sites. In South Wales, these Domestic Pigeons comprised 92% Racing Pigeons, 1% Tipplers, Rollers and Show Pigeons and 7% Feral Pigeons. Direct observation of prey brought back to breeding sites by Peregrines in May and June indicated that Domestic Pigeons were over-represented in prey remains. More prey were brought back to nest sites with young than at nest sites without dependent young, with fresh kills delivered at a rate of 0.29 per hour and 0.19 per hour respectively. There was no significant difference in prey delivery rates to broods of different sizes or ages, though the

sample size was small. It is estimated that a typical breeding pair of Peregrines in South Wales killed between 0.7 to 1.6 Racing Pigeons per day during the pigeon race season.

- The use of visual deterrents (i.e., replica Great Horned Owls and eyespot balloons) did not prevent attacks by Sparrowhawks and Goshawks at lofts in South Wales. The frequency of attacks at lofts with visual deterrents was within the range reported in two previous surveys carried out by the Royal Pigeon Racing Association and the Hawk & Owl Trust. Among lofts, there was a large amount of variation in the frequency of Sparrowhawk attacks. Lofts located close to areas of mature woodland and forestry suffered significantly more attacks by Sparrowhawks than lofts located away from wooded areas. On average, attacks by Sparrowhawks resulted in the death of 3.6 pigeons per loft in South Wales, although some lofts suffered significantly more losses. The problem of Sparrowhawk attacks is localised to individual lofts rather than a general problem over larger geographic regions.
- The use of on-bird deterrents did not reduce the level of losses of Racing Pigeons. Eyespot wing-transfers faded within one week and could only be applied to light-plumaged pigeons. Their use did not prevent raptor attacks on young-birds during exercise in a 10-day period following initial application. Sequins were difficult to attach to the plumage and caused feather damage when they were dislodged. There was a tendency for old-birds with sequins to be lost more frequently from training flights than old-birds without sequins. It is possible that sequins actually increase the likelihood of an individual pigeon within a flock being attacked by a bird of prey. Bali bells did not prevent exercising flocks of young birds from being attacked by Peregrines. There is little theoretical or practical evidence that these deterrents prevent or reduce attacks on Racing Pigeons by birds of prey.

Chapter 1

Review of raptor predation on Racing Pigeons

1.1 History of raptor predation on Racing Pigeons

Since the late 19th Century when pigeon racing first developed as a competitive sport in Britain, it has been recognised that birds of prey have been responsible for some losses. The principle predator appears to have been the Peregrine and there are few references in the early ornithological literature to attacks by Sparrowhawks. Some of the earliest references include notes on the prevalence of pigeons at nest sites in Pembrokeshire towards the end of the 19th Century (Matthew, 1894), and a little later Walpole-Bond described finding the remains of Carrier Pigeons strewn around a Peregrine nest site in Breconshire in 1902 (Walpole-Bond, 1903). In the early decades of the 20th Century many writers noted that during the breeding season Domestic Pigeons were the principal prey of Peregrines in several regions of Britain (e.g., Walpole-Bond, 1914; Gilbert & Brook, 1924). This had not by-passed the attention of pigeon fanciers and by 1925 they were already making requests to the House of Commons for Peregrines to be removed from the schedule of protected birds (The Racing Pigeon, 31st January 1925).

There is some evidence that the expansion of the Peregrine population into areas of Central Wales at the beginning of the 20th Century was fuelled by the rise in popularity of pigeon racing in the South Wales Valleys at that time (Dixon & Lawrence, 2000). The extent to which regional Peregrine populations may depend on a supply of Racing Pigeons tends to be overshadowed by their potentially detrimental impact on the sport (Dixon *et al.*, In press). Indeed, it was as a result of a petition by pigeon fanciers in South Wales in 1960 that a national Peregrine survey was undertaken and subsequently the pernicious effect of pesticide poisoning was identified (Ratcliffe, 1993). The crash of the Peregrine population in the late 1950s and their slow recovery through the 1970s meant that many pigeon racing areas that were formerly affected by predation had two decades of racing in an environment relatively free of Peregrines. In the 1980s the Peregrine population underwent a period of rapid increase such that the UK population in 1991 was higher than at any time in the recorded past (Crick & Ratcliffe, 1995). It has been postulated that this higher population level is supported by a greater availability of prey in the form of Racing Pigeons (Ratcliffe, 1993). This population increase has again brought the Peregrine into conflict with pigeon fanciers, with renewed calls for some form of control to be implemented. Currently, numbers tend to be stable or slightly declining in the core breeding range, yet range expansion continues with Peregrines colonising new areas that were formerly unoccupied (e.g., Shropshire, Tucker, 1998; inland Dorset, Harwood, 2000).

The prevalence of Sparrowhawk attacks at Racing Pigeon lofts appears to be a more recent phenomenon. Like the Peregrine, Sparrowhawks were badly affected by pesticide poisoning in the 1960s. However, the UK population has since recovered and Sparrowhawks are now more abundant than at any time in the recorded past (Gibbons *et al.*, 1993). Sparrowhawks are now frequently encountered in suburban

and urban areas throughout Britain and it appears that this habitat expansion has coincided with an increasing frequency of attacks at pigeon lofts.

Goshawks became re-established in Britain as a result of feral breeding by escaped falconry birds in the mid 1960s, and now viable populations have become established in extensively wooded areas in several regions of Britain (Gibbons *et al.*, 1993). In areas where levels of persecution are low these founder populations have expanded to colonise surrounding areas, particularly large commercial forestry plantations (e.g., Wales, Lovegrove *et al.*, 1994). Currently, Goshawks are widely distributed throughout Wales, Scotland and England and now occur in forests close to aggregations of pigeon lofts (e.g., the South Wales valleys). Loft owners in such locations have reported attacks by Goshawks on pigeons at the loft. Goshawks will also kill Racing Pigeons away from the immediate loft area in a similar manner to Peregrines.

To summarise, there is a long-standing history of Peregrine predation on Racing Pigeons in Britain but predation by Sparrowhawks and Goshawks appears to be a more recent phenomenon associated with expanding populations and ranges. Currently populations of all three species are at their highest recorded levels whilst the number of pigeon fanciers is in decline. A combination of these factors has resulted in the raptor-racing pigeon conflict becoming a major concern for many pigeon fanciers in the UK.

1.2 Research on the impact of birds of prey on Racing Pigeons

Introduction

In response to concerns voiced by pigeon fanciers, some Homing Unions conducted postal surveys of their members to determine the extent of the problem posed by birds of prey. The Royal Pigeon Racing Association (RPR) conducted a questionnaire survey through the pigeon press for fanciers throughout the UK and subsequently presented their findings to the UK Raptor Working Group. Whilst in Scotland, the Scottish Homing Union (SHU) conducted a postal survey of their members. The conclusion drawn from this survey was that the risk of attacks by birds of prey on Racing Pigeons in Scotland had become unacceptably high and unless urgent action was undertaken the sport of pigeon racing in Scotland would suffer irreparable damage (Scottish Homing Union, 1998). Prior to the publication of the SHU report, eleven voluntary bodies involved in wildlife conservation produced a document suggesting ways of minimising pigeon losses that did not involve the killing or removal of birds of prey (British Trust Ornithology *et al.*, 1997). This document suggested research was needed to quantify pigeon losses to birds of prey and other causes, and to increase knowledge about the circumstances and geographical variation of these losses. It further suggested that fanciers should look at ways of managing pigeon racing in such a way as to reduce the risk of predation and called for research into the potential use of deterrents against birds of prey.

These documents were produced at a time of renewed Government interest in the problem of raptors and Racing Pigeons. In 1995 the Government established the UK Raptor Working Group to investigate the potential impact of birds of prey on

upland and lowland gamebirds, Racing Pigeons and songbirds. The UK Raptor Working Group comprised participants from various interest groups and evaluated the available research on the subject, culminating in the Report of the UK Raptor Working Group (1999). Pigeon racing interests were represented on the UK Raptor Working Group by the Confederation of Long Distance Racing Pigeon Unions of Great Britain and Northern Ireland (also representing the RPRA). With regard to Racing Pigeons, there was little information on the level of losses and their causes so a research project was specifically commissioned and contract awarded to the Hawk and Owl Trust. The findings of the Hawk and Owl Trust research (Shawyer *et al.*, 2000) were incorporated into the report of the UK Raptor Working Group.

The pigeon racing interests on the UK Raptor Working Group disputed some of the findings of the Hawk & Owl Trust survey. The main conclusions of this report (Shawyer *et al.*, 2000) were:

- Collectively the annual losses of racing Pigeons in the UK totalled 52%. This conclusion was based on a survey of 271 lofts. Pigeon fanciers whose pigeons had turned up at raptor eyries or at wildlife hospitals supplied data via a telephone survey on the number of pigeons they lost over a year. There was no independent form of verification of this data and the reported level of losses was taken at face value.
- A significant proportion (42%) of the Racing Pigeon losses was attributed to straying. The data presented in the body of the report differed to that given in the relevant data table contained in the appendices (49.7% in the data table). Similarly wire strikes were said to account for 18% of losses in the body of the report and 9.4% in the data table. Collisions with solid objects accounted for 22% of losses, predation by mammals accounted for 10%, almost 3.5% were shot and other causes (excluding avian predation) made up nearly 3% of losses. This data was drawn from the condition of Racing Pigeons admitted to wildlife hospitals. Most of the wildlife hospitals were located in areas where Peregrines were scarce or absent. Clearly this method of sampling should not have been used to represent the proportions of pigeons lost due to straying from lofts. Pigeons that are killed by birds of prey are not represented in the sample from wildlife hospitals. Conversely, stray pigeons and those injured due to collisions are more likely to be handed in to such centres by members of the public. The headline figure that 42% of Racing Pigeons are lost as a result of straying was based on a fundamentally flawed sampling method.
- Attacks at the loft by Sparrowhawks accounted for 3.7% of the Racing Pigeon population in the UK. This data was obtained by a telephone survey of 160 loft owners. There was no independent verification of this data and the reported frequency of attacks together with the level of losses was taken at face value.
- Peregrine predation accounted for 4.2% and 3.2% of the loft populations of 'young' and 'old birds' during their respective race seasons. These values represent losses over the whole of the UK and included losses from lofts in regions where Peregrines are absent. Furthermore, the data only related to losses during the respective race seasons, thus young and old birds that were killed before (or after) their race seasons were not included.

- There was a highly significant difference in the level of losses attributable to Peregrines in different areas, with 15% and 20% losses resulting from Peregrine attacks in Northern Ireland and Scotland respectively. These estimates were derived by comparing the reported level of losses at lofts in a region with few Peregrines, Eastern England, with the level reported in other areas of the UK. Again the values only relate to losses during the respective race seasons of young and old birds.
- It was concluded that 70% of Racing Pigeons that had been subject to predation by Peregrines were living a feral existence or had strayed significantly from their racing or training routes. This conclusion was based on race history data provided by owners of 215 pigeons whose rings had been recovered at Peregrine nest sites. The data was not verified and it was assumed that the information supplied by fanciers was correct. Dixon *et al.* (MS1) found that a significant proportion of race history data from similar questionnaire survey was erroneous. Furthermore, Dixon *et al.* (MS1) found that the proportion of Racing Pigeons which had strayed significantly from their flight routes differed among Peregrine sites, with the greatest proportion of ‘strays’ killed by Peregrines inhabiting areas that were not overflowed by pigeon race routes.
- Peregrine predation on Racing Pigeons starts in April and ends when the young fledge in late June. This conclusion was based in the fact that the survey work and ring searches only took place from April to June. There was no survey work conducted after the young had fledged. This conclusion is plainly wrong and conflicts with other studies conducted on the diet of Peregrines (e.g., Richards & Shrubbs, 1999).

The purpose of the Raptor Working Group was to ‘consider’ the information supplied by relevant specialists, such as that provided by the Hawk & Owl Trust. The process of ‘consideration’ appears not to have involved any form of peer review of the research as the results of the Hawk & Owl Trust contract were included wholesale in the final report. Some of the glaring errors in the methodology and findings of this research were pointed out by the representative of the RPRA but despite this the Working Group did not agree with the criticisms. This meant that claims of a consensus opinion in relation to the raptor–Racing Pigeon conflict were not wholly true. Consequently, there were claims in the pigeon press of a ‘whitewash’ and there was broad opinion among pigeon fanciers that their concerns had been ignored. The RSPB have since attributed an increase in Peregrine poisoning in 2000 to discontent among pigeon fanciers with the conclusions of the UK Raptor Working Group (Braithwaite, 2001). The UK Raptor Working Group report (Page 32) pointed out that the illegal killing of birds of prey must be seen not just in terms of lack of law enforcement but also as a result of the lack of solutions to the problems presented by birds of prey.

1.3 Domestic Pigeons in the diet of birds of prey

In the following review of raptor diets in the UK most studies have not distinguished between wild Rock Doves, unringed Feral Pigeons and ringed Racing

Pigeons. Where no distinction has been made, I have used the generic term 'Domestic Pigeon'. Most studies of raptor diets involve the collection of prey remains found at nesting sites so the data can be biased towards large easily visible prey species such as Domestic Pigeons.

PEREGRINE

Ratcliffe (1993) outlined the regional variation in the main prey of Peregrines throughout Britain. Domestic Pigeons are the main prey of Peregrines in coastal areas of southern and western England, Wales and southwest Scotland, though along these coasts Feral Pigeons may comprise a significant proportion of the pigeons killed. In inland areas of western and northern England, Wales and south-central Scotland Domestic Pigeons are the main prey, a significant proportion of which can comprise ringed Racing Pigeons. In the Highlands and coastal areas of northern Scotland, Domestic Pigeons tend to be represented less frequently in the diet of Peregrines. The bulk of the UK Peregrine population occurs in areas where Domestic Pigeons are the most predominant prey species killed during the breeding season (Gibbons *et al.*, 1993).

Richard Mearns conducted a study on the diet of Peregrines in Southern Scotland through the collection of prey remains at nesting sites between 1975-80 (Mearns, 1982; 1983). In the breeding season, from the end of March to the end of July, he found that Domestic Pigeons made up 49% of kills (Mearns, 1983). This was consistent with earlier studies conducted in southern Scotland by Bleazard (1923-69), Ratcliffe (1946-74) and Roxburgh & Mearns (1974-75), which found that Domestic Pigeons made up 49%, 44% and 53% of kills respectively (Ratcliffe, 1993). The proportion of Domestic Pigeons in the diet, as evidenced from prey remains, appears to have been remarkably consistent over a long time period.

During the Langholm Study (Joint Raptor Study) data was collected on the diet of Peregrines breeding on, and adjacent to, grouse moors between 1992-96 (Redpath & Thirgood, 1997). Racing/Feral pigeons comprised 55% of kills in southwest Scotland, 46% in northern England and 31% in the Highlands of Scotland during the summer (Redpath & Thirgood, 1999). Hardey (1992 *cited in* Shawyer *et al.*, 2000) reported that 30% of prey remains at Peregrine sites in the Highlands were Domestic Pigeons. A lower frequency of Domestic Pigeons in the diet of Peregrines in the Highlands of Scotland was reported by Weir (*cited in* Ratcliffe, 1993) where he found that they comprised only 19% of prey items killed between 1964-75. It is thought that this is related to the availability of Racing Pigeons, as fewer Racing Pigeons pass through the Highlands than through southern Scotland during the race season (Ratcliffe, 1993).

Ratcliffe (1993) presented data on the frequency of Domestic Pigeons in prey remains found at Peregrine sites in northwest England from March to July for the period 1945-77, during which time they comprised 53% of kills. In Northern Ireland between 1970-71, Domestic Pigeons were found to comprise 62% of prey remains (McKelvie, 1973 *cited in* Shawyer *et al.*, 2000). In Snowdonia, Ratcliffe (1993) reported that Domestic Pigeons formed 70% of prey remains collected during the breeding season between 1950-79. In south Wales, over the period 1985-98,

Domestic Pigeons comprised 69% of kills from April to September (Richards & Shrub, 2000).

Fewer studies have been conducted on the diet of Peregrines outside the breeding season, but all those carried out so far reveal that the frequency of Domestic Pigeons killed declines markedly. In south Scotland the winter diet comprised 29% and 13% Domestic Pigeons in coastal and inland habitats respectively (Mearns, 1982). Whilst the Langholm study showed that the proportion of Peregrine pellets (regurgitated remains of bones and feathers) containing the remains of pigeons (*Columbiformes*) in summer and winter respectively was 85% v 44% in northern England and 73% v 31% in south-west Scotland (Redpath & Thirgood, 1997). In south Wales, Richards and Shrub (1999) found that Domestic Pigeons comprised only 25% of prey remains during October to March.

The above studies indicate the proportion of Domestic Pigeons in the diet but they do not provide information on the actual number killed over the survey periods. The daily food requirements of Peregrines have been estimated, and range from 150g, 175g and 188g per day for adults and 300g, 196g and 222g per day for chicks (values from Weir, 1978; Ratcliffe, 1993; Redpath & Thirgood, 1997 respectively). Weir (1978) estimated that Peregrine chicks eat about 80g per day soon after hatching, rising to a peak of over 300g per day at about 33 days. In a recent Australian study, the estimated daily food intake of male and female nestlings was 135g and 165g per day respectively (Boulet *et al.*, 2001). Using the estimated food requirement and the estimated proportion of pigeons in the diet it is possible to obtain some measure of the actual number of Domestic Pigeons killed over a particular time period. However, no published studies have attempted to do this.

Another way of attempting to calculate the actual number of Domestic Pigeons killed over a particular time period is by direct observation of prey brought back to the nest. Several studies have recorded the prey items brought back to the nest, but none of these have specifically identified the number of Domestic Pigeons involved. In 249 hours of observation at a Welsh coastal Peregrine site, Parker (1979) recorded a prey delivery rate of 0.31 prey items per hour, 18% of which were taken from larders of cached food. During the Langholm study, in 175 hours observation 54 prey items were delivered to the nests under observation, giving an identical prey delivery rate of 0.31 prey items per hour (Redpath & Thirgood, 1997). In southwest Scotland, Dickson (2000) recorded 0.58 prey deliveries per hour in 40 hours of observation and further calculated a value of 0.37 deliveries per hour for coastal Peregrines in Cornwall using data from Treleavan (1977; 1988). Studies of Peregrines in Australia showed that the number of prey items delivered to the nest declined over the nestling period from 0.45 per hour in the first week of hatching to 0.18 per hour at the time of fledging (Olsen *et al.*, 1998). Furthermore, the same study found that the rate of prey delivery tended to increase with brood size i.e., a prey delivery rate of 0.20, 0.35 and 0.47 prey items per hour for broods of one, two and three chicks respectively.

In Sweden there was an early study conducted in 1944-46 on Peregrines and homing pigeons that was carried out by two organisations representing Racing Pigeon and conservation interests (Lindquist, 1963). Losses of homing pigeons amounted to about 5% of the loft population, though losses attributable to kills by Peregrines were considered unlikely to exceed 0.2%. However, the study found that additional losses

due to scattering and straying after an attack could result in heavy losses, particularly if they occurred soon after the start of a race. The study concluded that fanciers could reduce losses by adopting new racing routes that avoided Peregrine territories and that any Peregrines that nested along these routes should be removed. The Swedish investigation called for understanding, good judgement and concessions from ornithologists and pigeon fanciers alike. In much the same vein, 12 voluntary bodies, in a response to the report of the UK Raptor Working Group, indicated a willingness to co-operate with others to develop mutually acceptable solutions to raptor conflicts (British Trust for Ornithology *et al.*, 2000).

SPARROWHAWK

Extensive studies have been conducted on the diet of Sparrowhawks inhabiting farmland, sheepwalk and forestry habitats in south Scotland (Newton, 1986). This work has shown that Domestic Pigeons comprised 0.19% of kills during April to August, and 0% of 412 kills from September to March (Newton, 1986). These data were collected from breeding sites and hunting ranges that did not encompass pigeon lofts and thus reflect the frequency of Racing Pigeon kills away from the immediate loft area.

There have been no studies on the diet of Sparrowhawks with hunting ranges that encompass Racing Pigeon lofts. The only information available is the reported frequency of attacks at lofts. A survey by the RPRA of 14 regions in Britain and Ireland found that Sparrowhawks attacks averaged 2.3 per loft each year (range 0.2 to 5.2; RPRA, 1996 *cited in* Shawyer *et al.*, 2000). The Hawk & Owl Trust survey found that 63% of lofts in the UK reported attacks by Sparrowhawks resulting in the death of an average of 2.7 pigeons each year per loft (Shawyer *et al.*, 2000). The same survey found that the percentage of lofts reporting attacks varied between regions of the UK from 42% in Central and Southern England to 87% in Northern Ireland. The average number of pigeons killed each year per loft ranged from 1.2 in Central and Southern England to 4.6 in Northern Ireland. The SHU survey concluded that attacks at the loft by Sparrowhawks were widespread in Scotland with 89% of lofts reporting a problem, though within Scotland there was variation among Federations in the percentage of lofts reporting attacks (range 57% to 100% of lofts).

GOSHAWK

At a study site in central Wales during 1991-93, Domestic Pigeons comprised 5.3% of 2,230 prey items collected at Goshawk nest sites from March to September (Toyne, 1998). There are very few lofts in this region of Wales, so most of the pigeons would have been killed away from the immediate loft area. There are few race and training routes which pass through central Wales and the availability of Racing Pigeons as potential prey is lower here than in south Wales (Dixon *et al.*, MS2). The frequency of a particular prey species in the diet is likely to be related to its availability (Solonen, 2000), thus Goshawks inhabiting areas where Racing Pigeons are more abundant are expected to kill them more frequently than those studied in central Wales. In a well-studied Goshawk population inhabiting forest areas along the main south and south-east race routes for pigeons from South Wales,

there has been a noticeable increase in Domestic Pigeon remains at nest sites in recent years (JMS Lewis, Personal Communication). This is likely to be a reflection of the increasing popularity of these race routes for Welsh pigeon fanciers, resulting in an increased availability of Racing Pigeons for breeding Goshawks in these areas.

In continental Europe Goshawks are more abundant than Peregrines, which means they tend to be the main avian predator of Racing Pigeons on the continent. In Jutland, Denmark, the proportion of Domestic Pigeons in the diet of Goshawks was 21% in a study area of 2417 km² that encompassed 324 pigeon lofts (Nielsen, 1998). Shawyer *et al.* (2000) cited a Dutch study (Rosendahl, 1995) in which the proportion of Racing Pigeons in the diet was related to habitat type, with most taken in forest habitats or along the forest edge. In this Dutch study, Racing Pigeons amounted to 39% of the prey species killed by Goshawks, with about 80% of these killed during the period April to July. The majority of these Racing Pigeons came from lofts within 30 km of the Goshawks' nests, though most of the pigeons killed were thought to have been stray birds, a view supported by Mentink (1996).

At 20 UK Goshawk nest sites, Shawyer *et al.* (2000) reported that Domestic Pigeons comprised 38% of prey remains found from April to early June and 10% between June and mid July, which was equivalent to 15% of prey remains over the whole breeding period. This work substantiated the findings of Toyne (1998) who found that the frequency of pigeons declined in the diet of the Goshawk as the breeding season progressed and fledging. A similar pattern was found in an upland area of northern Britain, where the proportion of Domestic Pigeons in prey remains peaked during June (42%; Petty, 1989). In the same study, over the breeding season from April to July, Domestic Pigeons comprised 36% of the prey remains found (Cooper & Petty, 1988). Clearly, there is marked variation in the frequency of Domestic Pigeons in the diet of breeding Goshawks in different areas of Britain. In south Wales (an area of high Racing Pigeon availability), breeding Goshawks are more abundant than Peregrines (A Dixon, Personal Data) and thus could potentially contribute significantly to Racing Pigeon losses in the area.

1.4 Mode of attacks on Racing Pigeons by birds of prey

Birds of prey can attack Racing Pigeons when they are in flight or at rest, and either close to, or away from, the loft. The circumstances and location of the attacks differs between the three main raptors that prey on Racing Pigeons. The circumstances and hunting methods adopted by birds of prey influences the potential effectiveness of particular deterrents. Attacks on Racing Pigeons in the immediate loft area are most frequently carried out by Sparrowhawks and are mainly directed towards pigeons at rest, though they can also attack Racing Pigeons that are in flight. Goshawks have been recorded attacking Racing Pigeons in the immediate loft area in a similar manner to Sparrowhawks, whilst Peregrines can attack pigeons in flight during exercise around the loft but rarely attack pigeons at rest.

All three raptor species are capable of attacking Racing Pigeons in areas away from the loft. However, the paucity of Domestic Pigeons in the diet of Sparrowhawks breeding in areas remote from pigeon lofts suggests that they infrequently attack Racing Pigeons during race and training flights. Sparrowhawks can use the 'high

soaring and stooping' method of hunting which enables them to take birds in flight (Newton, 1986) and this may be the hunting method by which they attack Racing Pigeons during race and training flights. Goshawks hunt by pursuing prey in flight, attacking prey on the ground and by 'high soaring and stooping' (Kenward, 1982). The propensity to adopt a particular hunting method may be determined by the availability and vulnerability of the prey species. Pursuit flights and the soaring-stooping hunting methods can both be used by Goshawks to attack Racing Pigeons on race and training flights (JMS Lewis Personal Communication; A Dixon Personal Observation). Peregrines use a variety of hunting methods, mostly directed at prey in flight. Peregrines have been observed attacking Racing Pigeons in flight by level pursuit and by stooping at them from above. They frequently hunt co-operatively as a pair and there is some evidence that this increases the success rate of attacks (Treleven, 1988; Svensson, 2001).

Predators can develop a 'search image' of their preferred prey species whereby they actively seek-out specific species when hunting. It is possible that certain individual birds of prey develop such a search image in relation to Racing Pigeons and actively seek them in preference to alternative prey species. Peregrines, in line with other specialist raptors feeding on avian prey, have short intestines and low digestive efficiencies which may be compensated by selectively catching prey of high nutritional quality such as pigeons (Barton & Houston, 1993). Hunter *et al.* (1988) and Rosenfield *et al.* (1995) found significant preferences of breeding Peregrines for certain taxa, but no such preference was found outside the breeding season in an Italian study (Serra *et al.*, 2001). It is possible that Peregrines are more selective during the breeding rather than the non-breeding season.

Chapter 2

Review of the potential use of deterrents to reduce attacks by birds of prey on Racing Pigeons

2.1 Loft area deterrents

A potential means of reducing attacks on Racing Pigeons in the immediate loft area is to discourage birds of prey from approaching the loft. It would be necessary for the 'bird-scaring' deterrent to be effective at discouraging raptors but not to influence the behaviour of pigeons at the loft. The use of bird-scaring devices is not new. There is a long-standing tradition of using scarecrows to keep agricultural pest species away from arable crops. Other types of commonly used bird deterrents include 'gas-cannons' that emit a loud noise like a shotgun firing. However, few of the deterrents aimed at protecting crops and grain stores from bird-pests are designed to differentiate between different types of birds. Though it is likely that some species are more effectively deterred than others, there is also evidence that many birds can become habituated to deterrents and that their effectiveness diminishes over time. Bird deterrent devices fall into three broad categories:

- Acoustic repellents
- Visual repellents
- Chemical repellents

2.1.1 *Acoustic Deterrents*

Most birds have a hearing range similar to humans and they cannot hear ultrasonic sounds; birds hear best in the frequency range of 1 to 5 kHz (Campbell & Lack, 1985). Acoustic deterrents aimed at birds are, therefore, also audible to humans. Bird-scaring devices based on noise emission (e.g., gas cannons, pyrotechnic shots) are not appropriate for protecting pigeons at the loft as the sound will also scare the pigeons and may cause a nuisance to human neighbours.

Some acoustic deterrents are targeted at specific species, for example, those which reproduce the distress calls of individual bird species. They are only effective at deterring the bird species whose distress call is transmitted, though they can also deter other species that may be associating with them. They produce a lower decibel sound level than other acoustic deterrents and have been used to deter songbirds from crops in North America as well as gulls and Feral Pigeons in the UK. There is, however, some anecdotal evidence to suggest that distress calls actually attract birds of prey (Fraser *et al.*, 1998).

2.1.2 *Chemical Repellents*

Chemical repellents have been used to protect fruit crops from foraging birds and studies have shown that repellents such as Cinnamamide can modify the feeding

behaviour of birds (Gill *et al.*, 1998). Musgrove (1994) conducted exploratory research on the potential use of chemical repellents to deter attacks by birds of prey on Racing Pigeons. A potentially useful aversive agent was developed, though the study concluded that more research was needed before it could even be considered for general usage. Chemical deterrents need to be fully tested and licensed before use. There may be problems associated with its usage particularly in relation to aversive conditioning (e.g., Smith *et al.*, 2000). The theoretical aim of conditioning significant numbers of wild Peregrines to avoid attacking Domestic Pigeons by the use of chemical repellents in conjunction with plumage markers is likely to prove difficult, if not impossible to achieve. As chemical repellents are unlikely to be developed for use in the near future, this review will concentrate on the potential value of visual deterrents that are currently available to fanciers.

2.1.3 Visual Deterrents

These deterrents rely on birds responding to movement or objects that are perceived as a potential predator. There is evidence that birds do not react as much to visual deterrents as acoustic deterrents and that they are rarely effective when used in isolation (Fraser *et al.*, 1998).

Visual deterrents that have been adopted by pigeon fanciers include putting a replica Great Horned Owl (*Bubo virginianus*) near the loft, using scarecrows, painting large eyes on the loft roof or walls, using 'eye-spot' balloons, stringing reflective discs or tape around the loft and placing mirrors near the loft entrance.

2.1.3.a Replica Owls

Replica Great Horned Owls (moulded in plastic) are known to elicit mobbing behaviour in passerine birds and have frequently been used by researchers investigating nest defence behaviour. Mobbing birds perceive the model as a potential predator. Given that certain species respond to replica Great Horned Owls by adopting the normal aggressive mobbing behaviour associated with the presence of a real owl, it is also possible that other species will react by avoiding the model. When used in agricultural situations as a deterrent to foraging songbirds, repellents such as hawk silhouettes, replica owls and snakes have only a limited deterrence effect for a short period of time (Fraser *et al.*, 1998).

The response of a bird to a potential predator will vary depending on circumstances and depends not only on the stimulus presented by the predator, but also by the motivation of the target species. For example, a bird defending its nest may approach a potential predator but the same bird, away from its nest, may flee. Away from the nest, the type of response shown can be determined by other factors such as hunger or competing stimuli. A hungry Sparrowhawk faced with the competing stimuli of a potential predator (model owl) and a large group of easily accessible pigeons may respond differently to a Sparrowhawk that is not so hungry or one which has an alternative prey source.

Large Owls, such as Eagle Owls (*Bubo bubo*) and Great Horned Owls have been known to kill birds of prey (Newton, 1979), though they are best regarded as competitors, rather than major predators of birds of prey. The rationale behind the use of replica owls as raptor deterrents at pigeon lofts is that birds of prey, principally Sparrowhawks, will not approach the loft area on sighting the replica owl. Research conducted on a closely related American species, the Sharp-shinned Hawk (*Accipiter striatus*), however, has shown that they actually approach model Great Horned Owls rather than avoid them (Kerlinger & Lehrer, 1981). Sharp-shinned Hawks appeared to recognise specific predators and the presence of large yellow eyes and prominent feather 'ear' tufts are important features in this recognition process. It was thought that this was because these features are associated with the owl species normally encountered by Sharp-shinned Hawks within their range and habitat in North America (Kerlinger & Lehrer, 1981). It was not clear whether this recognition is innate or learned. Juvenile Gray Jays (*Perisoreus canadensis*) reacted less than adults to a model Great Horned Owl, suggesting that the recognition of large owls as potential predators may involve some degree of learning (Montevicchi & Maccarone, 1987). In Britain, Sparrowhawks do not share habitats with large predatory owls and such recognition will not be learned, though it could still be innate and thus elicit some form of response. Tawny Owls (*Strix aluco*) can elicit a mobbing response from nesting Sparrowhawks (Newton, 1986). This close approach response is actually opposite to what is intended by the use of owl models as deterrents.

In order to be an effective deterrent at pigeon lofts, model owls must:

- be accepted by the pigeons
- be recognised as a potential predator by Sparrowhawks
- elicit an avoidance response in Sparrowhawks rather than a mobbing response

Furthermore, the deterrence effect must override any attraction presented by the pigeons as potential prey and there should be no habituation to the model owl

In this study, many fanciers reported that their pigeons either accepted the presence of a model owl with little adverse reaction or that they become habituated to the model after a brief period of wariness. It is possible that Sparrowhawks see model owls as potential predators and that the features that lead to this recognition, such the outline shape and the presence of large eyes are innate rather than learned. The mobbing response of Sparrowhawks to potential predators is most often noted in nest defence (Newton, 1986) and may not be the anti-predator behaviour adopted in situations away from the nest. However, Sharp-shinned Hawks demonstrated mobbing behaviour to model owls away from the nest site during migration, so this type of response may be difficult for the birds to 'turn-off' outside the nesting season (Kerlinger & Lehrer, 1981).

Sparrowhawks approaching a pigeon loft with a model owl in place may be faced with two opposing stimuli. The model owl may stimulate an anti-predation response (i.e., elicit avoidance or mobbing behaviour) whilst the pigeons may stimulate an approach and attack response. A large group of pigeons at the loft may act as a 'super-stimulus' that overrides any anti-predator response; there are many anecdotal stories of Sparrowhawks allowing close approach by humans when attacking pigeons at lofts. If the level of motivation is high enough, even repulsion

systems that inflict pain and injury cannot deter some bird species from achieving their goal (Haag-Wackernagel, 2000).

Before a case can be made for model owls being effective at reducing Sparrowhawk attacks at pigeon lofts it is necessary to show that Sparrowhawks recognise the model owls as potential predators and respond by avoidance rather than mobbing. Also, that the avoidance response overrides the attack response stimulated by the sight of the pigeons and that there is no habituation to the model owl. The field trials conducted in this study were undertaken without this information and the tests were based on a suggestion that model owls may possibly act as a deterrent rather than any firm evidence that they actually do repel Sparrowhawks.

2.1.3.b *Eyespot Balloons*

These are large, brightly coloured plastic balloons adorned with eyespot markings. They are sold as deterrents for fruit-eating birds that attack agricultural crops and gardens. In Britain, they have also been marketed as raptor deterrents for use at pigeon lofts and at garden bird tables, though there appears to be no evidence to support the assertion that the balloons have a greater repulsion effect on birds of prey than other species. Their use on farms in Canada suggests that they can be effective at repelling some pest species but have no effect on others (Fraser *et al.*, 1998). Research in New Zealand found that the balloons significantly reduced the number of House Sparrows (*Passer domesticus*) using a bird-feeding table (McLennan *et al.*, 1995). However, the sparrows became habituated to the balloon such that there was no repellent effect after nine days. In addition, the repulsion effect declined the further away the balloon was placed from the feeder, with no effect detectable at distances greater than 40 m. Eye-spotted balloons were reported as being effective at deterring Grey Starlings (*Sturnus cineraceus*) from fruit trees (Shirota *et al.*, 1983), though the experimental set-up meant that the reported repulsive effect was inconclusive. The mechanism of this repulsion effect was investigated by Nakamura *et al.* (1995) using Rufous Turtle Doves (*Streptopelia orientalis*) in a flight cage. They found that there was no significant difference in the deterrent effect of balloons with eyespots compared to balloons without. The weak deterrence effect was mainly due to the unusual stimulus of the balloon itself rather than to the eyespot patterns.

2.1.3.c *Eyespot markings*

Eyespot patterns are a common feature of visual deterrents so it is worthwhile noting the basis for this type of marking as a raptor deterrent.

Eyespot markings are exhibited by many animal species but are particularly prevalent in fish, butterflies and moths. It must be noted that not all eyespot markings are thought to have an anti-predator function (e.g., the eyespots on a male Peacock's tail). Eyespots have evolved mainly in smaller organisms that are preyed upon by larger organisms. One of the reasons for this is that eyespots may serve to mimic the eyes of a larger organism and that this mimicry is size constrained. Thus, a small organism with a cryptic body outline may fool a predator into thinking its eyespots are

the eyes of a larger organism, but a large organism with a clearly defined body outline cannot. In those species where eyespots serve as a means of avoiding predation the mechanism of their action can work in different ways:

1. Startle effect of eyespots. In some species the bright eyespot markings are not normally visible until a predator attacks the organism. On being attacked the eyespots are suddenly revealed and work by temporarily startling the predator. This serves to give the prey an opportunity to escape. Such patterns are commonly seen on the hind wings of moths.
2. Repulsion effect of eyespots. In species where the eyespot markings are permanently visible they may serve to deter initial attack by stimulating an innate or learned response in the predator by mimicking the eyes of a larger, potentially dangerous organism or by acting as a warning signal. Eyespots acting as warning signals are often secondary visual characters that compliment distasteful chemicals. Predators learn to avoid prey carrying these warning signals.
3. Diversion effect of eyespots. Eyespot markings may be positioned on less vulnerable parts of the body such as on the wings of butterflies and on the tails of fish. In such circumstances they may act as a false target for attack by a predator and thus the initial attack is deflected towards an area of the body where it is less likely to be lethal. The prey species is more likely to escape and survive an attack by a predator if the initial strike is targeted at a less sensitive part of the body.

There have been a number of studies carried out on eyespot markings and the response they elicit in birds. Early work on butterflies using Reed Buntings (*Emberiza schoeniclus*) and Yellowhammers (*Emberiza citrinella*) as predators suggested that eyespots elicited a flight response in these birds because they mimicked the large eyes of a predator (Blest, 1957). However, later and more extensive work using Great Tits (*Parus major*) showed no significant avoidance and even some mild attraction towards eyespot stimuli (Scaife, 1976). Blue Jays showed a startle response to eyespot patterns on the hind wings of moths but they soon became habituated to a particular pattern (Schlenoff, 1985). Tinbergen (1974) designed an experiment that showed that the startle response in Great Tits was greatest with stimuli that most closely resembled a pair of eyes.

In a series of experiments designed to assess the potential value of eyespot markings as bird scarers, Inglis *et al.* (1983) investigated the feeding behaviour of Starlings (*Sturnus vulgaris*; an agricultural pest species) in presence of 'eyes'. This work concluded that simple eye-like patterns could deter hungry Starlings from feeding in their vicinity. In order to be effective the eye pattern needed to possess a 'pupil/iris' distinction and coloured irises were the most effective. The size of the eyes was relatively unimportant within the range tested (0.5 to 4 cm diameter). However, the study also revealed a highly significant level of individual variation in the response shown and the Starlings rapidly habituated to the eyespots, making them ineffective beyond short-term use.

All of the above experiments conducted by Inglis *et al.* (1983) investigated the startle effect of eyespots i.e., the eyespots were not continuously visible to the Starlings. If birds can observe and assess the risk posed by eyespot patterns at a distance, the deterrence effect is likely to be lower and the process of habituation more rapid. Similarly, the size of the eyespots tested mostly corresponded to the real-life size of owl eyes and the deterrence effect of greatly enlarged eyespots, as employed on eyespot balloons remains unknown. Recent work has shown that the protective value of eyespot patterns is enhanced with increasing size and reduced pattern asymmetry (Forsman & Merilaita, 1999).

The deterrence effect of eyespots is likely to be influenced by the level of motivation in the target species. The motivation of a bird to reach a particular resource such as food or a nesting site may be high. A study of five different deterrents, including eyespots, at preventing Starlings from establishing nest sites showed that all were equally ineffective (Belant *et al.*, 1998).

To summarise, the repulsive effect of eyespot balloons varies between different bird species and the degree of deterrence declines relatively quickly over time. Furthermore, even the initial degree of repulsion tends to be weak and is effective over a very limited area. The mechanism of deterrence may work through the eyespot patterns or because of the unusual stimulus of the balloon itself. There is little evidence of a repulsive effect of continuous eye display (as opposed to a startle effect). As with the model owls, the field trials in this study were conducted in the absence of any evidence that greatly enlarged eyespots that are continuously visible have any repulsive effect on birds of prey.

2.1.3.d Mirrors and reflective objects

Reflective, iridescent foil tape has been used by some fruit growers in an attempt to protect their crops from foraging birds, though the effectiveness of this technique has not been quantified. Reflective tape may act as a deterrent to birds through a combination of presenting a reflective surface that moves and produces a noise. Seamans *et al.* (2001) evaluated the effectiveness of flashing lights in combination with reflective mirrors at deterring Starlings from nesting sites and concluded that, even when used in combination with lights, mirrors were not an effective deterrent.

I did not test the effectiveness of reflective objects in this study, though I was aware of a number of fanciers that used compact disks (CDs) either attached to the loft walls or suspended on a line above the loft. None of the fanciers made any claims as to the effectiveness of these as raptor deterrents but there were claims that they did appear to reduce the propensity of pigeons to land on the loft roof when released for exercise.

2.1.3.e Moving objects

Moving objects can influence bird behaviour. Sudden and unpredictable movement can trigger flight responses in birds. However, the type of moving object is very important. For example, tree branches that move in the wind are usually ignored but sudden movement of a human observer who has been still can cause birds to fly away. The principle behind this form of deterrent relies on birds perceiving the moving object as a potential threat. Birds habituate to predator models because, unlike live predators, their spatial context does not change (Shalter, 1978), they are inanimate and they never attack or kill other birds (Conover, 1985). In this respect, there was a measurable deterrence effect on American Crows (*Corvus brachyrhynchos*) of a model Great Horned Owl that was positioned on a model Crow with flapping wings (Conover, 1985); simulating a predation event. A similar response was noted from Starlings (Conover & Perito, 1981), though the deterrence effect was not solely due to movement but augmented by distress calls and the visual stimulus of a model of a predator holding a Starling.

I did not test moving objects *per se* in this trial but fanciers were requested to reposition their model owls at least once a week to reduce the opportunity of habituation, whilst the eyespot balloons were suspended on a cord and could move in the wind.

2.2 On-bird Deterrents

In order to deter birds of prey attacking pigeons when they are away from the immediate loft area it is necessary to apply deterrents to individual birds. These are aimed primarily at deterring attacks by Peregrines and Goshawks. These deterrents could confer some protection for the marked individual only or for the whole flock. Two 'on-bird' deterrents are visual (sequins and roundel transfers) whilst the third is acoustic (Bali bells).

Peregrines and Goshawks usually hunt by targeting and pursuing individual birds, either by selecting targets from within flocks or by attacking single birds. There is little information on the selection of individuals as prey but Ratcliffe (1993) quoted Charles Darwin, who noted in his *Origin of Species* that white pigeons were more vulnerable to attack by birds of prey, and further noted that several observers have suggested that Peregrines are drawn to attack birds showing conspicuous feather patterns in flight. There is some anecdotal evidence that Peregrines select the 'odd-bird out' among a flock. The high frequency of Budgerigars and other brightly-coloured, escaped cage birds in prey remains found in Wales concurs with the notion that odd-looking birds are more susceptible to attack (C Richards and A Dixon, Unpublished Data). Newton (1986) also reported that Budgerigars were killed more frequently by Sparrowhawks than would be expected by their availability, whilst Weir (1978) stated that Peregrines in Speyside preyed selectively on very rare and unusual birds. It is possible that on-bird deterrents may actually serve to increase the likelihood of predation by birds of prey rather than to reduce it.

2.2.1 *Sequins*

This method involves attaching small reflective discs (dressmakers sequins) to the plumage of the pigeon. We could find no research literature relating to this method of deterrence and their use seems to have arisen through individual experimentation by pigeon fanciers. There are two potential ways in which these deterrents may work. The first is through a repulsion effect in that a bird of prey will not approach the reflective object (see section 2.1.2.d above); in which case they can be placed anywhere on the bird where they will be visible to a predator. The second is that they could distract a bird of prey during an attack and give the pigeon a better chance of escape, in which case they need to be positioned where the distraction effect is greatest.

It is possible that the prominent white wing bars seen on many bird species have evolved because they distract predators during an attack. The combination of movement and highly contrasting wing coloration may interfere with the peripheral vision of a bird of prey as it strikes. Birds of prey have both monocular and binocular visual fields; the former is important in wide angle distance vision whilst the latter is thought to be most important for judging precise distances such as during landing or an attack (Campbell & Lack, 1985). However, we could find no published information on the potential distraction function of wing bars or on the interaction between monocular and binocular vision in birds of prey. Sequins placed on the wings of a Racing Pigeon could potentially have a distraction effect on an attacking bird of prey.

2.2.2 *Roundel transfers*

These ink transfers are commercially marketed to pigeon fanciers as raptor deterrents (*terror-eyes transfers*). They are made from waterproof inks in three colours to give an eyespot pattern with a red outline, black pupil and yellow iris. The markings are placed on the upper side of each wing on the secondary covert feathers. The rationale behind the use of roundel transfers is that the eyespot markings will deter birds of prey from attacking the pigeon. There is no published research on the effectiveness of these deterrents. Anecdotal evidence of a deterrent effect is equivocal. Shawyer *et al.* (2000) reported positive reactions from fanciers in Devon. Conversely, a survey by the Scottish Homing Union (1998) concluded that the transfers did not reduce the frequency of attacks by birds of prey on Racing Pigeons. The eyespot pattern of roundel wing transfers is continuously visible and much larger than the eyes of any natural predator. The movement of the wings may add to, or subtract from, the effectiveness of any potential deterrence effect. Furthermore, the outline of the pigeon's body is clearly discernible to a predator and the deterrence value of eyespot patterns without the concomitant cryptic colouration to disguise the body outline maybe lessened.

2.2.3 *Bali Bells*

Bali Bells are in fact whistles and not bells. They are attached to the base of the tail of the pigeon such that they make a high pitched wailing sound as a result of air

passing through them when the pigeon is in flight. They are sold to pigeon fanciers specifically as raptor deterrents though their use was originally developed for the aesthetic pleasure of the sounds they make (Hansell, 1998). In contrast to the other two on-bird deterrents, this is an acoustic rather than a visual repellent. The rationale behind its use is that the loud whistling sound will deter a bird of prey from attacking the pigeon wearing the whistle. Furthermore, it is possible that the acoustic deterrence effect could also prevent attacks on other pigeons within the same flock. However, the size of the whistle increases drag during flight such that a pigeon fitted with a Bali Bell flies more slowly than others without a whistle in the same flock. The effect of drag means that the whistles cannot be used on pigeons during races and their potential effectiveness at protecting a flock is limited even on relatively short-distance training flights because the pigeon wearing the whistle soon falls behind the rest of the flock (A Dixon, Personal Observation).

The use of Bali Bells is limited to the periods of exercise around the loft. There is an additional problem with noise pollution and they cannot be used at lofts in residential areas where the whistling sound can be a nuisance for neighbours. In south Wales there have been reports of threatened legal action involving Local Authority Environmental Health Officers as a result of the noise nuisance caused by the use of Bali Bells in residential areas. As a consequence, the opportunity to use Bali Bells as potential raptor deterrents is very limited.

Chapter 3

The Diet of Peregrine Falcons in South Wales

3.1 The diet of Peregrines throughout the year determined by analysis of prey remains

Introduction

Peregrines feed almost exclusively on other birds. Once they have caught their prey, Peregrines pluck the feathers from them on a perch. The larger flight and tail feathers are not normally eaten but some body feathers are. In the nesting territory Peregrines have certain favoured areas where they take their prey to be plucked. However, these 'plucking posts' are not the only sites that are used for plucking their prey and nesting territories can have many different plucking sites. It is possible to get some indication of the range of prey species that are killed by searching for plucked feather remains on nesting territories. The larger and brighter the feathers the greater the likelihood that they will be found during searches for prey remains. Thus, large and light-coloured species such as Domestic Pigeons may be over-represented in samples of prey remains collected at breeding sites.

Outside the breeding season Peregrines can range much more widely in search of prey and do not bring prey back to the nesting area. The prey can be eaten close to where it is killed and prey remains found at nesting sites outside the breeding season may be biased towards species killed close-by. For this reason, the prey spectrum found in feather remains collected at nesting sites is likely to be more representative of the actual prey species killed during the breeding season than outside it.

Despite the fact that Peregrines can wander much further outside the breeding season, our observations in south Wales indicated that nesting territories are occupied throughout the year by at least one adult bird. Even if birds were not seen on a visit to the nesting territory there were normally signs of recent occupation such as fresh pellets, droppings, moulted feathers or recent prey remains. Observations also indicated that Peregrines spend much of the day away from the immediate area of the nesting cliff from November to January and many only return to the nesting sites each evening to roost. Thus, the prey remains found at nest sites outside the breeding season could also be biased towards species that are active around dawn and dusk.

Methods

Quantifying the number of individual prey remains found at nesting sites can be difficult because each prey item is not necessarily plucked at just one location. For this reason counts of individual prey remains were confined to clusters of feathers found at plucking sites. If more than one cluster of feathers was found from the same species, the feathers were examined to determine the minimum number that may have been plucked. Thus, the number of individual kills found is a conservative estimate.

This was particularly true of Domestic Pigeons because the feather remains occurred so frequently on breeding territories it was sometimes difficult to determine how many had been killed, particularly when the plumage colours were similar. Conversely, Domestic Pigeon feathers are large and light-coloured, so they were found more easily than the smaller and dull-coloured feathers of many other species.

Prey remains were assigned to three categories according to how fresh they appeared to be. This was essentially a subjective judgement based on the condition of the feathers and how many smaller body feathers were present with the larger flight feathers. Prey remains were classified as fresh and allocated to the particular month in which they were found if the feathers were not flattened into the ground, in good condition and present together with smaller body feathers. For feather remains that had lain on the ground for longer i.e., flattened into the ground but still in good condition the kill was allocated to the season in which it was found i.e., Summer (April to September) or Winter (October to March). Finally, very old and heavily weathered feather remains were not classified according to the time of year they were taken.

Results

Prey remains were collected from 34 different breeding territories in south Wales. In total, 638 prey remains could be assigned to the particular month they were killed and 823 could be assigned as being killed either during the Summer (April-September) or Winter (October-March). In addition a further 47 prey remains were found that could not be classified according to the time of year they were killed. There were 52 different prey species represented in the total prey sample of 870 prey remains, which ranged in size from Goldcrest (*ca.* 6g) to Mallard (*ca.* 1kg).

The proportion of Domestic Pigeons in the diet was significantly higher within the pigeon race season (April-September) than outside it (69% *cf.* 25% of kills). In a larger sample, which included prey remains found at non-breeding sites, Dixon *et al.* (in press) found that Domestic Pigeons comprised 65% of kills during the race season and 24% of kills outside the race season. In terms of prey weight, the corresponding percentages were 84% and 45% respectively.

Within the race season the proportion of Domestic Pigeons killed was lowest in September, which corresponds with a decline in Racing Pigeon availability towards the end of the season (Table 3.1). Outside the race season from October to March the proportion of Domestic Pigeons killed was highest in March when Racing Pigeon availability is highest during pre-season training. The monthly variation in the proportion of Domestic Pigeons killed clearly indicates a close link with Racing Pigeon availability and suggests that the majority of Domestic Pigeons killed are racing pigeons. Examination of the type of Domestic Pigeons killed by Peregrines in south and central Wales indicated that 92% were Racing Pigeons, 1% were Tipplers, Rollers or Show Pigeons and 7% were unringed Feral Pigeons (Dixon *et al.*, MS1).

The apparent decline in the proportion of Domestic Pigeons killed in June is due to an increase in the frequency of two other species in the diet during this month. In June, Jackdaws made up 6.8% of prey remains, many of which were recent fledglings,

whilst Starlings made up 18.2% of kills, most of which were juveniles. Both these species aggregate in large, mobile post-breeding flocks and present a highly visible and abundant food source. In combination with Domestic Pigeons these three species made up 89.2% of the prey remains found at Peregrine breeding sites in south Wales during the month of June. By July the proportion of Domestic Pigeons found in the prey remains rises again and Dixon *et al.* (MS2) found that virtually all of the Racing Pigeons killed from July to September were young birds.

Discussion

In south Wales, Domestic Pigeons, particularly Racing Pigeons, are the most frequent prey species killed by Peregrines during the pigeon race season. In terms of prey weight, Domestic Pigeons comprised the majority of prey killed by Peregrines both within and outside the pigeon race season. The prevalence of Domestic Pigeons in the diet is likely to be a function of their relative abundance and also their susceptibility as prey. Furthermore, Peregrines may also develop a preference for a particular prey species based on factors such as their palatability, size and weight (Ratcliffe, 1993). This preference may change throughout the year and vary between the sexes. It is possible that individual Peregrines develop a preference for Domestic Pigeons and actively seek them during hunting forays.

During June, the male hunts mostly away from the nest area while females hunt in the vicinity of the nest. The prey species available to females tend to be Jackdaws and Domestic Pigeons, whilst males are exposed to a greater range of prey over a wider area. Though males do bring Domestic Pigeons back to the nest site in June it is possible that they preferentially take Starlings. Alternatively, there may be no preferential selection and their frequency in the prey remains during June merely reflects their relative availability as potential prey. In July females tend to hunt more widely though the young fledgling Peregrines tend to remain close to the nesting site. At this time young-pigeon training and racing begins, and the Racing Pigeon remains found at breeding sites in July were mainly young-birds.

Analysis of prey remains cannot be used to determine the actual number of kills made by Peregrines at any time of the year. It is simply not possible to find the remains of all, or even the majority of the birds that are killed. By the same reasoning it is not possible to use the number of Racing Pigeon remains found as a measure of the total number killed. Shawyer *et al.* (2000) used the number of Racing Pigeon rings found by fieldworkers at Peregrine nest sites as an indicator of the actual number that were killed, giving an estimate of two to four Racing Pigeons per week in prey-rich areas such as Cumbria, Wales and Devon. Clearly this approach to estimating the number of Racing Pigeons killed is flawed. Factors such as the topography and ground cover of nesting sites greatly influences the recovery level of Racing Pigeon rings. Simply because more Racing Pigeon rings are recovered at one site than another does not necessarily mean that the Peregrines occupying that site kill more pigeons.

3.2 The diet of breeding Peregrines as determined by observation of breeding pairs

Introduction

It is possible to derive an estimate of the number of Domestic Pigeons killed by Peregrines using the prey remains found at breeding sites. However, this process involves estimating the dietary requirements of breeding Peregrines in terms of food weight, estimating an average weight for each species in the prey sample and the estimation of a wastage factor to account for parts of the prey that are not eaten. Given the potential biases inherent in this process, it can only provide an estimate of the number of Domestic Pigeons killed.

A far more reliable way to assess the actual predation rate on Domestic Pigeons is directly to record the number that are brought to nesting sites by breeding Peregrines. It is then also possible to assess how the proportion of Domestic Pigeons found in prey remains relates to their proportion in the prey species killed. If the remains of Domestic Pigeons are over represented in prey remains as expected, then it is possible to apply a correction factor to account for any bias. It is assumed, however, that all prey killed are brought back to the nest. Some may be killed and eaten away from the nest, though it is likely that virtually all of the larger prey, such as Domestic Pigeons, will be brought back to the nest site to be consumed. At active nests, where the male has to provide food for the female and chicks, it is likely that the prey brought back accurately reflects the kill rate.

The assumption that all kills are brought back to the nest site is less likely to be correct at inactive nests or after the young have fledged. Thus, direct observation at nest sites is only likely to be a reliable indicator of the true kill rate during May and June when there are eggs or dependant young. To estimate the number of Domestic Pigeons killed in other months it is necessary to estimate the kill rate for each month and to use data on prey remains to calculate the proportion that are Domestic Pigeons, applying the correction factor obtained for May and June.

Methods

A total of 16 Peregrine nest sites in South Wales were watched during May and June at distances from 50 to 250 m. The behaviour of the adult birds was recorded throughout the duration of the observation periods. Observation periods at each nest site lasted from 1 to 12 hours (average = 4.7 hours; total observation time = 169 hours).

The prey brought back to the nesting cliff was identified to species if possible, but when this was not possible the prey was classified as being 'small' or 'medium'. Small-sized prey were about the size of a Skylark or smaller i.e., less than 50g and medium-sized prey were about the size of a Starling or Mistle Thrush i.e., from 50 g to 120 g. There were no larger prey items that could not be identified to species.

Results

During the observations, I recorded the delivery of 46 kills to nests, (a kill rate of 0.3 per hour). Of these, 17 were Domestic Pigeons (0.1 per hour; 37.0% of the prey species killed; Table 3.2). Starlings, particularly juveniles, were the next most frequent prey species and it is likely that some of the 'unknown medium-sized' prey species were also juvenile Starlings.

Overall, medium-sized species made up 47.8% (N = 22) of kills and small-sized species made up 10.9% (N = 5). Compared with the prey remains found in May and June, medium-sized prey was significantly under-represented and Domestic Pigeons were significantly over-represented in the sample of prey remains (Table 3.3). In May, the proportion of Domestic Pigeons was 24.9% higher in the sample of prey remains than in the sample of observed kills, whilst in June the proportion was 36.7% higher. Overall, the proportion of Domestic Pigeons was 31.3% higher in the sample of prey remains than in the sample of observed kills (Chi-square corr. = 3.612, 1 df, P = 0.05). The data in Table 3.3 indicates that the proportion of Domestic Pigeons found in the prey remains sample should be corrected by a factor of 0.54 to be more representative of the actual proportion that are killed.

For example, in May and June 144 Domestic Pigeons were found in a total of 211 prey remains (68.3% of prey remains). However, direct observation indicated that Domestic Pigeons only comprised 37.0% of kills made over the same period. If we apply a correction factor of 0.54 (0.54×144 Domestic Pigeons = 78) the corrected proportion of Domestic Pigeons in the prey remains more accurately reflects the proportion that were killed (i.e., $78/211 = 37.0\%$). The sample size for observed kills is relatively small in comparison with the number of prey remains found and a larger sample of observed kills may provide a more accurate assessment of the degree to which Domestic Pigeons are over-represented in the sample of prey remains. The discrepancy is due partly to under-recording of medium-sized prey remains and is potentially greatest during the months of the year when medium-sized prey are taken most frequently. This could be true during June, when juvenile Starlings are frequently killed, and during the winter months, when many migrant thrushes are preyed upon.

Using a the correction factor it is possible to estimate the proportion of Racing Pigeons killed in each month of the year from the sample of prey remains (Table 3.4).

We examined the frequency of prey deliveries at nest sites in relation to the number of chicks on the territory (Table 3.5). Peregrines without dependent young on the nesting territory brought back prey at a rate of 0.19 items per hour, whilst those with young killed prey at a rate of 0.29 per hour. Brood size did not appear to significantly influence the rate of prey delivery, though the sample sizes are small. It is possible that the increased food demands of larger broods are met to some extent by the killing of larger prey, such as Domestic Pigeons rather than by increasing the total number of prey killed. Unfortunately, the number of broods is too small to undertake any statistical analysis of the data but the proportion of Domestic Pigeons killed at territories with broods of 3 or 4 young were higher than at territories with 1 or 2 young (0.18 per hour *cf.* 0.08 per hour respectively). However, this higher rate of Domestic Pigeon kills was close to that found at territories with no young (0.18 per *cf.*

0.15 per hour respectively).

In addition to the number of young, the age of the brood may also influence the rate of prey delivery. We found no indication of a change in prey delivery rate in relation to brood age, though the sample size is small (Figure 3.1).

It is possible to estimate the actual number of Domestic Pigeons killed each day during May and June. We estimate that Peregrines with dependent young kill prey (i.e., all species) at a rate of 0.29 items per hour and those without young kill prey at a rate of 0.19 items per hour. The total number of available hunting hours during each month of the year will vary with day length (taken as the period from one hour before sunrise to one hour after sunset). In winter, when day length is shorter, the kill rate per hour will be higher if the daily food requirement is similar to that found in May and June. In May and June (61 days) there are approximately 968 hunting hours available to Peregrines. Two adults killing prey at a rate of 0.19 birds per hour will kill approximately 184 birds (3.0 birds per day). Two adults feeding a typical brood of two chicks and killing prey at a rate of 0.29 birds per hour will kill approximately 280 birds (4.6 birds per day). Assuming the daily food requirement of two adults is similar throughout the year it is possible to estimate the number of birds killed at a typical territory in south Wales during each month of the year. This is a crude method of estimating the number of Domestic Pigeons killed but it does give some indication of the level of predation at different times of the year (Table 3.6).

Over a year, we estimate that a typical pair of breeding Peregrines in South Wales, rearing two chicks will kill around 355 Domestic Pigeons. During the pigeon race season from April to September, breeding Peregrines will kill Domestic Pigeons at an estimated rate of 1.6 per day (285 pigeons killed over the 183 day period). Over the old-bird race season from April to June breeding Peregrines will kill Domestic Pigeons at an estimated rate of 1.6 per day (148 pigeons killed over the 91 day period)

Discussion

On average, Peregrines without dependent young killed prey at a rate of 0.19 items per hour, whilst those with dependent young killed prey at a rate of 0.29 items per hour, although delivery rates were very variable. In an Australian study, broods of three or four chicks received slightly more prey deliveries than broods of two, though the only statistically significant difference was between single nestlings and larger broods (Olsen *et al.*, 1998). Even then, the differences were only significant when the chicks were aged between 10 and 30 days old. Studies on Peregrines in Canada (Nelson, 1988) and on Prairie Falcons (Holthuijzen, 1990) also showed that prey delivery rates increased with brood size. Our data is consistent with other studies which showed that individual chicks in larger broods obtain less food than chicks in smaller broods (Enderson *et al.*, 1972; Olsen *et al.*, 1998; Boulet *et al.*, 2001). Clearly, Peregrine nestlings can grow and fledge successfully on widely varying amounts of food (see also Newton, 1978).

In our study it was not possible to assess the weight of prey delivered to nestlings because the Peregrines often made use of cached stores of uneaten food. It is possible that larger prey species are killed by Peregrines provisioning larger broods

and that larger prey items provide more than one meal. However, in our study we did not observe a higher usage of food caches at sites with large broods, though the sample size was small (Dixon *et al.*, MS3). Further research on the food consumption rates of nestling Peregrines would be useful, particularly in relation to the type of prey killed. The impact of a reduction in prey availability on brood sizes and fledging success is likely to be influenced by the ability of Peregrine nestlings to withstand a reduced food intake. In south and central Wales variation in the use of Racing Pigeons in the diet is related to population breeding density but not to the brood size of individual nests (Dixon *et al.*, In Press). It is possible that the removal of Racing Pigeons from the environment (e.g., by confining pigeons to the loft) would not reduce Peregrine brood sizes or fledging success.

In Australia, the mean food intake of nestling Peregrines has been determined using tritiated water and was found to be 134.4g for males and 165.4g for females at weeks old (Boulet *et al.*, 2001). The weight of food consumed is not the same as the weight of prey killed as not all of the prey items are completely eaten. In the UK, food requirement was estimated at 222g per chick and 188g per adult from the estimated weight of prey delivered to nests (Redpath & Thirgood, 1997). There is a large difference in the estimated weight of prey captured for chicks (i.e., 222g) and the estimated weight of prey consumed by chicks (i.e., 150g). Although not all of this difference will be due to wastage, it suggests that the estimate of 20% wastage given by Ratcliffe (1993) is reasonable.

The most common brood size in south Wales is two chicks. Thus, a typical brood in south Wales requires around 444g of food each day and the adult pair 376g. Thus, in May and June, we predict that breeding Peregrines with two young require about 50.0 kg of prey in total. In south Wales during May and June we estimate that a breeding pair of Peregrines will kill about 108 Domestic Pigeons. So, what is the weight of 108 Domestic Pigeons? This is not easy to answer because there is a large amount of variation in individual weight between the sex and age classes. Furthermore, there is significant weight loss during racing such that a pigeon nearing the end of a race is much lighter than when it started. The weight range given in Snow and Perrins (1998) for non-captive Domestic Pigeons is 230 – 370 g, but captive Racing Pigeons can be significantly larger and heavier. Shawyer *et al.* (2000) gave the mean weight of stray Racing Pigeons as 315 g (range 207 – 402 g). Ratcliffe estimated the weight of an average Racing Pigeon as 425 g. Based on an assessment of stray and yearling Racing Pigeons in the diet (Dixon *et al.*, MS1; MS2) we estimate that Domestic Pigeons killed by Peregrines weigh an average of 375 g. Thus, our observations in south Wales suggest that breeding Peregrines kill 40.5 kg of Domestic Pigeons during May and June, representing nearly 81% of their food requirements by weight.

3.3 The frequency of Racing Pigeons in the diet of breeding Peregrines determined by the recovery of rings from wing-stamped birds

Introduction

All Racing Pigeons are fitted with identification rings issued by the The

Homing Unions . According to the rules of the governing bodies, each pigeon is also supposed to be marked, either with a ring or with an ink wing-stamp, with the contact address or telephone number of the owner or the owner's club. However, this rule does not appear to be rigorously enforced and many Racing Pigeons only carry the Homing Union rings and no additional form of identification. Nevertheless, it is still possible to trace the owner of the pigeon through the records belonging to the Homing Unions.

Peregrines often eat the Homing Union rings, perhaps inadvertently when eating the fleshy parts of the legs or deliberately to aid the breakdown of bones. These rings are then regurgitated several hours later in pellets along with other undigested remains such as bones and feathers. Thus, rings are rarely found alongside the feather remains of the Racing Pigeons that have been plucked and eaten. Pellets can be cast well away from the nesting area and any rings they may contain will never be found during searches of the nesting site. Additionally, not all the rings that lie in the immediate nesting area will be found during searches. The proportion of rings that are found is determined mainly by the vegetation cover and topography of the nesting site (Dixon & Lawrence, 2000).

Method

The feather remains of wing-stamped Racing Pigeons that are found at Peregrine nesting sites provide direct evidence that the pigeon has been killed by a Peregrine. For each nesting territory we recorded the name and address of all the owners from the wing-stamps. We then collected rings from the same territories and traced the owners of the rings through the respective Homing Unions. We only included rings that were known to have come from Racing Pigeons killed during the current (2001) race season i.e., rings within fresh pellets, rings on fleshy legs and rings registered in 2001. Thus, we had two lists of pigeon owners: one derived from the wing-stamps and the other derived from the rings. Next, we calculated the proportion of owners in the wing-stamp list that were also identified in the ring list. This allowed us to estimate the proportion of rings that were recovered from Racing Pigeons that we knew to have been killed at a particular territory.

Unfortunately, the number of legible wing-stamps recovered at individual territories was small (range 1 to 8 wing-stamps per territory) and at other sites the number of rings recovered was small (range 0 to 49 rings per territory). In order to obtain the most accurate assessment of the proportion of rings recovered we restricted our analysis to eight territories that were systematically searched for prey remains and rings and within which we found the remains of at least 10 Domestic Pigeons and 10 rings.

Results

At the eight Peregrine nesting territories where systematic searches were conducted for both prey remains and rings we found 43 wing-stamps and 161 rings. We recovered both the wing-stamped feathers and the ring from 12 Racing Pigeons. Thus, we found nearly 28% of the rings from wing-stamped pigeons that were known

to have been killed (i.e., $12/43 = 0.279$). This suggests that our total of 161 rings actually represent about 28% of all the Racing Pigeons killed at these 8 territories. We estimate that the actual number of Racing Pigeons killed at these sites is approximately 577 birds (i.e., $161/0.279 = 576.9$).

The systematic searches were carried out during the old-bird racing season and the period covered at the sites ranged from 87 to 114 days. In total, our search period covered 813 hunting days at the eight territories during the old-bird race season giving a kill rate of 0.7 Racing Pigeons per day (range = 0.3 to 1.6 per day). Using this method we estimate that during the months of April to June inclusive, approximately 65 Racing Pigeons are killed by the typical breeding pair of Peregrines rearing two chicks.

Discussion

Using this method we estimate that the typical breeding pair of Peregrines in south Wales will kill Racing Pigeons at a rate of 0.7 per day during the old-bird race season i.e., nearly five Racing Pigeons each week. This differs markedly from the estimates given in Table 3.6, in which we determined that Domestic Pigeons were killed at a rate of 1.6 per day over the same period i.e., approximately 148 pigeons between April to June. So why the difference? It is possible that the difference between the two estimates is real and the higher value determined by direct observation and examination of prey remains is due to the presence of unringed Feral Pigeons in the diet. However, there is no statistically significant difference between our two estimates of the number of Racing Pigeons killed (Dixon *et al.*, MS4). The small sample sizes mean that the margins of error will be quite wide for the estimates derived by both methods. Nevertheless, our experience with Peregrines in south Wales leads us to believe that a working estimate of between 0.7 to 1.6 Racing Pigeons per day is a reasonable reflection of the true kill rate during the old-bird race season at a typical breeding territory with two chicks.

3.4: Summary

The diet of Peregrine Falcons in south Wales

Examination of fresh prey remains at Peregrine breeding sites in south Wales revealed that the proportion of Domestic Pigeons in the diet varied throughout the year. Domestic Pigeons comprised a significantly greater proportion of prey remains within the pigeon race season than outside, indicating that Racing Pigeons make up a significant proportion of the Domestic Pigeons killed during this period. Prey remains are likely to be biased towards species killed close to breeding sites and towards larger, more visible prey remains, such as Domestic Pigeons.

Direct observation of prey delivered to breeding sites in May and June indicated

that the frequency of Domestic Pigeons in prey remains was indeed higher than that observed being delivered to nests. By applying a correction factor of 0.54 to the frequency of Domestic Pigeons found in the prey remains sample it was possible to obtain an estimate that more accurately reflected their observed frequency in kills brought to the nest. Direct observation of the rate of prey delivery to nesting sites showed that Peregrines in south Wales killed prey at a rate of 0.19 items per hour at sites without dependent young and 0.29 per hour at sites with dependent young. There was no consistent variation in the rate of prey delivery between broods of different sizes and ages though the sample size was small. Using these kill rates we were able to estimate the number of kills made at a typical breeding territory in each month. The corrected proportion of Domestic Pigeons found in prey remains were then used to estimate the number of Domestic Pigeons killed at a typical breeding territory in each month. A typical territorial pair of Peregrines rearing two chicks would kill an estimated 355 Domestic Pigeons per year. In south Wales, 92% of Domestic Pigeons killed by Peregrines are Racing Pigeons, thus the typical breeding pair will kill an estimated 322 Racing Pigeons each year. During the old-bird race season, from April to June, it was estimated that breeding Peregrines kill approximately 148 Domestic Pigeons, of which approximately 136 would be Racing Pigeons.

An alternative method for estimating the number of Racing Pigeons killed was also carried out using the recovery rate of rings from wing-stamped Racing Pigeons known to have been killed at Peregrine territories. Using this method, it was estimated that each pair of Peregrines killed a total of 65 Racing Pigeons over the old-bird race season. There was no significant difference in the estimates derived from the two different methods and we suggest that 0.7 to 1.6 Racing Pigeons per day is a reasonable estimate of the kill rate at a typical breeding territory in south Wales.

Chapter 4

The use of deterrents to reduce raptor attacks on Racing Pigeons

A request was made via the RPRA and the British Homing World for volunteers from south Wales to participate in trials to assess the effectiveness of deterrents at reducing raptor attacks on Racing Pigeons. The request resulted in 19 fanciers volunteering to take part in the trial, though subsequently it was only possible to involve 15 of them. In order to get the 40 fanciers desired for the project it was necessary to directly request assistance from a list of fanciers that was supplied by the WHU. The response to this direct approach was very good and 38 fanciers were finally involved in the trials.

Each participant was supplied with three logbooks; one for periods of exercise around the loft, one for training tosses and one for races. In the exercise logbook fanciers were asked to record the date and time when their pigeons were released from the loft for exercise, the duration of the exercise period, the number of pigeons released and the number that returned to the loft after exercise. For pigeons that failed to return after exercise the fanciers were asked to record the ring numbers. In addition fanciers were required to record any attacks by birds of prey that were witnessed during exercise and the raptor species involved. In the training logbooks fanciers were asked to record the date and time when their pigeons were tossed, the number of pigeons tossed, the release location and the ring numbers of any birds that failed to return home. The racing logbooks were similar to the training logbooks except that the fanciers were asked to record the ring numbers of all birds sent and to note the date and time of returns. Supplementary data for races was also collected on weather conditions and general return rates at their local pigeon club.

4.1 Trial of deterrents aimed at reducing raptor attacks in the loft area

Introduction

The theoretical principle behind the use of replica Great Horned Owls and balloons with eyespot markings as raptor deterrents is outlined in section 2.1.3.

Methods

Two forms of visual deterrent were used at lofts i.e., replica Great Horned Owls and inflatable yellow balloons with large eyespot markings (*Guard'n eyes* balloons supplied by Dazer UK, Peterborough). The replica owls were placed in the immediate vicinity of lofts and fanciers were instructed to reposition the replica owls at weekly intervals. The replica owls were positioned so that they were highly visible from

several directions, normally on a pole or on top of the loft. The balloons were suspended on a cord near or on the lofts. Lofts were divided into three groups, one group with replica owls only (N = 17), another group with both replica owls and balloons (N = 3) and a third group with no visual deterrents in place (N = 16). At one loft it was reported that the replica owl disturbed the pigeons and it was eventually removed. No data relating to exercise periods were received from this loft. The number of fanciers who were willing to use both the balloons and the replica owls at their loft was small and for those that started with both only three continued to use both through the season. There were problems with balloons deflating, blowing away and being shot at by youngsters with airguns. Some fanciers felt that the balloons attracted unwanted attention to the loft from vandals. For the purpose of data analysis the replica owls and the balloons have been grouped together.

We did not allocate the visual deterrents to lofts randomly because some of the fanciers who agreed to participate in the trial reported no previous problems with Sparrowhawk attacks at the loft. Because the trial was to be conducted over one season we could not assess how the frequency of Sparrowhawk attacks varied at the same loft when visual deterrents were present and when they were absent. Our trial could only assess whether or not the presence of visual deterrents resulted in the complete cessation of attacks at lofts rather than any reduction in the rate of attacks. We only placed visual deterrents at lofts when the owners reported Sparrowhawk attacks in the previous season, however the reported frequency of these attacks varied widely. Furthermore, the reported frequency of attacks prior to the placement of the visual deterrents could not be verified. Suffice to say that all loft owners with visual deterrents in place had reported at least one previous attack at the loft by Sparrowhawks.

Results

Of the 20 lofts with visual deterrents in place, 14 owners (70%) reported attacks by Sparrowhawks in their exercise logbooks. This does not give the complete picture of the proportion of lofts that were likely to be attacked because only 15 owners completed their exercise logbooks for the whole season. The remainder submitted detailed records for only part of the season. At the 20 lofts with visual deterrents in place, 14 reported attacks by Sparrowhawks and two of these also reported single attacks by Goshawks. Both of the lofts reporting attacks by Goshawks were in the Neath valley, a heavily forested area with a large population of Goshawks.

At the lofts with visual deterrents, a total of 1554 days of exercise were recorded in the logbooks and a total of 41 attacks reported (39 by Sparrowhawks and two by Goshawks). The mean daily attack rate reported at lofts with visual deterrents was 0.029 attacks per exercise day (Standard Deviation = 0.032, range 0.00 to 0.12 attacks per day). There was a large amount of variation in the rate of attacks among lofts. When the analysis was confined to those lofts that experienced at least one attack by a Sparrowhawk (N = 16 lofts, including two lofts without deterrents) the mean daily attack rate was 0.038 per exercise day (Standard Deviation = 0.030, range = 0.008 to 0.118 attacks per day). Again, the attack rate was highly variable between lofts.

Overall, the 41 reported attacks by Sparrowhawks resulted in the loss of 24 racing pigeons (58.5% of attacks resulted in the death of a pigeon). Over the same recording period of 2989 loft-days, for lofts with and without visual deterrents, fanciers reported losing 221 racing pigeons (0.07 pigeons per exercise day). Pigeons killed by Sparrowhawks accounted for approximately 11% of those lost during exercise. Other reported causes of losses during exercise included attacks by Peregrines, attacks by Goshawks, poisoning and 'fly-aways'.

The presence of blocks of mature woodland (> 1 ha in extent) within 200 m of the loft was significantly related to the rate of attacks by Sparrowhawks and Goshawks (Mann-Whitney U test, $U = 51.5$, $P = 0.0002$). Lofts located in non-wooded, urban areas of south Wales were much less likely to suffer attacks by Sparrowhawks and Goshawks than lofts located near blocks of mature woodland or forestry (Table 4.1). The frequency of Sparrowhawk attacks varied through the race season. Attacks were more frequent in April than in any other month (Table 4.2).

Discussion

The use of visual deterrents in the form of replica Great Horned Owls and eyespot balloons did not prevent Sparrowhawks and Goshawks attacking Racing Pigeons during exercise in the immediate loft area. It was not possible for us to determine whether they reduced the frequency of such attacks at the lofts concerned because we did not have the corresponding data for the same lofts in the absence of visual deterrents. The attack rate at lofts with visual deterrents in place was 0.03 attacks per exercise day and 59% of these attacks resulted in the death of a pigeon. There have been two previous surveys of attack rates by Sparrowhawks at racing pigeon lofts, one conducted by the Hawk & Owl Trust (Shawyer *et al.*, 2000) and the other by the RPRA. In the former survey, fanciers in Wales and western England reported that they lost an average of 2.3 pigeons per annum to Sparrowhawk attacks at the loft. In the RPRA survey, fanciers reported losing an average of 2.3 pigeons per loft in 14 regions of the UK (range 0.2 to 5.2). If we assume that Racing Pigeons in south Wales are exercised for 200 days per year and 59% of attacks result in a kill, the frequency of attacks found in our study would result in the loss of 3.5 pigeons per year (i.e., $[0.03 \times 200] \times 0.59 = 3.54$ pigeons). This estimate falls within the ranges reported by the previous surveys and suggests that the frequency of attacks at lofts with visual deterrents were not significantly reduced.

Lofts that were located close to areas of mature woodland were more likely to suffer Sparrowhawk attacks than lofts that were located well away from woodland areas. This is clearly related to the habitat preferences of Sparrowhawks. However, even when the analysis was confined to those lofts that experienced at least one attack, there was still a large amount of variation among lofts in the daily attack rate. Thus, some lofts suffered very frequent attacks (the maximum recorded rate was 0.12 attacks per exercise day) during the racing season and consequently the loft owners can lose a significant proportion of their pigeons to Sparrowhawks. Significant levels of losses due to Sparrowhawk attacks are not exhibited at a regional level, the problem is localised to individual lofts.

Sparrowhawk attacks were most frequently reported in April. Few fanciers

reported the sex of the Sparrowhawk that was seen attacking their pigeons but it is likely that most were female. The main laying period for Sparrowhawks in Britain is May and for some days before egg laying begins the female is dependent on the male for food (Newton, 1986). Thus, at a typical breeding territory the female Sparrowhawk will hunt very little from early May until early July. During this period the male Sparrowhawk will do most of the hunting, bringing food back to the nest for the young and the female. Racing Pigeons are too heavy for male Sparrowhawks to easily carry back to their nests, so would not represent a suitable prey species during the breeding season. There was little evidence of an increase in attack frequency during July in this study, which suggests females and fledged young feed mainly on juvenile songbirds at this time of year. Even towards the end of the race season in September there was little sign of an increase in attack frequency at pigeon lofts. It is likely that female Sparrowhawks mainly attack Racing Pigeon at lofts prior to breeding when they need to increase their body weight and when juvenile songbirds are scarce in the environment. The pattern of attacks at lofts reported in this study indicates that most of the Sparrowhawks involved are likely to be breeding females rather than non-breeding birds but further study is required to confirm this.

4.2 Trial of deterrents aimed at reducing raptor attacks away from the loft

Introduction

There are two types of commercially available deterrent that are marketed at pigeon fanciers to protect their birds from attacks by birds of prey when they are away from the loft environment; 'Terror-eyes' wing transfers and Bali Bells. A third type of on-bird deterrent that has been used by fanciers are reflective sequins. The principle behind all three forms of on-bird deterrent has been covered earlier in this report (Chapter 2).

Methods

Transfers: From each loft 6 to 12 young-bird racing pigeons were chosen at random from a list of ring numbers. However, all dark plumaged pigeons were excluded from the list because the transfers did not show on the plumage. The 'terror-eyes' transfers were applied to each pigeon according to the instructions provided by the supplier. The transfers were placed on the secondary coverts of both wings. The area of the wing to which the transfer was applied was wetted with alcohol and the transfer was then pressed on using a soft cloth. The transfer was wetted with alcohol then dried using a hairdryer. Care was taken to avoid any movement of the pigeon's wing during this process. It took two people approximately 5 minutes to apply the transfers to both wings of each pigeon.

Sequins: From each loft 6 to 12 old-bird racing pigeons were chosen at random from a list of ring numbers. Circular, silver dressmakers sequins (8 mm diameter) were attached to two primary coverts of each wing using a contact adhesive (Superglue). A small piece of card was placed under the feather during the application of the sequin to prevent the glue seeping through and sticking the covert to

the feathers below. The sequins were placed such that they were visible when the wing was extended but not visible when the wing was closed. This was important because it was found that the pigeon to which the sequins were attached, and their loft mates, pecked at visible sequins when at rest in the loft. However, even when sequins were carefully positioned such that they could not be seen when the wing was closed they were still frequently pecked-at and dislodged. The pigeons removed some sequins causing little feather damage apart from a small patch of glue on the feather barbs but others were removed by stripping the barbs off the feather shaft or by snapping-off the feather at the point where the sequin was attached (Figure 4.1). We were reluctant to attempt to attach any sequins to the primary feathers because of the potential for feather damage that could affect the racing ability of the pigeon. Sequins that were attached to feathers without a strong central shaft, such as the lesser coverts and mantle feathers, were dislodged within hours. It took two people approximately 10 minutes to apply four sequins to each pigeon.

The only way we could assess the effectiveness of on-bird deterrents was to compare the losses of pigeons wearing them with those not wearing them. Attacks by birds of prey are not the only cause of pigeon losses and pigeons that fail to return home have not necessarily been attacked by a bird of prey. In order to minimise the level of losses due to inexperience and straying, sequins were only fitted to old-birds and the analysis was confined to training flights. Experienced old-birds are more likely to 'home' from a short-distance training toss than inexperienced young birds.

Bali-bells: Most of the lofts involved in the trials were located in residential gardens close to neighbouring houses. The whistling sound made by the Bali bell during exercise is loud enough to cause a public nuisance and consequently the number of lofts where this form of deterrent could be used was very limited. We were able to use Bali bells at three lofts, though subsequently records of losses were only supplied by two of the three fanciers concerned. The Bali bell was attached at the base of two central tail feathers of the pigeon and was left in place for a week before being transferred to another pigeon. Only one pigeon at a time from each loft was fitted with a Bali bell. There were problems with the Bali bells becoming detached and all seven that were used in the trials were lost during normal exercise. Two were lost when the tails feathers to which they were attached fell out and the others simply fell off during the exercise flights. Because of the increased drag caused by the Bali bell, they are not suitable for use on training or race flights.

Results

Transfers: A total of 174 pigeons from 15 different lofts were marked with eyespot wing transfers. Within two weeks the transfers had faded markedly and were barely visible unless the pigeon was viewed at rest from close range (Figure 4.2). When the pigeons were in flight, it was not possible to distinguish between those that were marked and those that had not been marked. Many fanciers were unwilling to repeatedly handle and apply transfers to their pigeons each week because of the time involved and the disruption this would cause. Thus, we did not re-apply transfers following the initial application. In order to compare the level of losses between marked and unmarked pigeons we have only analysed losses in the 10-day period following the initial application of the transfer.

We received records for the 10-day period immediately following the application of transfers from 12 of the 15 lofts. The young-birds were only involved in exercise around the loft at these lofts and did not participate in training flights or races. The number of pigeons involved in the exercise flights and the number of days of exercise differed between lofts. We have used the term 'bird-days' as a measure of the exposure of marked and unmarked pigeons during the 10-day recording period. For example, 12 marked pigeons released for 8 exercise bouts over the 10-day observation period will have been exposed for 96 bird-days ($12 \times 8 = 96$). Pigeons marked with wing transfers were exposed for a total of 954 bird-days whilst unmarked pigeons were exposed for 1821 bird-days (there were more unmarked pigeons than marked pigeons at most lofts). One marked pigeon and two unmarked pigeons were lost during the observation periods. The marked pigeon was subsequently reported at another loft 5 km away but the two unmarked birds were not recovered. Only one loft reported an attack by a bird of prey during the observation period; an unsuccessful attack by a Sparrowhawk which did not result in the loss of any marked or unmarked pigeons. For the two lofts where losses occurred, 1 out of 24 marked pigeons was lost and 2 out of 27 unmarked pigeons were lost.

Sequins: A total of 171 pigeons from 26 different lofts were each fitted with four sequins on their primary coverts (two per wing). After two weeks 22% of the sequins had become dislodged; 47% of these simply became unstuck with no feather damage, 38% had been snapped off with the feather and 15% had been pulled off along with the feather barbs. Because of the risk of feather damage we did not attempt to apply sequins to the primary flight feathers.

Old-birds wearing sequins were liberated on 572 training tosses and old-birds without sequins were liberated on 3037 training tosses. From these training tosses 12 (2.1%) pigeons with sequins were lost and 36 (1.2%) pigeons without sequins were lost. However, this tendency for old-birds with sequins to home less frequently than their loft companions without sequins was not significantly different (Chi square Corr. = 2.4, 1 df, $P = 0.12$).

Bali bells: We received records of losses during exercise from two of the three fanciers that used Bali bells. One of these fanciers didn't lose any pigeons before or after the Bali bells were used. The third loft was in the unenviable position of being located an allotment directly below a Peregrine nest site and well away from other lofts (see Table 4.3 for data).

Over the period from the 16th April to 11th May, the fancier concerned recorded the loss of eight pigeons during exercise, and five Peregrine attacks were witnessed. The average number of birds released for daily exercise over this period was 10 old-birds (range 9 to 13) and 39 young-birds (range 36 to 40). The old-birds were released for exercise on 19 days and the young-birds were released on 13 days over the recording period. Young-birds were released for around six hours exercise (normally from 11:00 to 17:00) whilst old-birds were normally only exercised for two hours each morning (normally 09:00 to 11:00). Over this period the female Peregrine was incubating eggs and there was no Bali bell used with the exercising flocks. A Bali bell was fitted to one pigeon in the flock during exercise for the period from 1st June to 8th July. Only young-birds were exercised at this time for around eight hours

(normally from 09:00 to 17:00). The average number released was 70 (range 42 to 95), and exercise took place on 34 days. The fancier recorded 41 pigeons lost over this period and 24 Peregrine attacks were witnessed. Over this period both male and female Peregrine were involved in attacks and they were feeding two chicks.

The attack rate per day of exercise during the period from 16th April to 11th May, when the Peregrines were incubating and no Bali bell was used, was 0.26 attacks per day. The attack rate per day of exercise during the period from 1st June to 8th July, when the Peregrines were feeding young and a Bali bell was used, was 0.85 attacks per day. The increase in daily attack rate was not surprising, as both adults were involved in the attacks when there were young in the nest and the food requirement was higher. The use of the Bali bell did not prevent attacks by Peregrines on the exercising flock. It must be noted that not all of the pigeons that were lost were killed and eaten by the Peregrines, some were also lost when the attacks were unsuccessful. The 29 witnessed attacks resulted in the death of 22 pigeons, a further 19 were lost as a result of these attacks, two were killed and eaten by Sparrowhawks and five were lost when no attack was witnessed. The level of losses as a result of an attack varied from 0 to 5 pigeons.

Discussion

The fact that the ink used in the wing transfers faded so rapidly meant that they could not be regarded as a practical deterrent for use on Racing Pigeons. If they were to be used by pigeon fanciers they would need to be applied each week in order to maintain maximum visibility. In the average loft of 70 Racing Pigeons this would involve two people marking birds for approximately 6 hours each week. If they were applied for only 20 weeks during the race season the average fancier would need to apply 1400 pairs of transfers, and the time needed for their application would require 240 man-hours. Clearly this is not a practical option and the use transfers would need to be restricted to a limited number of pigeons.

The fact that the transfers faded so quickly after their application meant that we could only obtain a very limited amount of data on the level of losses. The presence of pigeons with transfers did not prevent one attack by a Sparrowhawk on an exercising flock, suggesting that transfers on individual birds do not completely prevent attacks on flocks containing both marked and unmarked pigeons. The underlying principle of eyespot markings is that they may give some protection to the marked bird but not to unmarked birds in the same flock. It was not known whether the attack by the Sparrowhawk was directed at a marked or unmarked pigeon. Transfers can only be applied to pale-plumaged pigeons and the time and expense involved in their repeated application means that they are unlikely to be widely used by pigeon fanciers. Furthermore, the notional deterrence effect of the eyespot marking has not been proven. We suggest that proponents of this type of deterrent should first demonstrate that they do indeed confer some protection from attacks by birds of prey. If a deterrence effect can be shown it will also be necessary to develop a more permanent form of marker for the transfers to be considered a practical option for pigeon fanciers to adopt.

Old-birds wearing sequins did not home more successfully than their loft

companions that were not wearing sequins. In fact there was a non-significant tendency for the opposite to be true. It is possible that the sequins actually marks out an individual pigeon within a flock and makes it more vulnerable to attack by a bird of prey. However, we cannot say that any old-bird, with or without sequins, which failed to home from the training tosses, was killed by a bird of prey. What we can say is that the level of losses of experienced pigeons during training tosses was not reduced by the application of sequins.

The use of a Bali bell did not prevent Peregrine attacks on exercising flocks of Racing Pigeons. Our opportunities for testing Bali bells were limited and the data we have obtained relates to one loft and one pair of Peregrines. The loft in question was not typical in that it was isolated and located within 350m of a Peregrine nest site. The nesting cliff was on a hillside directly overlooking the loft and during exercise the pigeon flock often passed within a few metres of the Peregrine nest. The number of attacks reported by the loft owner were very high, particularly during the period when the Peregrines were feeding nestlings and shortly after the two young had fledged. On most of the occasions I visited this loft I also witnessed attacks and the effect they had on the pigeons. Most of the Peregrine attacks I witnessed occurred when the pigeons were flying as a batch high over the valley and were made by the pair hunting together. The whistle of the Bali bell could be heard when the pigeons were up to 800 m away and it appeared to have no effect whatsoever on the behaviour of the Peregrines. Generally, the Peregrines would sit on the rock face and wait for the pigeons to rise high in the sky before leaving the cliff and gaining height above the flock. One Peregrine would then dive towards the flock, splitting the birds, one of which was then pursued by the other Peregrine. The Peregrines may have been so accustomed to this regular mode of hunting that the use of a Bali bell was ineffective. Other Peregrines that do not have such a regular routine of hunting a particular flock of Racing Pigeons may react differently to a Bali bell, especially when there are alternative flocks without Bali bells available.

Chapter 5

An assessment of the conflict between birds of prey and Racing Pigeons

5.1 The Hawk Problem.

This is how many pigeon fanciers describe the raptor-racing pigeon conflict. It is a vague term and it is necessary to explore what exactly pigeon fanciers mean when they talk of ‘the hawk problem’.

Firstly, the term hawk in this context is used to describe three different raptor species that regularly kill racing pigeons i.e., Sparrowhawk, Peregrine and Goshawk. These three species differ in their abundance, their distribution, the number of racing pigeons they kill and the circumstances under which they kill those pigeons. As a result it is more sensible to approach the issue as being three different ‘problems’.

Secondly, we need to define exactly what the ‘problem’ is. The fact that all three species can, and do, kill racing pigeons is not disputed. What is disputed is that this predation actually constitutes a ‘problem’. We can imagine two extreme situations, one where a fancier does not lose any pigeons as a result of raptor predation and the other where a fancier loses all of his pigeons to raptors. All lofts in Britain will fall somewhere between these two extremes. For the individual fancier, the loss of just one racing pigeon to a bird of prey may be considered a problem. However, most fanciers accept that pigeon racing carries some degree of risk from attacks by predators such as birds of prey. The question arises, when does the level of losses to raptors become so great that it becomes a ‘problem’ and how does this problem manifest itself.

The Scottish Homing Union (1998) has described the problem in terms of an ‘unacceptably high’ risk of attack and further added that a corollary of this is that it forces some fanciers out of the sport. Evidence that raptor attacks are driving fanciers out of the sport is largely anecdotal. For some individuals, perceived or actual losses of their pigeons to raptors may have been the main factor for them retiring from the sport. However, I could find no evidence of more fanciers leaving the sport in areas of England where Peregrines are relatively abundant compared with areas where they are less numerous (A Dixon, Unpublished Data from information supplied by the RPRA). In all regions, the number of pigeon fanciers has declined over the last five years. Attacks on racing pigeons by Peregrines do not appear to be a major cause of this decline.

If we consider the problem to be mainly one of an ‘unacceptably high’ level of pigeon losses to raptors then it is necessary to identify the nature and extent of these losses. However, there appears to be no guideline as to what constitutes an acceptable level of losses to raptors. Part of the reason for this is that data on losses to raptors has not, until recently, been available to inform the debate. There have now been three published studies conducted in Britain to investigate this issue. The first was a survey conducted by the Scottish Homing Union on the situation in Scotland, the

second was a national study commissioned by the UK Raptor Working Group and carried out by the Hawk & Owl Trust and the third is the present study carried out in Wales. So what do these studies tell us about the level of losses to raptors?

5.2 The Sparrowhawk Problem

The Scottish Homing Union survey found that 91% of respondents (equivalent to about 43% of lofts in Scotland) reported a 'problem' with raptors. There was some evidence of regional variation within Scotland with a smaller proportion of respondents reporting a problem in the eastern area between Dundee and Aberdeen. However, the survey clearly showed that the perceived problem of raptor attacks was widespread in Scotland. The survey then went on to distinguish between attacks by Peregrines and Sparrowhawks. Attacks by Sparrowhawks were observed more frequently than attacks by Peregrines in the immediate loft area. However, this does not mean that Sparrowhawks attack Racing Pigeons more frequently than Peregrines, but simply that they are more easily observed. The percentage of lofts reporting attacks by Sparrowhawks varied between Federations (average 89%; range 57 to 100% of lofts). The main conclusion drawn from this survey was that reported attacks by Sparrowhawks in the immediate loft area were very widespread.

The Hawk & Owl Trust survey found that the reported frequency of Sparrowhawk attacks at the loft was significantly different between regions of the UK. The results indicated that 63% of lofts in the UK reported attacks (range 42 to 87% over the regions; Scotland = 82%) and that these attacks resulted in an average loss of 2.7 pigeons per loft (range 1.2 to 4.6; Scotland = 3.5). The report also stated that this figure was very similar to an estimate supplied by the RPRRA to the Raptor Working Group, which indicated that there was an average of 2.3 attacks per loft in 14 regions of the UK (range 0.2 to 5.2). There appears to be close agreement between the Hawk & Owl Trust research and the survey carried out by the SHU with respect to the extent of Sparrowhawk attacks at pigeon lofts. The SHU survey did not estimate the level of losses attributable to Sparrowhawks but the level of losses estimated by the Hawk & Owl Trust research was similar to that estimated by the RPRRA.

In south Wales, during this study, the estimated losses at lofts as a result of attacks by Sparrowhawks was 3.5 pigeons per year. In south Wales, the level of losses experienced by individual fanciers is primarily related to the location of the loft, and were most frequent in rural and suburban areas close to woodland.

With regards to attacks in the immediate loft area by Sparrowhawks, there appears to be a consensus of opinion on the level of losses and the extent of attacks. The evidence indicates that in the worst affected regions the average loss to Sparrowhawks is about 5 pigeons per loft (equivalent to 7 % of pigeons in the average loft). However, there does not appear to be a consensus of opinion between conservationists and pigeon fanciers over whether this is an unacceptable level of losses. In addition, there is no consensus of opinion over what constitutes an appropriate response to the problem. The two suggested responses are (a) direct control of the Sparrowhawk population through culling and (b) reducing the level of losses through the use of raptor deterrents in the loft area.

The Raptor Working Group suggested that trials should be conducted to test the efficacy of deterrents at reducing Sparrowhawk predation of racing pigeons in the loft area. This suggestion resulted in the funding of such a trial by the Confederation and the research grant was awarded to Lancaster University for work to be conducted in 2001. The results of this trial are presented in Chapter 4. There was no evidence that the loft area deterrents tested influenced the likelihood of a loft being attacked or the frequency of attacks by Sparrowhawks. These results support the contention, based on anecdotal information by the Scottish Homing Union survey, that loft area deterrents are not effective at resolving the problem of Sparrowhawk attacks. Recent discussions between the Scottish Homing Union and Scottish Natural Heritage have resulted in an agreed statement that a resolution of the problem may necessitate, as a last resort, “some form of lethal control under certain circumstances”. There is currently a proposal to further test raptor deterrents in Scotland, thus the ‘circumstances’ that would allow lethal control presumably depend on the result of this work.

In addition, it may be necessary to prove that the level of losses is ‘unacceptable’ and is having a detrimental impact on the sport. Given that there appears to be agreement over the level of losses to Sparrowhawks between studies conducted by pigeon interest groups and independent researchers, this aspect of the raptor-racing pigeon problem should be addressed prior to any further research into the efficacy of deterrents. Studies by the SHU, RPRA and Hawk & Owl Trust show that the level of losses varies between regions of Britain. Our study within south Wales indicates that the degree of variation is as great within a region as it is between regions (Chapter 4). Our work indicates that if any form of lethal control is contemplated it is best targeted at individual lofts that suffer frequent attacks, rather than through national or regional culls.

5.3 The Goshawk Problem

Attacks by Goshawks on Racing Pigeons are a localised problem. In Britain the current strongholds of the Goshawk population are in extensive forestry and woodland areas, especially in Wales and the English Borders, southern Scotland and northern England. There are also populations elsewhere in southern, eastern and central England. The numbers of Goshawks in several areas are limited by illegal persecution, particularly where they conflict with game rearing interests. In other areas, such as Wales, where the scale of persecution is lower, the range and breeding numbers have rapidly expanded in recent decades.

The proportion of Domestic Pigeons in the diet of Goshawks can be quite high in some areas of Britain (Chapter 1). In districts where Goshawks are relatively abundant and where hunting ranges coincide with pigeon lofts and flight-paths, their contribution to the level of pigeon losses is potentially significant. In Wales the breeding population of Goshawks exceeds that of Peregrines though the existing information on their diet suggests that they probably kill fewer Racing Pigeons than Peregrines. The contribution of Goshawk predation to Racing Pigeon losses remains unknown, but in common with Peregrines it is likely to vary regionally.

5.4 The Peregrine Problem

The Scottish Homing Union survey found that the percentage of lofts reporting attacks by Peregrines varied widely between Federations (average 52%; range 23 to 83% of lofts). The main conclusion drawn from this survey was that reported attacks by Peregrines in the loft area were widespread but more frequent in the West and South-west of Scotland. However, as Peregrine attacks on Racing Pigeons can also occur away from the immediate loft area the actual frequency of reported attacks will be under recorded.

The Hawk & Owl Trust study compared Racing Pigeon losses between a control region where Peregrines were relatively scarce in the home area and along the race routes (north-east England) with losses in other areas of the UK. It was assumed that no losses occurred due to Peregrine attacks in the control region and that all additional losses in other regions were due to Peregrines. The comparison was carried out separately for old-birds and young-birds in their respective race seasons. There were differences in the level of losses reported for different regions (young-birds: average = 7.1 % of loft population, range 0.4 to 16.8%. Old-birds: average = 7.0%, range 0.3 to 20.2%). For the UK as a whole i.e., including the control region, losses during the respective race seasons were estimated at 4.2% and 3.2% of the loft population of young and old-birds respectively. Outside the control region, the level of losses for young-birds before their the race season was also estimated (average = 10.3%, range 3.0 to 20.3%). In Scotland, the Hawk & Owl Trust research estimated that 35.6% of young-birds were lost as a result of Peregrine attacks from January to September and that 19.6% of old-birds were lost from April to July. The estimates for Wales were 15.9% of young-birds and 6.5% of old-birds over the same period.

Dixon *et al.* (MS5) used two methods to estimate the level of Racing Pigeon losses attributable to Peregrine attacks in South Wales. The first method was similar to that adopted by the Hawk & Owl Trust in which reported losses over a calendar year were recorded in two regions, Wales and northeast England. Northeast England was regarded as a control region where Peregrines are infrequent. The study found that 9% more young-birds and 12% more old-birds were lost in Wales than in northeast England. For young and old-birds separately the result differed from that found by the Hawk & Owl Trust, but overall both studies found approximately 10% more pigeons were lost in Wales than the control region. However, Dixon *et al.* (MS5) showed that the assumption that no pigeons from the control region were killed by Peregrines was incorrect, so the estimate of 10% losses to Peregrine attacks is best regarded as a minimum.

The second method used by Dixon *et al.* (MS5) relied on an estimation of the number of Racing Pigeons killed by Peregrines in south Wales and identifying the home origin of those pigeons. It was found that the majority of pigeons lost to Peregrines were killed within 8 km of the home loft and that the level of losses was primarily influenced by the number of breeding pairs within 8 km of the loft and, to a lesser extent, along the flight routes. Using this method, it was estimated that about 10% of pigeons in the average loft in south Wales were killed by Peregrines. This value closely agreed with our estimate derived from the previous method and that which was obtained by the Hawk & Owl Trust research.

The research indicates that there is regional variation in the level of losses to Peregrines, with the highest losses occurring in areas where breeding Peregrines are relatively numerous i.e., southwest and west England, Wales, Scotland and Northern Ireland. The question remains as to whether the level of losses to Peregrines in these regions is 'unacceptably high'. As with Sparrowhawk predation, there appears to be no consensus of opinion on this issue, with some conservationists adopting the position that there is no such thing as an 'unacceptable level' of losses to Peregrines when pigeons are liberated in the environment. Again, before any form of lethal control can be contemplated, there is a need for some form of guideline to be agreed between the Homing Unions and conservation agencies as to what constitutes an acceptable level of losses to Peregrines.

In regions where Peregrines are relatively numerous they are generally responsible for significantly more Racing Pigeon losses than Sparrowhawks. Racing Pigeons are the main food of Peregrines throughout most of the UK during the pigeon race season (Chapter 1). There is evidence that the breeding density of Peregrines is related to the availability of racing pigeons. This means that there are several potential options available for resolving, or at least reducing, the problem of Peregrine predation of Racing Pigeons. The potential resolutions fall into two main categories as follows.

1. Reducing the Peregrine population by:
 - Direct control of the population by culling, relocation or removal.
 - Indirect control of the population by reducing food availability
2. Reducing the frequency of Peregrine attacks on racing pigeons by:
 - The use of on-bird deterrents.
 - Reducing the exposure of racing pigeons to attack by Peregrines.

If any of the statutory conservation agencies contemplated issuing licenses allowing the direct control of Peregrines by culling there would undoubtedly need to be some form of review of the legality of such a decision in relation to national and international law. It is beyond the scope of this discussion to address the potential legislative complications of pursuing this option. Irrespective of the legal position, any decision would need to be informed by the practicalities of undertaking direct control and the potential effectiveness in reducing Peregrine predation on Racing Pigeons. The available evidence suggests that the removal of a territorial pair would simply result in the rapid reoccupation of the territory by replacement birds from the non-breeding population. The process of removing adults would need to be carefully timed and repeated, perhaps continually, at each territory. It is not clear who would do this, how it would be carried out humanely or who would pay for it. The removal of chicks would reduce the food demand on a territory but not cause the adults to abandon the territory.

The removal of Peregrines does not necessarily involve lethal control. It may be possible to reduce Peregrine, and other raptor numbers locally without detrimentally affecting their national conservation status (Thirgood *et al.*, 1999). They could be trapped alive and translocated to other areas (possibly outside the UK) or taken into captivity. The idea of clearing race routes as proposed by Lindquist (1963) may be

possible in some areas. In this regard the deliberate erection of artificial nest sites aimed at attracting breeding Peregrines to areas that are currently unoccupied and overflowed by Racing Pigeons should only be carried out after careful evaluation and due consultation (Ratcliffe, 1993). There is little conservation imperative for this form of action and it serves to further antagonise the pigeon racing community.

An additional consideration is the scale of any form of lethal control or removal that would be required to have a measurable effect of Racing Pigeon losses. If all the Peregrines were removed from south Wales the research evidence indicates that the average Welsh pigeon fancier would lose 10% fewer pigeons. The degree of variation in losses experienced at different lofts in south Wales exceeds 10%, as does the average annual level of losses. This degree of variation in losses means that the removal of all Peregrines in south Wales would not necessarily achieve any noticeable benefits for individual fanciers. The removal of the entire Peregrine population of south Wales is obviously not a proposition that would receive any serious consideration and the partial removal of the population would have even less of an impact on the level of pigeon losses. There are some lofts that are in locations that make the pigeons extremely susceptible to attacks by Peregrines but even in these circumstances, the relocation of these lofts would be a more practical option than the continual removal of the Peregrines. The case for any form of direct control of the Peregrine population to reduce the disruption and losses caused by attacks on Racing Pigeons is weak. The research evidence does not lend support to this course of action.

Indirect control of the Peregrine population through a reduction in Racing Pigeon availability is an alternative possibility. This form of action does not require any intervention by third parties or a change in the law. The idea behind this approach, which was raised by the Hawk & Owl Trust researchers (Shawyer *et al.*, 2000), is that Racing Pigeons should be removed from the environment for a period of time in order to reduce the food supply available to Peregrines. A response to a reduced food supply has been observed in Peregrines; a decline in Peregrine numbers was correlated with a reduction in their seabird prey at Langara Island, British Columbia (Nelson & Myres, 1976). As the size of the Peregrine population appears to be determined to some extent by Racing Pigeon availability, there is the possibility that changing the timing of the pigeon race programme could lead to a reduction in the breeding population. If Racing Pigeons were to be confined to their lofts, the timing of this would be crucial. Shawyer *et al.* (2000) suggested that the start of the race season could be delayed until May in order to reduce the food supply available to Peregrines early in the breeding cycle. This may have the effect of reducing the number of Peregrines that attempt to breed and/or increase nest failures for those that do lay eggs. However, such a strategy is likely to increase the level of losses for fanciers in areas where Peregrines breed, such as south Wales, because the only pigeons available within the hunting ranges will be local birds. It would not be possible for pigeon fanciers to confine their pigeons to the loft during April in the run-up to the race season, as they will need to be exercised and trained.

An alternative approach would be to have a break in the race programme during which time all pigeons are confined to the loft. This could be implemented when breeding Peregrines depend heavily on a supply of Racing Pigeons. The optimum time for such a hiatus in the race programme would be when food demand is high, hunting opportunity is constrained and the availability of alternative prey is low. The

period when young Peregrines hatch (generally late May) is likely to be the time when such a hiatus would have the greatest impact. During this period the male hunts alone and has to provide prey for the female and the young so hunting opportunity is constrained, there are few juvenile wild birds available so alternative prey sources are relatively scarce compared with other times of the year. It is possible that a sudden reduction in food availability at this time could reduce breeding success and the annual imposition of a break in the race programme may eventually reduce the size of the breeding and/or non-breeding population of Peregrines.

Many pigeon fanciers will be reluctant to adopt any form of change in the timing of the race programme as it would cause considerable disruption to the distances that can be flown. The benefits to fanciers of a reduction in the level of losses is likely to be relatively insignificant, depending on the success of a break in the race programme at reducing the Peregrine population. It seems unlikely that any form of direct or indirect control on the Peregrine population will be implemented. Under these circumstances the best option open to fanciers is to reduce the frequency of Peregrine attacks on pigeons by better management of exercising, training and racing.

The key to better pigeon management aimed at reducing attacks by Peregrines is to reduce the time of exposure to predation and to minimise the risk of attack on pigeons from individual lofts. The exposure time could be reduced by exercising pigeons under a regime whereby they are released for limited periods rather than left on an 'open loft' system. Fewer training tosses would reduce exposure to attacks by Peregrines; the frequency of training flights varies considerably among fanciers and between different racing systems. Training and racing should be conducted along routes that overfly areas where Peregrines are less abundant. The risk to an individual fancier's pigeons could be reduced by better co-ordination of training and racing. Fewer, but larger, races from a limited number of race points would limit the opportunity of Peregrines to attack pigeons on races. The availability of pigeons from a large number of different lofts would minimise the risk of attack for each individual fancier. To some extent this is the racing regime currently adopted, most federations only race on Saturdays and the diversity in loft origin of pigeons killed by Peregrines is testament to the dilution effect of this practice. However, there is still room for greater co-ordination between federations in terms of release sites together with the dates and times of liberation.

Pigeons that have deviated significantly from the intended flight-path are commonly found in the ring samples recovered at Peregrine sites (Shawyer *et al.*, 2000; Dixon *et al.*, MS1). The frequency of such strays in the diet is likely to be at least partly related to the fact that they are continuously available throughout the race season (and outside it) unlike 'homers' on races or training flights. Better management of the recovery of strays, perhaps following the example of the stray centre established by the Scottish Homing Union, is likely to result in more being repatriated with their owners and will reduce the overall level of losses. Furthermore, the availability of strays in the environment will influence the success of any attempt to control Peregrine breeding numbers by confining pigeons to their lofts.

Figures

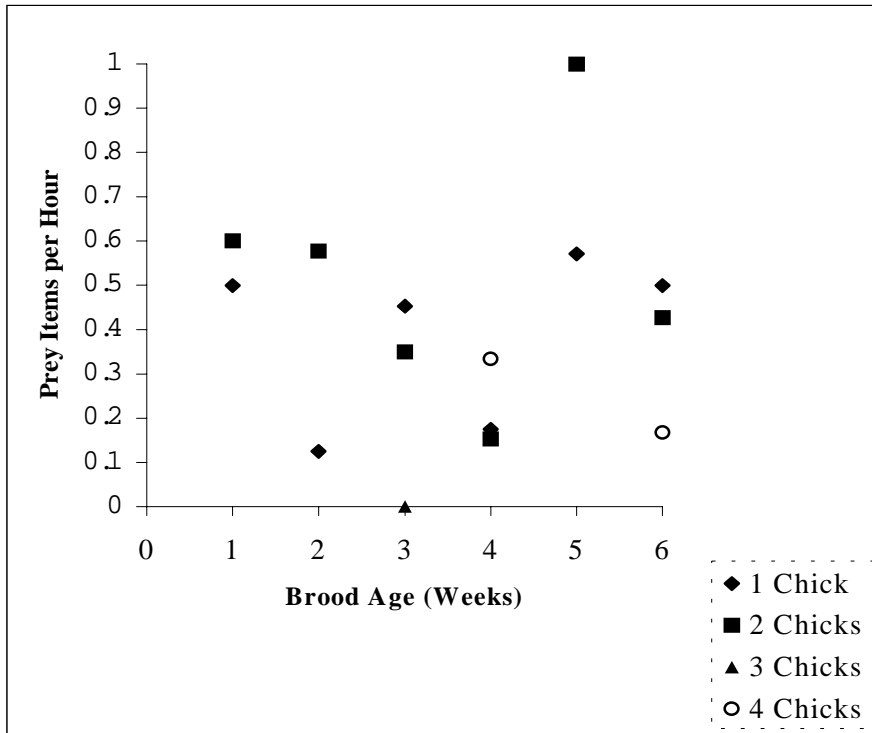


Figure 3.1: The number of prey items killed per hour in relation to the age of the brood in weeks. Data plotted separately for brood of one, two, three and four chicks.



Figure 4.1: (Above) Sequins attached to primary coverts of Racing Pigeon wing, (Below) snapped covert feathers caused by removal of sequins by the pigeon.



Figure 4.2: (Above) Racing Pigeon after initial application of eyespot wing transfer, (Centre) Racing Pigeon 14-days after application of eyespot wing transfer, (Below) Racing Pigeon 28-days after application of eyespot wing transfer.

Tables

Month	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
No. of Domestic Pigeons	7	10	19	40	49	95	55	35	21	8	6	3
% Domestic Pigeons	18.4	21.7	41.3	81.6	77.8	64.2	77.5	71.4	43.8	26.7	22.2	13.0

Table 3.1: Monthly variation in frequency of Domestic Pigeons kills found at Peregrine breeding territories in South Wales

Species	No. Killed
Domestic Pigeon	17
Meadow Pipit	2
Blackbird	3
Ring Ouzel	1
Starling	9
Jackdaw	2
Unknown 'small'	3
Unknown 'medium'	9

Table 3.2. Frequency of prey species brought back to Peregrine territories in South Wales

RECORDED SPECIES	Prey Remains		Direct Observation	
	May	June	May	June
Small	6.3% (4)	4.1% (6)	17.6% (3)	6.9% (2)
Medium	11.1% (7)	22.9% (34)	29.4% (5)	58.6% (17)
Large	4.7% (3)	8.8% (13)	0% (0)	6.9% (2)
Domestic Pigeon	77.8% (49)	64.2% (95)	52.9% (9)	27.5% (8)

Table 3.3. The percentage (frequency) of Domestic Pigeons, small-sized, medium-sized and large-sized prey species in prey remains and observed kills at Peregrine nest sites in South Wales during May and June.

Month	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Corrected No. of Domestic Pigeons	3.8	5.4	10.3	21.6	26.5	51.3	29.7	18.9	11.3	4.3	3.2	1.6
Corrected % of Domestic Pigeons	10.0	11.7	22.4	44.1	42.1	34.7	41.8	38.6	23.5	14.3	11.9	7.0

Table 3.4. The estimated percentage of Domestic Pigeons killed by Peregrines in each month of the year derived from the corrected number of prey remains found at breeding sites.

No. of young on nesting territory	Prey items per hour	Domestic Pigeons per hour	Minutes of observation
0 Chicks	0.19	0.15	1560
1 Chick	0.28	0.06	3200
2 Chicks	0.32	0.09	3990
3 Chicks	0.00	0.00	285
4 Chicks	0.28	0.22	1080

Table 3.5. The number of prey items per hour and the number of Domestic Pigeons per hour delivered to nesting territories with 0, 1, 2, 3 and 4 chicks.

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Number Of Days	31	28	31	30	31	30	31	31	30	31	30	31
Territory Occupation	Ads.	Ads.	Ads.	Ads.	Ads. + 2Y	Ads. + 2Y	Ads. + 2Y	Ads. + 2Y	Ads.	Ads.	Ads.	Ads.
Birds Killed per Day	3.0	3.0	3.0	3.0	4.6	4.6	4.6	4.6	3.0	3.0	3.0	3.0
Estimated Number of kills	93.0	84.0	93.0	90.0	142.6	138.0	142.6	142.6	90	93	90	93
Corrected Proportion of Domestic Pigeons	0.10	0.12	0.22	0.44	0.42	0.35	0.42	0.39	0.24	0.14	0.12	0.07
Estimated Number of Domestic Pigeons Killed	9.3	10.1	20.5	39.6	59.9	48.3	59.9	55.6	21.6	13.0	10.8	6.5

Table 3.6: Table showing for each month of the year, the number of hunting days available, the number of Peregrines occupying territories (Ads. = adult male and female; Ads. + 2Y = adult male and female plus two young), the estimated number of birds killed per day, the estimated number of prey items killed on the territory per month, the proportion of Domestic Pigeons in the diet (data from prey remains corrected to reflect the proportion observed in kills) and the estimated number of Domestic Pigeons killed at the territory each month.

Habitat within 200 m of loft	Mean attack rate per day	SE
Wooded	0.034	0.008
Non-wooded	0.005	0.002

Table 4.1: Attack rate per exercise day at lofts with and without mature woodland of at least 1 ha extent in the vicinity.

Month	Observation days	Attacks	Attacks/day
April	281	21	0.07
May	408	9	0.02
June	390	6	0.02
July	308	3	0.01
August	288	0	0.00
September	191	2	0.01

Table 4.2: Frequency of Sparrowhawk attacks reported by fanciers at lofts in South Wales throughout the pigeon race season. Observation days are the number of days of exercise recorded by fanciers for each month. Data from 16 lofts that reported at least one attack by a Sparrowhawk.

	Average flock Size		No. of days exercised		No. pigeons lost	
	OB	YB	OB	YB	OB	YB
No Bali bell	10	39	19	13	1	7
Bali bell	--	70	--	34	--	41

Table 4.3: Average flock size for young and old-birds during exercise, the number of days of exercise and the number of pigeons lost at a single loft in relation to the use of a Bali bell.

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