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Macaw Cam: Exploratory Camera Trap Techniques for Monitoring and Conservation of Scarlet Macaw (Ara macao) Nests

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1. Table of Contents

1. Abstract

In this study, we explored new, low-cost camera trap techniques to monitor Scarlet Macaws in one of their last two self-sustaining habitats in Costa Rica. Camera trap monitors have begun to produce new insights in avian research and we use them not only because Macaws are threatened, but their imagery can be used to enhance the public's understanding of the connections between science and conservation efforts. We mounted camera units on two trees with nesting Macaws in Costa Rica's Carara National Park and monitored one nest remotely for seven consecutive months.

The camera recorded digital video and still images effectively in a harsh tropical environment. New observations of defensive behaviors and nocturnal activity were captured including the more common occurrence of nest poaching by iguanas and the uncommon predation by kinkajous, a mammal typically characterized as an herbivore. The camera traps have illuminated the role of natural poaching and inform the design of conservation strategies to enhance Macaw nesting success. Moreover, the archival footage enhances scientific understanding as well as providing information to educate park visitors and local communities about the impacts of natural predation and human poaching on the Scarlet Macaw lifecycle. The methods utilized in this study simultaneously contribute to conservation science, inform policy, and provide a foundation for education through participatory ecological monitoring.

2. Macaw conservation

This study contributed to our understanding of Scarlet Macaw conservation by utilizing camera traps for the first time to observe nests in Carara National park. Scarlet Macaws are listed as a threatened species under the Convention on International Trade in Endangered Species (CITES). In Costa Rica, there are two remaining significant populations in Corcovado and Carara National Parks in the Osa and Central Pacific Conservation Area respectively (Vaughn, et. al 2005).Several studies on the Scarlet Macaws of Costa Rica exist but the body of published work is not extensive (Meyers and Vaughn 2004; Vaughn et. al 1991; Vaughn et. al 2003). Moreover, past nesting observational studies relied on human eye, mirror on pole, binocular and spotting scope strategies (Hudson et. al 2006, McQuillen et al 2000, Dajun et al 2006). Many of these are either opportunistic or conducted only when humans are present (Wall, 1995).We received a $4,000.00 Mentoring in Undergraduate Research (MUR) grant from Western Washington University's Foundation in 2008 to fund a student project complementing traditional approaches with new camera trap and video monitoring techniques.

Camera traps are increasingly important in wildlife ecology and as technology has advanced, cameras have become smaller, cheaper, and more agile in the demanding field environment (Dinata et al. 2008; Weatherhead and Blouin-Demers 2004; Cutler and Swann 1999). Camera traps have been used in the past to study various trends, patterns and presence in mammals (Cutler and Swann 1999; Dajun et. al 2006; Hudson and Bird 2006; King et. al 2001; McQuillen and Brewer 2000; Silver et. al 2004) and has made strides in avian research. However, few have tried to use camera traps in above ground strata until recently (O' Brien and Kinnaird 2008). In this study we explored, relatively low-cost, camera trap techniques to monitor Scarlet Macaws in one of their last two self-sustaining habitats in Costa Rica. Moreover, environmental monitoring is a cornerstone of adaptive management (Holling 1978, Walters 1986, Johnson 1999), providing vital evidence for success or failure of existing practices and a foundation for new conservation policy directions.

In this study we explore camera trap techniques to monitor Scarlet Macaws in one of their last two self-sustaining populations in Carara National Park, a transitional rainforest in Costa Rica. In three field visits between December 2007 and July 2008, a total of 23 field days of camera techniques were investigated complimented with visual observations. The Cuddeback No-flash camera traps used in this study are motion triggered and record color and infrared pictures as well as up to one minute of video. A total of 109 camera events in three and a half months were recorded. The events recorded decreasing nest attendance by macaws over the time period, capture of potential predators at the nest, and novel behaviors. Iguanas and Kinkajous were captured on camera at the nest on five and three occasions respectively. Bark removal was recorded in six events and defensive behavior in one event. Mounting the camera on a wooden frame attached to the nesting tree was successful and weather resistant but potentially difficult to reach. Future technology advances would allow for more flexible placement of similar cameras. Camera traps are postulated to become an essential monitoring tool as a key part of future conservation strategies to aid the recovery and stability of Scarlet Macaws. They can enhance awareness of park visitors and local communities on the impacts of natural predation and human poaching through visual and social media. Thus, camera traps could simultaneously contribute to conservation science, improve policy, and enhance education.

2.1. Equipment

The Cuddeback NoFlash is a digital camera with an infrared motion sensor and infrared camera abilities. During daylight hours the camera can take 3 megapixel color images and 1.3 megapixel black/white images during darker periods of the day. When light is insufficient the camera will use infrared light to enhance the exposure of the picture. Pictures can be recorded on specific time intervals and via motion detection using the motion sensor. The sensitivity of the sensor can be adjusted between low, standard and high. The sensor is dependent upon ambient air temperatures providing higher detection distances in cooler temperatures. The distance for infrared detection distance is approximately 20 feet with an ambient air temperature near 80F. After a picture is taken there is a 'camera delay' that can be set between 1min and 60min. The camera also has the option to record videos both during the day and night with and without infrared. The length of the video taken can be set between 10 seconds and 60 seconds. With the video options activated the camera will still take an initial still image.

Photo 1. Camera Trap Mount.

The unit uses 4 alkaline D cell batteries. Pictures are recorded to a standard compact flash memory card up to 2GB in capacity. This card can be removed and the contents read via a computer or with the use of a USB cord the data can be retrieved directly from the unit. We explored several methods for attaching the camera to the desired substrate. It can be attached via a screw through the center of the unit. A strap, wire, cord , or bungee was also used to secure the camera trap. The unit itself is encased in plastic casing with a small plastic cover for the control area that is screw tightened. The system is weather resistant and operates proficiently in warm tropical conditions. The cost for this system in 2008 was $399.00 U.S. dollars for one unit (batteries and compact flash extra).

2.2. Study Area and Methods

The study was conducted in Carara National Park in the Central Pacific Conservation Area located in the Central Pacific region of Costa Rica. The park encompasses 4700 hectares of Pacific Coast transitional rain forest and includes one of Costa Rica's last habitats for the Scarlet Macaw. The park is a transitional rainforest due to its geographical location situated between Costa Rica's tropical wet forests to the south and the tropical dry forests to the north. It is bordered to the west by farmland and the coastal town of Tarcoles; to the north by the Tárcoles River and the Guacalillo Mangrove Reserve; and to the west by agricultural highlands and the rural communities of Bijuagual and El Sur.

We mounted camera units on two trees with nesting Macaws in Costa Rica's Carara National Park and monitored one nest remotely for seven consecutive months. The camera trap actively operated for 4 months. This pilot study included three separate field visits to Carara National Park. During the first field visit for 10 days between December 2007 and January 2008, we attempted to place a camera at two different nesting sites located along the trail system. During the second field visit at the end of February 2008 we verified the status of the camera and replaced picture storage.

Map 1. Study Site.

During our third and final field visit for 10 days in July 2008 we took down the camera, transferred video files, and conducted further visual observations of both nesting sites.

The camera was set to record a still image and video recording only when the infrared sensor was triggered. The camera delay was 1 minute and the video recording length was set to its maximum of 60 seconds. The sensor sensitivity was also set to maximum. Batteries were replaced only once during the February visit though the batteries had not been fully discharged. A 2GB compact flash memory card was used to ensure the maximum space available for pictures and videos.

The aim of this pilot study was to test the feasibility and suitability of the Cuddeback system in the canopy monitoring scarlet macaw nest behavior. In locating sites for camera observation we found active nest sites within a couple hundred meters of the trail system. Two different tree types and locations were selected as camera sites to explore the potential applications of the cameras.

Photo 2. Camera Trap Placement, Site 2.

Camera Placement

Two different methods for the placement of the cameras were explored based on the two different tree locations and conditions. The first tree was a snag tree isolated away from trails in the park. We used ropes to suspend the camera near the location of the nest. The camera was secured to a block of wood with three rope anchor points; one central hoisting rope and a lower dual stability rope.

The second tree was a full canopy tree with the nest located near the center of the trunk. This site was adjacent to a length of the trail system on one side and a clearing on the other. The nest was freely visible from the ground with little understory nearby. We used a wooden A-frame secured to the trunk of the tree close to the nest. At the end of the A-frame a block of wood was placed perpendicularly with the attached camera facing the desired way. The block was fitted to the A frame so it could swivel to be better positioned once placed on the tree. It required four hours to hoist, place, and secure the camera system to the tree. Once this was finished the climbing ropes were exchanged with a place holding rope which was secured to the tree for future use.

3. Results and Discussion

Our first application of the cameras monitored the snag tree for 5 days. During that period (2) pictures of macaws were taken out of a total of (150) camera combined still image and video events. The camera was subsequently taken down due to its low capture rate of nesting macaws and high susceptibility to excessive motion by wind. During the second application of the cameras, the nesting pair of Scarlet Macaws were periodically vocal and remained near the nest during the entire process of securing the camera. Once placement was finished, the Macaws gradually moved closer to the nest, inspecting the camera and wooden frame. Within an hour the Macaws had returned to the nest and appeared to be ignoring the camera.

The second application did malfunction after three and a half months for unknown reasons. It was found to be properly working after removing it from the tree. It was generally not affected by weather processes. A potential difficulty is accessing the camera for maintenance. The availability of easily accessed trees with convenient areas for placement of cameras limits the wide spread application of these cameras with our methods. Future advances in technology may improve the ability to use the cameras in more diverse locations and therefore reduce observational bias.

Photo 3. Camera Capture of Iguana and Macaw defending nest.

The camera recorded 62 events in the first camera observation period from January 3 to February 29 while 47 events were captured in the second camera observation period from February 29 to April 17. A total of 109 still image and one minute video events were "trapped" in three and a half months. Due to the high sensitivity of the sensor and placement of the camera 43 events were of macaws or potential predators. The remaining events were tree branches in windy conditions, tourists, other small animals in and around the nest

The potential predators captured on camera were iguanas and kinkajous. Iguanas are a well know predator of Macaws. There were recorded in five events generally at the nest opening or moving along side of it. One specific event shows a macaw inside the nest as an iguana is clearing at the edge of the nest opening. Unexpectedly, Kinkajous, considered to be frugivores, were captured in four events. In one event they were seen climbing out of the nest cavity. In another, both a Macaw and kinkajou are seen in the same frame.

The camera also captured Scarlet Macaws arriving and leaving the nest, perched at the nest opening observing, and bark removal behavior (6 events). During bark removal behavior a Scarlet Macaw would scrape old and peeling bark from around the nest cavity opening creating an area of the trunk that was smooth. This was possibly an effort to reduce the traction afforded to potential predators near the nest.

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4. Conservation Implications

Overall, this study has shown the successful use of low cost camera traps in monitoring Scarlet Macaw nests in a harsh tropical environment. In addition to visually observed behaviors being recorded on camera and new behaviors including defensive behavior and bark removal from around the nest, these camera traps have illuminated the role of natural predation in the nesting success of Scarlet Macaws. This new knowledge relating to Scarlet Macaw nesting behaviors and predation events can be used to develop new conservation strategies to aid the recovery and stability of Scarlet Macaws in the Carara National Park region.

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