One of the challenges of bird photography is catching the action. Bird behaviours associated with feeding, bathing, playing, mating and flight shots, all hold a degree of special interest. Birds bathing at a water-hole, kingfishers diving, nectar feeders hovering on a flower, and small birds flying are compelling subjects. To 'freeze' the action, a very short exposure is usually required and in some cases this will be beyond the capability of the camera shutter or require an heroic ISO sensitivity setting. This is especially so when the action occurs in poor light such as early or late in the day, in dappled or full shade, or in overcast conditions. These conditions occur more often than not when we are trying to photograph bush birds so in keeping with the theme of this event, 'Digital Photography in the Bush', it is perhaps appropriate that we discuss catching the action in a flash.

Flash Output Characteristics

In difficult lighting conditions, photographers are forced to use flash exposure to partially or completely compensate for deficiencies in the scene illumination. Modern flash units, called a Speedlite (Canon), Speedlight (Nikon) or simply a 'flash', use a high-speed switch known as a thyristor to discharge a capacitor through a xenon gas filled flash-tube. The resulting bright flash of light has a typical pulse duration of about 1/800 sec. What is not generally appreciated is that the pulse duration depends on the amount of electrical energy switched through the flash-tube. If the flash power is reduced, the pulse width will also reduce. This effect is illustrated in Fig. 1 for a typical mid-size flash unit, the Canon 430EX II. Flash units from the various manufacturers all have

similar output characteristics as there is little scope to modify the basic design governed by the physics of the gas discharge, switching circuit and power supply (see www.speedlights.net).

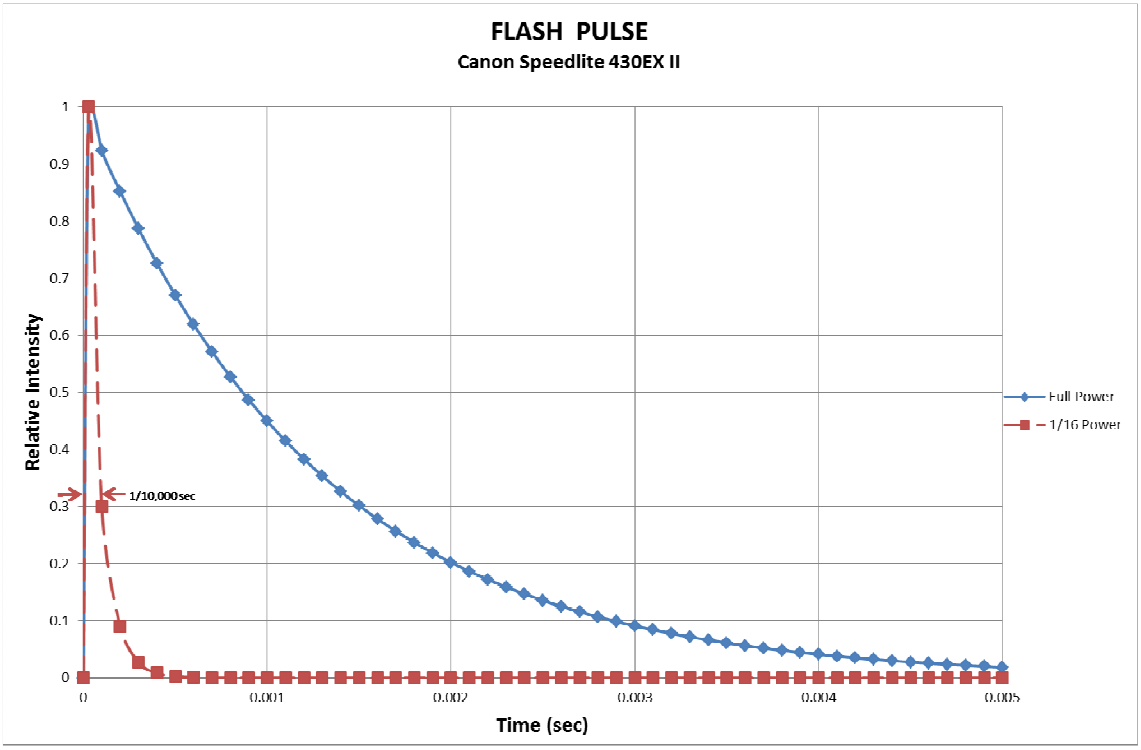

Fig. 1. The light output intensity after flash firing at time = 0. Note that when the flash unit is manually set to 1/16 power, the effective flash exposure time is between 1/5000 and 1/10,000 sec.

Manufacturers specify the pulse width measured at half the peak intensity or at the level where the intensity is 0.1 of the peak output. The effective exposure time is somewhere between these two values. Measured results for the Canon 430EX II using the more conservative definition of pulse width are shown in the table below. Note that most manufacturers use the more flattering shorter pulse width measured at half the peak intensity.

FLASH POWER	PULSE WIDTH* (sec)
Full Power	1/350
1/2	1/1630
1/4	1/3000
1/8	1/4300
1/16	1/5250
1/32	1/5600
1/64	1/6500

* Measured at 0.1 of peak intensity.

The output flash power can be set manually on most modern flash units. What is known as high-speed sync is also possible. This setting can be used at all shutter speeds, even the fastest available, typically 1/4000 or 1/8000 sec. High-speed sync works using the thyristor to switch the discharge off and on to produce a train of low power flash pulses while the shutter curtains are in motion, thereby ensuring even exposure across the focal plane. It is mainly used for fill-flash but is not useful as the main light in high-speed photography because the individual flash pulses are so weak that the ISO sensitivity required is very high. In contrast, *the high-speed technique discussed*

in this presentation relies on just one bright flash pulse to expose the entire focal plane while the shutter curtains are fully open.

Set-up Options

In principle, if a flash unit is used at reduced flash power, for example at 1/16 of full power, then it should be possible to get an effective exposure time of about 1/8000 sec. This will be fast enough to freeze most bird action using the right set-up. The key to success is arranging for the flash exposure to be significantly greater than the exposure due to ambient light. To minimize the amount of ambient light contributing to the image, the shutter needs to be set to the fastest fully open shutter speed available, usually 1/200 sec for full-frame cameras and 1/250 sec for cropped sensor cameras. This may seem like a very long time for the shutter to be open when aiming for an effective exposure time of 1/8000 sec, however, if the flash is bright enough, the ambient light contribution can be insignificant. To achieve this objective there are a number of things we can do:

- Use a powerful external flash unit.
- Move the flash unit close to the action.
- Use multiple synchronized flash units.
- Use Better Beamer flash extender(s).

It goes without saying that a big powerful flash unit is a better starting point than a small pop-up flash, and moving the unit closer to the action will dramatically increase the amount of light illuminating the subject. If the distance to the bird is halved, then the amount of flash illumination will increase by a factor of four. In addition, most modern flash units have a zoom setting designed to match the field of view of standard camera lenses, but not long focal length telephoto lenses. Nevertheless, it is worth manually setting the zoom flash coverage to concentrate the output as much as possible when using a long focal length lens.

An obvious way to increase flash exposure is to use multiple synchronized flash units aimed at the bird. Fortunately, flash manufacturers make it easy to do this using optical or radio wireless links between a master flash and one or more slave units. The slave unit(s) can be placed close to the action for maximum effectiveness while the photographer with camera mounted master flash can stand off at a distance which will not alarm the bird. We usually mount the slave flash about 1 m and the master flash between 5 and 7.5 m from the bird. The ideal set-up would use two or three flash units in front and one unit behind the bird. This is the typical set-up used to produce the spectacular shots of hovering hummingbirds regularly published in American birding magazines and on bird photography websites (see for example the online guide to hummingbird photography at www.rpphoto.com).

One more technique that can be employed to concentrate flash light is to fit a flash extender in front of the flash unit. A popular flash extender is the Better Beamer www.rpphoto.com, a pocket-size flat-pack comprising two fibre-glass supports for a Fresnel lens which, when assembled and mounted on the flash head, concentrates the output beam. The effect is to increase the intensity of the light illuminating the subject by up to four times. When multiple flash units are used, a flash extender is usually fitted to the master flash. Close slave units do not need the help of a flash extender because the output can be optimized using their in-built zoom coverage, but

slaves mounted more than about 1.5 m from the bird will be more effective if fitted with a flash extender. In sunny conditions, use flash extenders with care as they can focus sunlight to a small hot spot capable of burning skin, melting plastic or even starting a fire.

Depending upon the situation, we employ some or all of the options outlined above. The best results are obtained when the subject is in low light with a dark background, in which case the ambient light will contribute little to the overall exposure. With the right set-up, the total flash exposure will be similar to taking a shot in bright sunlight and the camera sensitivity required will usually be less than ISO 500 enabling the recording of images with good dynamic range (colour depth) and low noise. Depth of field becomes an issue for close range shots, and for long telephotos the lens aperture may need to be closed down to f/16 to get all the bird in focus. In doing so, one must be mindful that the effects of diffraction begin to degrade the resolution of fine detail for apertures smaller than about f/11, however, by getting closer, small details appear larger and the trade-off may be worthwhile.

Case Studies

Example 1. Single flash unit with bird at close range.

If the photographer can get close to the action, say within 3–5 m, such as in a hide or under camouflage netting, successful high-speed shots can be taken using just one flash unit fitted with a flash extender in a set-up like the one illustrated in Fig. 2. With powerful flash units such as the Canon 580EX or 600EX, there is plenty of energy at 1/16 power to record high-speed action in overcast or shady conditions (see for example Fig. 3). If there is high ambient light level, then those parts of the bird that are moving most, such as wing tips, will be recorded with a kind of ghostly halo. The halo is under-exposed movement blur recorded during the period the shutter is open (1/200 or 1/250 sec). In bright sunshine this will be objectionable but in some circumstances it can add an impression of dramatic action, for example, the exploding streaks of water droplets recorded when a bird takes a bath.

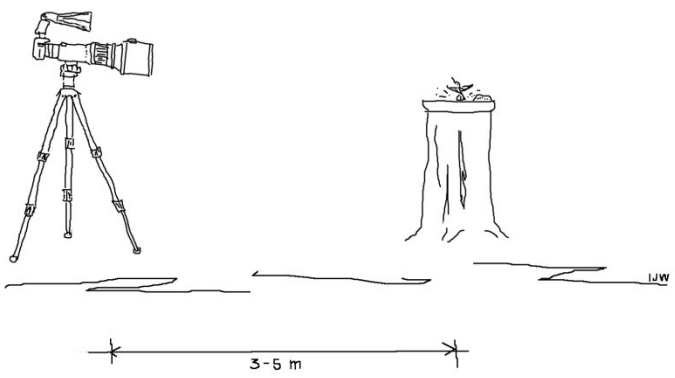

Fig. 2. Camera with single flash unit plus Better Beamer flash extender at close range.

Fig. 3. Eastern Spinebill taken with a single flash unit fitted with a Better Beamer flash extender. F/16, 1/200 sec, ISO 500, 1/16 flash power, tripod, partial shade, sunny day.

A good example of using high-speed flash at close range is around a bird-bath or small water-hole where lots of different species come to drink and bathe. For best results, the camera with flash should be mounted on a tripod with a gimbal head to enable fast image acquisition. Many species like to get into the water to bathe and usually give the photographer just enough time to focus on an individual before the sometimes spectacular action begins. Other species are coy and just dip their breasts or faces in the water. The most difficult action to capture is the high-dive. Some birds like to smack the surface after diving from an overhanging branch to which they return to dry themselves and preen. To catch the moment the bird hits the water is quite a challenge at close range because there is always uncertainty about the point of impact. The action is too fast for the lens autofocus to respond so one must anticipate the point of impact and pre-set the focus manually. A remote shutter release is invaluable as it negates the need to use the viewfinder, thereby enabling the photographer to take in the big picture and start firing a short burst as the bird is about to hit the water. After many attempts, a few will be worth keeping.

A single flash unit with flash extender has another application worth mentioning. It can be carried around mounted on the camera and used for hand-held shots. If the output power is reduced for a high-speed exposure, a multitude of problems are avoided included the need for a high ISO setting in poor light, movement blur, camera shake, and vibrations that may arise from the mirror and shutter drives. For close shots, the flash power should be set to 1/16 power and for longer range, 1/8 or 1/4 power should be used. Depending on the camera, the shutter speed is fixed at 1/200 or 1/250 sec and the f/No manually selected to give the right depth of field. Correct

exposure is achieved by manually adjusting the ISO setting as Auto ISO is not useful in this flash-mode because it has a default value of ISO 400. A possible disadvantage for people used to the convenience of aperture-priority and other semi-automatic shooting modes is the need to use manual camera settings, but the benefits can be considerable and well worth the trouble. Some of our best bird portraits have been taken using this technique.

Example 2. Using master and slave flashes at close range.

The problems arising from a high ambient light level can be overcome using a synchronized slave flash placed close to the action and triggered by a master flash standing further back (see Fig. 4). If the slave flash is located about 1 m from the bird, with zoom coverage adjusted for optimum lighting, and set to 1/16 flash power, then satisfactory exposure can be obtained in high ambient light. A set-up successfully used at our bird-bath has a Canon 430EX II slave positioned 0.75 m from the bath and the camera with 600EX RT master flash on a tripod about 5 m away. The master flash is equipped with a Better Beamer flash extender to concentrate its light on the target but, because the slave unit is so close to the bird-bath, it does not need the assistance of a flash extender. Another benefit is that the depth of field is greater when the camera is standing further back and the aperture can be opened up a little more than when at very close range. A picture taken using this set-up is shown in Fig. 5.

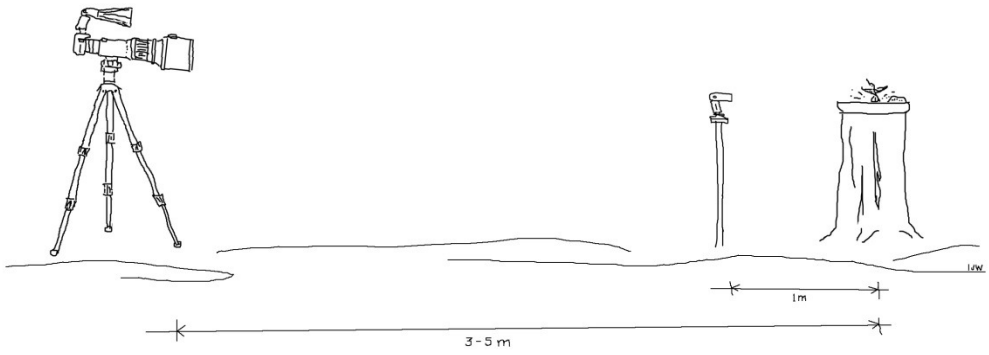

Fig. 4. Camera with master flash plus Better Beamer standing back and a slave flash close to the action.

We have also used a variation of this set-up to take shots with backlight by moving the slave unit to a position beyond the bird-bath (see Fig. 6). Pictures recorded at the bird-bath with flash backlight are notable for the large number of big and small water droplets that are highlighted by the back-flash. Even the smallest droplets strongly scatter light due to refraction and diffraction, making them highly visible (see Fig. 7). This can amplify the perception of action, but it can be a bit overwhelming. Highlights from wet surfaces can also be troublesome.

Fig. 5. Grey Fantail taken using a set-up similar to the one illustrated in Fig. 4. F/11, 1/200 sec, ISO 400, 1/16 flash power, tripod, full shade, sunny day.

When using a flash for backlighting, care needs to be taken to prevent the camera from directly seeing any of the flash output as it can cause stray light at the focal plane. To avoid this problem we use a black card fixed to the flash head with tape and positioned so that the line-of-sight to the camera is blocked.

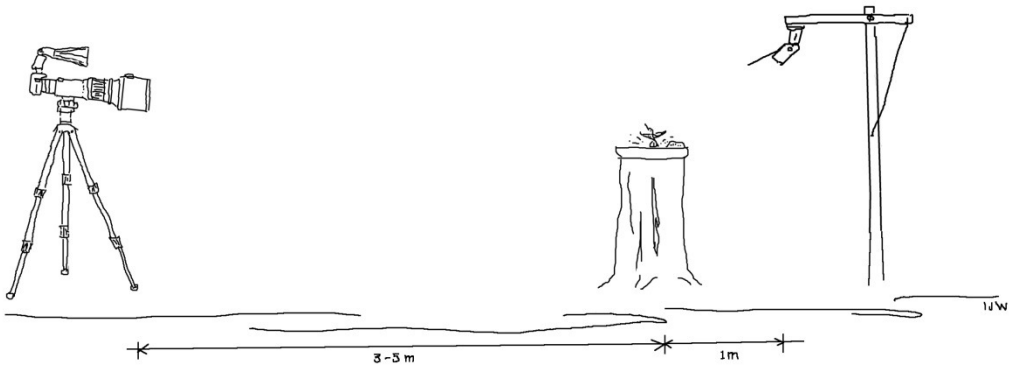

Fig. 6. Slave flash mounted on a boom behind the action to provide backlight.

Fig. 7. Brown Thornbill taken using a slave flash to provide backlight which highlights water droplets and translucent wing details.
F/16, 1/200 sec, ISO 400, 1/16 flash power, tripod, partial shade, sunny day.

Example 3. Using a master flash at longer range.

Sometimes it is not possible for the photographer to get close to the action but provided a slave flash can be mounted reasonably close, then high-speed photography is still an option. We had a situation like this during the winter when Eastern Spinebills were observed hovering under a banksia flower spike that was bent over and dripping nectar. For us, catching a good shot of an Eastern Spinebill hovering on a flower was a long-held aspiration. The flower spike was at least 4 m up and by climbing a step-ladder and trimming a little foliage using long-handled pruning shears, a line-of-sight was cleared. The slave flash was mounted on an articulated wooden boom about 3.5 m high and 1.8 m from the flower spike while the camera and master flash were at a range of 7.5 m. Both the master and slave units were fitted with Better Beamer flash extenders to maximize the amount of flashlight illuminating the target (see Fig. 8). The focus was pre-set manually on the end of the flower spike and a remote shutter release was used so the approaching birds could be easily watched and the shutter fired at the right moment. Our best shots were taken early in the day while the scene was in shade or on overcast days (see Figs 9–10).

An important question of personal taste that arises in high-speed photography is the choice of background. It is usually easy to arrange the set-up to produce a dark background which works well in some situations but looks inappropriate in others. One of the ways hummingbird photographers deal with this is by using a back-drop of vegetation, fabric or printed screen and no doubt there are ways of achieving tasteful backgrounds in post-processing.

Fig. 8. Set-up and typical ambient light for longer range shots using master and slave flash units fitted with Better Beamers. Canon 5D Mk III + 600 mm f/4, Canon Speedlites 600EX RT and 430EX II. The focal point on the flower spike is indicated by the ▶ mark.

Fig. 9. Eastern Spinebill taken with set-up shown in Fig. 8.
F/10, 1/200 sec, ISO 400, 1/16 flash power, tripod, cloudy day.

Equipment

While many of our shots were taken using professional equipment, this is not a requirement for success. Very acceptable shots can be taken with enthusiast level cameras, lenses, flash units and camera mounts. We are most familiar with Canon gear and have mentioned a few combinations, but similar equipment from other manufactures will also work well.

Cameras

Canon 5D Mk III with 300 mm to 600 mm lens.
Canon 7D or similar with 300 mm f/4, 400 mm f/5.6 or 300 mm f/2.8 + 1.4× extender.

Flash Units

Canon Speedlite 600EX RT with Better Beamer flash extender.
Canon Speedlite 580EX II with Better Beamer flash extender.
Canon Speedlite 430EX II with Better Beamer flash extender.

Remote Shutter Release

Plug-in cable model such as Canon RS-80N3.

Camera Mounts

Sturdy tripod such as Gitzo 3-section carbon fibre.
Gimbal head such as Kirkphoto 'King Cobra' or Wimberley equivalent.

Fig. 10. Brown Thornbill taken with set-up shown in Fig. 8.
F/10, 1/200 sec, ISO 400, 1/16 flash power, tripod, cloudy day.

Concluding Remarks

Various forms of high-speed photography have a place in ornithology to record action that is too fast for the human eye to properly see. Some of the resulting images are spectacular in their scientific interest and sheer beauty. Unfortunately, the technical difficulty and special equipment usually required for high-speed work can be formidable obstacles to amateur photographers. However, the techniques discussed in this presentation, based on a simple principle that can be exploited using gear that many bird photographers already have in their kit, is easy to implement. As well as having the right gear and understanding how to use it, a certain amount of planning and preparation is necessary and with a little practice, great pictures should be the reward. The critical success factor is arranging for the flash exposure to be significantly greater than the exposure due to ambient light.

Acknowledgement and Thanks

I would like to thank John Stirling for his encouragement during the course of the work and for his advice during the preparation of this presentation. I would also like to thank the BirdLife Photography Group organizers for inviting me to make a contribution to the Ingham programme and for the hard work of the behind-the-scenes volunteers who make these events a success.