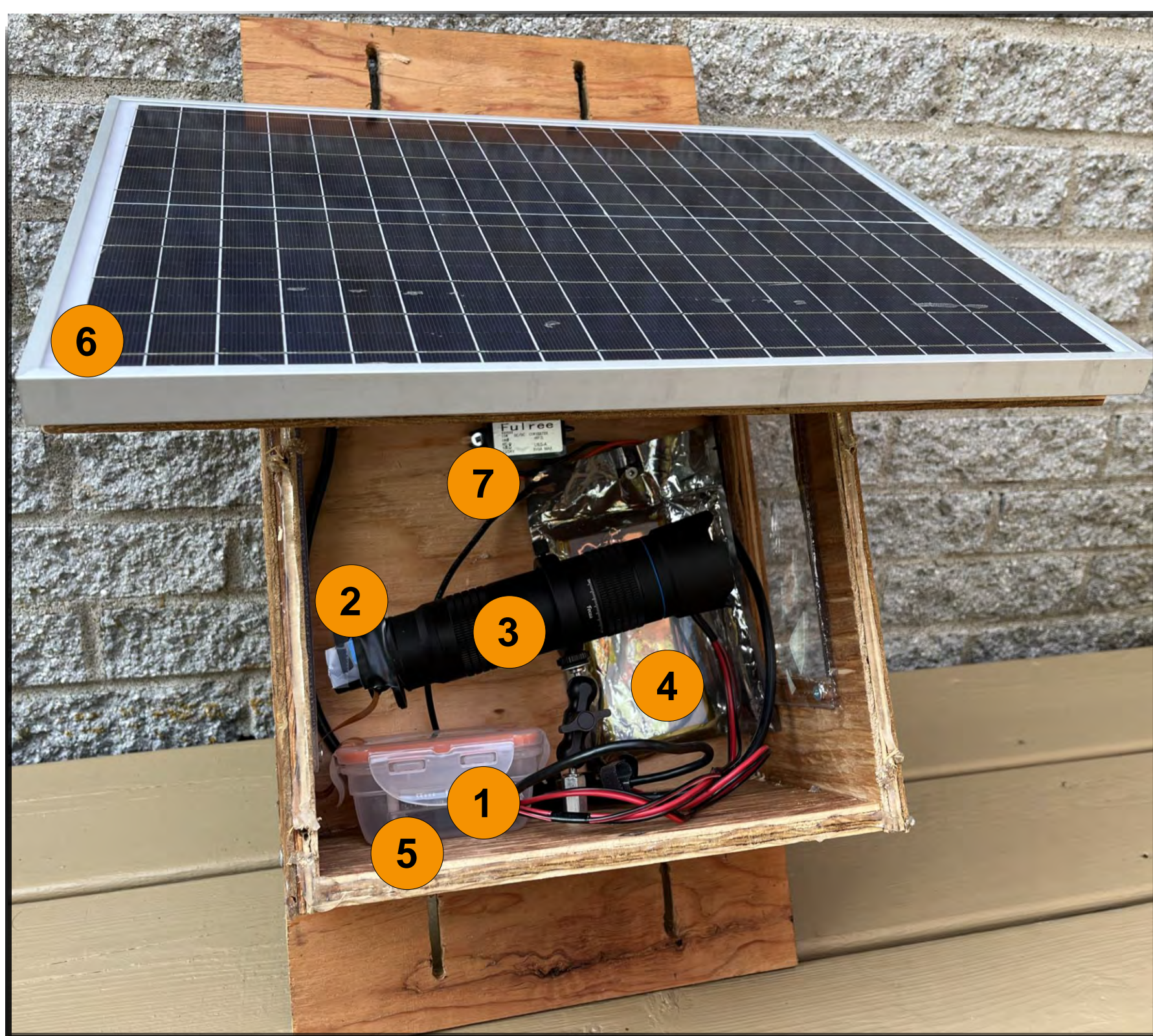


Telephoto nest monitoring camera with motion detection

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Introduction
Nest monitoring is used to measure the nesting success of bird species. However, considerable effort is needed to precisely monitor multiple nests, especially for large home range species and direct nest inspections are potential disturbances for birds. As part of a study where direct access to nests was impossible, we developed a long range camera system to monitor pileated woodpecker nesting in utility poles.



MotionEye, an open source software, allows the selection an area of the image (grid) for the motion detection to eliminate unwanted background noise.

Camera system
Hardware:
The camera system consists of a micro computer - Raspberry Pi Zero 2w (1) equipped with a camera module (2) attached onto a telephoto lens 20-40x (3). The system is powered by a 20 ah lithium battery (4). The charge is managed by PiJuice, a power manager (5). The 12v solar panel (6) provides off grid electricity which is converted (7) to 5v before going to the PiJuice to charge the battery.

Software :
All software is open source. The OS on the Raspberry Pi is Raspian Buster (Linux). The motion detection software is MotionEye. This software starts up automatically when the computer turns on. The power management unit (PiJuice) is programmed to turn the system on and off depending on the time of day and the state of charge of the battery.
Cost (DIY) : +- 450\$ CA each camera

Conclusion
This low cost camera system allowed us to monitor Pileated Woodpecker nests and secondary cavity user activity with precision. The reduced field effort allowed us to track a higher number of nests despite their vast distribution in remote areas without electricity.



Camera system monitoring two Pileated Woodpecker nests, one in a utility pole in Nominique Qc. (left) and the other in a dead tree in Laval, Qc. (right).

Eleven other species of birds and mammals were caught on camera at Pileated Woodpecker cavities : Great crested flycatcher, Black-capped chickadee, Downy Woodpecker, Yellow-bellied sapsucker, Hairy Woodpecker, Northern flicker, Common starling, Wood duck, Hooded merganser, Eastern bluebird and eastern gray squirrel (see photos on top).

Methods
We installed 8 cameras in the nesting season of 2022. Five of these were on nests in trees and three on nests in utility poles. The cameras were installed as soon as nests were found. We installed the camera systems either on large diameter trees or on metal posts next to the nest. When the nests were active, the camera system was programmed to turn on at 7a.m. and turn off at 7 p.m. After the young had left the nest, we changed the programming to better monitor possible roosting at night; the camera was on from 5 a.m. to 9a.m. and from 6 p.m. to 9 p.m.

Results
For all monitored nests, we have the precise date and time of the young Pileated Woodpeckers exiting the cavity, and on occasion we have the photo of the young while leaving the nest (see below). We also caught instances of adults exiting the cavity carrying an unhatched egg or a dead hatchling. We analyzed the frequency of adults visiting the nests to either incubate the eggs or feed the young for two nests (see figures below). For all nests, we compiled the number of different species attracted to the cavity.

Frequency of Pileated Woodpecker adults and other species visiting nesting cavity (preliminary results).

