

Socio-Economic Problems and Solutions in Raptor Predation

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ABSTRACT

Raptors can cause problems (a) for farmers through killing domestic animals, (b) for hunters by competing for a sustainable yield of game, and (c) for conservationists through direct and indirect impacts on other species in managed landscapes. Predation on domestic animals, and on game at release or feeding sites, can sometimes be prevented by (i) exclusion or (ii) landscaping techniques. Occasional use has also been made of (iii) deterrent, (iv) distraction and (v) pre-emption measures, all of which offer scope for further study. Economic loss from predation may also usefully be offset by eco-tourism, by predation on other problem species or by statutory compensation, provided that such payments do not drain conservation resources with no net gain for biodiversity. With few human resources available for maintaining biodiversity in increasingly managed landscapes, it is important that groups interested in different aspects of wildlife conservation should cooperate and not divert resources into disputes about total protection. New data show that early analyses overestimated juvenile mortality of some raptor species, and thus underestimated the density of non-breeders in healthy habitats and the ability of populations to sustain removal of first-year individuals without reduction in numbers breeding. Live-trapping on kills can selectively remove problem individuals, which are often dispersing juveniles. Selective removal of live raptors, based on agreements between interested parties to seek non-lethal approaches, to prevent general persecution or gratuitous killing of raptors and to monitor health of the managed populations, may be preferable to the illegal poisoning and shooting that can result when raptor predation is thought to threaten human livelihoods.

INTRODUCTION

The study of predation raises questions that are fundamental to the conservation of wildlife and wild places. A first question could be "is there a genuine problem for humans from this predation?" A follow-up might well be "can the problem be solved economically without putting any species at risk of local extinction?" However, it is important also to ask "is the solution cost-effective for conservation?"

As a hypothetical example, imagine a wild prey species that is abundant enough for humans to harvest, provided that numbers of natural predators are reduced; humans are competing with other predators for the prey. Let's say that areas of ground are at first reserved for harvesting that prey, to

the benefit of associated species, but that public opinion then moves towards protecting the predators. One solution to the resulting conflict between prey-harvesters and predator-protectors could be to breed the prey in enclosures. This might be a very cost-effective solution, enabling a higher stocking density than in the wild, with efficient growth and harvest of the prey's food as an intensive crop. However, the result would also be an increasingly managed landscape, that might well support fewer wild prey and fewer predators overall. What if public desire to protect predators then evolved into antipathy towards hunting or even eating animals at all? In Britain, such attitudes are leading to greatly changed land-use, habitat fragmentation and increasing isolation of wildlife in reserves.

The following is a brief review of ways to alleviate problems caused by predation. It does not repeat the more detailed considerations given in previous publications (Kenward & Marcström 1981, Kenward 1986, Kenward 1999), but draws attention to the wider economic and conservation implications of different solutions to problems from raptor predation. Some ways to reduce predation are convenient because they are inexpensive and relatively effective. Others deserve further study, because even if they prove impractical, the research into them may tell us more about predation mechanisms and give us new ideas for solving problems. However, it is important also to note new findings that raptors in prey-rich habitats can be as robust a renewable resource as many of their prey. When failure of measures to alleviate predation economically puts other aspects of conservation at risk, it may be appropriate to relax demands for absolute protection of raptors in favour of population management, provided that a return to wholesale persecution can be avoided.

SUFFERING FROM PREDATION

Raptors can cause problems (a) for livestock owners through killing domestic animals, (b) for hunters by competing for a sustainable yield of game, and (c) for conservationists through direct and indirect impacts on biodiversity in managed landscapes. Often, these problems are not distributed equally across all situations, but are severe in some cases and unimportant elsewhere (Lloyd 1976, Davies in press). This may be because prey are in some circumstances unusually vulnerable to any predator, or because an individual predator becomes a specialist on the prey, or both. For example, surveys of Buzzard *Buteo buteo* predation at pens of released Pheasants *Phasianus colchicus* showed an average take of 4%, but a distribution of kills ranging from none at many pens to more than 20% of the pheasants at a minority (Kenward *et al.* in review a). The pens with heavy predation had little shrub cover, much deciduous canopy and few Pheasants relative to the size of pen. Independent tracking of radio-tagged Buzzards showed that only 8% associated strongly with Pheasant pens, and especially where there was much deciduous canopy to provide perches and few Pheasants.

Where circumstances render prey especially vulnerable, prevention may be practical in ways outlined below. However, this may not stop individual predators from specialising, for example when Peregrine Falcons *Falco peregrinus* become wedded to a loft of racing Pigeons *Columba livia* near their nest (Musgrove 1996) or a Kestrel *Falco tinnunculus* to a local colony of rare Little Terns *Sterna albifrons* (James 1996). Nor may problems be solved easily when a prey species is strongly preferred by predators, such that they do not switch from it to alternative prey at low density of the favoured prey (functional response Type II rather than Type III of Holling 1959), and may thus have a severe impact if drawn to an area by abundant alternative prey. This was the situation for Goshawks *Accipiter gentilis* taking wild Pheasants in an area where Rabbits *Oryctolagus cuniculus* were abundant (Kenward 1986), and of Hen Harriers *Circus cyaneus* taking Red Grouse *Lagopus lagopus scoticus* in an area with high passerine density (Redpath & Thirgood 1997).

In the past, predation on game and livestock motivated general persecution of raptors, often supported by bounty payments (Newton 1979). This persecution was sometimes intense enough for local extirpation of raptor species, especially in Britain where early industrialisation produced an increased density of humans, an increase in leisure to hunt game and a reduction of woodland habitat below 4% of the land area. More recently, growth of leisure interest in raptors motivated legal protection for them, with added urgency when organochlorines were found to threaten extinction of some populations. Present emphasis is on restoring diversity of raptors to areas from which they

were eliminated (Evans *et al.* 1994), but this and the recovery of populations that were previously depressed has increased the call for solutions to predation problems.

BEHAVIOURAL SOLUTIONS

At least five possible behavioural solutions are available to those suffering from raptor predation on domestic animals, or on game at release or feeding sites. The most common are the prevention of predation by (i) exclusion or (ii) landscaping techniques. Excluding raptors from livestock in pens is as old as chicken netting, and justifies its cost by effects on predatory mammals too. Penning livestock for birthing has reduced losses to sheep from Golden Eagles *Aquila chrysaetos* (Murphy 1977), and wires that hinder access can reduce predation at fish farms (Draulens 1987). Landscaping can involve adding cover, as in Pheasant release pens (Lloyd 1975, Kenward *et al.* in review a) or removing trees that offer hunting perches above game release pens or feeding stations (Mikkelsen 1984). The improvement of general landscapes to minimise raptor predation on game is a seductive idea. However, although there are general indications, for example that Grey Partridges *Perdix perdix* suffer reduced raptor predation in areas with few trees (Potts 1984), experimental examples of its value are surprisingly lacking. One possible problem is that the agricultural intensification which removed cover may also have removed food for prey. There is also a risk that improved cover might conceal predators better than prey. Landscaping solutions are easy to suggest, but require experimental studies to show they are effective, economic and free from possible adverse impacts on other species.

Other possible behavioural solutions to raptor predation involve (iii) deterrence, (iv) distraction and (v) pre-emption. Deterrence by visual or auditory stimuli has been proposed, but not shown by robust laboratory or field experiments to be effective. However, following laboratory experiments with taste-repellent chemicals on food for raptors (Brett *et al.* 1976, Musgrove 1996, Nicholls & Bird this volume), the application of repellent or aversive chemicals seems worth trying in the field to deter predators during a short period of high prey vulnerability, such as when game is released. Where raptors are fed artificially at nests, they do not kill so many wild prey or travel so far to hunt, raising the possibility that similar artificial feeding might be used to distract raptors from unwanted predation during the breeding season. Initial trials with Hen Harriers have given promising results (S.M. Redpath and S.G. Thirgood, *pers. comm.*). However, this is an expensive approach, and it is important that increased settlement density in areas where food is provided does not offset reduced predation during breeding with an increase at other times of year. In Sweden, where Goshawk predation on wild Pheasants was low until the arrival of snowcover, it was recommended that shooting should be moved forward to late autumn from its traditional time at Christmas, not only to pre-empt the Goshawk predation but to leave fewer Pheasants to attract hawks into the area (Kenward & Marström 1981).

FINANCIAL SOLUTIONS

Where none of the five behavioural solutions is practical, conservation bodies may consider paying compensation, for example to farmers that have livestock killed by eagles (Davies in press). However, it is important that statutory compensation payments, and the checks necessary to validate claims, should not drain conservation resources without a net gain for biodiversity.

Compensation for raptor predation can also be indirect. For example, income from eco-tourism might be sought at sites where predation is conspicuous in small areas, such as fish farms. Another consideration is that raptors may themselves compensate for occasional killing of game or livestock by suppressing numbers of other competitors or predators. A fine example is the predation by Black Eagles *Aquila verauxii* on Rock Hyrax *Procavia capensis*. Although the eagles occasionally kill lambs (Davies 1999), they can also suppress hyrax populations, which compete with livestock for food (Davies this volume).

DEMOGRAPHIC SOLUTIONS

When other solutions are impractical or uneconomic, a last resort may be the removal of individual raptors that cause problems. In this case, the principle should be that conservation gains outweigh costs. A potential conservation gain from minimising predation is the maintenance of diverse land-use. If landowners are obliged to tolerate high predation on stock or game, or to pay a high price to reduce it, a marginal land-use may no longer be economic. If this will motivate changes that reduce biodiversity, it seems best to seek cooperation and compromise rather than to create single-species conflicts. A current example from Britain is the problem of Hen Harrier predation on Red Grouse, where joint research in Scotland by the Game Conservancy, Institute of Terrestrial Ecology and Royal Society for the Protection of Birds has shown that Harrier numbers on moorland can increase to a level where few Grouse remain to be shot (Redpath & Thirgood 1997, Thirgood & Redpath this volume), at which point the moorland is likely to be replaced by the more profitable land-uses of intensive forestry or sheep rearing.

Under such circumstances, there may be concern that relaxation of total protection will produce persecution to extinction. However, this fear is not supported by recent experience in countries where limited removal of problem raptors has been allowed. The probable reason is that healthy raptor populations are larger and more resilient than indicated by early population models based on ringing data.

In 26 early analyses of ring recoveries from raptors, the lowest estimate of first-year mortality was 50%, and 17 were more than 60% (Newton 1979). In contrast, extensive radio tagging during the 1980s showed that Goshawks on the Swedish island of Gotland had a first-year mortality of only 42%, and mortality of first-year Buzzards in southern Britain was a maximum 34% in the early 1990s (Kenward *et al.* in press, in review b). In each case, the proportion of deaths due to humans or impact with human artefacts was overestimated by contemporary ringing data, simply because birds (mainly juveniles) that die in association with people are most likely to be found and reported. On Gotland, 48% of ring recoveries were from Goshawks killed by humans (which was legal to protect poultry) compared with 35% of deaths among radio-tagged hawks, and the ringing data estimated more than 60% first-year mortality. A recovery bias may also have been augmented by persecution and pesticides to give the high first-year mortality estimates from early ringing data.

Juvenile mortalities of 42% for radio-tagged Goshawks and 34% for Buzzards predicted that populations in spring contained 2-4 times as many hawks as were breeding, and this was confirmed by independent tests. The data also predicted that the Goshawk population could have sustained 64% first-year losses without decline in breeding numbers, and the Buzzard population 76% (Kenward *et al.* in press, in review b). Even lower first-year mortalities, of 10-29%, have been recorded in studies of radio-tagged *Haliaeetus* eagles (Buehler *et al.* 1991, Bowman *et al.* 1995, Nygård *et al.* this volume). Although it has long been recognised that raptor populations contain non-breeders that can replace adults shot at breeding sites (Newton 1979), the underestimation of juvenile survival has resulted in underestimation of non-breeder density, and hence of the ability of some raptor populations to sustain removal.

Nevertheless, where removal of raptors might be the most cost-effective approach for conservation, it is important that techniques should be selective, humane and unlikely to damage overall biodiversity. For example, tests with spring nets set on Pheasant kills showed that all captured birds could be released unharmed and that, unlike box traps baited with live Pigeons, the spring nets caught only Goshawks that were killing Pheasants (Kenward *et al.* 1983). Moreover, the traps rarely caught hawks of breeding age, so hawks removed were primarily juveniles, which tended to accumulate in areas of high prey density after dispersal, and not the breeding adults (Marcström & Kenward 1981, Kenward *et al.* 1993). In Sweden, with relatively few areas of released Pheasants, it was practical to release Goshawks alive, because few returned after being translocated more than 30 km away from the site of capture (Marcström & Kenward 1981).

Permitting the setting of spring nets on kills was effectively fail-safe, because it could only be applied where there was a predation problem, and selectively removed only the minority of juvenile

hawks that caused problems. Moreover, the live raptors were available for fostering cooperation between different interest groups, through reintroduction projects, research, education and falconry. Conditions of any discussions to consider removal of problem raptors should be the seeking of all possible alternatives to killing, and the promulgation by all parties of the view that general persecution or gratuitous killing of raptors is unacceptable. Another desirable condition would be contribution of effort and resources to monitor impact on the affected populations, for example through mark-recapture estimates based on the live-trapping. All sorts of innovative contributions to conservation may be possible through management of raptor predation problems if minds are opened to all possible solutions.

CONCLUSIONS

Protection of raptors from deliberate destruction has been important for signalling that persecution to extinction is unacceptable, and for drawing attention to the needs of raptors and to the wishes of the wider community. However, where raptors can become abundant enough for their predation to put human livelihoods at risk (Redpath & Thirgood 1997), total protection does not prevent deliberate killing (Etheridge *et al.* 1997). Moreover, rigid protection can hinder management-based conservation projects, waste resources and detract attention from issues of more long-term importance (Kenward 1987). It also motivates illegal use of the least selective techniques, because these often leave the least evidence: poisoning is quieter than shooting which in turn provides less evidence than the safest of all management techniques, live-trapping.

While we are inspired by raptors and may wish their numbers never to be reduced deliberately by humans, we must also appreciate the relative importance of different constraints on persistence of their populations. The pressures on raptor habitats for human agriculture, forestry and living space are huge. Against them, all the human and material resources to conserve wildlife are tiny. However, the interests of farmers and game hunters, against other developers, often overlap with those of other conservationists. Grassland habitats for farming and ranching suit many raptors, as do the even more varied habitats needed for game abundance. It therefore behoves us wherever possible to work with different interest groups, and not to waste resources by fighting to protect each species; persecution to extinction is not the only alternative to total protection. In prey-rich habitats, most raptor populations can probably sustain selective loss of some individuals to protect livestock or to increase the human share of game crops. As an alternative to conflict between groups that could cooperate, an emphasis on tolerance, engagement, analysis and management would give a TEAM approach to conservation. Convergent use of all available human resources, by maintaining diverse use of wildlife resources, may prove the best way to preserve a diversity of wildlife and wild places.

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