A DEVICE FOR INSPECTING NEST CAVITIES

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Field studies of cavity-nesting birds require special devices to view the insides of cavities repeatedly without damage to the nests or their contents. In studying cavity-nesting forest birds, we developed a useful tool that was an improvement over available equipment and permitted easy examination of most cavity nests. We report here the details of constructing such a device because it is not available commercially, and there is a special need for productivity data on cavity-nesting species (North American Nest Record Card Program Newsletter No. 9. 1971).

Seidensticker and Kilham (*Bird-Banding*, **39**:228-230, 1969) described an extended penlight bulb and a dental mirror combination that proved effective for shallow cavities but not for deep ones. Poznanin (*in* Ways and means of using birds in combating noxious insects, Moscow 1956, The Israel program for scientific trans., 1960, p. 82-86) has successfully used a device similar to ours in Russia. Our device, which works well in all but very shallow cavities, consists of a battery pack, two telescoping tubes, and an angled mirror mounted in the end of the outside tube, and a retractable light bulb (Fig. 1).

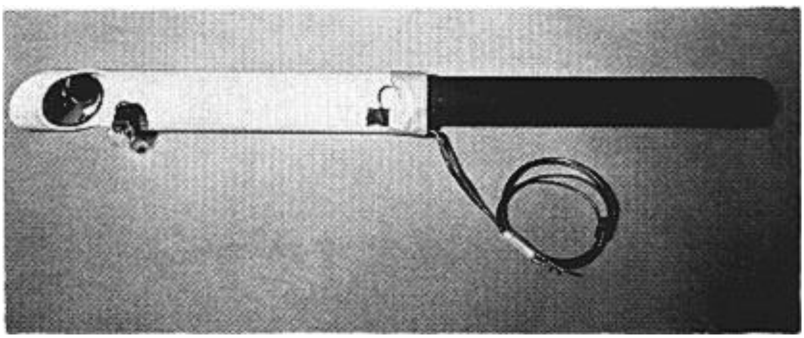

Figure 1. Device in position to inspect a cavity, with inside tube pushed in the bulb extended.

The outside and inside tubes are made of white 3.4 cm and 2.6 cm (outside dimension) rigid polyvinyl-choloride pipe, 23.0 and 25.0 cm long, respectively (Fig. 2). These are the "1-inch" and "3/4 -inch" pipe sizes available in hardware stores. Smaller pipe, of course, could be used to construct even smaller devices. The diameters used permit access to nests with entry holes as small as those of Mountain Chickadees (*Parus gambeli*) and House Wrens (*Troglodytes aedon*). A window cut in the outside tube allows the light bulb to move down, thus giving a right-angle mirror view of the lighted nest interior (Fig. 2, A and B). An angle on the inserted

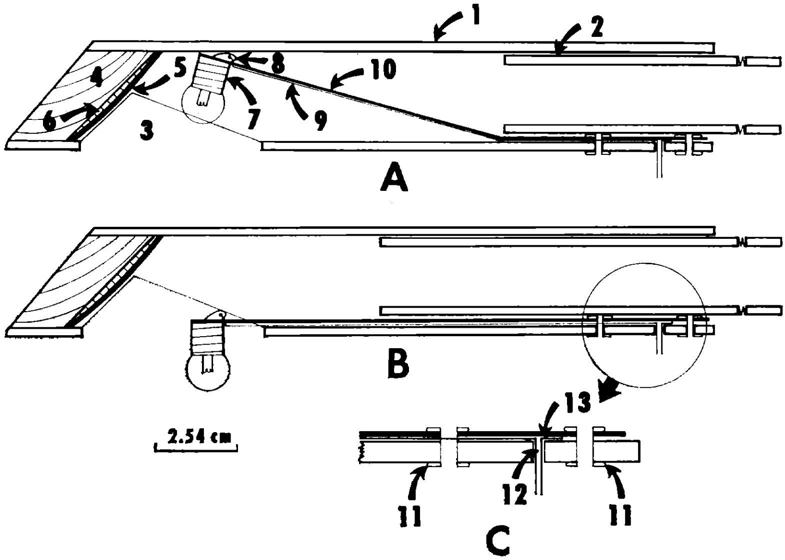

FIGURE 2. Mid-longitudinal, cross-sectional sketch of cavity inspection device showing internal parts: (1) outside tube, (2) inside tube, (3) viewing window, (4) wooden dowel, (5) mirror, (6) glue between mirror and wood, (7) bulb socket, (8) socket terminal, (9) insulated wire, (10) brass spring, (11) rivets, (12) hole for wire passage, and (13) insulated wire. A - inside tube disengaged and bulb retracted for insertion into cavity, B - bulb extended with inside tube engaged for viewing, and C - blow-up of brass spring attachment and electrical wiring leading from outside tube.

end of the outside tube allows it to slide easily through a cavity entrance to the maximum depth; this angle is not critical but should exceed 30 degrees.

The electrical element of this device requires: (1) a 6-volt electrical headlamp kit (or equivalent) with a battery pack that houses four D-cell batteries, (2) a 1.3 $\times$ 17.0 cm strip of 22-gauge brass sheeting plus two soft brass leather rivets, (3) a threaded bulb socket that receives 5.1 -volt headlamp bulbs plus two bulbs, and (4) two 80 cm lengths of 18-gauge insulated electrical wiring (Fig. 2, A and C). Items (1) and (4) are found in hardware stores and (2) and (3) in hobby shops. Two corresponding holes are drilled through one end of the brass strip and the outside tube (Fig. 2, 11), and a third hole is drilled in the tube for the electrical wires (Fig. 2, 12). One end of the brass strip is bent about 15° off plane to serve as a retraction spring so that the light and socket do not interfere with insertion into the nest cavity (Fig. 2, 10). The bulb socket is anchored by soldering one terminal to the bent end of the brass strip (Fig. 2, 7), which is kept insulated from the other terminal and serves as a conductor to one electrical wire soldered to the other end (Fig. 2, 13). The second wire is run along the strip's underside and soldered to the second terminal. Both wires run through the hole in the outside tube to the battery pack, where they are attached to the two terminals of the headlamp kit; this provides for use of the headlamp's convenient switch. To make the cavity device bulb respond to the switch, a strip of aluminum foil is placed under the headlamp bulb in its socket. The headlamp bulb will then not light and can be interchanged as a spare. During construction, before the brass strip is anchored, the two wires should be threaded through the hole in the outside tube and soldered to connect the bulb socket, one wire to the near end of the brass strip and the other to the free socket terminal (take care to keep the second wire and terminal insulated from the strip to prevent a short circuit). The other ends of the wires are then attached to the terminals at the battery pack (it does not matter which wire goes to which terminal), and the length of wire that runs beneath the brass strip is glued there with contact cement. Finally, the brass strip is anchored within the outside tube by hammering the two rivets into the matching holes (Fig. 2, 11).

A 116° window, which is cut in the outside tube before fitting in the brass spring and wiring, permits the bulb to move down out of sight when the inside tube is pushed in (Fig. 2, 3). For flexible operation, two interchangeable mirrors are used: one cut from flat mirror stock for viewing cavities deeper than about 30 cm, and one cut from convex automotive spot mirror for viewing shallower cavities. To eliminate chipped edges, the mirrors, each an oval measuring 3.8 $\times$ 2.9 cm when finished, are cut about 0.4 cm oversize with a hand class cutter and then smoothed to size with a lapidary grindstone. Each mirror is glued flat to an angled piece of 2.9 cm diameter (1 1/8) inch) rod that is cut the same length as the distance between the angled end and window margin of the outside tube (Fig. 2, 4). Before the mirror is glued on, the dowel rod is trimmed down in stages until it fits within the outside tube snugly enough to stay firmly in place but loosely enough to be adjusted and removed by hand.

To use the device, simply insert the outside tube into the cavity entrance with the inside tube partly engaged (Fig. 2, A). Then push the inside tube in to depress the brass spring and bulb socket (Fig. 2, B), switch on the light, and manipulate the device to best view the nest contents. Position the eye close to the viewing tube, and after a pause for the pupil to adjust, the cavity interior will appear in view.

Materials for one complete unit cost about $10.00 if a four-celled electrical battery pack is used for power. A two-celled flashlight (with compatible bulb) is a cheaper battery source, but it provides slightly less illumination, the attachment of electrical wiring is more difficult, and we found that its switch was often turned on accidentally, necessitating frequent battery changes. The four-celled battery pack has a simpler and more controllable on-off switch, comes with a belt clip, and has longer battery life. In any case, a pouch of some type should be used to protect the viewing device from damage.

Our device offers enough advantages over other available devices to be worth the effort to construct it. For extremely shallow holes, Seidensticker and Kilham's penlight and dental mirror device works better than ours. However, dental mirrors seem to have poor reflective properties, receive much interference from outside daylight, which makes it difficult to focus on the darkened image within the cavity, and do not reflect enough area from one position to cover all the contents in deeper holes. With our device, interference from outside light can be eliminated by attaching a foam ring around the viewing end of the tube, or by using a cupped hand around one's eye. It is simple and safe to operate because one hand is kept mostly free while the device is inserted, switched on, and adjusted with the other hand. The interchangeable flat and convex mirrors permit a good view of cavity contents at nearly all depths. Finally, by reducing the image, the convex mirror allows the observer to view and accurately count all contents in nests, such as those of woodpeckers, that may contain many eggs or young.

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