Kurze Mitteilungen

Use of miniature security cameras to record behaviour of burrow-nesting birds

The observation of birds in their natural habitats poses particular problems for biologists working in behavioural ecology. Direct observations may not be feasible as the presence of a human observer may disturb the birds and influence their behaviour. In some cases, breeding birds can even abandon disturbed nests or the breeding success can be reduced. In addition, the observation of burrow-nesting birds is often difficult or impossible. A variety of techniques has been used for the study of burrow-nesting birds, such as boroscopes, endoscopes, and miniature video cameras. However, those systems had a number of flaws. For example, they did not allow simultaneous recording of sound and images, or required the use of white light (which may disturb the birds and demand high power supply), or needed the continuous presence of an operator (which may also disturb the birds) or were expensive (c.f. SETO & JANSEN 1997). We here present a miniature camera video system which offers solutions to these problems, and facilitates revision of the filmed material away from the study site. We tested the system in two bird species in different habitats, namely Burrowing Parrots in Patagonia and Wilson's Storm-petrels on the South Shetland Islands, Antarctica.

Burrowing Parrots (*Cyanoliseus patagonus*) are highly gregarious colonial birds, that can form large flocks and roosts, sometimes in excess of 1000 birds. In Argentina, the species occurs from the Andean slopes in the Northwest to the Patagonian steppes in the South (BUCHER & RINALDI 1986). Burrowing Parrots excavate their own nest burrows by tunnelling into the faces of sandstone, limestone or earth cliffs (LEONARDI & OPORTO 1983). The nesting pairs use burrows which they have dug in previous seasons but they enlarge the burrows every year (MASELLO et al. 2002). The burrows are depressed cylinders in the sandstone's softest layers of the cliff. Most of the nests are about 1.5 m deep, but many can reach more than 3 m. The nests terminate in a nest chamber where the chicks are raised (for more details of the nest structure see LEONARDI & OPORTO 1983). Burrowing Parrots do not use nesting material but, rather, deposit their eggs on the sandy bottom of the nest chamber. Burrowing Parrots have a tendency to desert in response to disturbances during the incubation period (DE GRAHL 1985) and during the first week after hatching of the nestlings (Masello et al. 2002). After our first year working with Burrowing Parrots the need for a system that would enable us to observe the behaviour of the parrots inside the nests without disturbing them was therefore obvious.

Wilson's Storm-petrels (*Oceanites oceanicus*) are one of the most abundant Antarctic seabird species. They nest in colonies in scree slopes along ice-free Antarctic and Subantarctic coasts, where they lay a single egg in a natural cavity. Wilson's Storm-petrels exhibit intensive biparental care (QUILLFELDT & PETER 2000, QUILLFELDT et al. 2001). Incubation and chick feeding are shared between the sexes. The chicks remain in the nest for about 60 days, are not usually attended by an adult during the day, and are only fed during brief nightly visits. During the chick-feeding period, adults forage at sea and return to feed the chick at intervals of about two days (QUILLFELDT & PETER 2000). Adults arrive in the colony in darkness, and the feedings take place exclusively in the nest burrows, which are at least 50 cm deep and dark. Like many storm-petrels, Wilson's Storm-petrels tend to abandon their breeding attempt in response to disturbances. Thus, in order to study chick provisioning behaviour, a system was required which would record behaviour in complete darkness and in the observer's absence.

In order to accommodate the needs of the parrot and petrel projects, we constructed an inexpensive miniature camera video system which enabled us to record sound and image simultaneously, which worked in darkness and required a minimum of attention.

Study area and methods

The miniature camera system was first used between December 1999 and February 2000 at the largest breeding colony of Burrowing Parrots in the province of Río Negro, Patagonia, Argentina. The colony is located on a sandstone cliff, extending for 5 to 10 km (ANGULO & CASAMIQUELA 1982, YORIO & HARRIS 1997), but the first kilometre of the colony (41°3'S 62°48'W) is by far the densest with 6750 active nests (J. F MASELLO unpubl. data). We selected five nests at heights of 11 – 18 m in the densest sector of the colony to record the provisioning behaviour of the parrots. The nests were reached by climbing and the camera was placed into the nest chamber.

The study of Wilson's Storm-petrels was carried out in the Tres Hermanos (Three Brothers Hill) colony on King George Island, South Shetland Islands (62° 14'S, 58° 40'W) in the maritime Antarctic from February to March 2000. About 2000 pairs breed in this colony (HAHN et al. 1998), and non-breeding birds are also highly active (QUILLFELDT et al. 2000). Nests in the study colony have been marked in ongoing studies of breeding success. The behaviour of nestlings and provisioning adults was recorded with the camera placed in the nest entrance close to the nest chamber at a distance of ca. 15 cm from the chick. The camera was put in place in the first night of the observations, and left in the cavity for a period of 15 days. Every night before sunset, the system was provided with a recharged battery and empty cassette, switched on and left recording through the night.

This video system consisted of a miniature camera with infra-red illumination and a built-in microphone, a small monitor and a standard video cassette recorder (Fig.). We designed the system such that it can be assembled from components of different makes and models, which are available from electronic shops. The camera used was a black-and-white Charge Couple Device (CCD), which produces a video output signal of 1.0 – 1.1 V_{p-p} / 75 Ω, has a horizontal resolution of 512 x 582 lines, a focal distance f = 4.3 mm and an aperture of F = 1.6 mm. Six infrared light emitting diodes (LED) were used as light source, allowing the camera to work in darkness and providing good illumination at a range of three to four meters. The camera's automatic linear shutter and gain control produce an image at a minimum illumination of 0.5 lux (faceplate sensitivity). The camera has a built-in microphone with an audio output signal of 1 V_{p-p} / 600 Ω, and an audio frequency range of 40 Hz-16 KHz. The camera-LEDs-microphone unit was entirely housed in a standard plastic box for protection from weather and sand. The total dimensions of the unit were 55 x 55 x 27 mm, and the total weight was approximately 60 g. At the Burrowing Parrot colony, a mini-crampon was added to the base of the plastic box that housed the camera-LEDs-microphone unit for a better positioning in the sandy nest bottom.

A standard two core loudspeaker cable with heavy duty PVC sheath was used to connect the camera-LEDs-microphone unit to the rest of the system. The electrical connections are shown in the Fig. Two of the four wires needed for the connection provided energy to the camera, and the other two transmitted the audio and video (A & V) signals to the video cassette recorder (VCR). At the Wilson's Storm-petrel colony a cable of 3 m was used, while 50 m of cable were needed for connecting the camera-LEDs-microphone unit to the VCR and the battery at the Burrowing Parrot colony. For this connection, we used 6-pins military plugs (MIL-C-5015, 14S-6S and 14S-6P, RS-Components), which were necessary to resist the constant pressure on the connectors by the long cable exposed to the strong Patagonian winds. During transport, the cable was round on a reel for easy manipulation. Because of the long cable used, mismatched impedance and important cable attenuation of the audio signal were observed. To avoid this problem and obtain the desired audio signal performance, an audio preamplifier was designed and added at the camera output (Fig.). This audio preamplifier was based on an LM108 Operational Amplifier (National), has a high impedance input of 22 MW, a low impedance output of 10 KW and a voltage gain > 100.

The VCR used is a standard last generation equipment, cheap, light, and small, which recorded eight hours continuously with a standard video cassette in slow recording mode. A small monitor

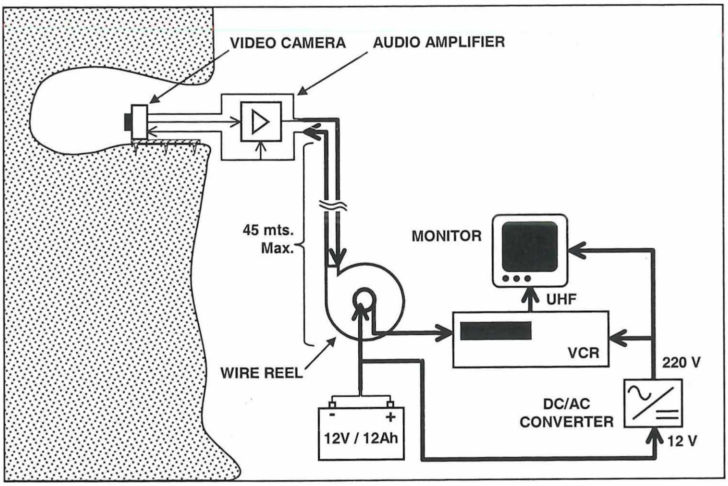

Fig.: Schematic diagram illustrating connections for the miniature camera video system. The distance between the audio amplifier and the camera-LEDs-microphone unit was 120 cm. – Schematischer Bauplan des Miniatur-Videosystems. Der Abstand zwischen dem Audioverstärker und der Kameraeinheit betrug 120 cm.

was used to position the camera in the burrow, and was normally switched off when the VCR was recording in order to save battery time (if not, the running time of the video system is reduced to four hours without changing the battery). A rechargeable 12 V–12 Ah battery supplied energy to the system. The VCR and the monitor required the most power in the system: 33 W (i.e. ten times greater than the rest of the system), and needed a 220 V power supply. A 12 V DC to 230 V AC converter was employed to obtain this kind of energy from the battery used as power supply. This standard DC / AC converter has a maximal power output of 150 W and supplies a current of 0.3 – 11 A (as a function of load requirements). The converter needs a voltage input of 11.5 – 14.5 V, which is provided by the portable battery. The inclusion of this converter does not increase substantially the final system power consumption. The monitor is also capable of working with 13.5 V DC, but the battery used could not maintain this voltage for long. The camera, LEDs and microphone were directly connected to the same battery (see Fig.).

The entire system, except the reel with the cable, was placed in two standard aluminium tool boxes to protect the system against humidity, snow and sand.Due to the small size of the camera-LEDs-microphone unit no modifications of the nests entrances were necessary, both at the Burrowing Parrot and Wilson's Storm petrel colonies.

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Results and discussion

Maritime Antarctica and arid Patagonia present extreme weather conditions. Electronic systems and components have to withstand low temperatures, rain, snow and strong winds during the summer in maritime Antarctica. During the summer in arid Patagonia they must resist strong winds, which carry a lot of dust, and heat. The miniature camera video system presented here proved to be fully effective in both habitats. The video system operated without inconvenience in a wide range of temperatures from –10 °C in the Antarctic summer to more than 30 °C in the Patagonian summer. It also presented no problems with snow, rain, and winds up to 20 knots.

Our miniature camera video system allowed recording image and sound simultaneously and produced a clear image in total darkness at a distance of 5 to 80 cm from the lens. We were able to identify, from the recorded material, items as small as insects crawling on the nest bottom at the Burrowing Parrot colony. It also allowed us to observe the behaviour of both bird species, the Burrowing Parrot and the Wilson's Storm-petrel, inside the nests without disturbing them. None of the nests in which the system was placed was abandoned by the adult birds and in all the studied nests the chicks grew and fledged normally. Seto & Jansen (1997) reported aggressive attacks on the camera they used to monitor Bonin Petrels (*Pterodroma hypoleuca*), especially when the system was used with white light. In 15 days of effective recordings and several days of testing the system at the Burrowing Parrot colony, and 36 nights of recordings at the Wilson's Storm-petrel colony, no attacks from the birds were observed on our system. This is possibly due to the small size of the system and the use of infra-red illumination. The Wilson's Storm-petrels showed no signs of detecting the camera at all, while the Burrowing Parrots detected the system, but got used to its presence in the nest in the course of one hour.

Using our video system parameters of chick provisioning could be quantified, such as feeding frequency, time of arrival, identity of the provisioning adult (presence of leg bands or plumage markers), duration of the stay of the adult in the nest, beginning and duration of feedings, number of feedings during one stay in the nest and number of food transfers during a feeding event. Meal sizes in burrowing petrels are usually estimated by daily weighing and correcting the daily mass differences for the metabolic mass loss (e.g. Quillfeldt & Peter 2000). Combining the video system with daily chick weighing, we could validate the formerly used methods.

The system could be transported on foot and operated efficiently by one person. It required the presence of an operator once every eight hours in order to change the video cassette and the battery. The entire system was constructed with standard and cheap electronic components. Miniature cameras of the type used are sold for security systems. The total cost of the components for the system, including battery chargers, was approximately US$ 400. It is thus an inexpensive alternative to other video systems previously available.

Zusammenfassung

Einsatz von Miniatur-Sicherheitskameras
zur Beobachtung von Höhlenbrütern.

Beobachtungen von Höhlenbrütern sind oft schwierig, weil die Nesthöhlen sich als zu tief und zu dunkel für direkte Beobachtungen erweisen. Außerdem geben viele Arten die Brut nach Störungen durch Beobachter auf. Um diese Probleme zu umgehen und das Verhalten von Höhlenbrütern bei der Fütterung zu untersuchen, entwickelten wir ein Miniatur-Videosystem. Mit Hilfe dieses Systems konnten wir zudem das gefilmte Material nach der Freilandsaison analysieren. Das System wurde erfolgreich bei zwei Arten in Extremstandorten eingesetzt: bei Felsensittichen (*Cyanoliseus patagonus*) in der Steppe Patagoniens und bei Buntfuß-Sturmschwalben (*Oceanites oceanicus*) in der maritimen Antarktis. Das gesamte Videosystem besteht aus preiswerten Standardkomponenten und kann daher günstig bei verschiedenen Arten von Höhlenbrütern eingesetzt werden.

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Comparative study of the autumn migration of Marsh Harriers (*Circus aeruginosus*) at three sites of the central Mediterranean

Both during spring and autumn migration substantial numbers of Marsh Harriers (*Circus aeruginosus*) cross the central Mediterranean (GIORDANO 1991, AGOSTINI & LOGOZZO 2000, AGOSTINI 2001a, 2001b, CORSO et al. 2001). In this area the greatest concentration occurs at the Straits of Messina (between Sicily and continental Italy) during spring (max. 3074 individuals counted in 2000; CORSO et al. 2001). In this study, observations were made on the autumn migration of this species at three sites of the Central Mediterranean where notable concentrations of Accipitriformes are recorded each season: the Circeo promontory (CORBI et al. 1999) and the islands of Malta (BEAMAN & GALEA 1974) and Marettimo (western Sicily, AGOSTINI et al. 2000). The aim was to investigate the routes used by the Marsh Harrier in this area, by comparing the variations of the migratory flow and the proportion of birds belonging to different age and sex classes recorded at each site, to verify the tendency of this species to migrate on a broad front undertaking long crossings of water using powered flight (KERLINGER 1989).

Study areas and methods

Observations were made from 15 to 29 September 2000, each day from 9.00 h CET until the dusk, aided with telescope and binocular. The Circeo promontory is located in the southernmost point of the Pianura Pontina reaching 541 m. a.s.l. (Fig.1). The observation post was located along its southern slope and was chosen to detect the direction of birds leaving the promontory. Here no monitoring was made on 20 September because of