Ecology and Conservation of European Forest-Dwelling Raptors

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Evaluating the success of release red kites in the UK

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Introduction

Once widespread and numerous in the United Kingdom, the red kite *Milvus milvus* was exterminated in England and Scotland during the 18th and 19th Centuries, primarily due to human persecution (Lovegrove, 1990; Carter, 2007). A relict population survived in Wales. Since 1989, the species has been subject to a reintroduction programme in the United Kingdom.

The re-establishment and growth of the reintroduced UK red kite population has been impressive, facilitated by the release of at least 650 red kites at nine locations since 1989, resulting in the re-establishment of nearly 500 breeding pairs (Carter *et al.*, 2008). This short review examines the main features of the red kite reintroduction and evaluates it in relation to various measures of what constitutes a successful wildlife reintroduction project. We also highlight some of the conservation issues that are currently relevant to red kites in the UK, and consider some areas of further research that could lead to an improved understanding of how this species is re-integrating to a landscape from which it has been largely absent for approximately 150 years.

Release and monitoring

Apart from one local release project that released both pre-fledged and fully-fledged birds (Murn *et al.*, 2008), all red kite reintroductions used fully-fledged birds. Wild-bred red kite chicks were harvested as 4-6 week-old nestlings and fledged in purpose-built aviaries for eight weeks before being released (Carter, 2007). Post-release monitoring was intensive for all releases (see Evans *et al.*, 1997; and Murn & Hunt, 2008 for details) and was accomplished by a combination of wing tag observations and tracking by radio telemetry. Results from post-release monitoring showed that red kites had high rates of survival, which usually exceeded 50% in the first year (Wotton *et al.*, 2002), and approached 70% in the 2nd and 3rd years (Carter & Grice, 2002). Release duration at sites varied between four and six years, with the number of birds released at each site ranging from approximately 70-100 (Carter & Newbery, 2004). Breeding populations became established quickly and rates of productivity were comparable to that of wild populations in continental Europe, at approximately two chicks per breeding pair (Carter & Grice, 2002). Dispersal of release birds was less than expected. Red kites showed strong philopatry and there was also an observable inverse relationship between population size at a release site and dispersal distance (Carter, 2007).

Evaluating a successful release project

There is no overall consensus of what constitutes a successful wildlife reintroduction or translocation project, despite calls for generally accepted criteria to be established (Fischer & Lindenmayer, 2000). Many measures have been proposed. For example, Cade (2000) asks two relatively straightforward questions as a means of evaluating the success of a raptor reintroduction project. The first is if the project establishes a viable, self-sustaining population. The second, if the population integrates to the ecological community and functions as their wild counterparts do (or did). As outlined above, self-sustaining breeding populations of red kites have become established at release sites. Additionally, at least two of these re-established populations have become donor populations for additional releases at new sites (Carter & Newbery, 2004). Foraging and reproductive behaviour of the reintroduced kites are similar to that seen historically, such as their living in close proximity to human settlements (Carter, 2007), and their preferred foraging habitats away from human settlements remain similar to red kites in continental Europe (Seoane *et al.*, 2003).

In a review of how information from the monitoring of reintroduced populations can benefit not only reintroduction managers but also ecologists, Sarrazin & Barbault (1996) highlight a number of criteria for evaluating the success of a wildlife reintroduction. They note the dynamic nature of self-sustaining populations and highlight that any estimates of persistence should incorporate overall growth rate and the variation of population growth rates. Carter *et al*. (1999) and Wotton *et al*. (2002) have examined these two features and demonstrated the potential growth of the population and differences between local populations respectively. Other short-term measures of success include: breeding of the first wild-born generation, the establishment of 500 free-living individuals or a three year breeding population where recruitment exceeds death rates. These are all features of the reintroduced red kite population (Wotton *et al.*, 2002; Carter & Grice, 2002; Carter *et al.*, 2008).

Sarrazin & Barbault (1996) emphasise the contributions to basic and applied ecology that can be offered by careful monitoring of reintroduced populations. Studies of the UK red kites have highlighted important features not only of population dynamics and population growth (e.g. Wotton *et al.*, 2002), but of breeding biology (Evans *et al.*, 1998), individual kite behaviour and juvenile dispersal (e.g. Carter, 2007), which have not been highlighted previously.

Finally, Armstrong & Seddon (2008) propose ten key biological questions for reintroduction biology that are focused on the population, metapopulation and ecosystem levels. In the context of the UK the red kite reintroduction, six of these questions, at the population and metapopulation level, are relevant.

The first two questions relate to the initial establishment of the population and: a) how this is influenced by the size and composition of the release group(s); and b) how survival and dispersal of the population are affected by pre- and post-release management. Despite breeding populations being established successfully at each release location, release numbers did not vary sufficiently between sites to answer the question of what constitutes an effective minimum release population size. Pre- and post-release management appeared to have no effect on survival, as the kites survived well in captivity prior to release and exhibited high rates of survival in the post-release phase. Rates of post-release dispersal varied greatly (Carter, 2007), and is very likely a result of individual behavioural variation, rather than post-release management (cf. Murn & Hunt, 2008).

The second two questions relate to the persistence of the population, and the effects on this of: a) habitat requirements; and b) genetic composition. Habitat requirements for the species were well-known, and a major part of the process used to select suitable sites for release. The genetic composition of the release population was broad, with donor birds being sourced from a variety of populations across a broad geographic area in Spain, Sweden and Germany (Carter & Newbery, 2004).

The final two questions are directed at the metapopulation population level. Specifically: a) how heavily should donor populations be harvested; and b) if translocation should be used to compensate for isolation. With regard to harvesting, detailed modelling of the impact on donor populations was conducted after the conservation status of an existing donor population (Spain) declined (Carter *et al.*, 1999). This resulted in the translocation from a new donor population (England) proceeding. Isolation of reintroduced red kite populations was accentuated by slow rates of dispersal, and lead to the establishment of at least seven other release sites in an attempt to encourage the spread of red kites throughout England and Scotland (Carter, 2007). The development of these additional release sites effectively accelerated the spread of kites, in addition to the movement between release areas by dispersing birds (Carter & Grice, 2002).

Thus, by a number of suggested criteria and biological queries, the red kite release in the UK has been a success. However, measures of success aside, Seddon (1999) suggests that the ultimate objective of a wildlife reintroduction should be the establishment of a population that persists without intervention. In terms of population persistence and growth for red kites in the UK, the main limiting factor for local populations (if not the national population) is human induced mortality (Carter, 2007; Carter *et al.*, 2008). This is despite increased legal protection and an improved public perception of the species. For example, the red kite population reintroduced to Scotland has suffered strong persecution and its growth has fallen behind that of the populations reintroduced to southern England (Wotton *et al.*, 2002; Carter, 2007). In the context of conservation management and the future of red kites in the UK, it is worth examining this limiting factor in more detail.

Threats and potential limiting factors to the UK red kite population

The scavenging habits of the red kite, the social nature of the species and its propensity to gather in numbers at sources of food make it particularly vulnerable to poisoning. Illegal poison baits are sometimes used to control predators such as foxes and corvids, however their effects are indiscriminate and can kill many non-target species. The growth of the Welsh kite population has been restricted by the use of poison baits, and illegal poisoning is the most frequent cause of death for both reintroduced and wild red kites in England and Scotland (Davis *et al.*, 2001; Carter *et al.,* 2003).

The impact of illegal shooting on red kite populations is difficult to assess, as known incidents are based only on witness reports and/or discovery of carcasses. Four kites have been found with shotgun injuries since the start of reintroductions in England, and post-mortems from the Scottish population suggest that as many as 8% of young birds between 1999 and 2003 were killed in this way (Carter, 2007). The relatively slow and often low-level flying style of the red kite and its frequent association with human activities make it particularly vulnerable to this form of persecution. Conspicuous roost and nest sites only add to this threat.

Similar to shooting, the deaths of red kites from accidental secondary poisoning are difficult to quantify, which makes preventing them difficult. This increases the threat secondary poisoning represents. Incidents of red kite deaths resulting from the misuse of agricultural pesticides remain small, and are unlikely to be the result of deliberate attempts to target wildlife. However, these incidences are also difficult to detect and quantify, and may represent a larger threat than is currently appreciated.

Red kite releasing area. Murn and Hunt.

Red kite flying in a snowy landscape. Carlos González.

The threat of second-generation anticoagulant rodenticides to red kites has been clearly identified in Britain (Carter & Burn, 2000; Ntampakis & Carter, 2005). The importance of the brown rat *Rattus norvegicus* as a prey item (mostly taken as carrion) and the habit of red kites to forage close to agricultural buildings (where rodent control is most frequently conducted) make the high potency of these rodenticides a potentially serious problem to local kite populations.

It is known that red kites can ingest significant amounts of lead from spent shot by scavenging on shot gamebirds, pigeons, and rabbits (Wildman *et al.*, 1998; Mateo *et al.*, 2003). These animals feature regularly in the diet of the red kite so the risk of poisoning from ingested lead fragments is high. Although relatively few cases of poisoning have been confirmed in the UK, recent analyses on pellets and post-mortem investigations found a significant proportion of wild birds with lead residues noticeably higher than the usual background levels, and in some cases exposure appeared sufficient to be fatal (Pain *et al.*, 2007). To eliminate this threat to red kites and other scavengers, the use of alternatives to lead in ammunition is required.

Red kites are vulnerable to electrocution on electrical distribution lines due to the species' wingspan being sufficiently large to bridge the gap between two energised wires, or an energised wire and an earthed structure. In Britain, red kites are regularly electrocuted, and victims are most commonly found close to poles with transformer boxes, where there is a complex arrangement of wires (Carter, 2007). The risk of electrocution can be reduced by positioning artificial perches above transformer boxes, or eliminated by completely insulating dangerous sections of wire. Given the distribution and number of these structures across many areas of Britain, it is unlikely that such remedial actions will be fully completed.

There are a number of other threats to red kite populations in Britain, most notably collisions with road vehicles, aircraft, and other structures, although the impacts of such factors is likely to be relatively small. Other human factors include nest destruction, illegal egg collecting and accidental trapping. Given the threats from other types of human activities and structures, the impact of these threats is likely to be localised and small, rather than affecting the population as a whole. In common with other species, the effect of wind turbines on red kite mortality is an area that requires urgent attention, particularly as wind farms are becoming an increasingly familiar site in Britain.

The population growth and range expansion shown by reintroduced red kites has also been seen in an ecologically similar species, the European buzzard *Buteo buteo*. The English buzzard population has expanded eastwards from western England and Wales and been increasing in number since the 1970s (Walls *et al.*, 2004). Determining the degree to which these two species compete and thrive in different areas could provide useful conservation management information, particularly in areas where relative densities of the two species vary. It has been suggested that buzzards can represent a threat to recently fledged red kites (Murn & Hunt, 2008) that may, in areas of high buzzard density, affect first year survival and/or dispersal of red kites.

Other analyses that could reveal interesting information is how productivity of red kites varies spatially and in relation to land use, feeding habits and food availability. For example, red kites in the Chilterns are commonly associated with human settlements and are often fed by local residents (who enjoy seeing the kites). Determining to what extent this abundance of food and local tolerance lead to increased rates of production, compared with areas of presumed lower food availability such as mid-Wales (Carter, 2007) might assist estimates of a potential maximum population size.

In summary, the red kite has shown that in the absence of the limiting factors that caused the initial decline, the species is adaptable and capable of growing to a substantial population. This, combined with a careful and well-planned reintroduction project, has resulted in the generally favourable outlook for the red kite population in the UK today. Conservation management efforts for the red kite clearly need to have emphasis on the major limiting factors which, for the red kite, remain illegal persecution and secondary poisoning.

Juvenile red kite perched on the ground. Carlos González.