Photography of birds in flight

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PHOTOGRAPHY OF BIRDS IN FLIGHT

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Foreword

Since Marey's classical studies on the flight of birds with the aid of motion pictures, half a century ago, considerable progress has been made in photographic methods and pictures showing much sharper details of the movement of the wings and feathers have been secured. Moreover, whereas early pioneers of aviation, such as O. Lilienthal, studied and wrote books on the flight of birds, and justified some of their designs by nature observation, attempts are being made, today, to apply the knowledge of the aviation engineer in the interpretation of bird flight, where the functions of sustaining surface and of propeller are performed by one single organ, a flexible wing. For this purpose photography is indispensable. The advent of high-speed cameras and telephotolenses has made it possible to obtain detailed records of the flight executed by the bird in nature. From these motion pictures naturalists have learned many surprising facts about the flight of different species and reasons for differences in performance.

Among the first to recognize the importance of photographing birds in flight, out of doors, was the Swedish naturalist, Bengt Berg. He secured a large number of pictures and photographs of flying birds and showed their value for a better understanding of wild life. The German firm "Ufa" followed with motion pictures showing the flight of birds. In the United States several ornithologists excel in the production of motion pictures or film strips showing the flight of birds under natural conditions, - in particular, the following specialists, Arthur A. Allen, Professor of Ornithology at Cornell University, Alfred M. Bailey, Director of the Chicago Academy of Science, Robert Cushman Murphy of the American Museum of Natural History, William L. Finlay, who has made a life study of birds and bird photography, Gordon C. Aymar, author of "Bird Flight", and others. The United States Navy has also produced such photographs for its own purposes.

PHOTOGRAPHY OF BIRDS IN FLIGHT

Summary

Improvements in high speed cameras, lenses and photosensitive materials have made it possible to take motion pictures of birds in free flight and to avoid the artificial conditions used by earlier investigators. The stress placed upon the study of exposures made in natural surroundings permits the use of the same moving pictures of birds on the wing in work on the natural history of the birds as well as in investigations on the mechanism of bird flight, and makes it possible to combine the experiences in both fields.

Pictures of flapping flight used by all birds in taking off are available in appreciable numbers, but movies of the horizontal free flight, during which all the larger birds support a gliding motion at intervals by strokes of the wings, are almost entirely lacking.

PHOTOGRAPHY OF BIRDS IN FLIGHT

The habits of birds make them difficult to photograph, and even the tamest of birds becomes over-excited when chased, handled, or harnessed. There are two good methods of getting close enough to birds to photograph them, namely, by attacting them to a chosen spot with food or nesting material, or by discovering their nests, to which they are almost certain to return.

In order that all essential parts of the picture shall be in sharp focus when the subject is close to the camera, it is necessary to obtain great depth of field by reducing the aperture. To prevent blurring by motion, shutter speeds at least as high as 1/100 and preferably 1/200 of a second are required for ordinary bird photography. The synchronous operation of shutters and electric flash bulbs permits the use of small apertures and short exposures. With the fastest film, for instance Eastman Super XX, and the brightest foil-filled bulb, good exposures can be obtained at 1/200 of a second and f/45. By means of a special trigger, the timing device can easily be operated at any distance from the camera (E. Porter, New England Naturalist, 5:5-9, 1939).

For the photography of birds in flight, the permissible exposure depends on the number of the wing beats and the speed of the wing movement. The following table shows the number of strokes per second for some birds (Gordon C. Aymar, p. 133).

Humming bird	up to 200	Blue Jay	3 1/3
Sparrow	13	Buzzard	3
Swift	10	Black Vulture	2 1/2
Duck	9	Heron (cinerea)	2
Pigeon	8	Stork	2
		Pelican	1 1/6

When the wing of a humming bird makes about 55 strokes per second, the tip moves about 29 feet per second, or 20 miles an hour. Aymar observed a Kingfisher hovering in almost motionless air and estimated that its wings beat at least 8 times a second (Aymar, p. 47).

The speed of flight ranges from 10 to 17 miles per hour for the Kingfisher and the Song Sparrow, 25 miles per hour for Flicker, Oriole and Red-winged Blackbird, 26 to 36 miles per hour for pigeons, 40 to 60 for geese and ducks, to over 70 miles per hour for the Swift. As regards the Swift, Col. Meinertzhagen, a British aviator, who has secured a number of records with the use of an aeroplane and surveying instruments, states that the Swift can increase the speed of 70 miles an hour to a velocity of over 100 miles per hour.

One of the easiest birds to photograph in flight is the gull. Even cameras with a short focus give sufficiently large pictures, because in suitable surroundings flying gulls are not as easily scared away at the approach of man as are the same birds at rest. The camera must be constructed for exposures of 1/1000 second, or at least not longer than 1/500 second (Steiniger). Gulls seem to be unable to make headway against a wind of 30 miles per hour (McMillan).

Where photographs have to be taken from a distance and minute details are not essential, miniature cameras with telephoto lenses have been used, as for instance, the Contax II, on a chest tripod, with a rapid lens, Sonnar f/2.8, f=7 1/8 in., at f/5.6 and 1/200 sec., for pictures of flying herring-gulls (Wachs). This camera contains the view-finder and the focussing control in the same field.

While landing on its nest on a sunny day, the titmouse (Remiz pendulinus) has also been photographed (Franke) with the aid of a Contax camera (Tessar f/3.5, focal length 2 in., at f/3.5, exposure 1/1250 sec.

Photographs of a sparrow taken with a Contax and a telephoto lens, show that the bird can attain remarkable speed in a short distance when startled from a window feeding box (Lemuel Lincoln in Aymar, p. 188).

For taking photographs of the wings in their various aspects, exposures have to be reduced to 1/500 or even 1/1000 second (Aymar, p. 131, climbing pigeon; p. 137, Mallard, 15 yards before landing). In an ordinary motion picture camera the film moves and stops between each two pictures; when the speed exceeds 128 pictures per second, the forces required to move the film quite often break the film. Cameras with continuous rotation of the film and with special shutters have to be used for taking pictures of birds in free flight.

The Magnan ultracinema, used for the photography of the motion of pigeon wings, with an objective of 55 min. focal length, behind a disc containing 6 radial slits gives 100 to 1,000 exposures per second of a pigeon at a distance of 4 metres. These are projected onto one half of the moving film; the other half of the film is used for recording pictures of the image of the bird reflected from vertical or horizontal mirrors. In other tests the oscillations of a manometer were photographed with the unused half of the film, through a 150 mm. objective.

Both Marey and Magnan attempted to secure three simultaneous pictures of the birds for each exposure, either by using three cameras (above, behind and beside the bird), or by projecting images reflected by mirrors showing the bird

as seen from above or from behind upon the same strip that records the image of the bird as seen from the side. The pictures thus obtained are small and show only the first few strokes of the wings; since the birds, pigeons, in particular, are caused, by means of an electric shock, to fly away, the movements of the wing and the behaviour of the bird, exposed to strong flashes of light, may be far from normal. In recent studies of the flight of pigeons, G. Guidi prefers, therefore, to take three series of pictures from three different directions, one after the other, and to compare pictures in which the angle of climb or of descent is about the same. When several hundred films are available, three pictures corresponding practically to the same phase of the wing motion are not hard to find (either 64 or 128 pictures per second, or 9 or 17 respectively for each stroke, exposure 1/2,000 second).

The most difficult subject to photograph in flight is, of course, the humming bird. To learn how a humming bird moves its wings, it is necessary to combine a stroboscopic lamp giving bright flashes with one of the special motion picture cameras designed to take several hundred pictures a second. In an ordinary motion picture camera the film starts and stops between each two pictures; in the high speed cameras of Magnan and that of Edgerton, the film moves steadily, and if necessary the light is timed to flash whenever there is film for another picture behind the lens. About 1935 Professor H. E. Edgerton was invited to photograph humming birds feeding in large numbers from sugar solutions. As yet, however, it has not been possible to secure motion pictures of humming birds flying at their top speed. The pictures taken showed rates of 50 and 75 complete strokes a second; there is evidence that the birds can move their wings much faster.

In the fastest photograph of a bird in flight, a picture taken of a Mourning Dove by Professor Harold E. Edgerton and Mr. K. Germeshausen, the exposure was reduced to 1/75,000 second.

In contrast with the humming bird which maintains itself in the air at the expense of unceasing wing motion, pigeons and other birds with very broad flexible wings, are able to glide and soar as soon as they have reached sufficient altitude. The transition from the nearly vertical rise with rapid wing beats to the gliding flights with infrequent beats is accomplished by a decrease in the noise produced, an inclination of the body, and a change in pitch of the wing surface. As is to be expected, the larger number of available motion pictures refer to the initial stages and not to free flight.

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