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Population Declines of Predatory Birds Coincident with the Introduction of Klerat Rodenticide in North Queensland

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Summary

Rodents are significant pests of crops in sugar-producing areas in North Queensland and, consequently, rodenticide is applied to canefields as a control measure. Klerat, a second-generation anticoagulant (active constituent brodifacoum), is the only rodenticide registered for use in sugar-cane in North Queensland. Regular monitoring of raptors over 21 years has revealed a major decline in the breeding populations of several rodent-eating species in the Herbert River district since 1992, coincident with the introduction of Klerat in that year. The raptor declines may be a result of secondary poisoning, a decrease in prey availability, or a combination of both. Habitat loss may also be an important contributing factor.

Introduction

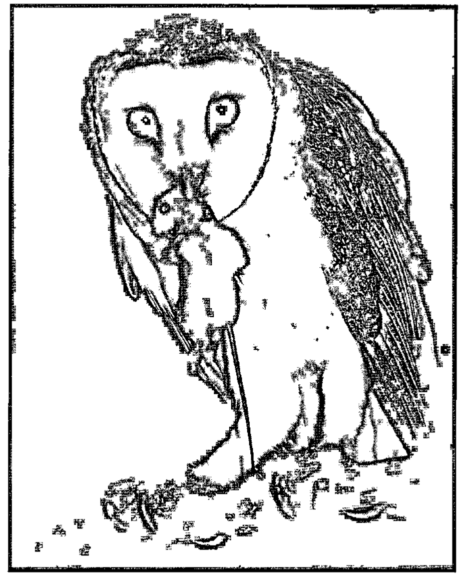
The Herbert River district has a diverse raptor fauna. Over the 21 years from 1975 to 1996, JY has recorded all 24 species of diurnal Australian raptor along with seven of the nine Australian owls. However, many of the resident breeding species have declined dramatically in numbers in recent years. The species concerned are the Spotted Harrier *Circus assimilis*, Rufous Owl *Ninox rufa*, Barking Owl *N. connivens*, Masked Owl *Tyto novaehollandiae*, Barn Owl *T. alba* and Grass Owl *T. capensis*, each of which relies on rodents for a component of its diet (Schodde & Mason 1980, Hollands 1991, Marchant & Higgins 1993).

Rodents such as the Canefield Rat *Rattus sordidus* and Grassland Melomys *Melomys burtoni* cause significant damage to sugar-cane (Watts & Aslin 1981, Rampaud 1990, Robertson et al. 1995, Whisson 1996). For example, Whisson (1996) estimated the value of Queensland crop loss to rodent damage at about $A2 – 4 million per year. Klerat, active ingredient brodifacoum, has been used extensively in Queensland since 1992 and is the only rodenticide registered for use in canefields. Brodifacoum is a modern (second-generation) anticoagulant rodenticide, developed because of the problems of resistance and increasing tolerance to earlier (first-generation) products such as warfarin, fumarin and coumachlor (e.g. Duckett 1984, Hadler & Buckle 1992).

Several overseas studies confirm that raptors have died after preying on animals poisoned with brodifacoum (Mendenhall & Pank 1980, Merson et al. 1984, Newton et al. 1990). There are indications that the same may be occurring in North Queensland canefields (Hollands 1995, Wells 1995). The purpose of this paper is to examine the recent declines in the local breeding populations of several raptor species, particularly in relation to the use of Klerat.

Study area and methods

The study area includes much of the Herbert River district surrounding Ingham (18°39'S, 146°10'E). Much of the vegetation within the study area has been cleared on a broad scale for the production of sugar-cane, but remnant vegetation has allowed many raptors to nest in close proximity to the canefields where they hunt for food. The sugar-cane has created a grassland ecosystem which suits rodents such as the Canefield Rat and the Grassland Melomys (Watts & Aslin 1981). Clearing of native vegetation for new canefields is continuing, and many vegetated areas which were once grazing land have also been cleared and planted with sugar-cane. Thus, the habitat containing sites suitable for nesting by many raptor species has declined markedly over the study period.



Adult Masked Owl with rat, Ingham district, Queensland.

Plate 17 Photo: John Young

The figures and comments presented in this paper are not based on a formal survey or population census, but are based on in-depth personal observations over a 21-year period. JY has been observing Ingham's birds of prey for 21 years and within the last ten years has assisted David Hollands with the field research for his book on owls (Hollands 1991). During this time, JY spent six days per week for five months of the year actively searching for owl nests and roosting sites. Roosting sites were often discovered during the day, either through disturbing roosting birds or by location of whitewash or pellets. Generally, nesting sites were located after hearing birds call during breeding-season activity. Once a roosting site or nest was located, it was carefully monitored. The birds generally returned to the same roosting sites frequently and their offspring were therefore able to be identified.

One owl found dead in the Ingham area in January 1996 was autopsied by Cropcare Australia.

Results

Observations over the ten years from 1985 have shown that the number of breeding pairs of the raptor species under investigation remained fairly stable until 1992, which coincided with the introduction of Klerat. Numbers have declined since 1992 (Figure 1). The most serious declines, in the order of 75–85%, occurred for the Spotted Harrier and the Masked, Barn and Grass Owls. The number of breeding pairs of Barking Owls almost halved over the observation period, and about a quarter of Rufous Owl pairs were lost. Of all species in question, the Rufous Owl is the only one for which numbers seem to have stabilised. Numbers of the other five species continue to decline.

Rat damage is used here as an index of rat populations. Rat populations appeared to fluctuate with rainfall, perhaps with a slight lag, and an extended trough in the years up to 1992 when raptor numbers were nevertheless high (Figure 2). However, unlike raptor numbers which were stable until 1992 then declined, rat numbers peaked in 1993 before the next decline. This result suggests that rat numbers were still high after raptor populations began to decline, and that declining food supplies should not have been a factor in the raptor declines in 1993–94.

The autopsied Grass Owl found in the Ingham area had residues of brodifacoum

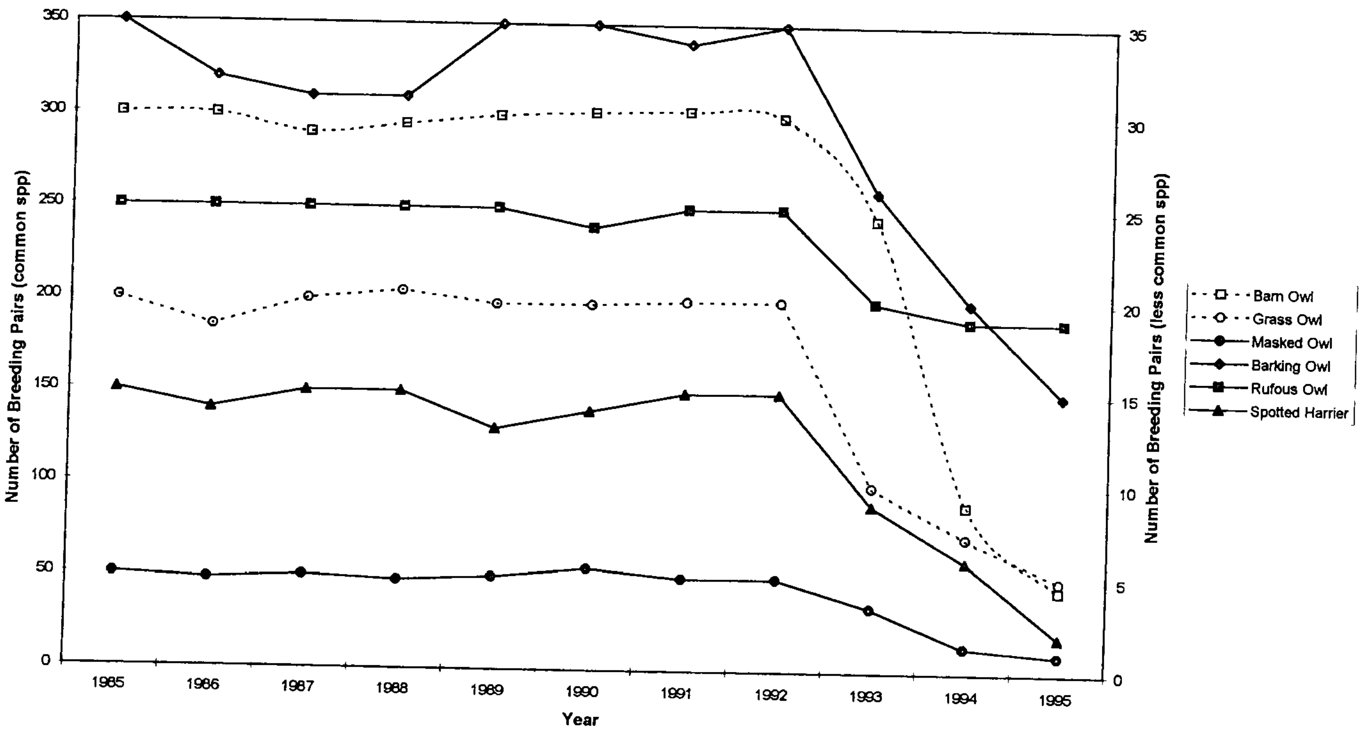


Figure 1. Trends in the number of breeding pairs of rodent-eating raptors in the Herbert River district, North Queensland, 1985 to 1995; Klerat introduced in 1992. The left axis and dotted line show the decline of the area's two most common species – the Barn and Grass Owls – and the right axis and solid line show the declines in the less common species – *the Masked, Barking and Rufous* Owls and the Spotted Harrier.

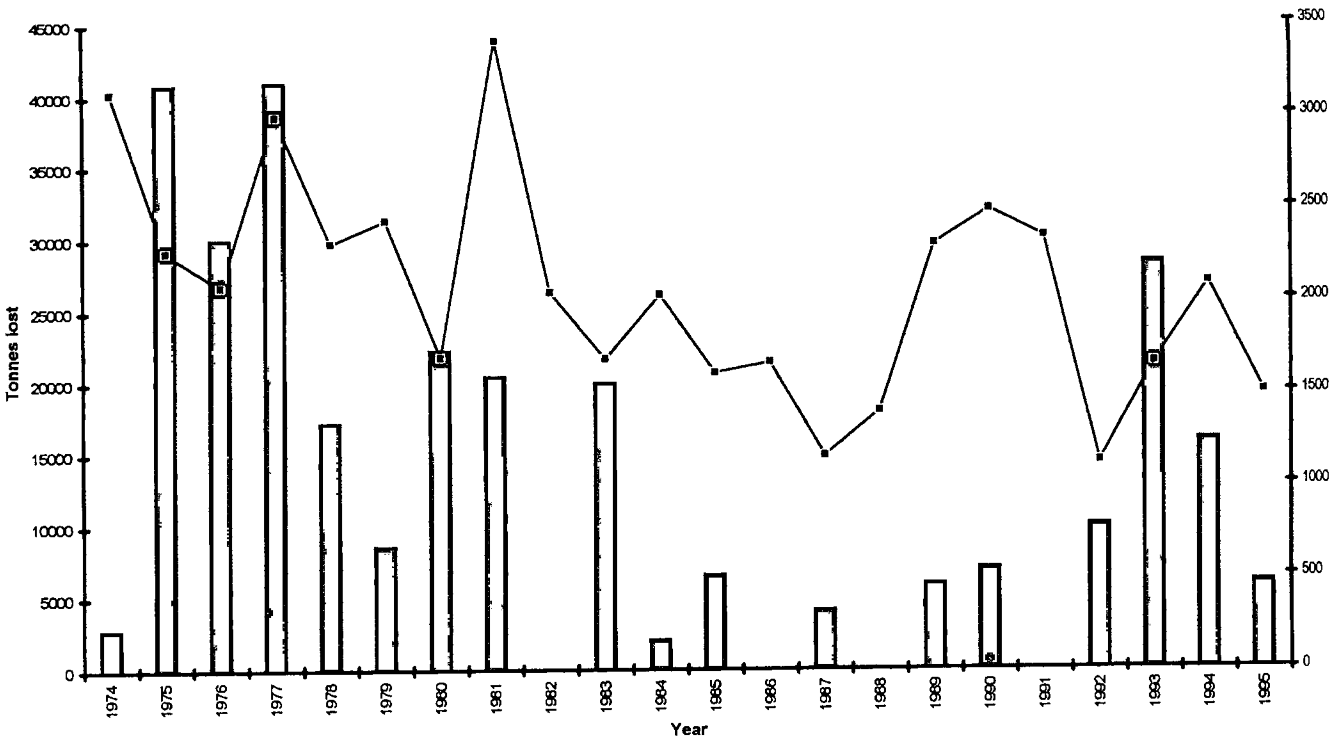


Figure 2. Rat damage (tonnes of sugar-cane lost per year; bars) in relation to annual rainfall (line) in the Herbert River district, 1974 to 1995. Data on rat damage for 1982, 1986, 1988 and 1991 not available.

in its liver (A. Brodie pers. comm.). Other owls in the area, in particular a pair of Rufous Owls (Plate 18) and one adult Masked Owl at an active nest, showed signs of anticoagulant poisoning. The symptoms included lethargy and bleeding from the eyes, nostrils and mouth; the Masked Owl also displayed muscle tremors. The male and female Rufous Owls died within a few days of each other.

Over the study period, habitat loss caused a small number of pairs of *Tyto* owls to disappear. For instance, a few breeding pairs of Grass Owls were displaced by conversion of their pasture habitat to sugar-cane. Usually, where habitat was lost there was intact habitat remaining nearby and in some cases Barn Owls and Grass Owls quickly moved to new locations. JY observed several instances where these two species were on eggs before habitat clearance, and within 25 days of disturbance they started nesting again nearby. In a vast number of locations, concerning both tree hollows and grassy paddocks, nest-sites were used for years but then became vacant although the habitat remained intact. Masked Owls were particularly affected: pairs used the same hollows for years then the birds suddenly disappeared, especially those living along wooded creeklines through canefields. Owl pairs that nested within extensive woodland, mostly up to 0.5 km away from the nearest cane, fared better.

Discussion

The major decline in raptor populations in the Herbert River district coincides with the introduction of Klerat to control canefield rodents in the region. Although the evidence is circumstantial, secondary poisoning of raptors by Klerat, through ingestion of poisoned rodents, is a possible explanation. Such an interpretation is consistent with studies elsewhere that have implicated brodifacoum in deaths and population declines of the Barn Owl and other owls (Mendenhall & Pank 1980, Duckett 1984, Merson et al. 1984, Newton et al. 1990). Brodifacoum secondarily kills a high proportion of individual owls that have eaten poisoned rodents and, based on dosage rates, the behaviour of intoxicated rodents and the food-intake rate of owls, mortality of owls in the wild is likely (from Newton et al. 1990, Hooker & Innes 1995). This side-effect occurs because: (a) brodifacoum is a delayed-action, single-dose poison; (b) rodents consume more than a lethal dose before dying; (c) they are easy prey when intoxicated; (d) an owl would eat at least one rat or several mice per day (JY pers. obs.); (e) the poison is persistent (Hadler & Buckle 1992) and could accumulate in raptor tissue until a lethal dose results. The question is whether there are significant effects at the level of local or regional raptor populations. The results of this study suggest that in some circumstances, i.e. where raptors are hunting in treated areas and eating the target rodent species (and perhaps poisoned non-target species), there may be serious effects on raptor populations. Regardless of potential effects on populations, it seems counterproductive to poison individual raptors that would otherwise be catching pest rodents.

Secondary poisoning by brodifacoum is the most likely explanation for the decline in raptor populations in the Herbert River district, for several reasons in addition to the coincidence in timing:

(i) The decline is most noticeable in the *Tyto* owls that specialise on terrestrial rodents caught in open situations (e.g. crops, grassland), and less marked in woodland *Ninox* owls which are less likely to hunt in canefields and whose diet comprises a smaller proportion of rodents (from Schodde & Mason 1980, Hollands 1991; JY pers. obs.).

(ii) Owls have been found dead or dying with symptoms consistent with anticoagulant poisoning, such as bleeding from external orifices (see Newton et al. 1990), and brodifacoum has been detected in one dead owl (although the poison may not have been the immediate cause of death).

(iii) The pattern of decline, and loss of known pairs from intact habitat, are more consistent with a sudden, additional mortality factor than with incremental environmental changes which were occurring before 1992.

Alternative explanations for the decline in raptor populations are possible, for instance loss of habitat, declining food supplies or catastrophic weather events. Declining woodland habitat should have affected the woodland owls most and the grassland raptors least, with Spotted Harriers, Grass Owls and perhaps Barn Owls (and their prey) favoured by habitat changes (e.g. Squire 1987). Furthermore, loss of habitat does not explain the disappearance of known pairs from intact habitat. The high raptor numbers in the 1980s and concurrently fairly low rodent numbers (compared with rodent peak years) argue against food shortage, particularly in combination with the 1992–95 situation when raptors were declining sharply while rodent numbers peaked in 1993–94. Natural disasters may have some effect, more on rodent numbers (food supply) than on the raptors themselves. There have been periodic floods in the region, most caused by cyclones passing near Ingham. One of the largest was the flood after Cyclone Winifred in 1986 when an estimated 200 000 tonnes of sugar-cane was damaged (Millard & Kingston 1986), yet there was no detectable effect on raptor populations (Figure 1). Most floods have been relatively short-lived and, although they might cause a decrease in rodent numbers in some localised areas, there is no evidence to show that any particular event coincides with the decline in raptor numbers.

Notwithstanding the foregoing considerations, raptor numbers have continued to decline while the area treated with Klerat has also declined (R. Kerkwyk pers. comm.), and it seems that reduced prey availability and habitat loss might be contributing factors. A test of the role of secondary poisoning by Klerat will be to determine whether raptor numbers recover after the decline in application rates of Klerat, if rodent control is maintained by other means and habitat conditions stabilise.

A major concern is whether secondary poisoning of raptors by brodifacoum is occurring throughout the Queensland canefields, and indeed in urban and agricultural regions of Australia generally, and whether other bird species are affected. In addition to the six species identified in this paper, our recent surveys indicate that Black-shouldered Kite *Elanus axillaris*, Tawny Frogmouth *Podargus strigoides* and (to a lesser degree) Papuan Frogmouth *P. papuensis* numbers have also decreased in recent years in the Herbert River district. Furthermore, the Queensland Museum received from the Brisbane area a Southern Boobook *Ninox novaeseelandiae* that died after eating a Black Rat *Rattus rattus* poisoned by a rodenticide (per S. Debus); currently the standard rodenticide for domestic use is Talon (active constituent brodifacoum). Given the habitat destruction that is also proceeding apace over much of Australia, it is likely that populations of many raptor species are declining.

Rodent damage to sugar-cane (and indeed other crops), and the effectiveness of rodenticides, are such that it is unreasonable to expect farmers to abandon the use of rodenticides. Nevertheless, the results of this study suggest that alternatives to broadscale field use of brodifacoum should be considered. Given that rodenticides will inevitably be used, one such alternative is Racumin (active constituent coumatetralyl), a multi-feed poison with no known risk of secondary poisoning (Hone & Mulligan 1982). It is used widely and successfully against rodents in Africa and elsewhere, with low risk to raptor populations, and indeed is recommended by the Poison Working Group of the South African Endangered Wildlife Trust (G. Verdoorn in litt.). Racumin, if used strictly according to directions and with collection and disposal of dead and dying rodents, may be the least ecologically harmful of the modern rodenticides.

A switch to a more environmentally friendly rodenticide should be accompanied by a move to integrated pest management. This is a concept that seeks to minimise the use of hazardous chemicals by understanding the ecology of the pest species, manipulating its environment (e.g. availability of food and cover) and taking advantage of its natural enemies, while using poisons sparingly and strategically at critical stages of the pest's life-cycle (e.g. Robertson et al. 1995, Brodie 1996). The Bureau of Sugar Experiment Stations in North Queensland has made a promising start with extension programs. In combination, there is also a local attempt to encourage owls back into the district. On account of past clearing and consequent loss of old dead trees for nesting hollows and hunting perches, artificial nest-boxes and hunting perches have been erected in Klerat-free areas, and the results so far have been promising. Meanwhile, research is required on the causes of death of raptors in croplands, and on the impact of brodifacoum on the populations of non-target species under field conditions.

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Debilitated adult pair of Rufous Owls after application of brodifacoum-based rodenticide to local canefields, Ingham district, Queensland. Both owls showed symptoms of anticoagulant poisoning (bleeding from eyes, nostrils and mouth) and subsequently died.
Plate 18

Photos: John Young