ENVIRONMENTAL MONITORING METHOD:

Landscape Scale Camera Trap Monitoring

About This Method

This document helps you to monitor fauna using camera traps. This method was developed by the Monitoring Country team. You can find more information about this monitoring method on the **Monitoring Country** website: https://monitoringcountry.org.au

This method has 3 parts: **1. Get Ready**, **2. Out on Country** and **3. Back in the Office.** Each part can be done separately but you must complete all 3 parts to finish the method. At the end of the document, you will find **Gather Your Gear – Complete List** with all the gear that you will need.

We recommend you read the whole document before you start.

Part 1: Get Ready

GATHER YOUR GEAR

Equipment required for this part:

- ☐ Electronic device(s) – charge ready for use and check that it has:
  - ability to take photos
  - data collection systems (app and form) (e.g. Fulcrum)
  - navigation system (e.g. Avenza) and site maps
- ☐ Laptop or computer with software for mapping (e.g. QGIS, Google Earth)
- ☐ GPS device (recommended)
- ☐ Camera traps (1 per site) with:
  - SD cards (2 per camera)
  - Rechargeable batteries (1 set per camera)
- ☐ Camera cleaning kit (e.g. soft brush or compressed air duster)
- ☐ Permanent marker
- ☐ Remote camera user guide/manual (optional)

Equipment required for making bait canister lures (if using lures)

- ☐ Bait canister parts (1 per site), for example:
  - 50mm PVC pipe with 2 caps OR
  - 50mm PVC mesh vent cowl with 1 cap
- ☐ Drill
- ☐ Handsaw
- ☐ Glue for PVC pipes
- ☐ Spare 50mm PVC pipe

ENVIRONMENTAL MONITORING METHOD:

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KEEP IN MIND

Why?

Make sure there is a clear monitoring question and that the method you have selected will give you the answers you need.

When?

Prepare well before heading out on Country so that you have time to gather equipment or train staff, if needed.

Who?

1 ranger/staff to plan and prepare.

Training and skills

Staff involved in planning are trained and competent in:

- ☐ Mapping software (e.g. QGIS, Google Earth) and/or monitoring point generator
- ☐ Navigation systems (e.g. Avenza, GPS)
- ☐ Data collection systems (e.g. Fulcrum, datasheets)
- ☐ Programming cameras
- ☐ Safely using drills and handsaws

Check permissions

Consult with Traditional Owners, landholders and relevant government agencies and authorities, to determine appropriate access and approvals for environmental monitoring:

1. Where you can go – consult with the owners/managers of the land.
2. What you can do – check if you need scientific licences or ethics permits
3. What or who can you take photos of
4. What can be done with data and photos – who owns them, where will they be stored and how will data be interpreted and communicated.

ACTIONS

Make a plan and prepare

If you have monitored the site in previous years, use the same sites, timing and set up. If it is the first time:

1. Decide how long you will leave the cameras out.
   - You may need to plan a "service" visit to swap the batteries and SD cards for fresh ones.
2. Plan which dates you will put out, service and collect the cameras.
   - Make sure that at these times of year your sites are accessible, and conditions are not too extreme.
3. Decide whether you will use a lure or bait.

- Lures can increase the chance of detecting some species, but it can also negatively impact your data.
- Lures are usually only effective for a few weeks (depending on weather).

4. Choose your sites:
   a. Decide how many sites you need.
      - This might be determined by how many cameras you have.
      - We recommend at least 20-30 cameras for a landscape-scale project (more is even better).
   b. Decide which camera placement design to use such as a grid, transect, or randomisation.
   c. Use the monitoring point generator or GIS software to select sites
      - It is best to leave up to 1km or more between camera sites.
5. Give each site/transect a unique name, and export and save the location data in your data management system.
6. Prepare maps of sites and load sites onto navigation devices.
7. Check **GATHER YOUR GEAR** lists for **Get Ready, Out on Country** and **Back in the Office** (complete list on last page) and get any equipment you don't have. See buying guide(s) for advice on which camera models, lure canisters, batteries and SD cards may be suitable to buy.
8. Be clear on how many people will be involved and what everyone needs to do the work.
9. Check the training requirements for **Get Ready, Out on Country** and **Back in the Office** steps to ensure that rangers know how to set up and use the cameras, data collection apps, navigation systems etc.

Plan how you will manage data

1. Plan how you will record data when on Country (electronic or paper data forms)
2. Plan your data management system (how you will store images and camera deployment data)
   - Images can take up a lot of space. It is common to save the images on the cloud and also put a copy on a hard drive for processing.
   - Think about how you will structure the filing system so that images from the same site and/or same survey are kept together.
3. Decide which image management software you will use
   - Example software: CPW Photo Warehouse, Wildlife Insights, Camelot, Timelapse Image Analyser
4. Decide if you will use an image classifier or object detector to speed up image processing
   - Example software: Megadetector, WildObs
5. Decide how you will analyse the data to answer your question(s).
   - There are 3 analysis methods outlined in **Back in the Office.**

Prepare cameras and lure canisters

1. Give each camera a unique name (e.g. 'CAM01') and write it on the camera with a permanent marker.

2. Allocate each camera 2 SD cards, label each card with a name that matches the camera but allows you to tell the 2 SD cards apart (e.g. 'CAM01A' and 'CAM01B').
3. Check all cameras are clean and in good working order.
   - Clean all lenses with a soft brush or compressed air duster
   - Consider testing cameras – older or damaged cameras can take photos that are very dark which will make it hard to identify animals.
4. Check SD cards are empty/cleared of images
5. Charge camera batteries
6. Insert SD cards and charged batteries into cameras
7. Check and change camera settings so that they are all the same. Common settings are:
   a. Number of images = 3 images per trigger
   b. Time between pictures = rapid succession
   c. Quiet period = no wait between triggers
   d. PIR sensitivity = high
   e. Shutter speed >= 1/60th second
8. Enter the camera's unique name and set the label to be printed on images
9. Check camera date and time are correct.
10. Turn off the camera
11. If using lures, prepare the lure canisters:

50mm PVC pipe with 2 caps:

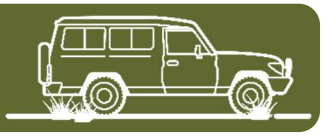
a. Drill a hole through the sides of the PVC pipe
   - Drilled holes let the scent out and a cable tie can be threaded through them to attach the canister to a post.
b. Put a cap on each end

50mm PVC mesh vent cowl with 1 cap:

a. If the vent cowls don't have mesh, cut and glue mesh to the inside.
   - The mesh stops the animals from accessing the lure.
b. Use the handsaw to cut a short piece of 50mm pipe
c. Glue the cap over half of the pipe
d. Insert the other half of the pipe into the vent cowl (but don't glue it!)
e. Drill a hole through the sides of the vent cowl.
   - A cable tie can be threaded through the drill holes to attach the canister to a post.

Next Section – Part 2: Out on Country

Part 2: Out on Country



GATHER YOUR GEAR

One set of this equipment for each team:

- ☐ Electronic device(s) – charged and ready to record data, take photos and navigate to sites
- ☐ Power bank – charged and ready to charge devices (optional)
- ☐ GPS device and spare batteries (recommended)
- ☐ Mallet, hammer or picket driver
- ☐ Pliers, multi-tool and/or adjustable wrench (for securing brackets/bolts)
- ☐ Storage boxes for transporting camera traps (recommended)
- ☐ SD card holder (recommended)
- ☐ Camera cleaning kit (soft brush or compressed air duster) (recommended)
- ☐ Spare camera traps, SD cards and charged batteries (recommended)
- ☐ Remote camera user guide/manual (optional)

One set of this equipment for each site when putting cameras out:

- ☐ Camera trap with SD card and charged batteries
- ☐ Stake, star picket or sand peg
- ☐ Camera fixings, such as brackets and bolts, strap or bungee cord
- ☐ Stake, cable tie, and lure canister (if using lures)
- ☐ Bait for lure canister (if using lures)

One set of this equipment for each site when servicing cameras:

- ☐ Replacement SD card
- ☐ Charged batteries
- ☐ Bait for lure canister (if using lures)

KEEP IN MIND

When?

Make sure your sites will be accessible when you plan to visit.

In hot weather, work in the early or late part of the day when temperatures are coolest.

Who?

At least 2 rangers per team.

Landscape Scale Camera Trap Monitoring

Training and skills

Make sure everyone knows the plan.

Field staff are trained and competent in:

- ☐ Navigation systems (e.g. Avenza, GPS)
- ☐ Data collection systems (e.g. Fulcrum, paper datasheets)
- ☐ How to put out, activate and service cameras.

ACTIONS

Put out the cameras

1. Navigate to the exact GPS coordinates of each camera site
2. Check that the area is clear of obstructions where you can put the camera (and lure if using one).
   - Avoid plants or rocks that might block the view of an animal
   - Avoid plants that will move in the wind or grow and cause a "false trigger"
3. If the camera site is not suitable, either clear the site or find a suitable area as close to the original site as possible.
   - Always check if you need a licence to clear vegetation.
   - If you moved the camera site, record the coordinates of the new location.
4. Hammer in the camera stake and attach the camera so that:
   a. The camera faces forward, towards the south (if possible),
   b. The camera's PIR sensor is 30-40 cm above the ground
   c. The stake and camera won't move or sway

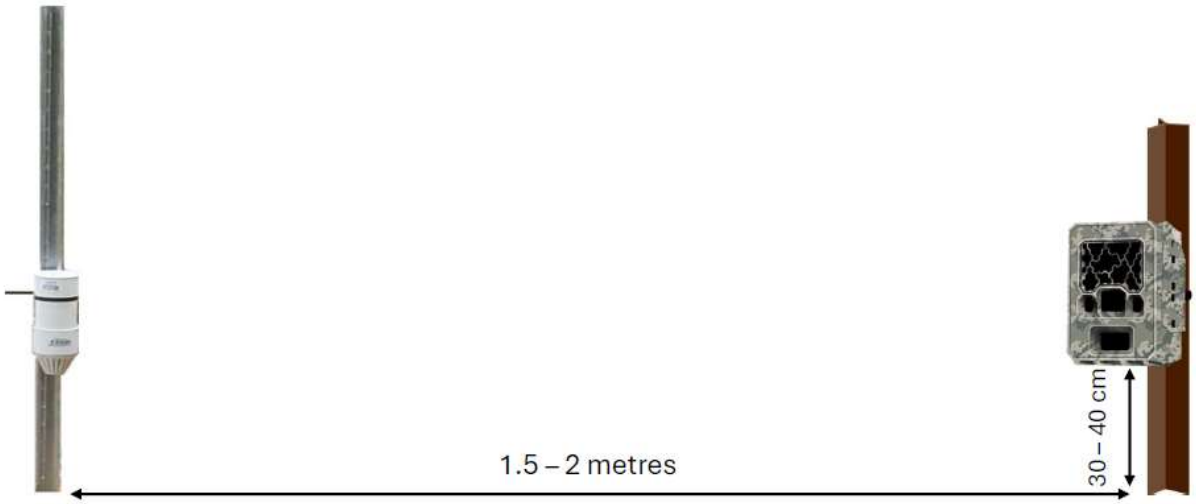


Diagram of camera set up with lure

5. If using a lure:
    a. Hammer in the lure stake in front of the camera.
        - Make sure it is far enough away so the camera can focus on the lure (usually 1.5-2m for Reconyx cameras)
    b. Put the lure inside the canister and put the lid on
    c. Use a cable tie to attach the lure canister securely to the lure stake
6. Turn the camera on and use the "walk test" mode to check that the camera is triggering at the area of focus.
    - The area of focus is usually about 1.5-2m in front of the camera, but it depends on the brand and model of camera you are using.
    - If using a lure, the area of focus is the lure canister.
7. Arm the camera
8. Once the camera is armed, walk in front of it once to trigger an image.
    - This image will be used to confirm that the camera was operational when it was put out.
9. Record **camera deployment data.**

RECORD DATA

Data to record when putting out cameras

What to record	Required?	Notes
Information to record about the project (metadata)		
Area name	Yes	Record the name of the general area you are monitoring
Site set up	Yes	Record the set-up details so that it can be done the same way next time. For example, height of camera, distance of lure from camera.
Site spacing	Yes	Record the distance between camera sites
Information to record about each camera put out		
Project name	Yes	Make it clear which project this data belongs to and its purpose
Date	Yes	Record the date the camera traps were deployed
Personnel	Yes	Record the name of the people who deployed the camera traps- this is helpful if any questions come up about the data
Site name/number	Yes	This is the name of the camera site
Location coordinates	Yes	Record an accurate location (using a handheld GPS if possible) (latitude and longitude or eastings and northings)
Camera trap ID	Yes	This is the ID that you have given the camera e.g. CAM01
SD card ID	Yes	This is the ID that you have given the SD card and matches it to the camera e.g. CAM01A

Battery percentage	Optional	Record the battery percentage at the time of deployment
Type of lure used	Yes	Record the type and amount of lure used.
Predators, or introduced species	Optional	Did you see, or see signs of predators or introduced species like cats and foxes e.g. tracks, scats or diggings?
Fire age	Optional	Record the fire history of the site.
Habitat description and/or photo	Optional	Describe or take a photo of the habitat type and landscape features at the site (e.g. open Eucalypt woodland next to granite outcrop)
Vegetation description	Optional	Record the most common plant species
Signs of disturbance	Optional	Types and causes of disturbance you can see at the site
Photo of site	Optional	Take a photo of the site and make note of which camera/tablet/phone it was taken on, and the filename of the photo (usually end in .JPG)
Stories and notes	Optional	Record information or stories from Elders, and anything else worth noting about the area or animals.
Video	Optional	Record videos of information or stories from Elders, and rangers performing or describing the work they are doing.

Service the cameras

1. Navigate to each camera site.
2. Check that the camera is securely attached to the stake and clear of obstructions
   - If there are obstructions like new plant growth, clear them away.
   - Always check if you need a licence to clear vegetation.
3. Check that the camera is clean and still working.
4. Note how many photos have been taken and what the battery level is.
5. Swap the SD card
6. Replace the batteries if the percentage is low
   - It is best to replace batteries if less than 50% battery remains.
   - Consider servicing cameras more or less often based on how full the battery is.
7. If using a lure, put fresh lure in the canister if needed.
   - Most lures need replacing after a couple of weeks.
8. Record **camera service data.**
9. Arm the camera
10. Once the camera is armed, walk in front of it once to trigger an image.
    - This image will be used to confirm that the camera was operational when it was serviced

Landscape Scale Camera Trap Monitoring

Data to record when servicing the cameras

What to record	Required?	Notes
Information to record about each camera serviced		
Project name	Yes	Make it clear which project this data belongs to and its purpose
Date	Yes	Record the date the camera traps were serviced
Personnel	Yes	Record the name of the people who deployed the camera traps- this is helpful if any questions come up about the data
Site name/number	Yes	This is the name of the camera site
Camera trap ID	Yes	This is the ID that you have given the camera e.g. CAM01
Number of images	Optional	Record the number of images recorded on the SD card
Battery percentage	Optional	Record the battery percentage before replacing them
SD card ID - out	Yes	This is the ID of the SD that you remove from the camera e.g. CAM01A
SD card ID - in	Yes	This is the ID of the SD that you put into the camera e.g. CAM01B
Lure	Yes	Record the lure used and if it was refreshed
Predators, or introduced species	Optional	Did you see, or see signs of predators or introduced species like cats and foxes e.g. tracks, scats or diggings?
Signs of disturbance	Optional	Types and causes of disturbance you can see at the site
Stories and notes	Optional	Record information or stories from Elders, and anything else worth noting about the area or animals.

Collect the cameras

1. Navigate to each camera site.
2. Check that the camera is still working
3. Note how many photos have been taken and what the battery level is.
4. Record **camera collect data.**
5. Turn off the camera and remove from the stake.
6. Remove all mounting equipment, including lures, stakes or bolts.
    - If you know that you will re-deploy cameras at the same site, you may consider leaving the stake.

Data to record when collecting the cameras

What to record	Required?	Notes
Information to record about each camera collected		
Project name	Yes	Make it clear which project this data belongs to and its purpose
Date	Yes	Record the date the camera traps were serviced

Personnel	Yes	Record the name of the people who deployed the camera traps- this is helpful if any questions come up about the data
Site name/number	Yes	This is the name of the camera site
Camera trap ID	Yes	This is the ID that you have given the camera e.g. CAM01
SD card ID	Yes	This is the ID of the SD card in the camera e.g. CAM01B
Number of images	Optional	Record the number of images recorded on the SD card
Battery percentage	Optional	Record the battery percentage
Predators, or introduced species	Optional	Did you see, or see signs of predators or introduced species like cats and foxes e.g. tracks, scats or diggings?
Signs of disturbance	Optional	Types and causes of disturbance you can see at the site
Stories and notes	Optional	Record information or stories from Elders, and anything else worth noting about the area or animals.

Next section – Part 3: Back in the Office

Part 3: Back in the Office

GATHER YOUR GEAR

Equipment required for this part:

- ☐ Electronic device(s) that you used to record your data
- ☐ Data management system, e.g. cloud storage
- ☐ Laptop or computer with software for spreadsheets (e.g. Microsoft Excel), mapping (e.g. QGIS, Google Earth), image management software (e.g. CPW Photo Warehouse, Timelapse Image Analyser) and image classifier software (e.g. Megadetector, WildObs)
- ☐ SD card reader
- ☐ SD cards
- ☐ External hard drive (optional)
- ☐ Storage boxes for camera traps (recommended)
- ☐ SD card holder (recommended)
- ☐ Camera cleaning kit (e.g. soft, brush or compressed air duster)

KEEP IN MIND

When?

Always try to complete this work as soon as you can after returning from your time on Country so that it is fresh in your memory and SD cards are not overwritten or misplaced.

Who?

At least 1 person to manage the data

Training and skills

Staff managing data are trained and competent in:

- ☐ Mapping software (e.g. QGIS, Google Earth)
- ☐ Spreadsheet software (e.g. Microsoft Excel)
- ☐ Data collection systems (e.g. Fulcrum, datasheets)
- ☐ Data management systems (e.g. databases, cloud storage, external hard drives)
- ☐ Using image management software
- ☐ Using image classifier software (optional)
- ☐ Identifying species in camera images

ACTIONS

Manage camera images

1. After putting out cameras, create an image filing system on your computer:
    a. Create a project folder and give it a short name like the project or survey area.
        - If monitoring is done at the same sites over time, consider adding another folder level to separate out each monitoring period (like the year or season)
    b. Within the project folder, make a folder for each site
2. After every visit to service and collect cameras, for each SD card:
    a. Go to the folder for the camera site that the SD card came from.
    b. In the site folder, make another folder. Give it the same name as the camera and the date it was collected e.g. CAM01_20260108.
    c. Put the SD card into the SD card reader
    d. Copy the images from the SD card into the folder.
    e. After the images have been copied, check that the number of images on the SD card matches the number in the folder (to make sure they all copied over).
3. Back up your data (save a copy on the cloud and/or on an external hard drive)
4. When you are sure that the data is secure, erase images from each SD card.

Data entry

After every visit to set up, service and collect cameras:

1. Record a summary of what you did and why, any observations (e.g. weather conditions, fire history, site condition), anything that went wrong or didn't work and things that worked well.
2. Upload or enter the **camera setup, service and collect data** to your data management system.
    - Enter data into a spreadsheet and your image management software.
    - Update waypoint coordinates if any sites were moved
    - Recommended: get someone else to proof the data to check for mistakes.
3. Upload any photos or videos taken during the survey to your data management system

Clean up

After collecting cameras:

1. Take batteries out of cameras
2. Check all equipment is in good working order and clean

3. Put equipment away in storage including cameras into storage boxes and empty SD cards into SD card holder

Process camera images

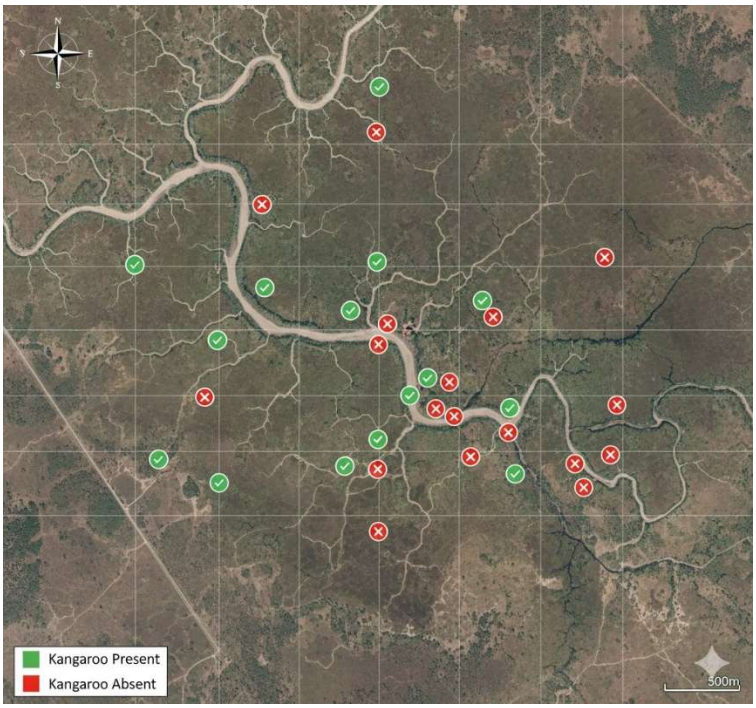
1. Run images through object detector or image classifier (optional)
   - Always proof automated processing by scanning through images and checking classifications are correct (especially false positives or negatives!)
2. Import images into the image management software.
3. Review the images to classify images (e.g. false trigger) and identify species.
4. If you have enough time and personnel to do so, get somebody else to proof the image classifications.
5. Export the data to upload to your data management system
6. Import the data into a spreadsheet for analysis

Analysis

Outlined below are 3 analysis methods: Map species presence/absence (where they are/aren't), Calculate naïve occupancy rate (how common or widespread a species is) and Calculate species richness per site (how many species were detected at each site).

Map species presence/absence:

1. Open up your GIS mapping software
2. Add a base map of your survey area
   - This could be a satellite image, topographic map or digital maps like Google Roads or Google Earth
3. Mark every site where you had a camera
4. Mark where a species was/wasn't detected during the monitoring:
   a. Use a tick or a solid circle for sites where the species was present (detected).
   b. Use a cross or an open circle for sites where the species was absent (not detected).



An example of how presence/absence data can be presented in a map (Image created with assistance from Gemini, a large language model by Google AI).

Calculate naïve occupancy rate:

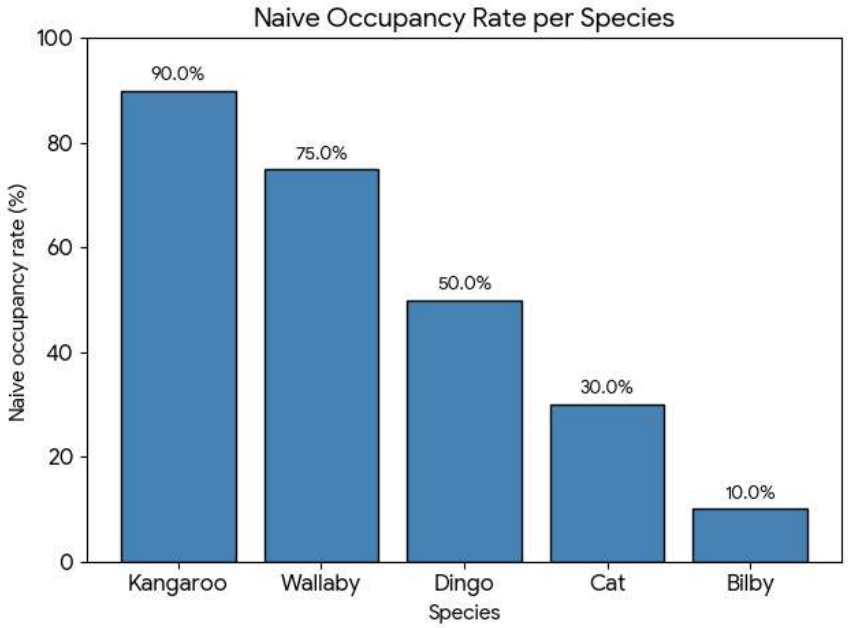
1. Open up a spreadsheet
2. Add up how many sites were monitored
3. Make a table with 3 columns:
    a. Species
    b. Number of sites where the species was detected
    c. Naive occupancy rate
4. Fill in the data for each row:
    a. Species – list every species detected (or the ones you are interested in)
    b. Number of sites where the species was detected – count how many sites it appeared on camera at least once
        - It doesn't matter if a species was seen 1 time or 100 times at a single site; it still only counts as 1 "present" site
    c. Naive occupancy rate - divide the number of sites where the species was found by the total number of sites, then times this by 100.

Total number of sites = 40		
Species	**Number of sites detected**	**Naïve occupancy rate (%)**
Kangaroo	36	(36/40)*100 = 90 %
Wallaby	30	(30/40)*100 = 75 %
Dingo	20	(20/40)*100 = 50 %
Cat	12	(12/40)*100 = 30 %

Bilby	4	(4/40)*100 = 10 %

An example table of how to calculate naïve occupancy rate for a project that had 40 monitoring sites.

5. Make a simple graph that shows the naïve occupancy rate for each species.



An example of how naïve occupancy data can be presented in a graph to show how common or widespread each species is (Image created with assistance from Gemini, a large language model by Google AI).

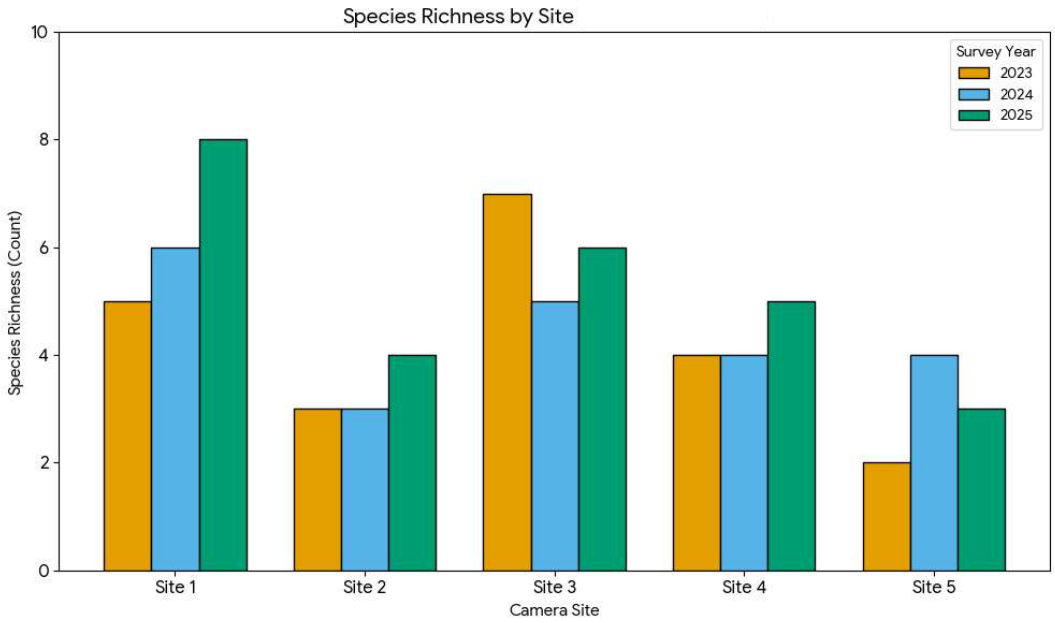
Calculate species richness per site:

1. Open up a spreadsheet
2. Create a table with 2 columns:
    a. Site Name.
    b. Species richness
3. Fill in the data for each row
    a. Site Name – list every site where a camera was deployed.
    b. Species richness – count how many different species were seen on camera at each site
        - It doesn't matter if a species was seen 1 time or 100 times at a single site; it still only counts as 1 species

Site Name	Species Richness
CamSite1	8
CamSite2	4
CamSite3	6
CamSite4	5
CamSite5	3

An example table of species richness for a project that had 5 monitoring sites.

4. Make a simple graph that shows the species richness for each site.



An example of how site level species richness data can be presented in a graph to track changes over time or show differences between sites (Image created with assistance from Gemini, a large language model by Google AI).

Reporting

1. Discuss with the ranger team or community the results of the monitoring, any reasons for the trends you see, such as presence/absence of animals/species at sites, and if there have been any changes to previous years.
    - Consider whether trends might be related to your management (e.g. introduced predator or herbivore control, right-way fire etc.) to check how well management is working, or if you need to make adjustments.
2. Share the data according to any data sharing or funding agreements you have made

Next section – Full Equipment List

Gather Your Gear – Complete List

The complete **GATHER YOUR GEAR** lists for **Get Ready**, **Out on Country** and **Back in the Office**.

Gear List	Required?	Get Ready	On Country	In Office
Electronic device(s): • Charged • Ability to take photos • App for data collection (e.g. Fulcrum) • App for navigation (e.g. Avenza)	✓	✓	✓	✓
Power bank • Charged	**Recommended**		✓	
Laptop or computer with software for: • Mapping (e.g. QGIS, ArcGIS, Google Earth) • Spreadsheets (e.g. Microsoft Excel) • Image management software (e.g. Timelapse, CPW Camera Warehouse) • Image classifier software (optional)	✓	✓		✓
GPS (e.g. Garmin handheld device) & spare batteries	**Recommended**	✓	✓	
Camera traps (1 per site) with: • SD cards (2 per camera) • Rechargeable batteries (1 set per camera)	✓	✓	✓	✓
Remote camera user guide/manual	**Optional**	✓	✓	
Camera fixings (1 set per site) • e.g. brackets and bolts, strap or bungee cord	✓		✓	
Stake, star picket or sand peg (1 per site)	✓		✓	
Lure canister parts (1 per site): • 50 mm PVC pipe & 2 caps • 50mm PVC mesh vent cowl & 1 cap	**If using lures**	✓	✓	
Equipment for making lure canisters: • Drill • Hand saw • Glue for PVC pipes • Spare 50mm PVC pipe	**If using lures**	✓		
Lure stake & cable tie (1 per site)	**If using lures**		✓	
Bait/lure (1 portion per site)	**If using lures**		✓	
Mallet, hammer or picket driver	✓		✓	
Pliers, multi-tool and/or adjustable wrench	✓		✓	
Storage box for transporting/storing camera traps	**Recommended**		✓	✓
Storage box for SD cards	**Recommended**		✓	✓
Camera cleaning kit • e.g. soft brush or compressed air duster	**Recommended**	✓	✓	✓
Spare camera traps, SD cards and charged batteries	**Recommended**		✓	

SD card reader	✓			✓
Data management system (e.g. cloud storage)	✓			✓