Utilizing Wireless Endoscopes to Capture Visual Nesting Data: An Affordable Time Efficient Solution

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ABSTRACT: Collecting data with wildlife can present several challenges to researchers, especially when the species is a bird nesting at heights requiring a ladder. These challenges can include using time to efficiently to visit large quantities of nesting sites, the costs to purchase new technology, and minimizing disturbances to wild animals. In order to meet these parameters, our team came up with a solution to allow us to do head counts and note general nesting behavior of barn owls, a biological control agent of voles. Our solution cost just $60 to provide equipment for a trained volunteer or researcher to collect this data on their own. Each team member uses a wireless endoscope, a small LED flashlight, a painter's pole, and a smart phone to collect data in the field without a need for cell phone service. This solution allows more data collectors to participate for less money and time. Otherwise, this would require more costly equipment and the setup and usage of ladders. Usage of said technology can also be an affordable way to advocate for wildlife by mounting permanent cameras to boxes that do not require a wi-fi or an ongoing cellular connection. This setup could also be used to monitor other wildlife in hard-to-reach places with minimal disturbance for a low price.

KEY WORDS: barn owl, bird box, equipment, devices, monitoring, nesting, *Tyto alba*

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INTRODUCTION

In Idaho, a continuous problem with farmers is the management of vole and pocket gopher populations feeding on common crops such as sugar beets, alfalfa, cereals, potatoes, and more (Gunn et al. 2011). One organism that will feed heavily on rodents are barn owls (*Tyto alba)* (Marti 2005). In order to promote sustainable barn owl management, we began building and deploying barn owl boxes in Southern Idaho crop lands in collaboration with local farmers. Wooden barn owl boxes were deployed between 8-14 feet off the ground. To collect scientific data for research and outreach purposes, we began investigating ways to monitor owl boxes for nesting activity with limited time, money, and personnel.

METHODS

Our team had limited personnel, time, money, and cell phone access. We also had a desire to minimize contact with animals for the safety of both researchers and animal subjects. Since many of the areas where barn owl boxes are deployed have limited electricity, cell service, or WiFi access, we began looking at devices that could create an independent wireless network but also had a camera. The device that best fit our needs was a DepsTech wireless endoscope (Shenzhen Deep Sea Innovation Technology Co. Ltd., Guangdong, China). This device has a built-in camera and LED flashlight that can take pictures and record video by connecting it to a cell phone or other smart device via WiFi. The device creates its own WiFi signal which you connect to your phone after installing the free DEPSTECH application (Figure 1). The camera is small and can be inserted into small holes drilled in barn owl boxes to see what is inside (Figure 2). Lighting can be an issue with any type of photography, so it is best to have boxes with a few holes in them to allow some light to enter or use an additional flashlight as listed below. To increase quality, we also purchased and tested a similar endoscope from the same brand with a 5.0 MP camera. We found this endoscope preferable because of the higher video quality and less connectivity issues, although some of our team till use the basic $36 model. An additional power source such

Figure 1. Live video feed transmitted through endoscope. A photo showing the video quality transmitted through a 2.0 MP endoscope to a smart phone via the DepsTech mobile application. Utilizing different holes in nesting boxes counts can be conducted quickly for a relatively low price.

Table 1. Essential equipment needed to carry out data collection. The painters' pole facilitates manipulation and insertion of the camera into nesting structures and the endoscope transmits video footage to a cell phone or other smart device.

Item Name	Model	Cost	Utility/Notes
DEPSTECH Wireless Endoscope	4331891326	$36	Features: 2.0 MP Camera, LED Light, 11 Ft Cable and WiFi Transmitter. The basic model without any bells and whistles.
Mr. Long Arm 6-12 Ft Painters' Pole	3212	$26	Allows manipulation of camera without usage of ladders facilitating footage capture.

Table 2. Additional gear. Additional gear can facilitate easier data collection, but costs more to equip researchers. The endoscope listed has more than double the megapixels ensuring a better picture. The flashlight facilitates dark nesting structures. The extension pole set allows the mounting of the camera to the end of the painter's pole with greater ease. The power bank allows you to hold more batter for longer since the endoscope operates off battery power.

Item Name	Model	Cost	Utility/Notes
DEPSTECH 5.0 MP WiFi Endoscope	B07V1QVC7F	$60	Features: 5.0 MP Camera, LED Light, 16 ft cable and WiFi Transmitter. This model clearly takes better pictures and has less connectivity issues as the basic one.
NEBO Larry Light LED Flashlight	6351	$10	Greatly enhances lighting in dark nesting boxes to take better pictures.
Great American Marketing Extension Pole Set 3'	PPE36340	$8	This is mounted to the end of the painters' pole with a hole drilled in it allowing you to manipulate the camera very easily.
ANKER PowerCore 10000 Power Bank	A1263	$26	Allows you to increase battery capacity to the endoscope for long days of research or power a permanently mounted endoscope.

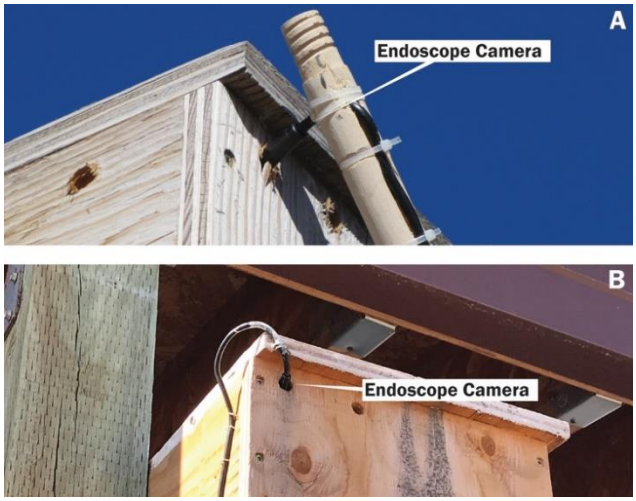

Figure 2. Insertion of endoscope cameras into nest boxes. To capture visual data with minimal disturbance the endoscope camera may be inserted from the painters' pole into holes drilled into the owl boxes (A) or by permanently mounting the cameras to the box (B). It is also possible to insert the camera through the entrance hole of the box, but this seems to disturb owls more (J. Thomas, pers. obervs.)**.**

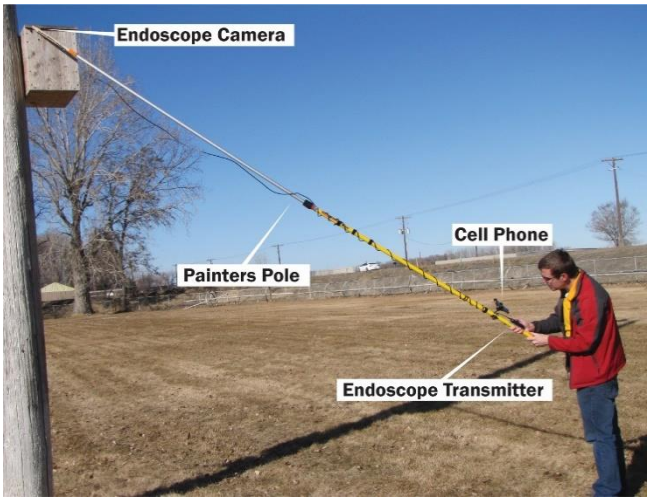

Figure 3. Wireless endoscope data collection setup. To carry out the research more efficiently we attached the endoscope to a painter's pole to transmit data independent of internet access to a smart phone. The camera of the endoscope was inserted into the nesting box. Collecting data this way we were able to conduct head counts within 1-2 minutes with ease.

as a power bank can also be helpful to keep the device running longer (Tables 1 and 2). In order to facilitate placement of cameras and achieve varying angles we used an extendable painter's pole to manipulate the camera from the ground (Figure 3). Usage of velcro or tape to attach the camera to the end of the pole is recommended. The best way to attach the camera is by purchasing an extension pole set. These are wood pole extenders that you can drill holes into to permanently affix the camera to the end of the pole at your preferred angle. Once the camera has been securely attached, you can wrap the cord around your pole leaving some slack so the pole can be extended.

ALTERNATIVE USES

One alternative use is to mount an endoscope permanently to each box. This is an affordable way to check boxes even faster for a relatively low cost. All you need to carry this out is a weatherproof box to put the transmitter into and a power bank to charge the device when checking them in the field. The camera itself is mounted inside of the box before nesting occurs. The cord from the camera is extended down to the weatherproof box and held in place by staples. This setup does not require a Wi-Fi connection and allows anyone with the free DEPSTECH app to turn on the device and look inside as long as the unit has battery

power. It is also possible to have landowners or other interested parties check their own boxes with little to no disturbance to the owls. Cameras should only be mounted during periods when nesting is not occurring. Disturbing migratory birds by placing cameras or opening boxes when migratory birds are present requires special permits. Check with your state fish and game office and the U.S. Fish and Wildlife Service to confirm these details and laws associated with migratory birds for your area.

DISCUSSION

Using this method, we were able to collect nesting data in less than a minute at each box with an average cost per researcher to be fully equipped with gear for under $100 each. Disturbances were kept to a minimum and the necessity to open boxes to conduct head counts was greatly reduced thus lowering the risk of potential zoonotic infection to humans and harm to the owls. Further work may be helpful to confirm the accuracy of this method by comparing it to manual counts. This method can be helpful for farmers and researchers to learn more about nesting patterns with limited investment.

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