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A device to record the specific time an artificial nest is depredated

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Abstract: We designed a timing device that records the calendar date and time of a depredation event on an artificial nest. The clock was simple to construct and successful in field trials, with only 6% failure (3 of 48 clocks). The average difference between actual and estimated depredation time was 4.6 minutes. Use of this clock improves daily survival estimates, provides insight into predator activity patterns, and allows the evaluation of investigator-induced depredation.

Key words: artificial nests, human–wildlife conflicts, monitoring, nest depredation, nest success, predator activity patterns

High levels of nest depredation reduce the nesting success of many bird species (Klett et al. 1988, Howlett and Stutchbury 1996, Pitman et al. 2006, Franzreb 2007, Perkins and Vickery 2007). For this reason, many studies have investigated nest depredation patterns. Artificial nests frequently are used to evaluate the effect of nest density, egg color, vegetation structure, odor, nest concealment, clutch size, seasonal and landscape characteristics, and other factors on nest depredation (Sugden and Beyersbergen 1986, Major and Kendal 1996, Jobin and Picman 2002, Conner and Perkins 2003, Ackerman et al. 2004). Although artificial nests allow for a more rigorous experimental design than observational studies on natural nests, argument continues over the utility of artificial nests, given that predation rates between natural and artificial nests often differ (see Faaborg 2004, Moore and Robinson 2004).

Estimating nest survival rates can be problematic in both natural and artificial nesting studies. Frequent visitation of nests by investigators can increase depredation rates (Major 1990, Esler and Grand 1993), but longer periods between nest visits reduce accuracy in determining when these events occur. Knowing the exact time and date of depredation events without having to make frequent visits to the nests, investigators could learn more about predator activity patterns and the factors that influence predator foraging behavior. We modified a nest-timer design by Ball et al. (1994) to create a device that recorded both the calendar date and time of a depredation event on an artificial nest. Additionally, our timer was easier to construct than Ball's because it involved only altering the wiring to the battery and, unlike the design by Ball et al. (1994), our timer did not necessitate locating the clock's oscillating crystal. We also developed a method to stabilize the trigger, thus minimizing conspicuousness of the device at the nest site. The purpose of this paper was to describe how to make the device and evaluate its effectiveness.

Methods

Construction of clocks

We purchased digital alarm clocks (Travel Alarm Clock® @ $8.24 each) that displayed both time and calendar date. We used a soldering iron to disconnect the wire that connected the clock body to the positive battery terminal. We used new wires (20–22-gauge hook-up wire, 1 to 1.5 m long) to connect the clock body and battery terminal through a trigger device (sub-mini SPDT lever switch @ $2.69 each) and soldered them in place to prevent disconnection (Figure 1). The length of wires can be altered to fit project needs. For example, when using the device for an above-ground, artificial nest, wires can be extended so that the clock is on the ground while the trigger and nest are several meters high. We made a #2-size ideal butterfly clamp ($0.04 each) into a treadle and attached it by both soldering and wire-crimping it to the trigger device. The wires were attached so that

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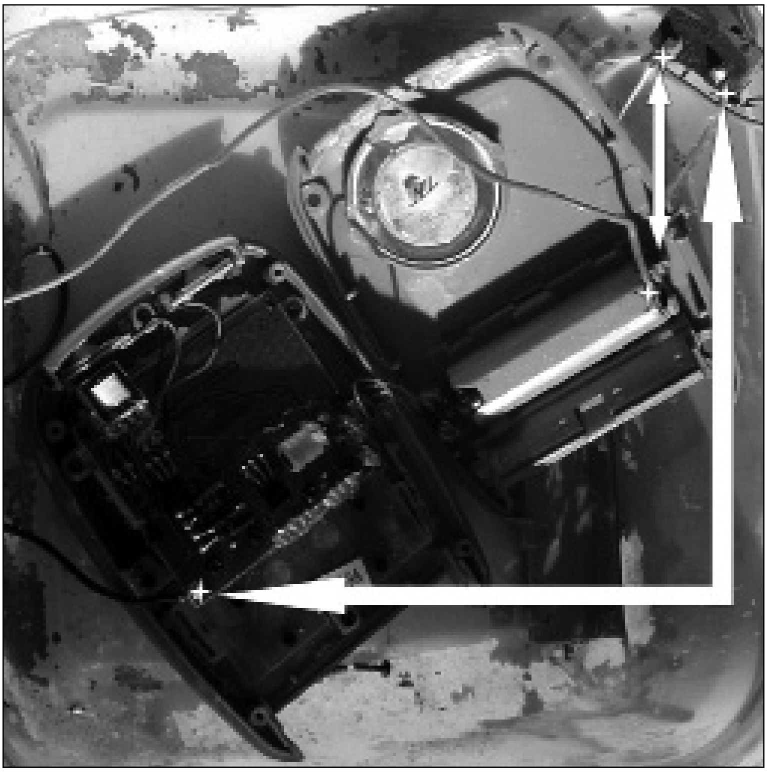

Figure 1. Inside of the digital clock within a plastic container showing attachment points for the new wires. Stars indicate solder points.

when the trigger was depressed (egg in place) the battery was disconnected. Once the trigger was released by removing the egg, the electric circuit was completed, and the clock started at 1200 hours, July 1 (start time and date differ by clock brand and should be checked). The clock display indicated the number of days, hours, and minutes that passed since the trigger was released (depredation event). The clock was placed into a plastic container to protect it from the weather. Wires were passed through a hole cut into the container that was sealed with epoxy to prevent water damage. The wires and container were spray-painted green, brown, and beige for camouflage. After painting, the clocks were left outside for at least 1 week to dissipate the odor. The trigger device was attached using 2 screws (#6 x 0.25 inch Phillips pan-head, sheet metal screws @ $0.04 each) to the blade of a heavy duty plastic knife to provide stability (Figure 2). Once familiar with the technique, we took <10 minutes to wire each clock. Battery life extended >1 year with clocks in continuous use (i.e., trigger-released).

Field trial

We placed 48 clocks in a grid pattern at the Green Canyon Ecology Station of Utah State University (Logan, Utah) in August 2007. We used medium-sized, white chicken eggs purchased from the grocery store. One fresh egg was placed on each treadle (Figure 3). Over the course of 3 days (August 27–29, 2007), each nest was "depredated" by a person other than the investigator. There was no precipitation during the testing period, and wind speed varied from 0 to 29 km/hr. This clock has worked well under variable weather conditions during predator research in North Dakota (personal observation). The exact time and date of the depredation event was recorded, but the investigator was not provided this information. The investigator checked all nests on August 31, 2007, and

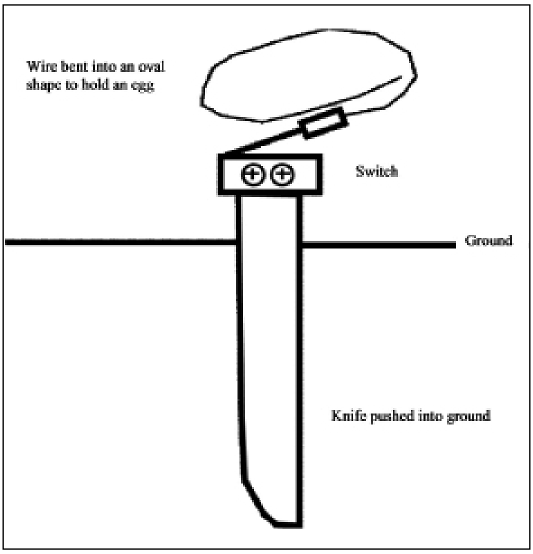

Figure 2. Diagram of the treadle attached to the trigger device, including a plastic knife that is pushed into the ground for stability.

recorded the date and hour on the clock, as well as the actual time. We subtracted the depredation period from the nest check time to estimate when the depredation event occurred.

After we estimated the time of each depredation event, we were informed when the actual event took place. We then compared the estimated simulated depredation time to the actual time of the event to determine the accuracy of our timing device. We calculated failure rate for the clocks, which we defined as any instance when the difference between the calculated and actual time was >1 hour.

Results

Of 48 total clocks, two failed due to loose wiring that could be corrected through more rigorous soldering, and 1 failed due to unknown causes (94% success). The remaining clocks averaged a time difference of 4.6 minutes (SE = 0.33), with a maximum difference of 8 minutes.

Discussion

Field trials showed that our clocks were very accurate, with time differences between actual and recorded depredation events ≤8 minutes. There are several benefits to knowing the actual time that a nest is depredated, including more accurate nest survival estimates and insight into nest predators and their activity patterns.

Precise recording of the day and time of a depredation have been hard to obtain in the past. Precision can be increased through more frequent nest-checks. However, a nest check interval of 5 days is recommended to minimize the risk of investigator-induced predation (Major 1990, Esler and Grand 1993). To estimate when the depredation event took place, investigators usually use the median date in the nest-check interval (Mayfield 1975, Klett et al. 1986). Our clock design eliminates the need for estimation and allows for a longer time between visits, while still providing a more robust measure of nest survival rate.

Investigator-induced depredations are often a concern in nesting studies because researchers may increase depredation risk by depositing odor trails to nests, disturbing vegetation around nest sites, or being observed at the nest site by a predator (Strang 1980, Götmark et al. 1990, Skagen et al. 1999, Bêty and Gauthier 2001). The importance of investigator-induced depredation on overall nest success remains unclear. Several studies found evidence of nest predators, both mammalian and avian, following observers' visits (Götmark et al. 1990, Morton et al. 1993, Sloan et al. 1998). However, observer effects are inconsistent among studies and over years (Bêty and Gauthier 2001, Keedwell and Sanders 2002) and are difficult to quantify. Researchers have used the direction of predator approach to a nest, comparisons of daily survival with different visitation rates, and depredation rates with human scent treatments to evaluate the impact of investigator-induced depredation (Major 1990, Esler and Grand 1993, Whelan et al. 1994, Verboven et al. 2001, Keedwell and Sanders 2002). Our timing device could provide a more direct test of investigator-induced depredation. If predators are watching observers or following observer scent trails, then nests may be depredated soon after the observer leaves the area.

Figure 3. An egg placed on the treadle at the Green Canyon Ecology Station, Logan, Utah.

Further, these clocks can be used to explore temporal patterns in depredation risk caused by weather. A predator's ability to locate a nest using olfaction is affected by humidity, temperature, wind speed, and atmospheric turbulence (Conover 2007). Previous studies reported a negative relationship between rainfall and nest survival, but they relied on averaging rainfall over the entire incubation period (Roberts et al. 1995, Roberts and Porter 1998). Roberts and Porter (1998) found that daily nest survival of turkeys (*Meleagris gallopavo silvestris*) was negatively associated with the departure from average seasonal rainfall. While this sort of analysis indicates a potential link between weather conditions and predator activity, the timing device allows us to determine predator responses to short-term weather events. Use of our timing device will allow researchers to evaluate weather conditions at the time of depredation to determine if there are consistent meteorological conditions that increase risk of predation.

Recruitment in many avian species is reduced due to high rates of nest depredation (West et al. 2007, Jiménez et al. 2007). Wildlife biologists and researchers who are studying or managing this problem have been hampered by their inability to determine the time of day when nests are most vulnerable to depredation. Our timing device can provide this information when used with artificial nests.

The timing device is simple to make, inexpensive (around $13 each), and accurate. By using this device, researchers can improve daily nest survival estimates, evaluate the impact of investigator-induced depredation in their research area, and study predator activity patterns.

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