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A Miniature Camera System for Studies of Grassland Passerine Nests

Populations of many grassland passerines that breed in North America have declined in recent decades. Nest depredation may contribute to these declines, but determining causes of nest failure and identifying important nest predators can be problematic. Indirect evidence is often lacking and can be misleading; direct observations are rarely possible or practical to obtain. Camera systems that have been used for surveillance of artificial nests (e.g., flash cameras with tripping devices) or nests in woodland habitats (e.g., tripod-mounted camcorders) are generally unsuitable for use at natural nests in grasslands. In grasslands, visual obstruction from surrounding vegetation often requires that cameras be placed closer to nests than in other habitats. Consequently, cameras must be small and unobtrusive to avoid disturbance to nesting birds and detection by predators or brood parasites.

Our goal was to design and test a miniature camera system suitable for determining nest fates and identifying predators at nests of grassland passerines. In 1996 and 1997, we deployed several prototype camera systems at passerine nests in a variety of grassland habitats. Our objectives were to determine whether the systems were (1) accepted by nesting passerines, (2) useful for determining nest fates, (3) useful for identifying various types of nocturnal and diurnal predators, (4) useful for documenting sources of sign at destroyed nests, (5) useful for documenting other activities at nests (e.g., incubation patterns, feeding of nestlings, cowbird parasitism), and (6) field-worthy (e.g., durable, weatherproof, portable).

Camera System Design and Deployment

In 1995-1996, we worked with electrical engineers to develop prototype camera systems. Each system included a miniature black-and-white electronic-board camera in waterproof housing (about 4x4x4 cm) with infrared light-emitting diodes around the lens to provide illumination at night. Several 3-4-mm lenses (horizontal field of view ranging from 51º to 88º) were tested. We placed each camera on a wooden dowel about 10-30 cm from a nest and connected it with a 50-m cable to a DC-powered time-lapse video cassette recorder (VCR). A 2-m cable connected the VCR to a deep-cycle marine battery. The VCR was housed in a waterproof case that had external connectors for the camera, battery, and a hand-held monitor. A 1.3-L frozen gel pack and a silica-gel desiccant canister were placed inside the VCR case in an effort to keep heat and humidity levels within the VCR's recommended operating range. Using time-lapse recording, we collected 24 h of data (about three images/sec) on a standard VHS tape. We made daily visits to the VCR to check nest status (using a hand-held monitor), change tapes and gel packs, and check battery power. Batteries were changed at least every three days. The camera was left in place until the nest was destroyed, abandoned, or fledged young.

The study areas were in 22 sections of Stutsman and Barnes Counties, North Dakota. Areas were dominated by medium or short grasses with varying amounts of low shrubs, forbs, and litter. Cameras were deployed at 69 nests of 10 grassland passerine species. We monitored an additional 295 nests of 13 species using nest visits only.

Camera System Evaluation

Acceptance by Nesting Passerines

Nearly 25% of nests were abandoned within one day of camera deployment. About 2% of nests without cameras were abandoned within one day of finding the nest. Only 1 of 20 camera-monitored nests with nestlings was abandoned within one day (5%), compared to 15 of 49 camera-monitored nests with eggs (31%). Abandonments were not restricted to any species, habitat, or nest type.

Determining Nest Fates

Using cameras, we determined nest fates for 47 of 53 non-abandoned nests (equipment failed or was pulled before nest completion at six sites). We documented many events that could lead to errors when nest fates and causes of failure are assigned using information from periodic nest visits. Examples include (1) premature fledgings induced by predators at six nests; (2) two active shrub nests that gradually tipped over, dumping nestlings on the ground; (3) a parent that knocked two-day-old nestlings out of the nest when it was flushed at night (Photo 1); (4) a red fox (*Vulpes vulpes*) scavenging eggs that had been punctured by a brown-headed cowbird (*Molothrus ater*, Photos 2 and 3); (5) removal of three eggs from one nest by a cowbird/cowbirds that laid no parasitic eggs; and (6) a predator killing and removing a parent from the nest (Photo 4). Using nest visits rather than videotapes, we would have misclassified the success or failure of three to four nests (depending on whether nests with predator-induced fledgings were considered successful), the cause of failure at three nests, and the stage of failure (incubation versus nestling) at one nest. Our estimated number of fledglings also would have been wrong at several nests.

To evaluate the possible effects of cameras on predation rates, we compared Mayfield daily predation rates of nests with and without cameras. To ensure that exposure days and nest fates were assessed similarly for nests with and without cameras, we calculated the number of exposure days for nests with cameras as if they had been on the same visitation schedule as nests without cameras, and we assigned nest fates based only on evidence at nests. Nests were classified by stage (incubation or nestling) and by height (on the ground or above ground) to prevent these factors from confounding tests for camera effects. We obtained insufficient data for above-ground nests during incubation to include this group in our analysis. For the other three groups, we detected no effects of cameras on predation rate ($P = 0.33$). Nevertheless, nests with cameras tended to have lower daily predation rates (mean difference = 0.013, SE = 0.013), suggesting that some types of predators may avoid nests with cameras. If so, data from cameras might result in underestimation of actual predation rates and biased assessments of the relative importance of some predators.

Predator Identification

On videotape, we documented depredations of eggs or nestlings from 29 nests (Photos 2-9). Predators at most nests could be identified to species: thirteen-lined ground squirrel (*Spermophilus tridecemlineatus*; eight nests), Franklin's ground squirrel (*S. franklinii*; five), American badger (*Taxidea taxus*; two), white-tailed deer (*Odocoileus virginianus*; two), long-tailed weasel (*Mustela frenata*; one), red fox (scavenger; one), brown-headed cowbird (two), northern harrier (*Circus cyaneus*; one). Three were identified to genus (*Peromyscus*, *Zapus*, *Buteo*). In two cases, we narrowed predator identifications to two species (red fox or coyote [*Canis latrans*]) or genera (*Peromyscus* or *Zapus*). Three predators could not be identified because they were screened from camera view by vegetation. Large predators were difficult to identify because cameras had to be placed relatively close to nests to monitor the contents. The wider-angle lenses in some cameras were meant to minimize this problem; however, image quality decreased as camera field of view increased. Images produced during the day were sharper than those produced at night with infrared light, although shadows produced by bright sunlight sometimes made images difficult to interpret.

Identifying Sources of Sign at Depredated Nests

Using cameras allowed us to link sign left at nests with specific predators. At 12 of 26 depredated nests, no sign was evident. Disturbance to the nest bowl was more common at above-ground nests than at ground nests. Some researchers associate major nest disturbance with predation by large mammals, minor disturbance or eggshell fragments with predation by small mammals, circular holes in the bottom of nests with predation by snakes, and lack of disturbance with predation by birds or snakes. We found that larger predators often left no sign, an avian predator completely destroyed a nest, disturbance by ground squirrels varied from one extreme to the other, and ground squirrels left circular holes in three nests. Such intraspecific variability and interspecific overlap in types of sign indicate that evidence at the nest is not a reliable basis for predator identification.

Documenting Nest Activities

Videotapes of nests were useful for determining incubation and brooding patterns and parental visitation rates. Documentation of adults feeding nestlings (Photo 10) and removing fecal sacs was easy to obtain;

however, camera positions and taping rate limited our ability to quantify these types of events. Video image quality also limited our ability to identify food items. Other events documented with cameras included parents eating egg shells (Photo 11), interactions between adults (Photo 12), and reactions of adults and nestlings to disturbances.

Field-worthiness

Most equipment withstood our field tests; however, a number of repairs had to be made during the second field season. Two cameras failed because their housings were not watertight. Cable connectors occasionally developed electrical shorts. Near the end of the 1997 season, all cables connecting cameras to VCRs were severely chewed, apparently by rodents. No VCR or tape failures occurred. Ease of transporting equipment depended on vegetation density and distance from vehicle access. Camera systems usually were transported, set up, and maintained by one person, even (with the aid of a cart) at nests more than 1 km from roads or trails.

Conclusions

Potential uses of this camera system for studies of grassland passerines may be limited by increased abandonment rates, the possibility of bias in predation rates, and image quality. Nevertheless, the camera system proved useful for identifying predators and accurately determining nest fates, and for obtaining data on nesting grassland passerines that were previously unavailable. Cameras also were useful for evaluating the accuracy of methods commonly used for identifying predators and assigning nest fates.

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1. A two-day-old western meadowlark crawling back into the nest 12 h after it was displaced by the female flushing from the nest at night.

2. Brown-headed cowbird removing an egg from an unattended western meadowlark nest. The cowbird destroyed the entire clutch of five eggs.

3. Red fox scavenging western meadowlark eggs that had been punctured by a cowbird.

4. Thirteen-lined ground squirrel killing a female chestnut-collared longspur at the nest. The ground squirrel had already removed four of five nestlings.

5. American badger removing Baird's sparrow nestlings.

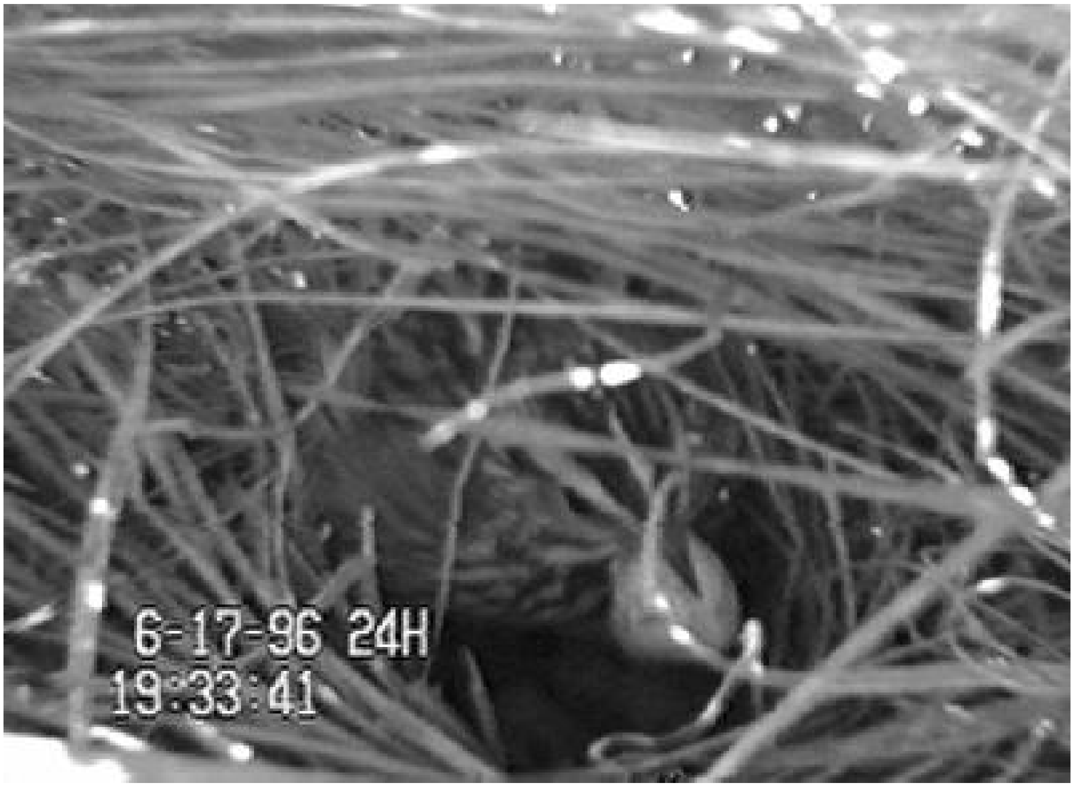
6. White-tailed deer removing nestlings from a savannah sparrow nest. Large predators were often difficult to identify.

7. Long-tailed weasel inspecting the camera after depredating a common yellowthroat nest.

8. Northern harrier removing nestlings from a chestnut-collared longspur nest.

9. Mouse killing five-day-old clay-colored sparrow nestlings.

10. Clay-colored sparrow bringing food to nestlings.



11. Savannah sparrow eating the shell from the first hatched egg.

12. Male chestnut-collared longspur giving food to the female, who then feeds the nestlings.

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