Camera Traps are an Effective Tool for Monitoring Lewin's Rail (*Lewinia pectoralis brachipus*)

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Camera Traps are an Effective Tool for Monitoring Lewin’s Rail (Lewinia pectoralis brachipus)

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Abstract.—Precise sampling and observational techniques are fundamental to the management and conservation of many bird species. An array of camera traps \((n = 15)\) was deployed to collect information on a poorly known wetland bird, Lewin’s Rail (Tasmanian) \((Lewinia pectoralis brachipus)\) on Tasman Island, Australia, from 25 August 2012 to 10 June 2013. Using camera traps located to maximize detection probability, images from 1,213 camera events quantified Lewin’s Rail occurrence and temporal variation in activity. Observations of social organization and behavior, agonistic behavior, foraging, relations within family groups, breeding activity, and diel activity were recorded. Lewin’s Rail behavior was documented for a total of 294 days \((n = 3,975\) camera trap days). This study demonstrates the effectiveness of camera traps as a tool for studying secretive ground-dwelling birds. Although camera traps cannot replace other avian survey methods, they provide a complementary method for collecting behavioral data on Lewin’s Rail and other ecologically similar species.

Key words.—camera trap, Lewinia pectoralis brachipus, Lewin’s Rail, marsh bird, Tasman Island, trail camera, wetland bird.

Monitoring populations by conventional sampling and observational methods is reliant on target species either being widespread, abundant or conspicuous. For small populations, strict habitat specialists, secretive species and species that inhabit logistically challenging environments, alternative sampling and observational methods are required (Bibby et al. 1992; Glen et al. 2013). Wetland (marsh) bird species such as rails, crakes and bitterns are categorized into the latter group (i.e., they are furtive, inhabit thick vegetation, and are patchily distributed in small populations). Marsh birds are detected primarily by their vocalizations, and most monitoring relies upon presence/absence estimates using call-playback and passive aural surveys (Bibby et al. 1992; Conway and Gibbs 2005). Hence, due to our limited ability to visually observe some marsh bird species, the resultant knowledge gaps constrain our understanding and management of many species.

Camera traps (hereafter cameras) have been used extensively to study large mammals (Karanth 1995; Gerber et al. 2014), but it is only during the last 15 years that cameras have become more frequently used in the study of birds (O’Brien and Kinnaird 2008; Meek et al. 2015). In addition to the standard applications of camera data to document species occurrence and for use in wildlife inventories (where a species can be individually identified from unique markings), new applications have been designed to answer specific ornithological questions regarding behavior (Picman and Schrimi 1994; O’Brien and Kinnaird 2008).

Rails (Rallidae) are poorly represented in ornithological research, and little is known about the population status, distribution, biology and ecology of many rail species (Taylor 1998; Conway 2011). This ground-dwelling group of birds, which prefer to walk or run than fly, is particularly vulnerable to declines that may go unnoticed due to the difficulties of detecting these birds in the field (Taylor 1998; Conway and Gibbs 2005). Lewin’s Rail \((Lewinia pectoralis)\) has a relatively wide distribution, ranging from Indonesia and Papua New Guinea to Australia. Of eight described subspecies, three are endemic to Australia: \(L. p. pectoralis\) on the east coast of mainland Australia, \(L. p. brachipus\) in Tasmania, and \(L. p. clelandi\) in south Western Australia, which is presumed extinct (Garnett et al. 2011). The Tasmanian subspecies of Lewin’s Rail \((L. p. brachipus)\) is a small-bodied species that rarely emerges from dense vegetation and is seldom seen or heard. Hence, many aspects of its life history, distribution and conservation status are poorly understood.
The objectives of this study were to: 1) evaluate the effectiveness of cameras to provide behavioral information on a previously identified population of Lewin’s Rail; and 2) document the advantages of deploying cameras for extended periods of time in a remote location.

**Methods**

**Study Area**

This study was conducted on Tasman Island (43° 14’ 31” S, 148° 00’ 09” E), a 1.6-km x 1.0-km (120-ha) island located off the southeastern coast of Tasmania, Australia (Fig. 1). The island is characterized by steep dolerite cliffs and scree (rising to 300 m above sea level), which encircle an undulating plateau. At its closest point, Tasman Island is approximately 500 m from Tasmania, separated by deep and unpredictable seas. Recognized as an important breeding site for seabirds (Robinson et al. 2015), Tasman Island has been uninhabited since the lighthouse was decommissioned in 1977. The vegetation of the island is a mosaic of dense coastal scrub and tussock grasses (Harris and Kitchener 2005).

**Data Collection**

An array of 15 cameras was deployed for 42 weeks from 25 August 2012 to 10 June 2013. RECONYX HC600 cameras (n = 14; Holmen) were programmed on the “rapidfire” setting (three consecutive still images from trigger event) at medium sensitivity. Additionally, one Scout Guard SG550VB-31 camera (HCO Outdoors) was programmed to take three consecutive still images (at 1-sec intervals) on medium sensitivity mode.

Cameras were unbaited and positioned 0.5-1.0 m (detection zone) in front of dense vegetation or a dolerite rock background (to increase the probability of being triggered by a small-bodied animal moving past and minimize the likelihood of false triggering from wind-blown grass). Cameras were mounted on metal or wooden posts 22-46 cm from the ground, or on small rocks 2 cm from the ground, and were aligned horizontally (film plane perpendicular to the ground).

Figure 1. Map of the Lewin’s Rail study site, Tasman Island, Tasmania, Australia.
or adjusted to an angle of 10-40° facing downward. They remained in the same location with the same positioning (alignment) for the duration of the study unless a location was deemed unsuitable due to false triggers (as identified by image analysis preceding each site visit).

Cameras were strategically positioned to maximize detection of the target species (Meek et al. 2014b). As there are no native or invasive terrestrial mammalian predators present on Tasman Island (Robinson et al. 2015), tracks and openings throughout the vegetation can be reliably attributed to thoroughfares created by birds, including rails. Cameras were positioned beside tracks and openings so as to avoid inhibiting bird movements, and preference given to sites that contained evidence of Lewin’s Rail (e.g., feathers, tracks or fecal matter).

To estimate the impact of cameras on Lewin’s Rail behavior, I deployed an additional camera that was vertically aligned (i.e., film plane parallel to the ground, 0.7 m directly above the detection zone) from 18 February 2013 to 10 June 2013 (Table 1). Analysis of images collected on a previous field trip revealed agonistic behavior exhibited by a Lewin’s Rail toward one of the horizontally positioned cameras. The behavior was aimed directly at the camera, or a reflection from the camera housing, and was identified as an issue of potential animal welfare concern.

After each visit, camera images were reviewed and species identified. Images of Lewin’s Rail were categorized to include age class (chick, sub-adult or adult), behavior, and interactions with other species, with the corresponding date and time stamp information. When multiple images were taken of Lewin’s Rail in the same minute or successive minutes (up to 5 min), I adopted a protocol to filter images into ‘separate events’ (Meek et al. 2014b). Thus, multiple images were treated as a single event, unless different individuals were definitively identified. Mean detection rate was calculated as total number of Lewin’s Rail events/deployment time.

One camera trap day was defined as a 24-hr period from 00:00 to 24:00 during which the camera was operational (Meek et al. 2014b). Camera effort was calculated using the number of camera trap days from the beginning of deployment until retrieval of the memory card, multiplied by the number of individual operational cameras. If a camera or memory card malfunctioned, it was classified as ‘not operational’. When the total number of images on one camera exceeded more than 500 events during a collection period, a sample size of 500 was used in the analysis.

### Results

The research effort resulted in a total of 3,975 camera trap days from 25 August 2012 to 10 June 2013 (n = 294 calendar days; Table 1). After the first deployment period (n = 93 calendar days), one camera was relocated 20 m from its original position due to the high number of false triggers. The total number of camera events was 4,582, with 1,213 (~26%) of those events recording Lewin’s Rail (mean detection rate = 0.305). The number of physical days I spent on Tasman Island was 45, ~7 hours in the field each day (n = 315 hours). Field hours included extended periods of equipment retrieval and deployment, and traversing the island (~5 km daily). The total number of incidental observations of Lewin’s Rail was 64 events (n = 59 aural and n = 5 visual observations).

### Behavioral Observations

Cameras captured a variety of rail behaviors. Pairs of adult Lewin’s Rail were observed with chicks, allopreening and copulating during August to March. Lewin’s Rail chicks (≤4) were observed with single (Fig. 2) or paired adults, preening and foraging together. Over a 14-day period, one adult and three chicks returned to the same camera location on eight separate days. Periods of preening after bathing were in excess of ~35 min duration. Stretching occurred during sunning, with rails extending one leg to ~180° and opening the wing on the same side of body (Fig. 3), then holding and retracting the wing and leg after ~5 sec. Two rail sunning positions were recorded: standing with wings partially spread open, or crouched with wings spread fully open. Lewin’s Rail and Common Greenfinch (Chloris chloris),

### Table 1. Camera trap effort on Tasman Island by deployment period, from 25 August 2012 to 10 June 2013.

<table>
<thead>
<tr>
<th>Component of Sampling Effort</th>
<th>November 2012</th>
<th>December 2012</th>
<th>February 2013</th>
<th>March 2013</th>
<th>June 2013</th>
</tr>
</thead>
<tbody>
<tr>
<td>Camera trap days</td>
<td>1,395</td>
<td>322</td>
<td>741</td>
<td>370</td>
<td>1,147</td>
</tr>
<tr>
<td>Number of cameras</td>
<td>15</td>
<td>14</td>
<td>13</td>
<td>10</td>
<td>14</td>
</tr>
<tr>
<td>Mean camera trap days</td>
<td>93.0</td>
<td>25.0</td>
<td>57.0</td>
<td>37.0</td>
<td>81.9</td>
</tr>
<tr>
<td>Cameras removed</td>
<td>0</td>
<td>0</td>
<td>1</td>
<td>1</td>
<td>1</td>
</tr>
</tbody>
</table>
and Lewin’s Rail and Common Blackbird (*Turdus merula*) were observed together with no indications of interspecific competition or agonistic behavior. Lewin’s Rail foraged by pecking the surface or probing the substrate, at times through leaf litter and also in scree boulder fields. The bill was drilled directly into the substrate to the forehead. Several skink species were predated on. A Lewin’s Rail was documented roosting in the scree at 10:30 hr, in a small cave nocturnally inhabited by Fairy Prions (*Pachyptila turtur*).

The record of Lewin’s Rail agonistic behavior being directed toward one of the horizontally positioned cameras involved spreading its wings, flapping and moving toward the camera. Results from the trial deployment of the vertically positioned camera (*n* = 119 camera trap days) indicated that vertical orientation did not eliminate the behavior as the agonistic behavior was redirected at a surrounding low shrub.

Lewins’ Rail observations peaked during late summer during January 2013 (*n* = 265 events) and February 2013 (*n* = 271 events). Temporal activity peaked in the early morning (06:00-08:00 hr; *n* = 196 events) and evening (17:00-18:00 hr; *n* = 87 events), with nocturnal activity of Lewin’s Rail only accounting for ~2.9% of observations (21:00-05:00 hr; *n* = 35 events; Fig. 4).

Other Species Observations

During the course of this study on Lewin’s Rail, cameras recorded an additional 16 bird species varying in weight from 650-g Forest Ravens (*Corvus tasmanicus*) to 11-g Silvereyes (*Zosterops lateralis*) (Higgins *et al.* 2006). Two reptile species were also recorded: Metallic Skink (*Niveoscincus metallicus*) and Ocellated Skink (*N. ocellatus*).

**DISCUSSION**

Little is known about the behavior of the Tasmanian subspecies of Lewin’s Rail, as sightings are uncommon and fewer than 70 observations have been made since 1995 (Department of the Environment 2015). The cameras have proved to be a valuable tool for observing previously unknown Lewin’s Rail behavior, which has contributed to our understanding of both Lewin’s Rail and the Tasmanian subspecies. The deployment period of 294 calendar days enabled observations of breeding activity from August to March, extending the previously known range from mid-August to December (Marchant and Higgins 1993). Pairs of Lewin’s Rail were not observed outside the breeding season, and no sub-adults were observed with adults. Previously thought to be predominantly crepuscular, observations of diel activity indicated consistent diurnal activity in Lewin’s Rail.

Cameras are undoubtedly valuable research tools; however, their limitations must also be taken into account. Long-term camera deployments with limited site visits are prone to issues of vegetation growth, which can obstruct the camera’s field of view and increase false triggers. Additionally, many gaps remain in our current knowledge of how camera placement and orientation in-
fluence detection probability for different target species (Meek et al. 2015). This study also highlights the advantages of reviewing a sample of images prior to leaving a remote site to mitigate ineffective placement or false trigger issues.

Controlled laboratory-based investigations to test audio and infrared optical outputs determined that cameras do produce sounds and illumination that can be seen and heard by some mammals (Meek et al. 2014a). Therefore, it is plausible that Lewin’s Rail may have been affected by sound or light emission from the camera (or reflection from the camera housing), as indicated by the agonistic behavior directed to cameras with both horizontal and vertical positioning. The trial I conducted using a vertical camera orientation was effective in confirming the presence of Lewin’s Rail and recording the agonistic behavior. Vertically positioned (i.e., ground facing) cameras have been an effective method of detection for some mammal species (Smith and Coulson 2012); however, horizontal positioning is currently the most widely used method in wildlife studies.

The initial financial outlay for cameras is costly, but over time they can become an economically viable research tool (De Bon-di et al. 2010). The minimal number of observations I made during the physical field time serves to highlight the worth of cameras for collecting behavioral data of Lewin’s Rail (five visual field observations vs. 1,213 camera events). Although not an appropriate tool for all objectives of avian studies, cameras can be a valuable complementary methodology. This study demonstrates the effectiveness of cameras for monitoring a secretive bird species, in a remote location, with minimum disturbance to species and their habitat over an extended time period.

Acknowledgments

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