Ecological Field Monitoring Protocols Manual

Using the Ecological Monitoring System Australia

Camera Trapping Module – PROCEDURE ONLY

Citation

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Version

Readers are advised that all modules of the Ecological Field Monitoring Protocols Manual regularly undergo revision. Readers should check the website tern.org.au/emsa-protocols-manual/ to ensure they are viewing the current version.

Version 2

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Main front cover photograph: Reconyx camera trap deployed in Deep Creek National Park, South Australia.

Version control

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The version history of this module is identified below. The version history of the Ecological Field Monitoring Protocols Manual, the methods and data implications, both historical, current and future interpretations of data, are available from the TERN website. Enquiries should be directed to tern@uq.edu.au.

Version	Date	Version update overview
1	21 July 2023	First published version
2	17 April 2024	Updated details for uploading camera trap array spatial data; added deployment start date step; updated details in the steps to repeat steps in the deployment protocol; updated details for the deployment ID; updated details in the deployment end date step in the retrieval protocol.

1 Camera trap deployment protocol

1.1 Field collection

1.1.1 Pre-requisites

To ensure the integrity and quality of the data collected, camera traps must be in proper functioning order. Adequate care and maintenance of the required equipment is essential and close attention must be paid when preparing and calibrating the camera traps before they are deployed in the field.

The following tasks need to be undertaken before commencing a deployment field survey:

- Camera trap identification, firmware update and settings configuration (Appendix 1)
- SD card identification and formatting (Appendix 1)
- Batteries preparation (Appendix 1)
- Desiccant installation (humid/wet conditions; Appendix 1)
- Camera trap array development and upload (Appendix 1)
- Study design and planning considerations (Appendix 2).

1.1.2 Time requirements

Survey time requirements will vary depending on the number and experience of personnel, the number of camera traps being deployed, whether additional equipment is being used (e.g. bait stations, drift fence), the level of site preparation required at each camera trap point, the size of the project area, and the level of difficulty in traversing the project area.

As a general guide:

- Allow one week prior to the field survey to prepare camera traps, SD cards, batteries and camera trap arrays.
- Allow 10–30 minutes at each camera trap point, depending if installing a bait station or carcass.
- Allow travel time between camera trap points.
- Consider the deployment period.

1.1.3 Personnel requirements

Personnel number and skills:

- Camera trap deployment is best conducted with two personnel, one setting up the camera traps, and the other recording the data directly into the app.
- The surveyor deploying the camera traps should be familiar with and experienced in the operation and settings of the camera traps. If surveyors are not confident, time should be dedicated to practising, using instruction manuals, and seeking advice before conducting this protocol.
- For large project areas and camera trap arrays, camera trap deployment is best conducted with two or more teams in separate vehicles.
- The use of camera traps involves interference with wildlife. Therefore, scientific permits and wildlife ethics approvals are likely to be required, so always check with your local authority. Access permissions are required.

1.1.4 Equipment

General deployment equipment:

- Mobile device (tablet/phone) with the Monitor app pre-loaded
- GNSS receiver capable of achieving <30 cm accuracy (e.g. Trimble R1 or DA2), hand-held GPS, or device built-in GPS (least preferred)
- Camera traps (same make and model)
- Batteries – as many as required per camera trap for all camera traps
- 1 x SD card per camera trap
- 1 x mounting post per camera trap (e.g. star dropper)
- Mounting apparatuses (e.g. cable ties, tie wire, mounting straps)
- Anti-theft devices and keys (e.g. cable lock straps, padlocks, security boxes)
- Chocks to angle camera traps to features (e.g. small wooden offcuts)
- Steel post driver or mash hammer
- Pocket tape measure
- Protractor
- Compass
- Inclinometer
- Site preparation equipment (e.g. gloves, secateurs, pruning saw, rake, shovel)
- Hand-held digital camera, SD card image viewer or USB-C/Lightning to SD card reader
- Rechargeable battery chargers
- Flagging tape.

Project dependent equipment:

- 1 x bait or lure per bait station
- 1 x ventilated bait container per bait station
- 1 x small olfactory lure container per bait station
- 1 x mounting post per bait station
- Dust or granular insecticide for ants
- 1 x carcass per camera trap point
- 2 x metal stakes and tie wire per carcass
- Angle brackets (90°) and fasteners (horizontal camera trap orientation)
- Drift fences (directing species towards the detection zone)
- Cork tiles (thermal contrast between tile and species)
- 1 x desiccant packet per camera trap (humid/wet conditions).

1.1.5 Instructions and procedures

1. The camera traps should have been prepared and calibrated prior to the field survey. If not, refer to the pre-field survey tasks (Appendix 1) to install batteries, SD cards and desiccant packets (for humid/wet conditions), and configure the settings for each camera trap before continuing.
1. If deploying camera traps in an array, ensure the proposed array has been uploaded to your device (csv file with ‘Name’, ‘Latitude’ and ‘Longitude’ columns, with latitude and longitude in decimal degrees; see Appendix 1).

2. If deploying camera traps within a Fauna Plot, ensure the Plot Selection and Layout Module has been completed to establish the Fauna Plot and mark out the plot boundaries and trapping configuration.
3. Select the Camera Trapping Module in the Monitor app.
4. Select Camera Trap Deployment.
5. Record a *survey label*. This is a descriptor to distinguish the camera trap deployment for subsequent re-equipping and retrieval (e.g. June 30 array deployment).
6. Select the *survey type* from the following drop-down list (you can only complete one type of survey at a time):
    - Camera trap point
    - Camera trap array – grid
    - Camera trap array – transect
    - Fauna plot.
7. The *start date time* of the deployment survey will be automatically recorded. Update if required.
8. If a camera trap array *survey type* is selected, load the *array planned points* into the app by picking the relevant csv file (with 'Name', 'Latitude' and 'Longitude' columns, with latitude and longitude in decimal degrees).
9. Traverse your project area and locate a proposed camera trap point, whether at a feature of interest, as part of an array or within a Fauna Plot. Approach it with the required equipment. Use the mapping interface to locate *array planned points*.
10. Select the *add camera trap point* button.
11. Record a *camera trap point ID* that is suitable for your project (e.g. CTP001). Consider you are planning to deploy a paired camera trap at the camera trap point (e.g. CTP001A and CTP001B). Consider the name of any permanent camera trap points that are being used.
12. Record the *deployment start date*. The app will automatically record a *deployment ID* using the *camera trap point ID* and *deployment start date* (e.g. CTP001-2023-06-30 15:00:00). The *deployment start date* is also used to calculate the *deployment period* upon retrieval.
13. If a camera trap array *survey type* is selected, the app will prompt you to record the *distance to closest camera trap point* in metres (m). The initial entry will be automatically populated for subsequent deployments, and can be updated if the minimum distance between points changes. Select the *mark closest camera trap point* button in order to distinguish camera trap points that have deployed camera traps among the array on the mapping interface.
14. If the camera trap array – transect *survey type* is selected, the app will prompt you to record the *transect number*. This will be automatically set to '1'. However, you can update this if you are deploying camera traps along multiple transects.
15. If the fauna plot *survey type* is selected, the app will prompt you to select which *fauna plot* you are surveying in from a drop-down list of established fauna plots.
16. If targeting a specific taxa or species, record the *target taxa* and *target species* from the drop-down lists. Multiple taxa and/or species can be added.
17. Scan the immediate area to ensure it is suitable to secure a camera trap mounting post with the focal point in a southerly direction. If it is not suitable to secure a mounting post or there are issues with the detection zone and field of view, move to the nearest suitable area.
18. Use a steel post driver or mash hammer to secure a camera trap mounting post into the ground in a northerly direction from your desired focal point. Ensure the post remains tall enough so the top of the mounted camera trap is a suitable height for your project needs. If there is a large tree trunk or stem in a suitable position this can be used. Ensure the post is secure or the tree trunk or stem is large enough to prevent false triggers from camera movement. Record the *camera trap mount* from the drop-down list (e.g. 'Star dropper', 'Tree').
19. When standing directly at the camera trap mounting post, press the *record camera trap point location* button.
20. Record the *feature* that will be the focal point of the camera trap from the drop-down list or input a custom value (e.g. trail, waterpoint, bait station, carcass, palatable plant). Record the *distance to feature* in metres (m), a *feature*

photo and any *feature comments*. If relevant, record the *carcass species*, *plant species* or *sign species*. Multiple features can be recorded (e.g. trail and bait station).

21. If using a bait station, install this first so you have a focal point when setting up the camera trap. Use a steel post driver or mash hammer to secure a mounting post into the ground. Ensure the post remains tall enough so the bait container is a suitable height above the ground for your project needs. Ensure the post is secure enough that it cannot be easily removed by animals. Record the *bait station mount*. If using a bait, place the bait in the bait container and secure to the post using a mounting apparatus. If using an olfactory lure, place the required amount inside a small container and carefully place this into the mounted bait container. If using an audio or visual lure, secure it to the post using a mounting apparatus. Record the *lure height* in centimetres (cm), *lure type* and *lure variety* used from the drop-down list or manual entry. Where ants may be a problem, spread dust or granular insecticide for ants around the base of the bait station.
22. If using a carcass, install this first so you have a focal point when setting up the camera trap. Use a mash hammer to secure the two metal stakes to the ground. Do this at a distance that will allow you to secure the carcass to the stakes using wire around the neck and hind achilles tendon.
23. If required for your project, install drift fences to direct species towards the detection zone, and/or cork tiles to create a sufficient thermal contrast between the tile, which is heated by the sun, and the species.
24. Before mounting the camera trap, open the housing and check and record the *camera trap number* and *SD card number*.
25. Record the camera trap information, including *make*, *model*, *manufacture year* (same model may vary between years), *illumination*, *activation mechanism* (e.g. 'PIR') and *trigger speed* in seconds. Once the data is entered for the first camera trap you configure, your previous selections will automatically appear for each subsequent camera trap you deploy during the current survey.
26. Switch the camera trap on and navigate to the settings menu to check that the following camera trap settings have been configured to suit your project, recording each in the app as you progress:
    - *media type* (i.e. image and/or video)
    - *images per trigger* (for images)
    - *image interval* in seconds (for images)
    - *video length* in minutes and seconds (for videos)
    - *sensor sensitivity*
    - *quiet period* in minutes and seconds
    - *aspect ratio*
    - *image quality* in megapixels (for images)
    - *video resolution* (for videos)
    - *day/night recording*
    - *night mode shutter speed* in seconds
    - *time format*
    - *date* and *time*
    - *unit of temperature*
    - *battery type*
    - *user label*
    - *time lapse (on/off)*
    - *time lapse interval* in minutes and seconds (if time lapse turned on)
    - *time lapse schedule start* and *end* (if time lapse turned on; multiple can be recorded).

    The app will only display the fields relevant to the *media type* selected. Once the data is entered for the first camera trap you configure, your previous selections will automatically appear for each subsequent camera trap you deploy during the current survey. If you wish to retain the same settings, you will just need to update the *camera trap*

number and *SD card number* in the app, and *user label* in the camera trap and in the app. Close the camera trap housing.

27. Using a mounting apparatus and anti-theft devices if necessary, mount the camera trap so that it is at a height to suit your project needs and facing the focal point. It should be facing south wherever possible (otherwise in a southerly direction). Use chocks to angle the camera so it captures the feature in the middle of the field of view. If required for your project, use an angle bracket to orientate the camera trap horizontally (i.e. downward-facing detection zone and field of view).
28. Record the *camera trap height* in centimetres (cm), from the surface of the ground to the camera lens.
29. Record the *camera trap angle from vertical* (0–90°). If using an angle bracket to orientate the camera trap horizontally, record the angle as '90°'.
30. Record the *camera trap direction* relative to north (0–360°) and the *detection angle* (°) relative to the predicted path of the target taxa/species.
31. Record the *slope* and *aspect*. If the area is flat, record '0°' for both. See the guidelines for setting camera traps on sloped ground.
32. Ensure that the sensor screen and camera lens are clean.
33. Check that there are no obstacles in front of the sensor, flash unit or camera lens (e.g. branches, mounting straps, flagging tape).
34. If required, undertake site preparation to prevent false triggers, maximise species identification and reduce fire risk to equipment. Clear all vegetation (low hanging vegetation, grass, sticks, leaves, etc.) between the camera trap and feature. Clear vegetation at least 1 m behind the feature and at least 1 m around the camera trap (to mitigate fire damage). Consider the field of view of the sensor and clear vegetation at least 1.5 m either side of the feature.
35. Record a *camera trap photo*.
36. Test if the camera trap is positioned correctly using one of the following methods:
    - **Walk test (if available):** open the camera trap. Switch it on and navigate to the *walk test* function. Close the camera trap. Test the field of view by moving your hand around the focal point while watching for the red light on the camera trap to indicate when are within the field of view. Adjust the camera trap and repeat the exercise as necessary.
    - **Trigger the camera trap:** open the camera trap. Switch it on and arm the camera trap. Close the camera trap. Trigger the camera trap by moving your hand around the focal point. If you can review the test images on your camera trap do so. If not, switch off the camera trap, remove the SD card and view the images using a hand-held digital camera, SD card image viewer or on your device using an SD card reader. Adjust the camera trap and repeat the exercise as necessary. Delete the images before arming the camera trap.
37. Switch on and arm the camera trap. Close the camera trap ensuring the rubber seal is clean and waterproof.
38. Position yourself or arm or leg in the detection zone to trigger a capture sequence, which is used to indicate the start of the sampling period.
39. Record the *habitat (major vegetation group)* (optional).
40. Record any additional *deployment comments* (optional).
41. Select the *save camera trap point* button.
42. Use flagging tape in a nearby tree to mark the location for easy camera trap re-equipping or retrieval. Ensure the flagging tape is not in the field of view of the camera trap. If there is a security risk, do not mark the location of the camera trap, it can be located using its coordinates.
43. Repeat steps 10–43 for each proposed camera trap point for the selected *survey type*.
44. Once all camera traps for the selected *survey type* have been deployed, complete the camera trap deployment component. The end date time of the deployment survey will be automatically recorded. Update if required. Check the data summary before queuing the collection for submission.
45. Repeat Steps 4–45 for a different *survey type* (creating a new collection for each) if required.

1.1.6 Additional guidelines

The following points are adapted from Gillespie *et al.* (2015), Molloy (2018) and TEAM Network (2011).

Traversing the project area

- Disturbance of the project area should be minimised by using existing tracks and trails or establishing temporary access routes that can be used simultaneously to undertake multiple modules.
- Some camera trap points may need to be traversed to on foot.

Camera trap deployment

- Look for features of interests, where fauna activity is likely to be high (e.g. water points, trail intersections).
- Look for signs of animal paths, or natural openings through the area, such as adjacent to rock ledges or creek beds; also place camera traps in areas with contrasting vegetation structures, such as densely vegetated versus open areas.
- Opportune observations may also give an indication of areas that could be targeted.
- Avoid deploying camera traps in areas where there is a risk of inundation during the deployment period.
- Deploy camera traps so that they are orientated south to prevent glare and sun damage to the camera lens and sensor, and to reduce false triggers from the rising and setting of the sun.
- There is evidence of overheating and malfunction of camera trap batteries on days where daytime temperatures exceed 40°C. Depending on the location and time of year, shade may need to be provided to protect the back of the camera trap from sun exposure (Dundas *et al.* 2019).
- If possible, try to deploy camera traps so they are on an angle relative to animal paths.
- In sloped terrain, camera traps should be angled and parallel to the ground to ensure detection.
- Level camera trap points are preferable as they provide undistorted and unobstructed view of subjects, particularly smaller animals. Downward slopes increase the size of blind zones (although this can be partially rectified by angling the camera trap downward) and upward slopes reduce the photographed area and proved a greater opportunity for concealment by increasing the effect of on ground structures.
- If camera traps are deployed in a Fauna Plot while ground trapping is being undertaken, take care to avoid ground trapping near detection zones to prevent false triggers.
- Refer to the relevant camera trap make and model user manuals for guidance in the operation and functionality of the camera traps.
- Check that the housing of each camera trap is properly closed to prevent moisture damaging the electronics.
- All camera traps used in a survey should all be set up with the same settings. Refer to Appendix 2 for a summary of informed camera trap settings for different taxa.
- An angle bracket can be used to orientate the camera trap horizontally (i.e. downward-facing detection zone and field of view) to survey small mammals and reptiles (e.g. Dundas *et al.* 2019; Moore *et al.* 2020b).
- Where camera trap points are in a regular grid or transect array, distance between points can be recorded as a single value. However, where camera trap points are randomly or irregularly located, the distance to the closest point is recorded, which allows for values such as the average, minimum and maximum distance among the points, along with a measure of the distribution of distances (e.g. standard deviation).
- Theft and vandalism inevitably occur. Consider the risk of this in your project area and use anti-theft devices. Cable-locking camera traps or using security boxes will act as a deterrent and is advisable in areas with high human visitation or if setting camera traps along vehicle or walking tracks.
- When multiple camera traps are deployed it is advisable to use combination locks, or have locks keyed-alike, to avoid having to carry multiple keys into the field. Coil excess cable length up off the ground.

- In many cases, people who discover cameras may not disturb them, but will be curious about why they are there. Attaching a small sign to the side of each camera with a brief description of the project and some contact information is likely to satisfy curiosity and may help to limit vandalism or other interference.
- Minimise animal interference of camera traps by securing them tightly, securing the door with a cable tie, or placing the camera trap inside a metal security box. Reconyx manufacture sturdy metal cases for their cameras for additional protection if needed.

Site preparation

- Determine what vegetation may cause false triggers, such as overhanging branches, or plants nearby that may grow into the sensor field during deployment, and remove with secateurs or rake as necessary.
- If deployment will extend over a growing period, dig out perennial grass and shrub bases of the cleared area.
- Avoid piling cleared material right next to the camera trap point as this may just blow across the field of vision, triggering false images, or impede animal access.
- If in doubt regarding vegetation clearing, set the camera trap and trigger it to take a couple of photos, then view the images on the camera trap or remove the SD card and view the images using a hand-held digital camera, SD card image viewer or on your device using a SD card reader.

Installing bait stations

- Standard mammal trapping bait of peanut butter, rolled oats and honey has been successfully used in surveys targeting a wide variety of small and medium-sized native mammals, such as quolls, bandicoots, possums and rodents.
- Bait containers should be ventilated (i.e. mesh) to allow scent to escape. A suspended metal tea infuser a common option (Meek *et al.* 2012a; Andrewartha *et al.* 2021; McHugh *et al.* 2022). Alternatively, PVC pipe with a ventilated end cap and an overhanging cover is recommended to reduce dehydration and water diluting the bait in the wet conditions (Gillespie *et al.* 2015). A comparative design is the PVC Vent Cowl (Figure 21 in Meek *et al.* 2012b).
- If suitable for your project, bait stations can be secured to the ground using a large tent peg rather than attached to a bait station mounting post.
- Bait stations can also be interfered with if not secured or designed properly. Crows and some rat species are notorious for breaking into or damaging bait stations, and dingoes will readily remove bait stations that are not adequately secured.

Installing carcasses

- Camera trap points should be spaced at distances sufficient to minimise carcass scent travel between points, such that scavengers would have to actively forage and seek out carcasses rather than being able to move quickly from one camera trap point to another. A minimum distance of 1 km has been used in recent studies in Australia (Spencer and Newsome 2021; Spencer *et al.* 2021).
- Carcasses can be sourced from management culls, simulated culls, hunter kills and road kills.
- Any carcass that displays evidence of disease (e.g. heavy parasite loads) should not be used.
- Following collection, carcasses should be placed in the field without freezing within 24 hours in warm conditions and within 36 hours in cool conditions.
- Cameras should be removed, or carcass replaced, when a carcass has been reduced to skeletal remains and all edible soft tissue has been removed as the carcass loses its attraction to scavengers (Behrendorff *et al.* 2018).
- Research licences or permits may be required to obtain, relocate and monitor carcasses.
- Consider the indirect impact of carcass provision on native species before use (Spencer *et al.* 2021).

Selecting palatable plants

- Before undertaking camera trapping, determine the most palatable plants within the study area. For example, the following papers discuss plant palatability for rabbits, which are likely palatable for other species (Cooke 1988; Cooke *et al.* 2010; Bird *et al.* 2012; Cooke 2012; Mutze 2016; Mutze *et al.* 2016a, 2016b).
- The preferential foraging behaviour of the target species within the area should be established through research and observation because observing grazing impacts is the only guaranteed method of determining palatability (Bohning and Wilkie 1999). Alternatively, a cafeteria study may be conducted (Arcese *et al.* 2014). The most palatable species is likely the most noticeably browsed species in an area (McDonald and Brandle 2009) or the species lacking juvenile cohorts (Mutze *et al.* 2016b).
- A plant's chemical and physical components determine its palatability (Forsyth *et al.* 2005). Palatable species generally have high protein content, carbohydrate aroma compounds and alkaloids, low tannin content, and minimal organic acids (Raufirad *et al.* 2016).
- The palatability of plants depends on a wide range of complex factors such as available species, the abundance of species, season and stock type (Bohning and Wilkie 1999). Climate, topography, soil moisture, past grazing use and plant growth stage should be considered because they influence some plant species' chemical composition and palatability (Raufirad *et al.* 2016).
- Where a palatable plant neighbours an unpalatable plant, the palatable plant is vulnerable to herbivory (Rautio *et al.* 2012). Where herbivores selectively graze, the camera should be positioned on a palatable plant neighbouring less or non-palatable plant species.
- The selection of palatable plant species should depend on the target pest species:
  - Goats are less selective, a consequence of adaptations that neutralise tannins and their ability to stand on their hind legs (McDonald and Brandle 2009). As a result, goats prefer the species most prevalent in the landscape (Raufirad *et al.* 2016).
  - Deer preference depends on the ecosystem – in a temperate forest, select species with lower leaf fibre content (Forsyth *et al.* 2005), and in a grassland, preference species with a greater specific leaf area (Lloyd *et al.* 2010).
  - Rabbits prefer palatable, short-lived species such as acacias and casuarinas as opposed to less palatable, long-lived eucalypts (Cooke and McPhee 2007).

Palatable plant camera placement

- Camera traps should be positioned for the height of the browsing on palatable plants (e.g. rabbits browse up to approximately 40 cm) and positioned so they can detect this herbivory on palatable plants.
- Camera traps should be arranged to maximise visual coverage of potential foraging areas (e.g. two camera traps; Reid *et al.* 2020).
- Areas around camera traps should be cleared to roughly 25 m^2 (Reid *et al.* 2020).
- Where long grass is present, camera traps should be placed a minimum of 1 m above ground to reduce false triggers (Reid *et al.* 2020).
- Plants chosen should have significant dimensional characteristics and maintain a presence irrespective of seasonal conditions (McDonald and Brandle 2009).

1.2 Post-field survey tasks

Not applicable for camera trap deployment. See Section 5.2 for post-field survey tasks required after camera trap retrieval.

2 Camera trap re-equipping protocol

2.1 Field collection

2.1.1 Pre-requisites

The following tasks need to be undertaken before commencing a re-equipping field survey:

- Camera trap identification, firmware update and settings configuration (Appendix 1)
- SD card identification and formatting (Appendix 1)
- Batteries preparation (Appendix 1)
- Desiccant installation (humid/wet conditions; Appendix 1).

2.1.2 Time requirements

Survey time requirements will vary depending on the number and experience of personnel, the number of camera traps being re-equipped, whether any damaged or missing camera traps need to be replaced, whether additional equipment is being used and needs to be replaced, the level of follow-up site preparation required at each camera trap point, the size of the project area, and the level of difficulty in traversing the project area.

As a general guide:

- Allow one week prior to the field survey to prepare replacement camera traps, SD cards and batteries.
- Allow 5–20 minutes at each camera trap point, depending if replacing a bait station or carcass.
- Allow travel time between camera trap points.
- Consider the deployment period.

2.1.3 Personnel requirements

Personnel number and skills:

- Camera trap re-equipping and recording the data directly into the app can be conducted by a single surveyor. However, it is best conducted with two personnel, one re-equipping the camera traps, and the other recording the data directly into the app.
- The surveyor re-equipping the camera traps should be familiar with and experienced in the operation and settings of the camera traps. If surveyors are not confident, time should be dedicated to practising, using instruction manuals, and seeking advice before conducting this protocol.
- For large project areas and camera trap arrays, camera trap re-equipping is best conducted with two or more teams in separate vehicles.
- The use of camera traps involves interference with wildlife. Therefore, scientific permits and wildlife ethics approvals are likely to be required, so always check with your local authority. Access permissions are required.

2.1.4 Equipment

General re-equipping equipment:

- Mobile device (tablet/phone) with the Monitor app pre-loaded
- GNSS receiver capable of achieving <30 cm accuracy (e.g. Trimble R1 or DA2), hand-held GPS, or device built-in GPS (least preferred)
- Anti-theft device keys
- Replacement batteries – as many as required per camera trap for all camera traps
- 1 x replacement SD card per camera trap
- Replacement camera traps (same make and model)*
- Replacement mounting posts (e.g. star dropper)*
- Replacement mounting apparatuses (e.g. cable ties, tie wire, mounting straps)*
- Replacement anti-theft devices and keys (e.g. cable lock straps, padlocks, security boxes)*
- Replacement chocks to angle camera traps to features (e.g. small wooden offcuts)*
- Steel post driver or mash hammer
- Pocket tape measure
- Protractor
- Compass
- Inclinometer
- Site preparation equipment (e.g. gloves, secateurs, pruning saw, rake, shovel)
- Hand-held digital camera, SD card image viewer or USB-C/Lightning to SD card reader
- Rechargeable battery chargers
- Flagging tape.

**Ensure a suitable number of each item is taken into the field to replace any that have been damaged or are missing/stolen.*

General re-equipping equipment:

- 1 x replacement bait or lure per bait station
- Replacement ventilated bait containers*
- Replacement small olfactory lure containers*
- Replacement bait station mounting posts*
- Dust or granular insecticide for ants
- 1 x replacement carcass per camera trap point
- Replacement metal stakes and tie wire to secure carcasses*
- Replacement angle brackets (90°) and fasteners (horizontal camera trap orientation) *
- Replacement drift fences (directing species towards detection zone) *
- Replacement cork tiles (thermal contrast between tile and species) *
- 1 x replacement desiccant packet per camera trap (humid/wet conditions).

**Ensure a suitable number of each item is taken into the field to replace any that have been damaged or are missing/stolen.*

2.1.5 Instructions and procedures

The following steps should be followed to check and replace camera trap batteries and SD cards, and bait stations if being used, to prolong the deployment of each camera trap in the same location using the same settings and mode of deployment. If retrieving a camera trap and deploying at a new camera trap point and/or with different settings or mode of deployment, refer to the camera trap retrieval protocol (Section 5) and then the camera trap deployment protocol (Section 3).

1. Replacement camera traps should have been prepared and calibrated prior to the field survey. If not, refer to the pre-field survey tasks (Appendix 1) to install batteries, SD cards and desiccant packets (for humid/wet conditions), and configure the settings for each camera trap before continuing.
2. Select the Camera Trapping Module in the Monitor app.
3. Select Camera Trap Re-equipping.
4. Select the relevant deployment *survey label* (e.g. June 30 array deployment).
5. The *start date time* of the re-equipping survey will be automatically recorded. Update if required.
6. Traverse your project area and locate a camera trap point. Approach it with the required equipment from the front to trigger a capture sequence, which is used to indicate the end of the sampling period.
7. If the camera trap is missing, search the vicinity as it may have been dislodged and shifted by fauna. If you cannot find the camera trap, you will record it as 'Missing' in step 9.
8. Select the relevant *deployment ID* from the drop-down list.
9. Record the *re-equipping date*.
10. Keeping the camera trap mounted, open the housing and turn it off to disarm it.
11. Turn the camera trap on and navigate to the *check status* function. The number of images captured, amount of space on the SD card and amount of battery power remaining will be displayed. If the display is blank, the batteries may be flat. Replace the batteries and switch the camera trap on to determine if the camera trap was not operational due to flat batteries or being damaged. Record the *operational status* from the drop-down list.
12. If the *operational status* is 'Operational', 'SD card full', 'SD card failure' or 'Batteries flat', replace the batteries, SD card and desiccant packet (for humid/wet conditions) and record the *number of images* (optional) and the *replacement battery type* and *replacement SD card number*, and then skip to Step 20, or Step 17 if using a bait station, Step 18 if using a carcass, or Step 19 if you need to replace missing drift fences or cork tiles.
13. If the *operational status* is 'Hardware failure', 'Unknown failure', 'Vandalism' or 'Missing/theft', consider the security risk and whether replacement is worthwhile. If it is, check the *camera needs replacing* checkbox.
14. Before mounting the replacement camera trap, open the housing and check and record the *replacement camera trap number*, *replacement battery type* and *replacement SD card number*.
15. Switch the replacement camera trap on and navigate to the settings menu to check that the camera trap settings have been configured to be the same as during deployment. The app will display the camera trap information and settings recorded during deployment (auto filled based on the selected *deployment ID*). Update the *date* and *time* as these will have changed, and the *user label* if changing.
16. If the camera trap mounting post is missing, use a steel post driver or mash hammer to secure a replacement camera trap mounting post into the ground at the camera trap point. This should be the same as the initial deployment. If not, update *camera trap mount*. Ensure the post remains tall enough so the top of the mounted camera trap is a suitable height for your project needs (this should be the same as the initial deployment). Ensure the post is secure to prevent false triggers from movement.
17. Using a mounting apparatus and anti-theft devices if necessary, mount the replacement camera trap. Ensure that the *camera trap height*, *camera trap angle*, *camera trap direction* and *detection angle* of the replacement camera trap are the same as during deployment (the app will display the mode of deployment).
18. If using a bait station, replace the bait or olfactory lure in the bait container, or replace the audio or visual lure if required. Replace the bait container and mounting post if they are missing. Update *camera trap mount* if the replacement is not the same as the initial deployment. Ensure that the *lure height*, *lure type* and *lure variety* of the

replacement bait station are the same as during deployment (the app will display the lure information recorded during deployment). Where ants may be a problem, spread dust or granular insecticide for ants around the base of the bait station.

19. If using a carcass, replace the carcass. Secure the carcass to the two metal stakes using wire around the neck and hind achilles tendon. Replace the stakes and wire if they are missing. The *carcass species* should be the same as the initial deployment. Update if required.
20. If using drift fences or cork tiles, replace these if they are missing.
21. Ensure that the sensor screen and camera lens are clean.
22. Check that there are no obstacles in front of the sensor, flash unit or camera lens (e.g. branches, mounting straps, flagging tape).
23. If required, undertake follow-up site preparation to prevent false triggers, maximise species identification and reduce fire risk to equipment. Clear all vegetation (low hanging vegetation, grass, sticks, leaves, etc.) between the camera trap and feature. Clear vegetation at least 1 m behind the feature and at least 1 m around the camera trap (to mitigate fire damage). Consider the field of view of the sensor and clear vegetation at least 1.5 m either side of the feature.
24. Record a *camera trap photo.*
25. Test if the camera trap is positioned correctly using one of the following methods:
    - **Walk test (if available):** open the camera trap. Switch it on and navigate to the *walk test* function. Close the camera trap. Test the field of view by moving your hand around the focal point while watching for the red light on the camera trap to indicate when are within the field of view. Adjust the camera trap and repeat the exercise as necessary.
    - **Trigger the camera trap:** open the camera trap. Switch it on and arm the camera trap. Close the camera trap. Trigger the camera trap by moving your hand around the focal point. If you can review the test images on your camera trap do so. If not, switch off the camera trap, remove the SD card and view the images using a hand-held digital camera, SD card image viewer or on your device using an SD card reader. Adjust the camera trap and repeat the exercise as necessary. Delete the images before arming the camera trap.
26. Switch on and arm the camera trap. Close the camera trap ensuring the rubber seal is clean and waterproof.
27. Position yourself or arm or leg in the detection zone to trigger a capture sequence, which is used to indicate the start of the sampling period.
28. Record any additional *re-equipping comments* regarding the re-equipping (optional), including any equipment (other than batteries, SD cards or lures) that was replaced.
29. Select the *save camera trap re-equipping* button.
30. Use flagging tape in a nearby tree to mark the location for easy camera trap re-equipping or retrieval. Ensure the flagging tape is not in the field of view of the camera trap. If there is a security risk, do not mark the location of the camera trap, it can be located using its coordinates.
31. Repeat steps 5–30 for each camera trap point for the selected *survey type*.
32. Once all camera traps for the selected *survey type* have been re-equipped, complete the camera trap re-equipping component. The end date time of the re-equipping survey will be automatically recorded. Update if required. Check the data summary before queuing the collection for submission.
33. Repeat Steps 2–32 for a different *survey type* (creating a new collection for each) if required.

2.1.6 Additional guidelines

- It is important to confirm whether or not the camera trap was operational for the whole survey period. If there is no capture sequence upon re-equipping of the camera trap it makes it impossible to know whether it was operational for the full deployment period. For example, if the last image occurs in week 3 of 4, this could reflect either no animals at the camera trap point post week 3 or a camera malfunction sometime after this capture.
- If the SD card was full, it is recommended that the SD card is replaced with one with greater storage capacity, or checking the SD card storage at a shorter period to maintain camera trap functionality.

- If the batteries were flat, it is recommended that they be checked at a shorter period to maintain camera trap functionality.
- Consider if the site preparation might have caused false triggers and undertake more clearance if necessary.
- If the camera trap was stolen or vandalised, consider the risk of this happening again and if anti-theft devices and measures will be enough to prevent this.

2.2 Post-field survey tasks

Not applicable for camera trap re-equipping. See Section 5.2 for post-field survey tasks required after camera trap retrieval.

3 Camera trap retrieval protocol

3.1 Field collection

3.1.1 Pre-requisites

There are no tasks that need to be undertaken before commencing a retrieval field survey.

3.1.2 Time requirements

Survey time requirements will vary depending on the number and experience of personnel, the number of camera traps being retrieved, the size of the project area, and the level of difficulty in traversing the project area.

As a general guide:

- Allow 5–10 minutes at each camera trap point, depending if removing a bait station or carcass.
- Allow travel time between camera trap points.

3.1.3 Personnel requirements

Personnel number and skills:

- Camera trap retrieval and recording the data directly into the app can be conducted by a single surveyor. However, it is best conducted with two personnel, one retrieving the camera traps, and the other recording the data directly into the app.
- The surveyor retrieving the camera traps should be familiar with and experienced in the operation and settings of the camera traps. If surveyors are not confident, time should be dedicated to practising, using instruction manuals, and seeking advice before conducting this protocol.
- For large project areas and camera trap arrays, camera trap retrieval is best conducted with two or more teams in separate vehicles.
- The use of camera traps involves interference with wildlife. Therefore, scientific permits and wildlife ethics approvals are likely to be required, so always check with your local authority. Access permissions are required.

3.1.4 Equipment

- Mobile device (tablet/phone) with the Monitor app pre-loaded
- GNSS receiver capable of achieving <30 cm accuracy (e.g. Trimble R1 or DA2), hand-held GPS, or device built-in GPS (least preferred)
- Anti-theft device keys.

3.1.5 Instructions and procedures

1. Select the Camera Trapping Module in the Monitor app.
2. Select Camera Trap Retrieval.
3. Select the relevant deployment *survey label* (e.g. June 30 array deployment).
4. The *start date time* of the retrieval survey will be automatically recorded. Update if required.
5. Traverse your project area and locate a camera trap point. Approach it with the required equipment from the front to trigger a capture sequence, which is used to indicate the end of the sampling period.
6. If the camera trap is missing, search the vicinity as it may have been dislodged and shifted by fauna. If you cannot find the camera trap, you will record it as ‘Missing’ in step 10.
7. Select the relevant *deployment ID* from the drop-down list.
8. Record the *retrieval date*. The app will automatically calculate the *deployment period* (number of camera trap nights based on the deployment date).

9. Open the camera trap and turn it off to disarm it.
10. Turn the camera trap on and navigate to the *check status* function. The number of images captured, amount of space on the SD card and amount of battery power remaining will be displayed. If the display is blank, the batteries may be flat. Replace the batteries and switch the camera trap on to determine if the camera trap was not operational due to flat batteries or being damaged. Record the *operational status* from the drop-down. Record the *number of images* (optional).
11. Switch off and close the camera trap.
12. Record any additional *retrieval comments* (optional).
13. Select the *save camera trap retrieval* button.
14. Remove the camera trap and bait container (if bait station used) from the mounting posts, and remove the mounting posts. Remove any materials used to secure the carcass (if used). Remove any flagging tape used to mark the location of the camera trap.
15. Ensure all equipment is packed appropriately for transport. Camera traps, in particular the PIR sensor, may become damaged if they are left loose in a vehicle or backpack.
16. Repeat steps 5–15 for each camera trap point for the selected *survey type*.
17. Once all camera traps for the selected *survey type* have been retrieved, complete the camera trap retrieval component. The *end date time* of the retrieval survey will be automatically recorded. Update if required. Check the data summary before queuing the collection for submission.
18. Repeat Steps 1–17 for a different *survey type* (creating a new collection for each) if required.

3.1.6 Additional guidelines

- It is important to confirm whether or not the camera trap was operational for the whole survey period. If there is no capture sequence upon retrieval of the camera trap it makes it impossible to know whether it was operational for the full deployment period. For example, if the last image occurs in week 3 of 4, this could reflect either no animals at the camera trap point post week 3 or a camera malfunction sometime after this capture.

3.2 Post-field survey tasks

3.2.1 Data curation

- When back in the office, backup the media data (images and video) from the camera trap SD cards for long-term storage and processing, to a server of your choosing.
- Media data should not be deleted from SD cards until it has been checked that they have been backed up successfully.
- It is good practice to keep an additional back-up of media data (e.g. cloud storage, external hard-drive) until electronic delivery of the receiving server.
- Once all data is backed up and checked, a good practice is to clear all SD cards, preferably by formatting. This ensures that SD cards are working correctly and prevents full cards from being reloaded into camera traps in future deployments.
- Arrange for electronic delivery of the media data to the receiving server (see the Submitting EMSA Digital Media information sheet).
- This will involve linking the project administration data and camera trap survey data to the media data via the project number, deployment number, camera trap number and SD card number.

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