CHAPTER 10

Executive summary

GENERAL OVERVIEW

Wild birds have been considered as pests of agricultural production since the advent of agriculture, by consuming produce at various stages of the harvest (Pope & Irving 1976; Akande 1982; Ruelle & Bruggers 1982; Bomford 1992; Watkins *et al.* 2000). Yet despite significant losses caused to such agricultural industries, programmes aimed at developing strategies to reduce or eliminate crop damage have a poor record of success (Wright 1982; Jarvis 1990; Watkins *et al.* 2000). Producers quite often use ineffective bird control techniques, with little or no net benefit in terms of a reduction in bird damage (Boyce *et al.* 1999). Bird control strategies have traditionally been directed at either deterring or repelling birds from crops (by chemical, visual, and audible means), by preventing birds from reaching crops with physical barriers such as netting, or by reducing the population of problem birds through direct persecution or by reducing food resources.

Export table grapes have been produced within the Orange River valley, Northern Cape Province, for nearly two decades. Wild birds, however, are reputed to cause severe damages to the grape crops during the harvest season, apparently amounting to millions of Rands lost per annum. Individual grapes are either pecked or plucked, causing cosmetic damage to the bunch and resulting in the fruit being unsuitable for export, thus reducing the economic value of the harvest. Furthermore, this damage generally results in secondary infections, with additional economic consequences. This preliminary investigation into the relationship between birds and table grapes in the Orange River valley was driven by four key questions (1) what is the extent of this damage and its economic implications?, (2) how does the presence of grape crops affect the species composition and abundance of birds in vineyards and adjacent native habitats?, (3) how effective are current control methods?, and (4) are there ecologically sound management options available to producers to protect their crops?

Numerous control methods aimed at reducing bird damage are used by grape producers; these including mist-netting and cage-trapping, as well as non-lethal methods such as exclusion bags, sound and visual scaring devices. Lethal control methods may, however, no longer be regarded as ecologically and ethically acceptable as European import standards become increasingly stringent. The EurepGAP protocol provides international verification frameworks over a wide range of agricultural-production sectors, setting minimum standards for all aspects of agricultural enterprises and produce, including crop protection and environmental management. Producers may therefore now be faced with fewer options for controlling bird damage, while still having to meet the demands of the market in terms of the quality and quantity of exportable grape bunches. This study attempts to elucidate some of the complex interactions related to the utilisation of vineyards and grapes by birds in order to provide producers with the elementary knowledge required to address bird problems in an ecologically-based manner with long-term benefits.

QUANTIFICATION OF BIRD DAMAGE

Despite extensive damage to grape crops, quantitative methods of assessing bird damage remain poorly developed (DeHaven & Hothem 1979; Heÿl 1986; Porter *et al.* 1994), while growers' subjective estimates are often unreliable for accurate cost-benefit analyses. Recent advances have been achieved towards developing an objective damage assessment technique for grape vineyards (Tracey *et al*. 2001; in press), and these methodologies were used during this study.

The extent of bird damage was assessed quantitatively for the most commonly cultivated grape cultivars in the region. It was found that the earliest ripening cultivar, Prime Seedless, which is also of the highest economic value, sustained the highest damage levels averaged at 20% (range 1.5 to 52%). Other cultivars sustained damages of less than 5% in most cases. Bird damage to Prime Seedless decreased with increasing distance from the river habitat, and with increasing block size. The estimated annual financial loss as a result of bird damage to the early Prime Seedless cultivar was conservatively estimated at R4,041,804.00, excluding secondary flow-on expenses. The estimated losses sustained by other cultivars were comparatively lower, such as Thompson's Seedless (R2,833,975.00), Sugraone (R2,650,377.00), Flame Seedless (R1,427,544.00), Red Globe (R266,313.00), Regal (R169,690.00) and Victoria (R429,678.00), and La Rochelle (R76,534.00). The total estimated loss for the 2001/2002 season was approximately 12 million Rand. The high damage levels associated with early ripening cultivars appears to be as a result of birds establishing fixed feeding patterns at these vineyards at the onset of the harvest season. Birds capitalise on the availability of early grapes when food resources are scarce in their natural foraging habitats at that time of year (early November). Once fixed feeding-patterns are established, effective reduction of damage levels by any means will rarely be successful. The results of the research also tentatively suggest that traditional, lethal bird control methods, such as cage-trapping and mist-netting to reduce population densities, are ineffective in reducing damages to acceptable levels.

DENSITY AND TRENDS OF BIRD POPULATIONS

The density and community structure of bird populations was investigated across four bird habitat types within the Orange River valley, including vineyards and three native habitats (riparian bush, Karroid veld and dry drainage lines). This was to ascertain whether bird density and species abundance in vineyards and native habitats were influenced by the availability of grapes, and whether certain environmental factors influenced the density and abundance of species in vineyards. Populations were surveyed monthly using a standard point count technique. Bird densities varies significantly between the four habitat types, with average densities being 275 ± 84, 76 ± 34, 43 ± 11 and 7 ± 2 birds/ha for riparian bush, vineyards, drainage lines and Karroid veld, respectively. Bird density increased in vineyards from 26 to 100 birds/ha at the onset of the grape harvest, the majority of these being resident mixed feeders and granivores. Mixed feeders and frugivores were the only dietary classes that responded positively to the availability of grapes, as indicated by density and species composition changes. Densities of nomadic granivores were higher at vineyards with dense grass swards, while factors such as distance of vineyards from riparian habitat and vineyard size had no influence on overall bird densities. Some typical problem species appeared to be resident in vineyards, exhibiting high densities and breeding behaviour, having possibly extended their distributional ranges to encompass vineyards as an additional habitat.

BIRD BEHAVIOUR IN VINEYARDS

The foraging behaviour of problem birds was determined during the bird damage assessment surveys. The objective was to better understand the behaviour of various bird species, especially their spatial and temporal feeding patterns. Bird behaviour was thus compared between early- and late-ripening cultivars to determine possible seasonal and cultivar-specific behavioural differences. Most problem bird species reduced their frequency of feeding on grapes from early-ripening vineyard blocks to late-ripening blocks, with a concomitant increase in insect foraging, suggesting that there is a shift in their dietary preferences during the course of the harvesting season. Their dependence on grapes as a source of food appears to wane as the season progresses, with many mixed-diet species foraging more frequently on insect prey rather than fruit. A daily bimodal feeding pattern was detected at early ripening blocks where the frequency of grape feeding was highest during early- to late-morning and late-afternoon, with a marked decrease in feeding activity during midday. Most birds also preferred feeding from the top of bunches, a strategy that probably requires less energy expenditure than hanging from the grape bunch. There were clear differences in foraging strategies among the most commonly recorded species, which included mostly mixed-feeders. Cape White-eyes gleaned insects from vine bark and foliage, Red-eyed Bulbuls generally hawked insects, while Olive Thrushes foraged exclusively for invertebrates amongst the ground litter. The role that such mixed feeders play in controlling potential pest invertebrates in probably grossly underestimated. Granivorous species generally foraged for seed on the ground, but some species were responsible for damage to grapes at early-ripening blocks. It is suggested that these granivores learn to feed on grapes by observing typical problem species, thereby exacerbating the level of damage at early ripening blocks.

FINANCIAL COMPARISON OF DAMAGE-MITIGATING METHODS

The financial implications of the most commonly used methods for reducing bird damage, and other potential methods, were compared as a partial assessment of their efficiency. The variables affecting the financial costs of each were considered, to determine the cost for protecting one hectare of crop over a one-month period during the harvest season. The general variables included were the following: unit cost, number of units, unit longevity, number of personnel and related salary, man-days per hectare, number of vines per hectare and number of bunches per vine. The least expensive method was cage-trapping (R156.00/ha), but which was also considered ineffective in reducing damages to acceptable levels. The audible methods, such as carbide guns and Gropgard had similar expenses (R800.00 – R903.33/ha), but may only be effective when used in conjunction with other methods, such as lure crops and non-perforated bags, especially at early-ripening cultivars. Mist-netting for one month would cost R862.12/ha, but became increasing expensive for two (R1,582.12/ha) and three months (R2,302.12/ha), primarily because of increasing personnel expenses required to operate nets. Like cage-trapping, mist-netting is not considered as an effective damage-mitigation method. A more expensive technique, such as Irri-tape, with 50% (R3,939.00/ha) and 100% crop coverage (R7,038.00/ha) may also not guarantee effective protection, as birds habituate quickly to this scaring device. A small lure crop consisting of approximately 200 vines (R225.00/ha) may reduce damages to early-ripening blocks by providing a suitable alternative food supply. This method may be more effective if a significant proportion of the harvest crop is afforded some means of protection, using non-perforated bags or a combination of audible and visual scaring devices. The cost of bags varies between R5,120.00 and R5,853.33 per hectare depending on the type of bag used.

The overall cost of this method is influences largely by the unit price per bag, the number of vines per hectare, and the number of bunches per vine. While the number of vine and bunches are generally constants, a reduction in the unit cost of the bags would significantly reduce the cost of this method. Non-perforated bags are thus considered the most cost-effective short-term method with the potential to reduce bird damage to acceptable levels. At a cost of R4,500.00/ha, hail netting presents the most cost-effect long-term method, owing to significant reductions in both hail insurance premiums and bird damage.

RESULTS OF PRODUCER'S QUESTIONNAIRE

A questionnaire concerning bird damage to table grapes was distributed to a proportion of producers along the Orange River to obtain their perspectives and experiences, and elementary details concerning vineyard characteristics. The Red-eyed Bulbul was regarded by most respondents (89%) to be the most important problem bird in the region, followed by mousebirds (81%), Olive Thrushes (74%), Cape White-eyes and Cape Sparrows. Most respondents experience damage during November (80%) and December (76%). More than a third of respondents (40%) believe that bird damage has increased over the past five years, while 32 and 15%, respectively, stated that it had remained the same or declined. Flame Seedless experiences the most severe damage (89% of respondents that cultivated the cultivar), followed by Prime (55%), Sugraone (45%), and Thompson's Seedless (35%). Most respondents (76%) implement bird control to reduce damage to their crops, with the mostly commonly used control methods being plastic-mesh or non-perforated bags fitted to individual grape bunches (57%), cage-trapping (34%), mist-netting (26%), and shooting (17%). Other control methods, such as sound and visual scaring devices, were not popular among respondents.

The most commonly cultivated cultivars, as indicated by the number of producers who grow these, were, Thompson's Seedless (96%), Sugraone (83%), Flame Seedless (69%), Prime Seedless (54%), Regal (43%), and Red Globe (39%). The average area per farm that is cultivated for table grapes is 49$\pm$38 ha, with an average of 17$\pm$14 vineyard blocks. The average minimum and maximum block sizes are 1.6 and 6.4 ha, respectively.

REVIEW OF CURRENT DAMAGE-MITIGATING METHODS

Despite a variety of damage-mitigating methods being available, both lethal and non-lethal, little success has been achieved in reducing damages to acceptable levels. Lethal measures of controlling bird numbers appear to be unsuccessful, as bird populations are generally dense in the riparian habitat and dispersed over large areas of the Orange River floodplains. Efforts directed at reducing bird populations thus seem unrealistic, as most trapping is done in localized areas, allowing bird populations to recover through influxes from neighbouring populated areas. With regards to non-lethal bird-deterring devices, these are mostly used incorrectly which results in birds becoming habituated to the devices due to pro-longed exposure. Further, once these birds have established fixed feeding-patterns at early-ripening blocks, effective reduction of damage levels by any means will rarely be successful. Thus, when control methods are used that rely on aversive stimuli to reduce crop damage, such as sound and visual deterring devices, alternative food sources must be provided for birds for these to be effective. Alternative food sources should be of a similar quality as the harvest crop, and be strategically placed so as to lure foraging birds from these. Without constant vigilance in vineyards and frequent shifting of devices (Jarvis & Heÿl 1991; Fisher 1992), together with the availability of alternative food sources other than the vineyard (Rooke 1984), the methods will soon become redundant as the birds become habituated. A combination of management practices is also generally required to reduce damage to grape crops (Hothem & DeHaven 1982; Jarvis & Heÿl 1990a; Jarvis 1991; Sinclair 2000). Current non-lethal methods could therefore be used successfully to some extent, provided that producers make a concerted effort to employ these correctly and adopt a pro-active approach to their damage-mitigating programme.

RECOMMENDATIONS

Cost-effective management strategies to reduce bird damage rely on an integration of the understanding of the causal factors that result in the conflict situation, and accurate quantitative assessments of crop loss (Weatherhead 1982). In the Orange River valley, the ripening of early cultivars coincides with a period of food scarcity for birds, which then capitalise on the grapes to replenish depleted energy reserves after the winter. Efforts to prevent birds from establishing feeding patterns at early-ripening blocks should receive priority, such as by reducing the attractiveness of vineyards to birds (minimising grass and herb swards), and by proving alternative food sources (a suitable grape type is recommended) in the form of lure crops. Where damage levels are still unacceptably high, then it should be attempted to localise damage within the vineyard by providing protection to individual bunches with non-perforated bags, while leaving a portion of the vineyard, such as the periphery, open as a sacrifice crop. Complete enclosure of crops with hail netting, which provides additional benefits besides protection against bird damage, may be warranted for early-ripening high-value crops. Although initial costs are high, the annual expenses are low, making this an attractive alternative to other available methods.

Damage-mitigating steps can also be taken when deciding on a suitable location for the establishment of new vineyards or blocks. The location of a block with respect to neighbouring cultivars, its size and shape may affect the extent of bird damage that it is likely to sustain. Damages would be most severe at small blocks situated close riparian vegetation of the Orange River and vice versa because of the negative relationship between crop damage, block size and distance from riparian vegetation. When blocks of the same cultivar or two or more different early-ripening cultivars are to be established on the same property, then it may be beneficial to plant these in close proximity to each other, rather than as isolated blocks across the property. In the latter case, these are most likely to attract separate bird populations, and hence experience higher damages than otherwise.

CONCLUSION

Bird damage to grape crops is influenced by numerous factors, which may be both intrinsic and extrinsic in nature. Factors such as vineyard size, location with respect to other blocks and surrounding habitats, together with crop maturity and other fruit conditions attract a wide range of species with different preferences and behaviours. As a result, bird damage varies considerably between cultivars and between blocks of the same cultivar, and between years. This makes it unrealistic to prescribe a single management programme that suits all producers and situations. There is also paucity in the knowledge concerning the biology and behaviour of problem species, and the factors that result in the conflict situation. Producers therefore need to identify their particular bird problem and develop their own management programme accordingly. To successfully develop and implement a damage-mitigating programme, it is necessary that producers gain some elementary knowledge of the extent of damage and the species that are involved. Effective cost-benefit analyses of possible management programmes can only be achieved if the percent crop loss is known, so that decisions can be make with respect to the amount of capital that can be spent on damage-mitigating methods. Knowing the species that are responsible for damage is necessary so that the most effective methods for manipulating those species are selected.

The provision of alternative food sources at the onset of the harvest season cannot be over-emphasized. The success of other damage-mitigating methods, such as bird deterring devices, would depend to a large extent on the availability of lure or sacrifice crops during the lean period for problem birds. Birds require an incentive to leave a harvest crop and feed elsewhere, otherwise damage-mitigating methods, both lethal and non-lethal, will become redundant and ineffective. The incorrect use, and infrequent shifting and alternation of most deterring devices also result in rapid habituation by problem birds. This can be avoided by employing a responsible person to operate a damage-mitigating programme during the harvest season and to maintain vigilance in the vineyard.

The recommended ecological-based damage-mitigating methods provide a framework for further experimentation in the field, for which there is still much scope. Effective reduction of damage will require producers to recognise the value of a damage-mitigating programme and to incorporate it into their management protocol. Although the effectiveness of potential methods could not be tested because of time constraints, they attempt to mitigate the primary cause of bird damage to grapes in the Orange River valley, namely, the lack of suitable alternative food resources. Once this need has been satisfied, producers will be able to develop more effective methods that meet their specific needs, and the requirements of the export market. However, pro-active planning, execution, and monitoring of such damage-mitigating programmes are crucial to ensure success and long-term benefits.