Psychological warfare in the vineyard: using drones and bird behaviour to control bird damage to wine grapes

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Bird damage in agriculture is a significant and long-standing problem globally, especially for high value fruit crops such as wine grapes. In Australia, bird damage can result in up to 83% crop loss, even when vines are protected. Based on our review of current vineyard bird damage control strategies, there is no economical and effective solution for large vineyards. The ideal solution would be a natural predator, such as a falcon, ideally that required no training by falconers, but that would still effectively keep birds off the vineyards by triggering their antipredator behaviour. We devised a novel unmanned aerial vehicle (UAV, more commonly referred to as a drone) using bird behaviour to achieve this goal.

The UAV used in the trials was a multirotor hexacopter (Figure 46). With a global positioning system (GPS) antenna and long-range telemetry radio, it is possible to plan autonomous missions using GPS co-ordinates and a ground control station (e.g. a laptop). The perceived predation risk to the birds is generated by distress calls broadcast from a piezo horn tweeter. A tweeter is chosen because its high frequency response (3–17 kHz as per manufacturer's specification) is similar to natural bird calls.

However, according to the literature on bird behaviour, a distress call alone will not be effective. It will need to be paired with a 'cause' for the birds to respond to the UAV as a predator. Therefore, we installed a taxidermied crow, upside down, with wings open, in a vertical pose on the UAV's undercarriage to simulate the cause. The intention of this pose is to create the impression that the UAV has just caught the crow, and the distress call is coming from the crow in apparent danger.

Figure 46. UAV equipped with horn tweeter and taxidermied crow.

The targeted species in this study are Australian raven, common starling, sulfur-crested cockatoo and silvereye. Since ravens, starlings and cockatoos appear in flocks and tend to stay on the vines while foraging, it was easier to see the UAV's impact by directing it to chase the flock. We counted the number of birds at an initial position before the UAV flight and recorded the time taken for the birds to return to that initial position after the UAV flight. Additionally, we also recorded the time taken for more than 50% of the original flock to return. In some trials, the birds did not return to the initial position, but they could be seen settling on the vines elsewhere in the vineyard. In these cases, this distance was estimated based on GPS co-ordinates.

The minimum radius of influence on ravens, cockatoos and starlings was 50 metres and the maximum was 300 metres (Table 9). This radius of influence has a moving centre as the UAV can fly freely, which effectively increases the radius of influence to the UAV's radius of action by approximately 50 metres. In all trials (n=9), 100% of the birds left the initial location after the UAV flight. Although in the last trial the starling flock returned to the initial position after only five minutes, but they did not return to forage in the vines. They perched on the power lines near the initial position and left the vineyard before sunset. The results indicate that the UAV is an effective bird deterrent for the target species in this study.

Silvereyes like to perch in trees close to the vineyard and make frequent flights into the vines. To determine the effectiveness of the UAV on silvereyes, the frequency of their flights into and out of the vines was counted for 15 minutes before and after the UAV was flown closely to the birds (Figure 47). During the 15 minutes post-flight, the frequency of visits to the vines decreased by 66%, 95% and 42% in experiments 1, 2 and 3 respectively (Figure 48). This short-term response from the birds is very promising. As the activity level of the birds is proportional to the level of damage they cause to the vines, the UAV provided effective relief from bird damage in the 15 minutes after the flight.

In conclusion, combining an understanding of bird behaviour and an UAV is a viable bird control method. The short-term response from a variety of bird species indicates that the UAV can potentially eliminate birds from the vineyards. Multiple UAVs might become necessary on large vineyards as the radius of influence is localised on the UAV, and the UAV can only deter the birds to another location 500 metres away most of the time.

More information

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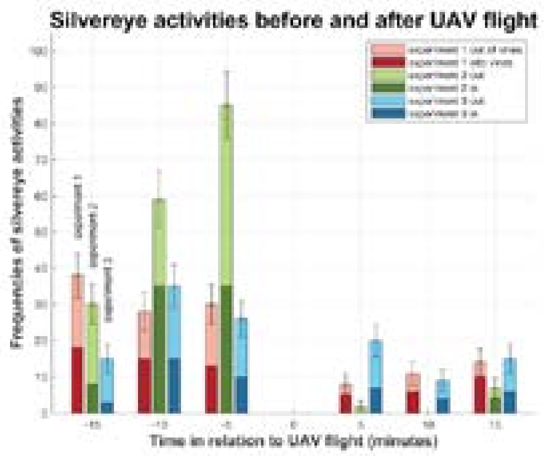

Figure 47. The flights of silvereyes into and out of the vines for the 15 minutes before and after exposure to the UAV flight.

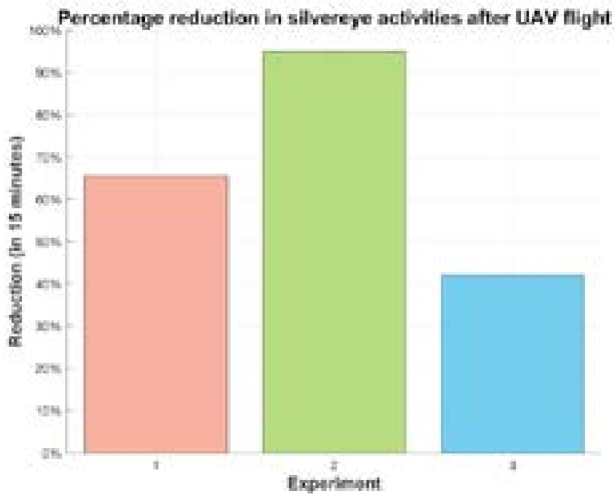

Figure 48. During the 15 minutes post-flight, the frequency of visits to the vines decreased by 66%, 95% and 42% in experiments 1, 2 and 3 respectively.

Table 9. Radius of influence and duration of influence of UAV on large birds.

Trial	Species	Number of animals before UAV flight	Time at UAV launch	Response distance (m)	Number of animals at initial position after UAV flight	Time taken to return to initial position	Settle distance from initial position (m)
1	Raven	100	8.52 am	50	0	N/A	500
2	Raven	100	9.40 am	100	0	N/A	550
3	Raven	100	10.20 am	300	0	N/A	400
4	Raven	100	10.58 am	100	0	N/A	450
5	Raven	100	11.11 am	150	0	N/A	350
6	Raven	100	11.30 am	150	0	N/A	600
7	Cockatoo	50	6.10 pm	50	0	Not seen before dark	N/A
8	Starling	50	5.30 pm	50	0	Not seen before dark	N/A
9	Starling	50	5.57 pm	100	0	5 (perching on powerlines, flew away before dark)	N/A