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A simple, inexpensive video camera setup for the study of avian nest activity

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ABSTRACT. Time-lapse video photography has become a valuable tool for collecting data on avian nest activity and depredation; however, commercially available systems are expensive (>USA $4000/unit). We designed an inexpensive system to identify causes of nest failure of American Oystercatchers (*Haematopus palliatus*) and assessed its utility at Cumberland Island National Seashore, Georgia. We successfully identified raccoon (*Procyon lotor*), bobcat (*Lynx rufus*), American Crow (*Corvus brachyrhynchos*), and ghost crab (*Ocypode quadrata*) predation on oystercatcher nests. Other detected causes of nest failure included tidal overwash, horse trampling, abandonment, and human destruction. System failure rates were comparable with commercially available units. Our system's efficacy and low cost (<$800) provided useful data for the management and conservation of the American Oystercatcher.

SINOPSIS. **Una cámara sencilla y de bajo costo para observar la actividad en nidos**
La video fotografía por lapsos de tiempo se ha convertido en una herramienta muy valiosa para tomar datos de la actividad en nidos e identificar depredadores. Sin embargo, los equipos comerciales son costosos (>USA $4000/unidad). Hemos diseñado un equipo de bajo costo para identificar las causas de fracaso en la anidada del ostrero *Haematopus palliatus*, y a la vez evaluar su utilidad. El estudio se llevó a cabo en Cumberland Island National Seashore, Georgia. Identificamos a *Procyon lotor*, *Lynx rufus*, *Corvus brachyrhynchos* y a *Ocypode quadrata*, como depredadores de los nidos de ostreros. Otros eventos que causaron el fracaso de la anida da lo fueron, el efectode mareas altas, pisadas de caballos y destrucción de los nidos por humanos. La tasa de mal funcionamiento del equipo que utilizamos fue comparable con la del equipo comerical. La eficacia de nuestro sistema y bajo costo (<$800) provee de datos útiles para la conservación y manejo del ostrero.

Key words: American Oystercatcher, Georgia, *Haematopus palliatus*, nesting behavior, nest failure, predator identification, video surveillance

Time-lapse video-monitoring documents birds' activities at nests and causes of nest failure with minimal disruption to the nest site or adults (Thompson et al. 1999; Pietz and Granfors 2000; Stake and Cimprich 2003; Renfrew and Ribic 2003; Hoover et al. 2004). Commercially available video monitoring systems, however, can cost >USA $4000 per unit, often making multiple video system projects prohibitively expensive. The development of an inexpensive video system would permit greater use, promoting further investigation into avian nesting ecology and causes of nest failure. Researchers have described several "home-built" video systems (Granfors et al. 2001; Sanders and Maloney 2002; Hoover et al. 2004); however, these require at least daily maintenance and may not be suitable for an oceanfront beach environment.

In 2003, we began a two-year study on the effects of disturbance and predation on the reproductive success of beach nesting American Oystercatchers (*Haematopus palliatus*) at Cumberland Island National Seashore (CINS), Georgia. To meet our financial objectives and goal of monitoring every nest, we required a video monitoring system that would cost <USA $1000, record nest activity at a minimum of 1–2 frames/s continuously for at least 48 h, and be secure from vandals and typical environmental conditions.

METHODS

We designed a video system consisting of a black-and-white, infrared camera and a time-lapse recorder, powered by a 12-volt deep cycle

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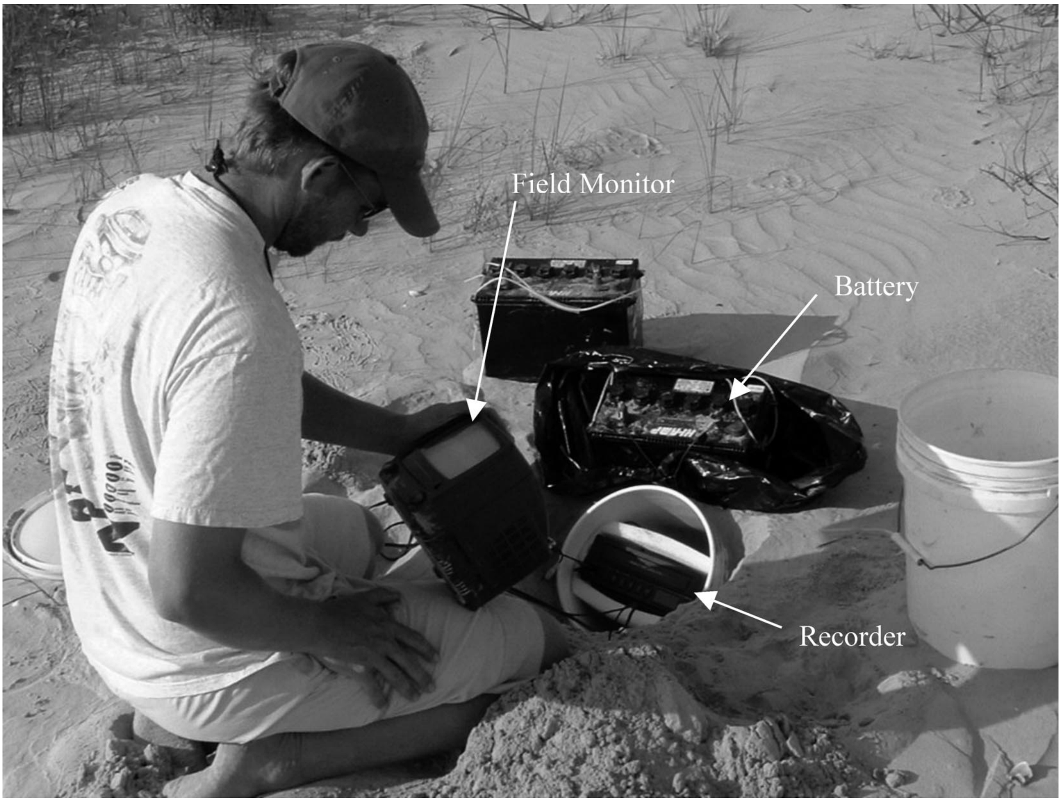

Fig. 1. Recorder and battery used to record avian nest activity. Recorder and 19-liter bucket were buried 2–3 cm in the sand, and the battery was concealed in a plastic bag. A portable television was used to orient the camera view and to setup the recorder.

battery (Figs. 1, 2) for use on the oceanfront beach of CINS. This beach is typical of those found on barrier islands in the southeastern United States, though human development is low. At 28 km in length, the beach is used daily by tourists, residents, and National Park Service employees.

We used Sony 3.6-mm, waterproof, black-and-white, infrared cameras, approximately 6.3 cm in diameter and 6.6 cm in length (ca. $130). Integrated infrared light emitting diodes (LED's) provided illumination at low light levels, allowing us to monitor nests 24 h/day. We secured the camera to a short wooden stake using an adjustable mount provided by the camera supplier. To provide protection against adverse conditions, we shielded each camera with a plastic bottle (Fig. 2). The handle and mouth of the bottle were removed, and sand was glued with a spray adhesive to the exterior of the bottle for camouflage.

We used Intelligent 12-volt DC, 960-h time-lapse recorders. This recorder (ca. $400) could be set to several recording speeds (frames/s), providing 8–1288 h of recording time on a single T-160 VHS tape. We set the recorders to record 2.86 frames/s, which was sufficient to capture short duration avian depredations, while providing 168 h of continuous recording. We waterproofed the recorders with 19-liter plastic buckets. We drilled a small hole at the base of the bucket for the video and power cables and sealed the hole with silicone caulking. The recorder was secured in the bucket with foam packing material (Fig. 1). To reduce operating temperature, we buried the bucket and recorder 2–3 cm under the sand.

We sought 48 h of continuous run time to minimize disturbance to nesting birds. We used 12-volt, 200-amp-h marine deep-cycle batteries (ca. $65) to power the equipment for at least 68 h. Two batteries were required per setup;

Fig. 2. Each camera was mounted on a wooden stake, placed approximately 1.5–2 m from a nest, and protected by a cutout plastic bottle. An 18.3-m cable buried 2–3 cm in the sand substrate connected each camera to a recorder and battery.

one to power the equipment while the other charged.

Although cameras were rated to record to a distance of 10 m in zero light, the infrared light dispersed quickly outdoors. We placed each camera 1.5–2 m from a nest to provide sufficient illumination (Fig. 2). Each camera was connected to a recorder via an 18.3-m, RCA, audio/video and power cable (ca. $30), which was buried 2–3 cm. The recorder and battery were placed 18 m from the camera. We placed the battery in a plastic bag, next to the recorder, and partially buried it. The battery was replaced every 60 h and the tape was replaced every 120 h. We used a small, battery-powered, black and white television (ca. $40) to properly align the camera's field of view and set the recorder.

RESULTS

Cost of the camera, recorder, two batteries and other supplies totaled <$800 per video system (2002). At this price we were able to purchase 10 systems that effectively monitored 32 oystercatcher nest attempts in 2003 and 2004 at CINS. We recorded > 15,000 h of nest activity and documented 20 nest failures. We failed to record two of the 20 nest failures because of battery failure. Battery failure and overheating were the primary causes of equipment failure; however, equipment failure did not usually result in missing a predation event. Other causes of equipment failure included human tampering and horse trampling.

Camera installation resulted in no nest abandonment. Camera installation and battery change caused the incubating bird to stand and walk from the nest, but our activities at each nest were limited to early mornings and evenings (before 08:00 and after 18:00) during moderate weather conditions to minimize adverse impacts on eggs. Initial setup of the system averaged 12 min. Battery and tape change required 7 min on average. Birds returned to incubate typically within 1–2 min after our departure from the nest site. Predation was the most common cause of nest failure (13 of 18 failures). We identified three egg predators: raccoons (*Procyon lotor*, $N = 9$), bobcats (*Lynx rufus*, $N = 3$) and American Crows (*Corvus brachyrhynchos*, $N = 1$). One chick was depredated by a ghost crab (*Ocypode quadrata*) shortly after hatching. Other causes of nest failure included tidal overwash ($N = 1$), horse trampling ($N = 1$), abandonment ($N = 2$), and human destruction ($N = 1$).

DISCUSSION

We recorded 32 oystercatcher nesting attempts with only minor problems. Early in the first season, recorders tended to overheat and shut down during midday. Hence, we buried the buckets 2–3 cm under the sand. This solved the overheating problem, but increased the time necessary to replace the VHS tape by ca. 30 s. The plastic bottle shielded the camera from the heat of direct sunlight. Cameras came into contact with moisture daily, but the cameras were sealed effectively against moisture. We experienced no camera malfunction.

The position (10 cm above ground) and orientation of the camera resulted in a few difficulties. The angle from the camera to the nest was shallow, limiting view into the nest and making chick observation difficult. Because the camera was close to the ground, rainfall splashed sand onto the camera lens, sometimes obstructing the field of view. A solution to both problems would be to elevate the camera, but this may make the camera difficult to conceal from pedestrians.

Heat, humidity, sand, and salt water, found in abundance in the oceanfront beach environment, are potential causes of electronic equipment failure. Our camera setup functioned reliably under the environmental conditions encountered with few equipment failures. Equipment failure rate during nest failure events was 10% (2 of 20), similar to studies using commercially available equipment. Thompson et al. (1999) and Brown et al. (1998) reported 11% (3 of 28) and 7% (2 of 27) unrecorded failures, respectively.

Because of low sample size, we made no attempt to discern an effect of the camera on predation rate or nesting activity using unrecorded control nests. We were concerned that a faint red glow emitted by the infrared LED's would be seen by the nesting birds or attract predators to the nest. Although we were unable to test this hypothesis, Sanders and Maloney (2002) found that a glow emitted by their cameras had no effect on depredation rate ($\chi^2_1 = 0.22$, $P = 0.64$). Most researchers have found that predation rates at video-monitored nests were not different from those at nests without video equipment (Brown et al. 1998; Pietz and Granfors 2000; Thompson and Burhans 2003; Stake and Cimprich 2003; Renfrew and Ribic 2003). In our study, video equipment and associated activities had no detectable impact on reproductive success, when compared to previous studies without video monitoring in Georgia, North Carolina, and Virginia (Nol 1989; Davis et al. 2001; George 2001). Although two nests were abandoned, no nests were abandoned within 20 d of camera installation, and nesting activity appeared to return to normal within minutes after installation, suggesting that the camera had little or no effect on the birds' behavior. Some researchers have found increased abandonment rates at video-monitored nests and suggest caution when using cameras (Brown et al. 1998; Renfrew and Ribic 2003).

Because our video equipment coped well with environmental extremes encountered at CINS, we believe that the system would function reliably in most settings and may be adapted for many applications. Using the adjustable mount, cameras may be secured to a clamp for attachment to a branch or pole that would allow for monitoring of canopy and shrub nesters. Ground nesters and grassland species may be monitored using the same staking technique we used. Monitoring of smaller species or nests in dense vegetation may require that the camera be closer to the nest than our setup (1.5–2 m). It is unknown how camera proximity may affect the rate of nest abandonment by other species. Camouflage with local vegetation or debris, or use of a smaller camera, may be less obtrusive. Smaller cameras are available at a slight increase in price (ca. \$60–70).

Evidence from our study and current literature suggests that with careful application, cameras have few negative impacts on reproductive success, depredation rates, and nesting activity. With this equipment, we successfully identified previously undocumented causes of nest failures (e.g., horse trampling and crab predation on nestlings) and collected valuable data on nesting activity with relative ease and at a cost of $<$ 25% of commercially available equipment (Thompson et al. 1999). Sanders and Maloney (2002) suggest that video equipment be used for more than just identifying nest predators.

They encourage research designed with sample sizes large enough to quantify the relative impacts of different causes of mortality. With our cost effective video system, this research is possible.

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