Photographing birds in flight at close range

Techniques, problems and opportunities of stop-motion flight photography

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FIVE YEARS AGO I became involved, with several of my physics students, in a project of photographing 22-caliber rifle bullets in flight. Using Harold E. Edgerton's book *Electronic Flash Strobe,* (McGraw-Hill 1970) as a reference, and with apparatus consisting of a 35mm camera, a General Radio Strobotac producing a flash less than a millionth of a second, a low power laser light source, and a photosensing system, we were soon photographing bullets passing through light bulbs, playing cards and pieces of stretched string. Edgerton's book includes a chapter on nature photography, and describes some of the electronic flash and light-sensing equipment used by Crawford Greenwalt in his excellent work with hummingbirds. This led me to consider modifying the project by replacing bullets with birds as subjects. Other pioneers such as Eric Hosking had used light-triggering circuits more than thirty years ago, and I believe my experiences paralleled those of these two to a large extent.

Photographing birds had been more than a passing interest, having previously spent many hours working from a blind with my telephoto lenses. The reduced range enabled me to enjoy a far more intimate relationship with the birds, and the idea of photographing them in flight from short distances intrigued me. Soon I had visualized using equipment similar to that described in Edgerton's book, which consisted of a bank of flash units attached to a camera prefocused on a light beam, which when broken, triggered the shutter. The end result would be a fully automated system capable of taking a complete roll of film without further attention. This sequence of events marked the beginning of my experience in photographing birds in flight at close range. Such equipment was expensive, and approximately $2500 was necessary to get started. Fortunately, funding was available. With this obstacle cleared, I was ready to continue. Some of these experiences are perhaps unique and worth sharing with you.

It seemed appropriate to carry out the project in two phases, with the flash units and light-triggering system making up the first phase. Typical commercial flashes have a light duration on the order of 1000 microseconds (1000 millionths or 1 thousanth of a second) which is too lengthy to produce a sharp photograph without any blur. Edgerton described a flash circuit with a flash duration in the order of 60 microseconds. Since this was sufficiently brief for what I felt necessary, I constructed a bank of six photo flash units using Edgerton's circuits. The flashes were used with my Nikon F2 and Nikon FTn cameras, and with this equipment I found hummingbirds comparatively easy to photograph, because they hovered near, or at the feeder.

Equipment used by the author. In spite of the formidable array of apparatus, many birds quickly accept its presence at feeders, nesting cavities and burrows.

HOWEVER, DIFFICULTIES connected with the light triggering system became apparent. Motor-driven cameras have an inherent delay between triggering switch operation and firing of the flash. With a Beckman/Berkeley 7350 digital counter in my physics laboratory I measured the delay on the Nikon F2 and Nikon FTn cameras, and found these to average 44 ± 1 millisecond and 55 ± 1 millisecond respectively with the mirrors in the locked positions. During these intervals a bird flying only 6 mph will travel 4.6 inches and 5.8 inches respectively after being detected. For hovering birds such as hummingbirds the delay is not a problem. However, it becomes most significant in photographing birds with speeds comparable with that of swallows. If birds flew only in fixed direction, at constant speed and elevation, compensating for the delay would have been simple. Since this was unrealistic, I decided to concentrate on birds flying only in one direction. When a bird broke the beam while flying in another direction the result was wasted film.

On occasion I have placed two beams crossing each other at right angles, forcing both beams to be broken for camera operation, and this would not occur unless the bird passed fairly near the desired field of the camera. Since any part of the bird can break the beam, critical focus becomes unpredictable and there is no guarantee that the entire bird will be in suitable focus. The speed of the bird is another variable. Collectively, all of these variables caused portions of the tail feathers, wings, and head to be "off-camera" in what would otherwise have been excellent photographs. Substituting a wider-angle lens, or placing the camera farther from the subject minimized this problem, but the subjects were then too small for suitable projection in slide programs.

In phase two, problems related to the camera were encountered. Most 35mm cameras have a typical flash-synchronized shutter speed of 1/60 or 1/80 second, and on bright days this permitted background light to leak through the wing feathers, even if the lens was stopped down to minimum aperture (f/32). However, this was not a problem on overcast days or if a shaded background was used. In this phase a Hasselblad 500EL/M was added. With its shutter speed adjustable down to 1/500 second, background light leaking through the bird's image virtually disappeared. Its 2¼" x 2¼" transparency size more than tripled the surface area of that in the 35mm format, the number of usable

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Five stop-motion close-up photographs by Russell C. Hansen taken with the equipment described

1. *Evening Grosbeak*
2. *Red-breasted Nuthatch*
3. *House Wren*
4. *Eastern Bluebird*
5. *Tree Swallow*

5.

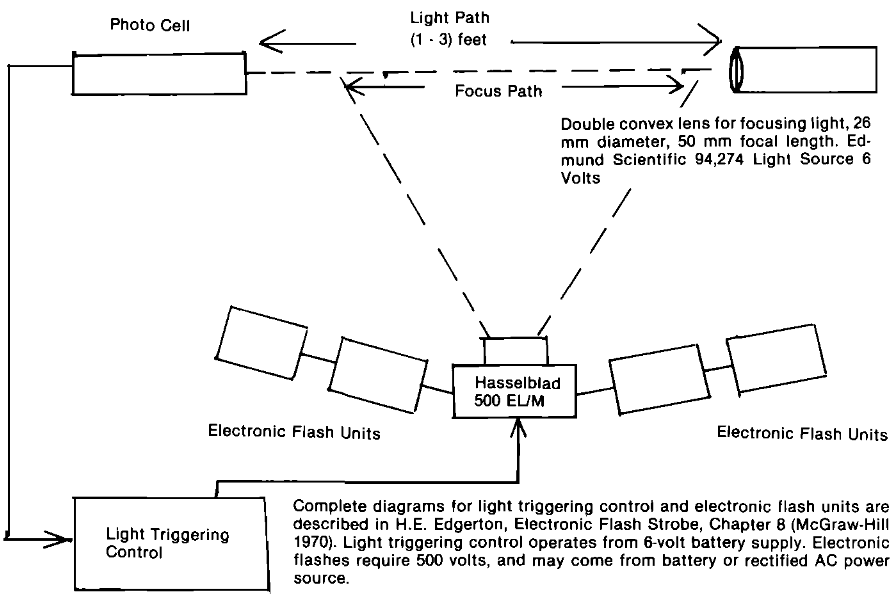

Fig. 1. Block diagram for photographing birds in flight at close range

pictures increased astronomically since images were of larger size, and usually showed the entire bird. Many of these could be later cropped into 35mm slide mounts for use in slide lecture programs. The inherent delay between triggering switch operation and operation of the flash in the Hasselblad was found to be less than in the Nikons, and I have measured the delay of this camera to average 32 $\pm$ 1 millisecond with the mirror in the locked position. The Hasselblad camera is the better camera to use in this work if one has a choice.

WHILE THE SYSTEM has been used primarily at conventional feeders and hummingbird feeders, it has also been used near flowers, nest cavities and burrows. Nocturnal birds, such as Leach's Storm-Petrel, have been photographed in darkness. Each situation creates its own challenge. Although the system causes a brief inconvenience to the birds, they quickly adjust to its presence. It is designed so that it may be temporarily disconnected by remote control, and when operated near a nest or nesting box it should not be operated without frequent idle periods. Furthermore, it does not intefere with the bird's normal activity because the camera and flashes are usually located 2-3 feet from the nest or box, and at best only a comparatively small percentage of the approaches result in a photograph. When photographing hummingbirds by manually controlling the system's operation, I discovered how insensitive they are to the flash. On one occasion three successive photographs of one bird were taken as it fed, indifferent to the flashes. Most other birds seem to share this same characteristic. Actually the noise of the motor-driven camera does more to disturb birds.

Birds may be photographed from a variety of angles. If they can be enticed to approach head on, photographing them is not too difficult, because they begin to slow down sufficiently to fall into a fairly predictable focal range where compensation becomes more precise. Such photographs have been most successful. Photographing from a direction perpendicular to the bird's flight also provides good results, and this technique is most frequently used at nest boxes. Additional work photographing birds from directly above, or below, the flight path is planned. In fact, the more I become involved with this type of photography, the more I realize how much can be done. To date I have photographed over 40 species of birds this way. The excitement continues.

THE LIGHT-TRIGGERING system I have been using recently has been more or less constantly in the drawing board stage, and portions are still being redesigned. Briefly, it uses integrated circuits, and incorporates a number of useful features. Among these is a 5-second delay which prevents the system from operating until the flash capacitors have recharged after each exposure. In normal operation this feature is unimportant because it is rare that a second bird will break the beam again within 5 seconds. However, in a recent trip to Trinidad I photographed fruit bats during the night at a feeder. At one point they were so active that they appeared in the beam almost continuously, and in the period of one minute a total of 8 photographs were taken. They paid virtually no attention to the noise of camera and flashes (a noise is also present within the flash when it operates). I'm sure that without insuring sufficient recharge time some of the results would have been disappointing. Another practice which has proved useful is to operate as many as three cameras from one operation of the flashes. In this, a delay is programmed into the operation of the Hasselblad camera to bring it closer to that of the Nikons and then the flashes slaved to operate with the camera having the longest delay. To overcome the problem of wasted film, I have included the option of forcing the bird to fly through two beams in a definite *sequence* in order to operate the camera. Here, I am at liberty to concentrate only on incoming birds, or those outgoing, or birds flying only to the left, or to the right. All this adds to the complexity of the system, but it appears to be worth the effort.

Acknowledgement

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Additional Reference:

"Improvements in Electronics for Nature Photography", Edgerton, MacRoberts and Khanna, IEEE Spectrum July 1969.

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