Test of an inexpensive camera set for nest and animal activity observations

The possible factors involved in nest predation have been studied for a long time (MARTIN 1993, MAJOR & KENDAL 1996). Neither the reviews on nest site characteristics nor those on landscape structure yielded clear results and it became obvious that the set of possible predators in the study area had to be investigated (MARTIN 1987). Amongst many other methods (BAKER 1980, BULL et al. 1992, MAJOR 1991) phototraps have led to interesting results (DANIELSON et al. 1994). But the systems used either had the disadvantage of being rather expensive (KUCERA & BARRETT 1993, CARTHEW & SLATER 1991) and thus were not suitable for large-scale studies, or they were cheap but worked with simple mechanical cameras taking only one picture between two control visits (BROWDER et al. 1995, PICMAN 1987, MAJOR 1991). Additionally, these cheaper systems consisted of several movable components which need to be adjusted. One system solved this problem (GOETZ 1981), but as with others it does not come up with a databack. It would therefore require a clock near the nest or a clock would have to be connected to the trigger to be able to determine the time of an event (BALL et al. 1994, BAYNE & HOBSON 1997, HENSLEY & SMITH 1986, PICMAN 1987).
Simple AF rangefinder cameras with electronic releasers, integrated light meters, automatic flash, automatic film advance and databack, are used in more recent phototrap systems, which are either home-made (MAJOR & GOWING 1994, DANIELSSON et al. 1995) or commercially available (KUCERA & BARRETT 1993). These systems work very well and can be constructed quite simply, but the Trailmaster Camera used by KUCERA & BARRETT (1993), BROOKS (1996), HERNANDEZ et al. (1997 a+b) is rather expensive and, like the systems of MAJOR & GOWING (1994) or DANIELSSON et al. (1995) lacks the capacity to be adapted to different trigger circuitries. If the nest is to be baited with several eggs to mimic a bird's clutch, microswitch devices pinned to a single egg are inappropriate. In addition, the modern cameras are fitted with a power management which switches the camera into the sleep mode after several minutes. This function is controlled by a microchip and cannot be programmed as long as the companies do not release the protocol of the chip. Problems mainly occur at night because the flash's capacitor is not charged in the sleep mode and it takes up to half a minute to reactivate. Thus MAJOR & GOWING (1994) set a time delay circuitry between the trigger and the camera. This is appropriate when a predator stays at the nest for several seconds. Our observation using a videocamera is that a predation event may last only a few seconds, particularly, when a single egg is taken off by a bird predator (SCHAEFER unpubl. data). On these occasions, a time-delayed system might fail.

We constructed a circuitry which bypasses the power management and releases the camera. It can be fitted with several kinds of trigger mechanisms, in this case a light barrier. We built 15 phototraps and tested them at the Western Lake of Constance (47°45'N, 9°00'O), Germany, in the breeding seasons 2000/01 from mid-May to the end of July.

We used a low-cost camera with the properties mentioned above. As the camera lacked a cable release mechanism, we opened the camera, tested the three assignments of the releaser's contacts and connected them and the on/off switch with our circuitry via a 4 * CMOS switch (MAX 4521) through a small hole drilled into the camera's casing (Fig 1). To facilitate the handling, a plug was mounted onto the camera so that camera and circuitry could be separated. First, the light meter was switched on and after 100 ms the shutter was released. Both contacts remained closed for another 100 ms to ensure a proper reaction of the camera. The camera exposed and forwarded the film automatically. The power management was outwitted by switching the camera off and on every 30 s, which kept the camera in the stand-by mode and ensured only a short delay after an impulse from the trigger system. The usual delay from the sleep into the active mode amounted to a few seconds. But at night it may take up to half a minute to charge the flash capacitor. If the camera is in the stand-by mode, the capacitor will be charged and the delay after a signal is about 200 ms. For the control of the whole system a single chip microcontroller was essential. It was programmed to check the light barrier every 5 ms and to control the functions of the camera by the CMOS switch (Fig 1). The programme memory of the microcontroller (8 kB flash) was programmed via a serial interface with a 3 kB software written in PASCAL. The power of the camera was supplied by the batteries of the camera itself, but we chose a camera where AA accumulators allowed a life capacity of several weeks. The circuitry and the light barrier were driven by 6 V, provided by four AA- NiMH- accumulators with 1300 Ah, so at cold weather the supply lasted one, at warm weather two days.

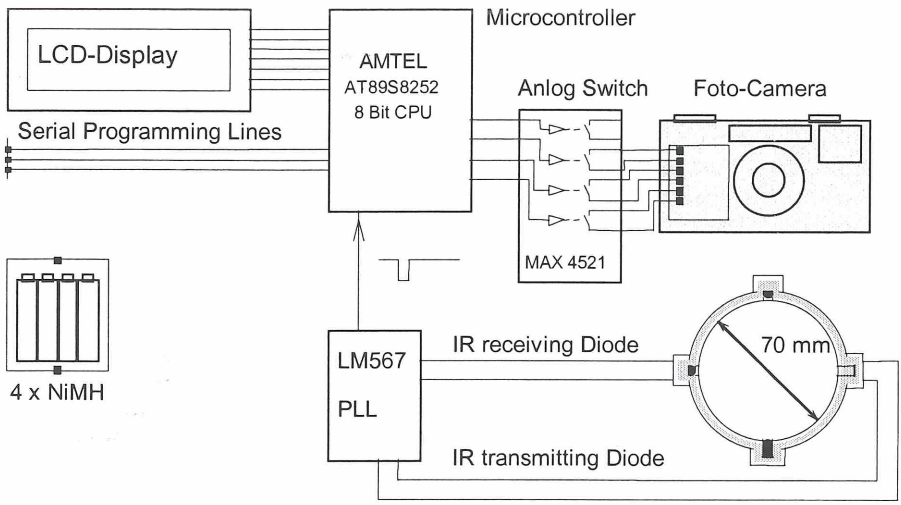

Fig. 1: Scheme of the circuitry of a multi-purpose camera set with an automatic rangefinder camera. The light barrier can be replaced by a microswitch or a motion sensitive device.
Abb. 1: Schema der Schaltung für eine multifunktionale Kameraanlage mit automatischer Sucherkamera. Die Lichtschranke kann durch Mikroschalter oder Bewegungsmelder ersetzt werden.

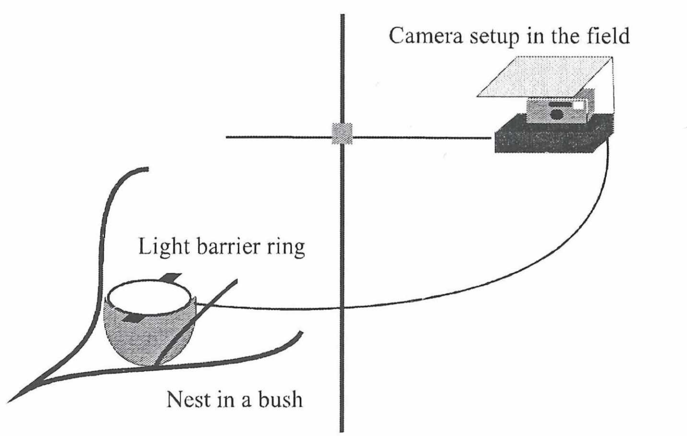

Fig. 2: Scheme of setup in the field. The light barrier ring is fixed to the nest with nails. The ring is camouflaged with tufts of grass. The camera releases when something interrupts the light barrier.
Abb. 2: Schema der Fotofalle im Feld. Der Lichtschrankenring wird mit Hilfe von Nägeln auf das Nest gesteckt. Die Kamera löst aus, sobald die Lichtschranke unterbrochen wird.

The circuitry was mounted into a waterproof box, the camera onto the box, covered by a simple plastic roof attached to the box. The box was fixed on a rod of 80 cm connected with a 2 m pole by a coupling, which allowed movements in all three dimensions (Fig. 2). Trigger impulses were obtained by interrupting an infrared light barrier with a wavelength of 840 nm, which was built into a plastic ring and fixed onto the nest (Fig 2). To compensate for temperature and solar irradiation, which might lead to false releases, the barrier was driven with a modulated signal from a PLL-circuitry (Phase-Lock-Loop). The ring was connected to the camera circuitry by a simple 3-poled cable. We ran the phototrap with a light barrier for several reasons. Firstly, we baited the nests with several eggs so a microswitch attached to a single egg was inappropriate. Additionally, we wanted to monitor shrub-nesting birds' nests, so a motion-sensitive device would lead to false releases as soon as a single leaf moved (circuit layout and PASCAL software can be provided by the authors on request).

Robbed or abandoned nests of the Blackcap (*Sylvia atricapilla)*, one of the most abundant shrub-nesting bird species in the area, were baited with three infertile Blackcap eggs from the aviaries of the Vogelwarte Radolfzell to simulate an entire clutch. To camouflage the light barrier ring and adapt it to the nest we wound tufts of grass around it and fixed it onto the nest with nails. The camera was mounted at a distance of 150 cm at an angle from above allowing a view of nest's contents. The setting up of a trap took about 10 min. The batteries of the circuitry had to be changed daily, but the camera's batteries lasted for several weeks.

We took about 230 photographs of predatory individuals at 36 different nests from five rodent and three passerine species and documented 95 predatory events. A series of photographs of the same individual allows estimations on the time a predator stayed at the nest. At night, the camera took up to 5 pictures per minute. Even though the circuitries were exposed for more than 20 weeks in two subsequent breeding seasons not even one failed due to technical problems. There was no failure due to humidity and the cameras worked well between temperatures of 8 °C and 45 °C . No nest was robbed without a picture being taken, but in about 10 % (n = 757) of the daily controls, there were false releases due to snails entering or leaves falling into the nests.

The price of one set is approximately 50 € without the trigger and batteries costing another 15 € and thus comparatively inexpensive. As the set consists of only one part, no components have to be adjusted. Furthermore, the set is rather small and inconspicuous and allows photos even in dense vegetation. The winder provides the opportunity to take several pictures within two controls and the data back indicates the time of any event. Finally, the circuitry allows any kind of trigger impulse such as microswitches or motion-sensitive devices, which is rather important if the system has to be adapted to different approaches or scientific projects.

An alternative to the rangefinder camera used here is a digital still camera, which facilitates the viewing of the results and allows series of more than 36 pictures. Additionally, costs due to film material, development and copies do not occur. We tested a digital camera regarding the suitability for the circuitry and found that the same devices would be needed to operate the power management and release the camera. Unfortunately, digital still cameras are presently not available for less than 150 €. Therefore, particularly with respect to financial considerations, a rangefinder camera proved to be an appropriate alternative. A clear disadvantage of the circuitry is that some technical knowledge is required to build it up. But, as most universities dispose of skilled technicians this inexpensive and easily appliable device can be recommended unreservedly.

Zusammenfassung

Test einer kostengünstigen Fotokameraanlage für Nest- und Verhaltensbeobachtungen.

Um Prädatoren von beköderten Nestern zu bestimmen, wurde eine Schaltung entwickelt, die missliebige Funktionen gebräuchlicher AF-Sucherkameras umgeht. Die Schaltung gestattet den Einsatz verschiedener Auslösemechanismen und ist daher für zahlreiche Anwendungen, bei denen Tiere mit Bewegungsmeldern oder Lichtschranken dokumentiert werden sollen, einsetzbar. Wir setzten einfache Sucherkameras mit Motor und

Datenrückwand ein und testeten 15 Systeme über sechs Monate in den Jahren 2000 und 2001 unter Feldbedingungen an mit unbefruchteten Eiern beköderten Nestern der Mönchsgrasmücke. Fotos wurden von einer Reihe von Vogel- und Säugetierarten gemacht. Der Zeitpunkt jedes Ereignisses konnte bestimmt werden, Bildfolgen gestatten darüber hinaus, die Dauer eines Ereignisses zu schätzen. Die Kosten belaufen sich auf etwa 50 € ohne Auslösemechanismus und Batterien.

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Erfolgsbrut einer Tannenmeise (*Parus ater*) an ungewöhnlichem Neststandort

Tannenmeisen (*Parus ater*) sind – wie alle Arten der Gattung *Parus* – Höhlenbrüter, die allerdings auch ausgefallene Nistplätze „wie Raubvogelhorste, Eichkatzkobel, Erdlöcher und dergl." (Berndt 1936) annehmen. Dass sie dies „trotz der erwiesenen Vorliebe für Baumhöhlen" tun, geht wohl darauf zurück, „daß die Konkurrenz der übrigen Höhlenbrüter sie dazu zwingt"(Löhrl 1974). Wenn allerdings am richtigen Ort ein Überangebot an künstlichen Nisthöhlen existiert, kann *P. ater* ggfls. sogar zur dominierenden Höhlenbrüterart werden, wie dies z.B. in unserem mit rund 550 Holz-