Eyespotted Balloons as a Device to Scare Gray Starlings¹

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A balloon (260 cm in diameter) with five eyespots (60 cm in diameter) was raised in a peach orchard and a vineyard to scare gray starlings (*Sturnus cineraceus*). The starlings were kept away from the ripening fruit. An operation period of only 2 weeks was enough to protect the harvest.

INTRODUCTION

Flocks of gray starlings (*Sturnus cineraceus* TEMMINCK) attack fruit in orchards throughout the season. Recently the damage has become very serious in Japan (NAKAMURA, 1981; SAKAMOTO, 1981; SHIROTA, 1979). Previous attempts to scare them away—for example, by scarecrow, Av-alarm, loud noisers, etc.—were not effective.

It appears that one of the most effective alarming signals to birds is a pair of eyespots or bright concentric circles (BLEST, 1957; COSS, 1972; SCAIFE, 1976 a, b). SHIROTA (1980) discovered that a pair of artificial eyespots on the thorax of a silkworm was to some extent effective against attacks by starlings. Although the response varied among the six birds tested, larger eyespots were generally more effective than small ones.

As INGLES (1980) has claimed, it is surprising that no work seems to have been conducted to develop eyespots as devices to scare off birds. We tested a balloon with very large eyespots as a device to scare gray starlings and obtained positive results as described below.

MATERIALS AND METHODS

Balloon. Five eyespots were arranged on a transparent balloon of 260 cm in diameter in such a way that two of them were always visible from any direction. Each eyespot was a red circle of 60 cm in diameter, with a central black spot of 30 cm. Eyespots and balloon were made of vinyl. The balloon was filled with helium gas and ascended to about 15 m above the ground (Fig. 1).

Experiment I. This was a kind of "control" experiment and was carried out in order to estimate the loss caused by birds that were not scared off by any devices. In the early summer of 1982, cherry trees planted along the hedge of the University Farm (Fig. 2) were exposed to starlings' attack. There were 10 cherry trees, and 100 cherries from each tree were sampled to evaluate the damage by starlings.

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Fig. 1. Balloon (260 cm in diameter) with five eyespots (60 cm in diameter), used as a device to scare gray starlings in orchards.

Fig. 2. Sketch map of the Experimental Farm of Hirosaki University, showing the locations of the peach orchard, vineyard, and the row of cherry trees used in this study.

Experiment II. In August, after starlings have completely consumed the cherries, they usually attack the plums and peaches in the orchards of the University Farm. The eyespotted balloon was raised on August 6, just before the onset of the starlings' attack on the peach orchard. When there were more than 100 peaches in one tree, at least 100 were sampled at random. When the number of peaches was less than 100 all were examined to calculate the damage rate. The number of sampled trees was 14.

Experiment III. In September 1982, the balloon was raised after starlings had started to attack the vineyard in the University Farm and the damage rate had already reached a level higher than 40%. The total number of the grape vines was 160, and more than 800 bunches of grapes from at least 80 vines were examined to determine the damage rate.

The damage rate is defined as (number of injured or lost fruits) / (number of fruits examined). In each series of experiments, fruits samplings were made every 3 or 4 days during the season. The location of the experimental sites in the University Farm (Fujisaki near Hirosaki) is shown in Fig. 2.

RESULTS

The result of Experiment I is shown in Fig. 3. Along the hedge there were two varieties of cherry (Satonishiki and Napoleon), whose ripening seasons were about two weeks apart. Starlings attacked the early variety, Satonishiki, first and after almost complete consumption switched to the late variety, Napoleon. The damage rates of the two varieties increased as sigmoid functions of time, and by the end of the season in early July all cherries had been eaten by starlings.

Starlings came to the orchard from early morning till evening. During the fruit

Fig. 3. Changes in the damage rate to cherries caused by starlings. Each line represents an individual tree. Varieties (a) Satonishiki and (b) Napoleon.

Fig. 4. Effect of balloon with large eyespots when protecting peach orchard from starlings. The line with $\odot$ indicates the protected rate (=non-damaged rate) and the solid bars the number of injured fruits. Figures in parentheses represent the number of peaches examined. Solid and broken drawings of balloon indicate the days of ascent and descent of the balloon.

season they formed family groups, and parents and the young were observed to feed together. Young starlings were very careless; even when there were observers near the tree they eagerly fed on cherries.

The result of Experiment II in the peach orchard is shown in Fig. 4. Only 9 peaches were attacked by birds. The bird species that attacked the peaches could not be identified from the beak marks. After the balloon was raised, starlings did not appear in the orchard, although they used to come there in large numbers. Therefore, the birds which attacked the peaches may have been some other species, such as sparrows, which are sometimes seen in the orchard. Unfortunately, the balloon disappeared

Fig. 5. Effect of balloon with large eyespots when protecting vineyard from starlings. The line with ● indicates the damage rate to grapes. The broken line represents an increasing trend of damage rate inferred from a logistic curve as shown in Fig. 3. Figures in parentheses represent the number of grapes examined. For other keys see Fig. 4.

in the night of August 20, and we had no substitute balloon. Nevertheless, starlings did not approach the orchard thereafter, and peaches of good quality could be harvested.

The result of Experiment III in the vineyard is shown in Fig. 5. By September 3, the damage rate had reached a level higher than 40%, and the balloon was raised on September 6. Before this day, starlings had come in large flocks and attacked the grapes every day, but the balloon scared them away from the vineyard. In the night of September 19, a typhoon hit this district and destroyed the balloon. But the starlings did not appear again, and the harvest started on October 27.

DISCUSSION

When we did not raise the balloon, the crop loss was almost complete (Experiment I). When the balloon was raised before starlings began to visit the orchard, the fruit crop was effectively protected (Experiment II). In Experiment III, starlings were first allowed to attack grapes. Therefore they learned of the presence of food in the vineyard. Nevertheless, they never came again after the balloon was raised.

In Experiment II and III, we raised the balloon for about 2 weeks. These short periods of time were enough to protect the fruit crops from attacks by starlings. Probably because the birds remembered, the scaring effect continued for at least several weeks after withdrawal of the balloon. Therefore we may conclude that a balloon with large eyespots can be used as a device to scare starlings.

It was not certain, however, whether starlings were scared by the large eyespots or by the balloon itself. To answer this question we made some preliminary experiments (SHIROTA, unpublished). First, the balloon with eyespots was presented to five caged starlings. Their behaviour suggested they were scared. One of them hurted itself against the cage net and broke its beak. Then we took off the eyespots from the balloon and showed it again to the same starlings. This time they were not scared. Final-

ly we returned the eyespots to the balloon, and the birds were scared again. A similar experiment was repeated the next day and similar results were obtained. Therefore it was the eyespots, not the balloon itself, that had the scaring effect on starlings.

It is important to assess the effectiveness of various kinds of eyespots. SCAIFE (1976 b) has reported that the configuration of eyespots is important to scare birds. Eyespots giving a three-dimensional effects may be better than flat-looking ones. We are now studying this problem.

Even if we can find a highly effective visual stimulus to frighten birds, there is the possibility of 'habituation.' 'Habituation occurs in animals ranging from worms to man, whenever a stimulus is repeated without reward or punishment' (KREBS, 1980), and birds are no exception. How soon starlings will become habituated to large eyespots is still open to question.

Although all these problems should be resolved, the use of eyespot patterns to protect fruit crops in relatively small areas for short periods is quite feasible.

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