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AN INEXPENSIVE CAMERA SETUP FOR THE STUDY OF EGG PREDATION AT ARTIFICIAL NESTS

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Abstract.—Nest predation is an important factor reducing reproductive success of many birds. However, few data are available on the relative role of different predators. This paper describes an automatic camera setup that can be used to study predation on artificial nests. Because the setup is relatively inexpensive, it should allow fieldworkers to conduct large-scale investigations of nest predation and determine its importance as a selective force in the evolution of avian reproductive strategies.

MONTAJE DE CAMARAS FOTOGRÁFICAS EN NIDOS ARTIFICIALES, PARA ESTUDIOS DE DEPREDACIÓN DE HUEVOS

Sinopsis.—La depredación en nidos es un factor de importancia en la reducción del éxito reproductivo de muchas aves. Sin embargo, hay pocos trabajos que documenten el rol de diferentes depredadores. Este trabajo describe el montaje de una cámara automática que puede ser utilizada para estudiar la depredación en nidos artificiales. Debido a que el montaje es de bajo costo, esto debe permitirle a los investigadores, llevar a cabo amplios estudios sobre el efecto de depredadores y sus implicaciones en la evolución de estrategias reproductivas de aves.

Predation is the most important cause of nesting mortality in many birds (e.g., Murphy 1983, Nilsson 1984, Page et al. 1985, Ricklefs 1969) and has played an important role in the evolution of avian reproductive strategies (e.g., Crook 1964, Lack 1968). Very little work has been done, however, to identify individual nest predators and determine their impact on prey. This is presumably because predation events are rarely witnessed and there has not been any inexpensive technique available that would allow fieldworkers to effectively study this phenomenon on a larger scale.

In 1985 I began a large scale study of intensity, type, and temporal and spatial patterns of predation on artificial nests in different habitats. To record the predation at artificial nests, I designed an inexpensive automatic camera setup, described here.

DESCRIPTION OF THE CAMERA SETUP

To avoid difficulties associated with the use of battery-operated flashes and to keep the price of the setup minimal, I selected an inexpensive camera, the Kodak Instamatic X-15F (approximately $17 Cdn). Although the camera's optics and smaller film format (126) result in only a moderate quality picture, the advantages of this camera (flip flashes and low cost) justify its use.

The setup consists of four main components: (1) a nest support with trigger mechanism, (2) the Kodak Instamatic camera X-15F attached to the support, (3) a clock placed on the support near the nest, and (4)

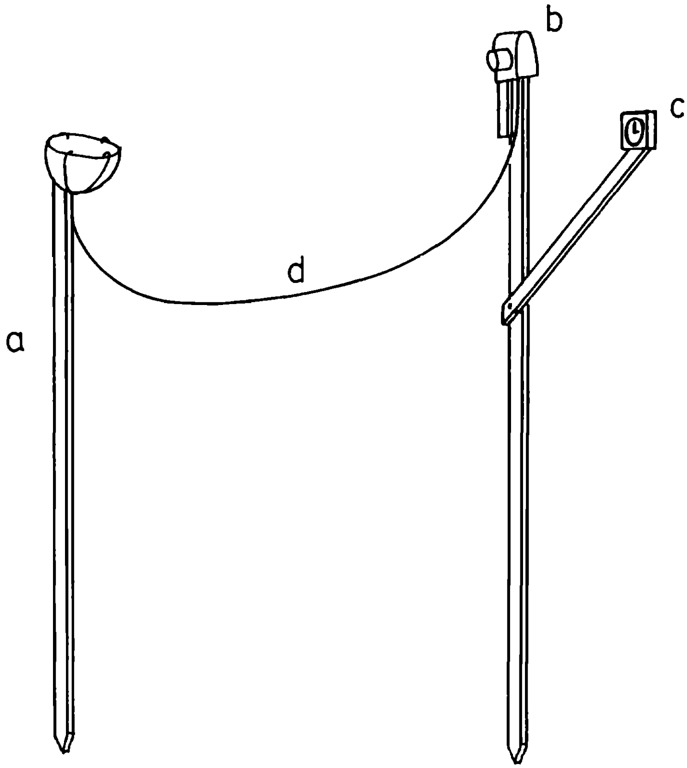

FIGURE 1. The main components of the camera setup; nest support with trigger mechanism (a), camera with support (b), clock (c), and covers protecting camera, trigger and clock. The brake cable (d) is connecting the trigger mechanism on nest support and the camera shutter lever. Details of individual components are shown in Figures 2–4.

protective covers (Fig. 1). In the following description the capital letters refer to parts shown on Figures 2–4.

The nest support and the trigger mechanism (Fig. 2).—To the top of a 120 cm long stake (40 × 16 mm; A) I attached a basket (support for the artificial nest), which I made from vinyl-coated fencing wire (G, H). The attachment was achieved by pushing the two ends of the basket through the pre-drilled holes (the same diameter as the wires) in the stake and bending the ends of the wires toward the stake (H). The bottom end of the stake A is pointed so that it could be pushed into the soil. The trigger mechanism consists of three parts. An L-shaped wire (B) made of piano wire (diameter 1.75 mm) with a large loop (diameter 20 mm) at one end for egg support, a small hook at the other end that holds part C in place when the camera is set up, and a small loop (diameter 2 mm) approximately 30 mm from the hook end. The part B is attached to the support stake A through the small loop with a screw (length 10 mm), which functions as a hinge. Part C is a short (about 35 mm) straight wire (piano

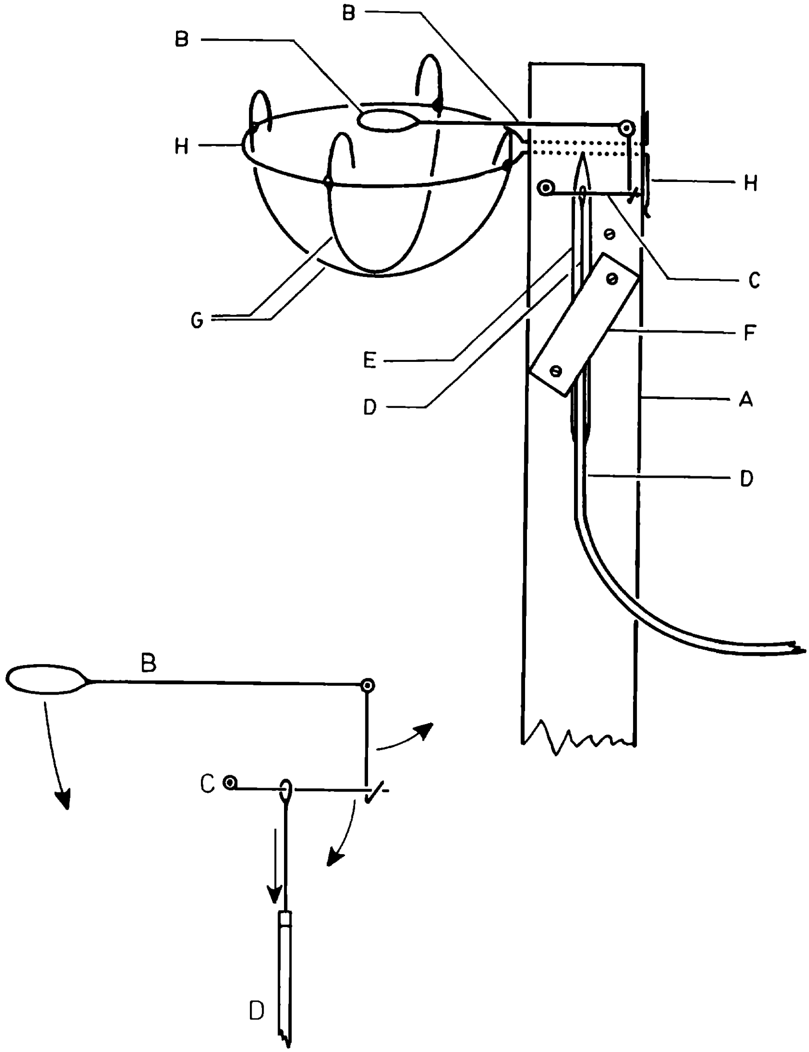

FIGURE 2. Nest support, parts of the trigger mechanism and movement of trigger parts following depression of the trigger loop which supports an egg.

wire, diameter 0.75 mm) with a small loop (diameter 2 mm) at one end. This part is attached through its loop to the stake A with a small screw (length 10 mm), which also functions as a hinge, allowing it to rotate freely around the screw. The third part is an approximately 120 cm long bicycle brake cable (D). The nest end of the cable is placed in a notch (110 mm long, 6 mm wide, 4 mm deep; E) made in the stake A. To hold the cable, a 50 mm long mending plate (F) is attached to the stake. The

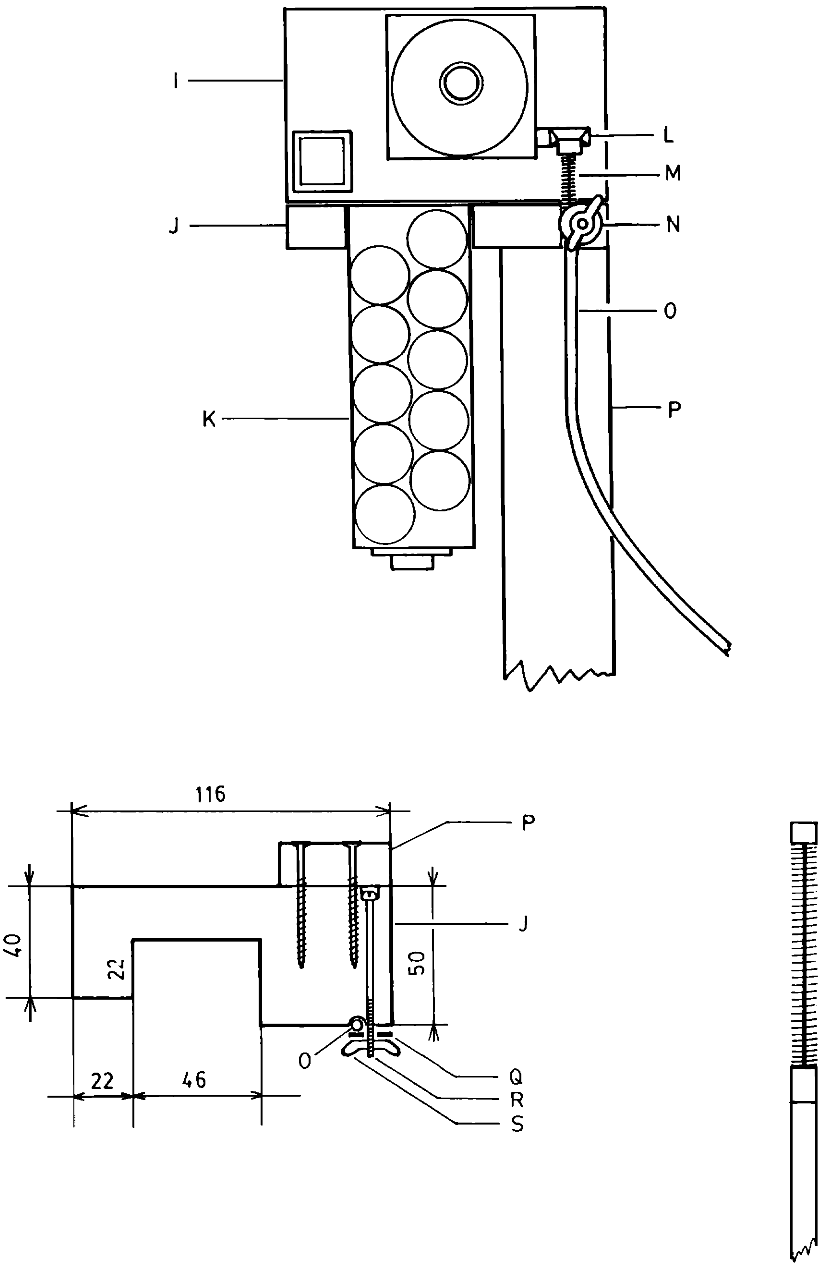

FIGURE 3. Details of the camera support and the attachment of the brake cable to the camera shutter lever, the top view of the camera base (J) indicating dimensions and position of the notch for the flip flash, and the detail of the camera end of the brake cable (O) with the compression spring (M) installed.

brake line at the nest end of the cable is cut off and a small loop is made by twisting the steel wires together. The wire C is then placed through this loop. A screw W (length 15 mm) is screwed about two thirds of the way into the stake A above the top of the mending plate F (Fig. 2). The function of this screw is to restrict the movement of wire C, therefore preventing it from escaping from the brake line loop. The movement of the trigger parts B, C, and D, following the depression of the loop end of the part B in which the egg is placed, is shown in Figure 2.

The camera support (Fig. 3).—The camera support consists of two main components, a brake cable attachment and a camera support. The camera end of the brake cable is not altered with the exception of the addition of the compression spring (M). The spring is constantly exerting pressure on the cylindrical end of the brake line, pulling it out of the cable (this end of the brake line sets off the camera). This spring creates constant downward pressure on the trigger bar C (Fig. 2) at the nest end of the brake cable. I found it necessary to glue a small (5 mm diameter and length) plastic cylinder to the shutter lever of the camera. This cylinder houses the end of the brake line, thereby preventing it from slipping away from the shutter lever when the trigger is depressed.

The wooden camera base (J) is attached with two screws (length 40 mm) to the stake P (40 × 16 mm, but 20 cm longer than the support A in Fig. 2, so that the picture is taken from slightly above). The joint between the two parts (J and P) is further strengthened by gluing these parts together with Epoxy glue. The base J has a notch for the flip flash (see Fig. 3 for dimensions and position of this notch on the base). The camera, in an upside down position, is placed on a camera base and attached with several elastic bands. The camera end of the brake cable (O) is then placed in the notch 4 mm deep in the camera base (Fig. 3) and positioned by tightening the wing nut (S) on bolt R (length 60 mm, diameter 4 mm), which presses the washer (Q) against the brake cable. When the brake cable is in the right position, the metal cylinder at the end of the brake line must be pressing against the shutter lever of the camera.

The clock attachment (Fig. 4).—To record the time of the predation event, I used a battery-operated clock (Brown AG; Type 4750/AB 3) to which I added an AM/PM indicator (X). This indicator is a thin (1 mm), light disk (Y) cut out of plastic gardening labels, with a small hole (diameter 1 mm) drilled in its center and is turned by the passage of the hour hand. The length of the hour hand determines the position and the size of the disk (i.e., the center of the AM/PM indicator must be located above the end of the hour hand). If the hour hand is too long and does not leave enough space for the disk, it has to be shortened slightly. To one side of the disk I glued four dividers (cut out of the gardening labels) subdividing the disk area into four equal fields (Z in Fig. 4). The height of these plastic dividers is determined by the distance of the hour and minute hands from the face of the clock (i.e., the dividers should be slightly higher than the distance of the hour hand from the face of the clock, but

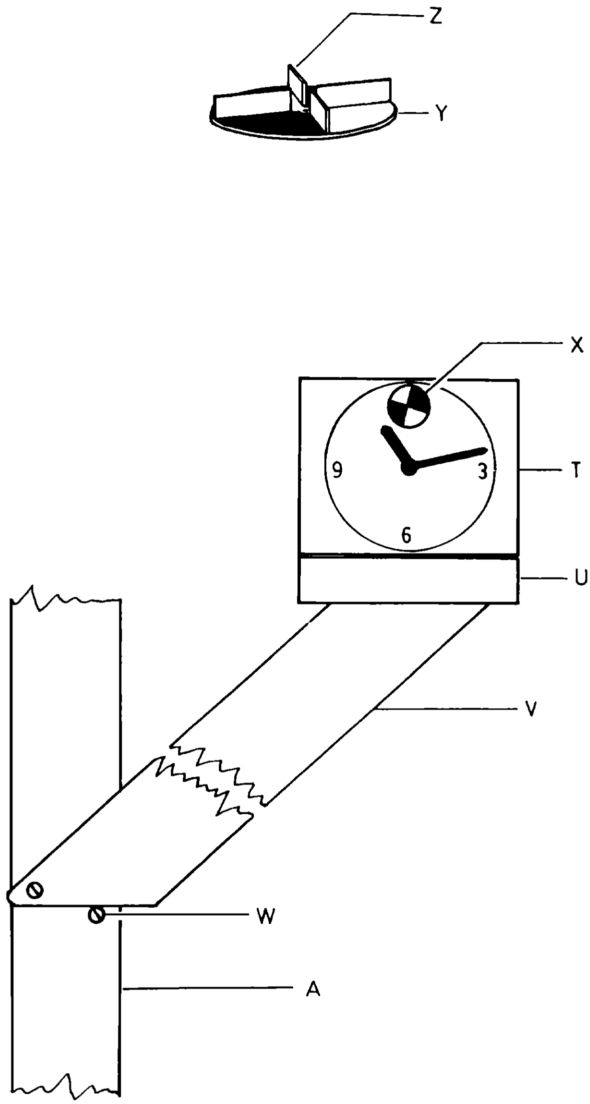

FIGURE 4. The clock attachment and the detail of the AM/PM indicator.

lower than the distance of the minute hand from the clock). Two opposite 90° fields are painted black and the other two white. The disk is then hinged through the hole in the center of the disk to the top part of the clock with a small nail (diameter 1 mm, length 10 mm, but any excess length that would interfere with the mechanism inside the clock must be cut off). The AM/PM indicator has to be positioned as close as possible to the face of the clock but must be allowed to rotate freely around the nail. The nail is then glued in position from inside the clock with Instant Krazy Glue®. Because only the hour hand can rotate the disk, the indicator is rotated every 12 hours by 90° and the position of the white and black fields can be used to determine AM/PM from the pictures of predation events. The clock is positioned about 30–40 cm aside from the nest. This placement is less likely to result in predators standing in front of the clock.

The clock T is attached with two elastic bands to the clock support base U which is hinged through the stake V to the nest support A. Hinging the clock attachment to the nest support allows collapsing the clock to the nest support stake, making transportation of the setup less awkward. The screw W (length 20 mm), which is screwed about two thirds of the way into the stake A, fixes the supporting stake V in a selected position.

I have tested different types of clocks and found digital clocks unsuitable. In addition, I recommend the use of a clock with a black face and white hands and numbers because these are more legible on pictures than black numbers and hands on a white background.

Protective covers.—The trigger mechanism, the camera and the clock must be protected from moisture. I used a vinyl ground sheet (sold for camping) from which I made small protective covers for the camera, clock and the trigger parts on the nest support stake (see Fig. 1). I attached these covers to the equipment with elastic bands. The vinyl covers are durable and provided adequate protection for 50 setups for approximately four months.

In addition, to protect the camera lenses from moisture, I glued 30 mm long shields to the camera objectives. These shields were cut from the plastic covers sold for the metal pipes supporting shower curtains. A hole was cut in the vinyl camera covers so that they would fit tightly around the protective lens shield.

To better camouflage the camera setup, I painted the exposed parts, including the vinyl covers and the entire brake cables brown and green.

USE OF THE CAMERA SETUP

Nests of most passerines are usually well concealed in supporting vegetation. Therefore, I placed the camera setups in dense vegetation (dense shrubs and small trees allow the best concealment of the support stakes, the cable connecting them, and the camera). The camera and nest supports are placed about 100 cm apart (the minimum focusing distance of the camera is approximately 90 cm) and are driven about 20 cm into the ground. Ideally the camera should face to the north to prevent sun flares. The artificial nest is placed inside the supporting basket and attached by bending the ends of the wires around its edge. An egg is placed on the trigger loop and the trigger set up. This requires that the camera end of the brake cable be removed from the camera support and the brake line pushed inside the brake cable by compressing the spring. The vinyl protective cover is placed over the trigger parts and attached with an elastic band near the top of the stake (Fig. 1a). The camera is then inverted and fastened to the camera support with elastic bands and a protective cover is placed over it and attached with one elastic band. The flip flash is pushed into its slot in the camera. The end of the brake cable is installed by pressing the end of the line against the shutter lever and, simultaneously, tightening the wing nut. The position of the camera is checked (i.e., both the nest and the clock have to be in the camera's view) and the surrounding vegetation arranged to better camouflage the setup. To set up a camera and a nest in a new location may take 10–20 min, depending on the complexity of vegetation. The check of a setup where predation occurred which requires placement of a new egg on the trigger loop, winding the camera, and setting up the trigger mechanism takes about 5 min.

I recommend using artificial nests because they are more durable. I make these nests by pressing two layers of dry grass into a mold, with several strips of glue poured over the first layer. The study of egg predation also requires a large number of eggs. I have used Blue-breasted (*Coturnix chinensis*) and Common quail (*C. coturnix*) eggs which are inexpensive and readily available. However, this technique could be adapted to study predation on any eggs, regardless of their size, although it may require some changes in choice of materials for nest support and trigger parts.

The nest height could be altered by changing the length of the nest support (A). The camera support (P) should be adjusted accordingly (the camera should be positioned approximately 20 cm higher than the nest). However, the study of predation on eggs of ground-nesting birds would require one additional modification. Because in this case the nest support would have to be short (about 40 cm), the clock support must be separate from it.

Finally, I recommend the use of the Kodachrome 64 slide film which results in the best quality pictures.

Problems encountered and their solutions.—There are three possible causes of camera failure. First, the trigger is sometimes stiff and small predators such as mice will not depress it. This problem can be eliminated by moving the loop of the brake line (D, Fig. 2) closer to the hinge of the trigger bar (C, Fig. 2). In addition, because the trigger parts, made of piano wire, will corrode when exposed to moisture, oiling them on a regular basis will slow down this process and reduce friction between the moving parts.

Second, the picture may not be taken because the predator has lifted an egg from the trigger loop without exerting the necessary pressure to set off the trigger. This is more likely to happen when the trigger loop (B, Fig. 2) is small relative to the egg placed on it. Therefore, making the loop larger so that the egg will fit in it more tightly will reduce chances of this failure.

Third, the camera might fail to take a picture because of cable friction or a weak spring. These problems can be corrected with oiling, and adjusting the cable mechanism.

According to my experience approximately 10–20% of predation cases result in camera failures (inexperience may, however, result in higher failure rates). Therefore, I recommend that the trigger parts be carefully examined each time the trigger is set up. Oiling the moving parts should be done regularly (i.e., once every 2 wks) and more frequently in rainy weather.

I have used flip flashes at all times, regardless of the light conditions. For this reason, pictures taken on sunny days and in the open habitats were slightly overexposed. In spite of overexposure, however, the identification of predators on the slides was relatively easy. However, to improve quality of pictures in such a situation one could use flip-flashes only when light conditions are poor (but this would also increase the number of visits to the setups).

Flip flashes rarely fail. However, if one flash fails, all the remaining flashes will also fail. Thus, to ensure that the flip flash is operating properly, the number of the flash used should be recorded following the predation event.

In 1985 I tested 10 setups and in 1986 I used a total of 60 setups during a study of predation on passerine nests in different habitats. During this study in each of the four habitats studied (marsh, meadow, scrubland, and coniferous forest) I distributed 10 nests in 10 m intervals along one or two transects. I obtained a total of about 900 pictures of predation events. These pictures revealed a number of birds (e.g., Blue Jays, *Cyanocitta cristata,* Fig. 5; crows, *Corvus brachyrhynchos*; Marsh Wrens, *Cistothorus palustris*; House Wrens, *Troglodytes aedon*; Catbirds, *Dumetella carolinensis*) and mammals (e.g., red squirrels, *Tamiasciurus hudsonicus*; flying squirrels, *Glaucomys sabrinus*; raccoons, *Procyon lotor,* Fig. 5; striped skunks, *Mephitis mephitis*; longtail weasels, *Mustela frenata*; deer mice, *Peromyscus maniculatus*), suggesting that the cameras will sample and identify a wide variety of egg predators. Predation was extremely high in the coniferous forest where usually all eggs would be removed by predators within 24 hours, intermediate in the meadow and scrubland areas (on average about 40% of eggs depredated per day) and relatively low in the marsh (about 20% of eggs depredated per day). Predation rates on experimental nests varied, however, with the time in a season. Results on different predation rates, however, suggest that the time between consecutive camera and nest checks should be shortened in habitats with high predation to allow sampling of all predators operating at different times of day.

Perhaps the most important shortcoming of this technique results from the use of artificial nests. Predation on artificial nests could differ from predation on real nests because: (1) the artificial nests and their location differ from real nests; (2) there are no birds defending the experimental nests or covering the experimental clutches; (3) the presence of cameras near nests might distract some predators; and (4) the scent left by human observers may affect chances of predation. Although some of these difficulties could be solved by comparing predation rates on real and artificial

FIGURE 5. Sample predation events as recorded by the camera setup described above: top, raccoon; bottom, Blue Jay (*Cyanocitta cristata*).

nests and examining the appearance of depredated nests, results on predation from the camera study must be interpreted with caution. Despite these problems, however, I believe that the camera technique should prove very useful for studies examining nest mortality factors of individual species as well as passerine communities in different habitats.

In conclusion, the automatic camera setup described is an efficient tool for studying predation on bird nests. Because each setup is relatively inexpensive (between $40–50 Cdn), it is possible to build many of these setups and use them for large-scale studies of predation.

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