

## SOME OBSERVATIONS AND EXPERIMENTS BEARING UPON THE PREDATION OF THE SPARROW HAWK

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Last June (1939) the author was fortunate in finding a young Sparrow Hawk (*Falco sparverius*) that had fallen from its nest hole to the sidewalk in Chico, California. Having had in mind for some time the testing by experimentation certain general observations on the methods of predation used by this species, with special attention to the protective resemblance of its prey to the environment, special care was taken in feeding the young bird to keep it alive and in good health.

At the time of its discovery the young falcon was covered with down and was not able to support itself on its legs. An improvised nest was made in an old shoe box which served well until the bird was old enough to sit on a perch. It was then transferred to an outdoor cage that was 8' x 6' x 6'. This cage was covered with light cheese-cloth and had no floor except the ground upon which it stood.

The young falcon was fed ground beef, chicken livers, mice, lizards, and a variety of insects. The only food that was repeatedly rejected was parts of frogs. Its food preference while still downy was the livers of various animals, but as it grew older it preferred lean beef.

From the beginning its powers of perception were remarkable. It would watch for several minutes at a time small insects such as flies and mosquitoes as they crawled up the side of the cage. In order to teach the young bird to eat living insects, small, soft grasshopper nymphs were decapitated and placed within easy reach. Later, when the bird could hop or fly, larger, unharmed grasshoppers were merely turned loose in the cage. After six weeks, it was completely feathered without a trace of down. It would fly to the hand for food both inside and outside the cage.

To discover whether grasshoppers (*Trimerotropis*, sp.) which were fed daily to the falcon were protected from its attacks because of their concealing coloration, markings or any peculiarities of behavior, three experiments were devised.

*Experiment 1.*—The cage was moved to a place where grasshoppers were plentiful. The grass was between two and four inches high and most of the blades were green in color. The insects were carefully removed from the area covered by the cage. Ten mature grasshoppers were then released in the cage, five of which were normally colored. The other five had any protective resemblance to their natural background somewhat destroyed by being dipped in flour. The flour did not stick to the insects well but enough adhered to make them easily discernible to the eye even while they remained quiet in the grass.

The falcon, on being released in the cage, immediately caught one of the "whitened" grasshoppers. As it ate the insect, it occasionally shook its head violently to eliminate the floury paste that formed in its mouth. After a minute or two it caught another "whitened" locust and ate it with the same evident dislike for the flour that covered it. About two minutes later the falcon began to regurgitate, and both insects were expelled. It did not catch any more grasshoppers during the rest of the hour it was observed.

*Experiment 2.*—A strip of neutral gray canvas two feet wide and eight feet long was placed down the middle of the grassy floor of the cage. Thus the canvas occupied one-third of the total floor area. About two dozen grasshoppers in all stages of development were released at 9 a. m. daily for eight consecutive days. No efforts were made to scare the insects out of the grass onto the canvas where they were conspicuous because of differences in color, markings and general texture. Following the release of the insects, the falcon was watched for an hour each day and records kept: (1) the

number of grasshoppers captured on the canvas strip; (2) the number of grasshoppers captured on the two grass strips; (3) and the number of unsuccessful attacks made on insects in both areas. An attack was counted as being successful, even though the falcon had to strike several times in quick succession, if the insect was finally captured. Frequently the falcon would fly down to the grass and hop about to scare the insects out. This method of hunting was observed many times and these "flushed" grasshoppers were sometimes captured only after several strikes were made on the grass, but they more often hopped on the canvas where they were more readily taken.

During these observations the falcon made only five unsuccessful attacks, and all of these were on insects that were concealed in the grass. There were 83 successful catches made, of which 55 were made on the canvas and 28 in the grass.

*Experiment 3.*—In order to determine what part the movements of the grasshoppers had to do with their being detected by the falcon, ten of the mature insects were drowned and then five of them were placed in lifelike positions on the canvas; the other five were similarly placed in the grass. The experiment was repeated for two consecutive days, and the time was recorded when the falcon found and ate each insect.

Nine minutes after the bird was released in the cage during the first trial it had found and had eaten all of the five grasshoppers that were posed on the canvas. One-half hour later none of the grasshoppers that were placed in the grass had been found. The next day during the second trial the five on the canvas were found, and were eaten after an interval of eight minutes. Fifty minutes later all but one of the insects placed in the grass were still untouched.

*Discussion.*—The results of these experiments are interesting when compared with Cushing's (Condor, vol. 41, 1939, pp. 100-111) conclusions in his recent paper on predation and coloration. He contends that color cannot play a significant role in predation because its protective value is lost when an animal moves.

In spite of the incompleteness of these experiments, several things are indicated which the author believes are significant. (1) When all protective resemblance to the background had been removed, the falcon readily found its prey even though the prey did not move because it was dead. Hence, any grasshopper sitting on a gray stone or a bare place in the meadow could certainly be seen and caught even though it did not move at all. (2) Grasshoppers which did not move (dead ones) in the grassy area were seldom seen and captured even after a much longer period of time had elapsed. We must not overlook the fact that a great deal of time is spent by insects and other animals in a state of rest or inactivity at which time any resemblance to their immediate surroundings would certainly be protective. (3) Movement on the part of an insect in the grass was the property which probably most generally led to an attack by the falcon; however, strikes made at insects in the grass were occasionally failures whereas no failures were recorded on nearly twice as many strikes made on insects on a non-protective background. Hence, it seems more difficult for a falcon to strike accurately at prey even though it is moving or has recently moved if the environment resembles the color and markings of the prey. Granting the importance of motion in the detection of prey, the predator still has a poorer chance of making a successful strike if that prey resembles its surroundings. (4) Sparrow Hawks and possibly other predaceous birds may occasionally obtain their prey by flushing it from cover where it is otherwise relatively safe because of its protective resemblance and by remaining quiet.

*Conclusions.*—Grasshoppers are better protected from Sparrow Hawks when they remain quiet and confine their activities to grass where their concealment is more effective because of protective resemblance.

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