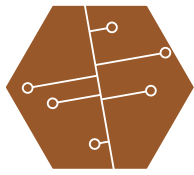

NKMP Methodologies



Line transects

NATIONAL KOALA MONITORING PROGRAM

The National Koala Monitoring Program (NKMP) aims to fill knowledge gaps for future Koala recovery and management efforts. CSIRO is leading the co-design of the four-year program and facilitating the roll out of NKMP with the broader Australian community. The key objectives of this monitoring program are:

- Inclusive – to enable all members of the Australian community to contribute to this national koala monitoring effort.
- Long-term – to build individual and collaborative capacity to collect robust data that can be used for evidence-based decision-making.
- Integrative - to build best-practice methods and data management systems to integrate available and new data to provide local and national insights into koala population status and trends.

The NKMP uses a wide range of approaches to monitoring koalas. This enables us to use a wealth of existing knowledge and suit our data collection methods to the specific needs of each site.

Keen to learn more? Visit [National Koala Monitoring Program](#). Any questions or keen to find out how you can share your koala observations or data? Contact us at KoalaMonitoring@csiro.au

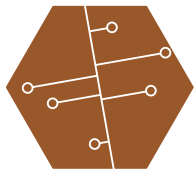
WHAT YOU WILL NEED TO DO A TRANSECT SURVEY

- 1 A colleague to do survey with you.
- 2 A GPS and a backup system (e.g. mapping app on your phone).
- 3 Sufficient battery power in the GPS and the backup.
- 4 A map of the site, with salient features marked.
- 5 A notebook/datasheets
- 6 Binoculars.
- 7 Laser rangefinder.
- 8 Compass.
- 9 Two-way radios.
- 10 Appropriate field gear (PPE) such as sturdy walking shoes/boots, hat, suitable long pants and long-sleeved shirt for some scrub-bashing.
- 11 Enough water and some snacks to spend a few hours away from a car, on your own.
- 12 Basic first aid kit (including compression bandages for snakebite).

Surveys at night:

- 13 Good quality headlamp (optional: a handheld thermal scope).
- 14 Warm clothing (if needed).
- 15 Reflective flagging tape.

Note: The more remote the area you are working in, the more safety systems you should employ (e.g. satellite phones, personal locator beacons, safety check-in systems, extra provisions).



Line transects

PROTOCOL

To get a good estimate of a species' population size, or to detect relative changes in that size over time, we need to conduct systematic surveys. A systematic survey will record both the number of animals seen and the amount of effort it took to find those animals (e.g., distance walked, time spent searching, area covered). A variety of survey methods exist but this guide will focus on visual encounter surveys conducted along walking transects. There are several approaches to surveying along a transect (single count, multiple observers, double counts, spotlighting, etc). First, we will cover setting up a transect and then we will talk about the different ways to survey once you have a transect established.

Choosing Your Location

If you are following an NKMP survey design, you will be provided with an ordered list of sampling points within a cluster. Start by selecting the first point in the list. If that point is not accessible for safety or logistical reasons, move down the list to the next point and so on until you have an accessible survey point.

The survey points are selected to fall within habitat with some non-zero likelihood of finding koalas (based on habitat variables such as the predicted presence of preferred tree species). The map layers used to generate the points have a spatial resolution of 250m². The point sits at the centre of the cell. If the point itself falls within an area of poor habitat (e.g. a gravel plain, carpark, dense shrubs <2m tall), relocate the transect within 125m of the original point to capture any available habitat with higher potential for koalas while staying within the original cell.

You may be following a different survey design set up by your organisation. In this case follow your site selection protocol and try to incorporate the methods outlined below as far as practicable into your own design.

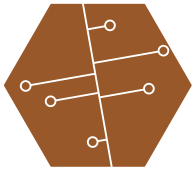
Note: Once you have selected the actual point for your survey, in some cases a habitat condition assessment will have to be recorded. This is covered in a different protocol.

Setting Up Your Transect

Conditions in the field do not always match the scenarios mapped out in pre-planning. You should aim for one of the two scenarios laid out below as a starting point. If adjustments have to be made due to field conditions (e.g. a boulder or creek that is impassable), that is okay. The most important thing is to **record** what changes you made. Most crucially, record **your track**, the **area covered**, and the **time spent** searching.

If your point falls close to an established track or road that goes through suitable habitat, then it makes sense to use the track as the transect line for ease of travel. If there is no track or the track would take you far away from any koala habitat, then consider one of the options below.

NKMP Methodologies



Line transects

SCENARIO 1: FOUR SHORTER TRANSECTS

Ideally, we are trying to capture as much of the habitat within the 250m² cell centred on the sampling point. Habitat can change dramatically in a short distance. As such, it is preferable to plot out several, relatively short, transects centred on the sampling point. The exact number and length of these transects can change but aim to cover a total area of at least 10ha.

Using the map in the survey app or some other software (e.g. Google Earth, ArcGIS) plot out a group of four 500m transects with a 50m strip width (25m each side) centred on the selected survey point making sure they do not overlap by leaving at least 20 metres between the edges of each strip. This is the survey area; koalas within these areas are the target of this count. See Figure 1 below. This will cover an area of 10ha. Record the GPS location of the start and end of each of the planned transects.

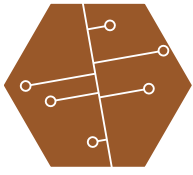
The square configuration shown in Figure 1 is a suggestion. Individual transects can be staggered around the vicinity of the sampling point in any configuration that is logistically useful, so long as they **do not overlap**.

The start, middle and end of each transect should be loaded as waypoints onto your GPS and your phone app. For Garmin GPS units you will need the Basecamp program to upload the waypoints. The proposed transect line can be pre-loaded into the survey app from a KML to help you follow it in the field.

If you don't have the ability to upload a KML onto a map you can follow in the field (e.g. on a phone or iPad) you can mark out the transect line in advance. In advance of the actual survey, walk the planned transects while recording your track, keeping as straight a line as possible using your GPS and compass. Mark trees or bushes with flagging tape (reflective if spotlighting) at regular enough intervals so that from any flag you can see the previous flag and the following flag in a direct line of sight. Marking flagging tape with consecutive numbers can help with navigation (by ensuring that you don't skip over any points). Having a pre-marked route means you will spend less time navigating and more time looking for koalas.

Note: Check with the landholder if it is okay to use flagging tape, particularly if you intend to leave it there for more than one survey. If it is a one-off transect, make sure to go back and take down your flagging tape. If you are establishing a transect for regular revisits, consider using more permanent markers, in consultation with the landholder.

NKMP Methodologies



Line transects

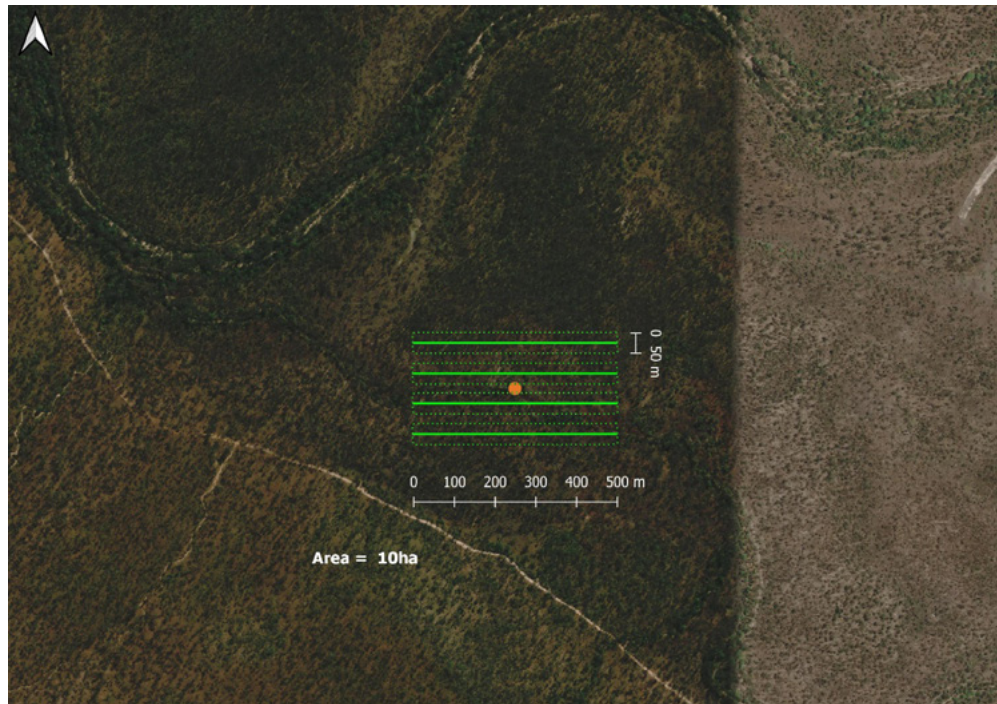


Figure 1: Four 500m long transects (solid green lines) with 25m buffer each side (dotted lines) centred on a sampling point. A 20m gap is left between the edges of each transect strip. Area covered = 10ha.

SCENARIO 2: SINGLE LONG TRANSECT

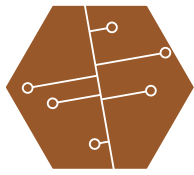
There may be logistical reasons for doing a single long transect. For example, the point may be in a large patch of homogenous habitat, and it is easier to just walk one transect rather than four short ones. Alternatively, the point may fall near an established track or road that makes it much easier to survey, allowing you to cover more ground quickly.

As above, on your survey app or other software, mark out a 2km transect with a 50m strip width (25m each side) centred on the selected survey point. The direction of the transect is up to you and can be chosen for ease of travel, maximising habitat crossed or other reasons. See Figure 2 below. This configuration will cover an area of 10ha. Record the GPS location of the start and end of the planned transect.

The start, middle and end of the transect should be loaded as waypoints onto your GPS and your phone app. For Garmin GPS units you will need the Basecamp program to upload the waypoints. The proposed transect line can be pre-loaded into the survey app to help you follow it in the field.

If possible, try to set up transect so that you can drop off one observer at each end without having to pre-walk along the transect to get to the starting point and potentially scare away animals.

NKMP Methodologies



Line transects

Running a transect along a road is easier for the observers, who will be less likely to get lost or deviate from the track. However, this has the potential to introduce bias if we only sample along existing roads/tracks. If going off a track, you can set up the transect parallel to the track to aid in navigation but offset some distance (~150m) into the bush. If going perpendicular or completely off road, make sure to use flagging tape frequently to help navigation, particularly if working at night.

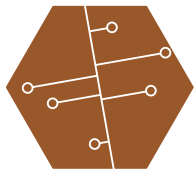


Figure 2: A 2km long transect (solid green line) with 25m buffer each side (dotted line) centred on a sampling point. Area covered = 10ha.

A note on strip width

Whilst in pre-planning we estimate a strip width of 50m along the transect (i.e., 25m either side of the transect), in reality visibility can change drastically as we walk along. This is particularly true in areas where the transect crosses more than one habitat type (e.g. crossing from dense forest to open scrub). Using a laser range finder, or estimating by eye, it is important to keep a record of the actual visibility you have in the field. Taking a record of actual strip width at intervals along the transect will help account for this in later analysis of the data.

NKMP Methodologies



Line transects

SURVEYING ALONG YOUR TRANSECT

Single Count

A single count survey involves walking the transect only once. The count can be done by one observer or by multiple as long as the number of observers is recorded. All observations are taken to be part of the same count.

If you don't intend to re-visit the exact same transect, pre-marking the route with flagging tape may not be necessary but still can be very helpful. Having a pre-marked route allows the observer to concentrate less on navigation and more on searching. If time or logistical constraints don't allow for pre-marking the transect, you will need to navigate in as straight a line as possible using your GPS/phone app while searching for koalas.

Mark your start time.

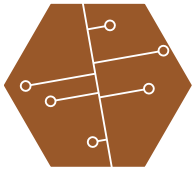
Data fields needed are:

Point	Y	X	Time
BV01_start	-27.646003	153.26399	07:42

Required fields for a transect:

- Timestamp (start): the date and time that you commence walking and searching, formatted as yyyy-mm-dd hh:mm:ss (e.g., 2022-10-01 21:00:10).
- Transect name: if you're survey with NKMP supplied clusters and sites, the transect name should be the cluster ID, followed by a hyphen, followed by the site ID. For example, site 7 in cluster 1 would be "1-7".
- Often, it's more convenient to use a name rather than a site ID, so you can also record the name of the park/property or the nearest town as the site name.
- Observer name: your name.
- Survey method: single count or double count.
- If you have a second person with you, record their name as observer 2.
 - If you're conducting a double count survey, this is the name of the second observer. They will also be recording their observations as they undertake their own walking transect, and they should record their name as observer 1 in their app and your name as observer 2.
 - If you're conducting a single count survey but have a companion, record their name as observer 2 and walk in tandem with them to look for koalas.
- Record the type of transect you are about to undertake: on foot on an established track (e.g., road or walking track), on foot but bush bashing, or in a vehicle.

NKMP Methodologies



Line transects

- Strip width: Estimate the distance you can see either side of you. If you can see approximately 25 metres either side, you have a strip width of 50m.
- Tools used: e.g., headtorch/spotlight, thermal camera.

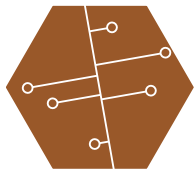
If you're using the NKMP Koala Counter app, you will be prompted to fill out the fields mentioned above. The app will automatically fill in the start and end times when you press the Start and Stop buttons. The app will also use your GPS to record the track you walk and display it on the map. If you have a standalone GPS device with you, you can record your vehicle and starting locations and the track you walk as a backup.

A screenshot of the NKMP KoalaCounter app's 'Transect details' form. The form includes fields for Transect name (1-7), Site (Dalby), Observer (Stewart Macdonald), Method (Single count selected), 2nd observer (John McEvoy), Transport (Foot - track selected), Width (m) (50), Tools used (Spotlight selected, Thermal scope unselected), and a Notes section. The app's navigation bar at the bottom shows icons for Transect, Habitat, Media, Observations, and Map. The status bar at the top shows the time 1:10 and signal strength.

Figure 3: An example page from the NKMP KoalaCounter App

In your GPS, use “Go To” to give you a bearing to your marked end point. That's the direction you need to walk, and the best way to do it is to find a landmark as far away as you can – this might be a distinctive tree only 50 m away – and walk towards that. Once you've reached that tree, repeat the process.

NKMP Methodologies



Line transects

Walk slowly, looking for koalas each side of the transect you are walking.

When you get to the end of the transect, record the actual finish location and the time.

Data fields needed are:

Point	Y	X	Time
BV01_end	-27.6481	153.26146	08:11

Double Count

Double counts are where two observers walk the same transect(s) through a section of habitat searching for koalas independent of each other. The idea is that they do not compare notes or share findings of their transects until the transects are completed by both observers.

If you aren't both following the same pre-loaded line on the map or haven't pre-marked the transect with flagging tape, it can be easy to miss your colleague on a double count or lose your bearings. Include a GPS mark in the middle of the transect as a pre-arranged meeting point (especially if you need to hand over car keys).

Each surveyor walks the transects searching for koalas independently of their colleague. In some situations, you may be able to walk the opposite direction, such that you cross paths approximately half-way through the survey, exchange car keys and agree on a pickup point. Alternatively, one observer should leave approximately 30 minutes after their colleague (if one person walks consistently faster than the other, have the fast walker go first).

At the end of the transect surveys, the two observers compare results, such that the following information is clear:

- Number of koalas seen by observer 1.
- Number of koalas seen by observer 2.
- Number of individual koalas seen by both observers.

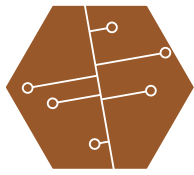
Spotlighting

Both of the above approaches can be done in daylight hours or at night. In daylight, navigation is easier, but koalas may be easier to spot at night with the help of spotlights or thermal scopes.

Whether it is a double or single count, walk the transect slowly just like a daylight survey. Try to get the headlamp centred as close as possible to between your eyes. You are looking for "eyeshine", reflected light from the eyes of your target. Koala eyeshine is usually very strong and is red in colour.

Record the same data you would for a daytime survey: start and end times, start and end locations.

NKMP Methodologies



Line transects

WHEN YOU SEE A KOALA

There are two potential approaches to recording the location of the koala.

Option 1: Leave the transect, get exact GPS location

Mark your place on the transect so you can find your way back. Walk directly to the tree the koala is in and take a GPS mark of the location. Record any details you can about the tree and the habitat. This can include:

- The tree species (consider taking photos and/or a leaf sample for identification)
- Size, diameter at breast height (DBH) in cm
- Height of the tree (Estimated or measured using a laser range finder)
- How high up in the tree was the koala? (Estimated or measured with a laser range finder)
- Taking as many photos as possible of the koala, the tree, the leaves and bark, the surrounding habitat. Photos (even low-quality ones) can help in comparing later with your colleague to see if you have seen the same individual.

Return to your marked point on the transect and continue your survey.

Note: If you walk off the transect line to get out to a koala, and you see another koala that you wouldn't have seen if you'd stayed on the transect, you record that koala as an "off survey" incidental sighting

Option 2: Stay on the transect, get distance to the koala

If it is not possible to leave the trail either due to difficult terrain or a strong possibility of getting lost in dense vegetation, you can record its location in relation to you and the transect. You can do this by recording:

- SightDist = Sighting distance = the horizontal distance from you to the koala at first detection
- PerpDist = Perpendicular distance = the right-angle distance off the actual transect

Use the laser rangefinder to get these SightDist, PerpDist and Height values (add your height at eye-level onto the height you get from the rangefinder).

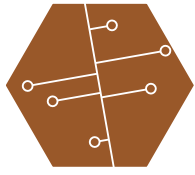
If possible, record tree species (or take photos and hope that a colleague can ID the tree) and other relevant notes.

If possible record tree species and other relevant notes.

Point	Y	X	Time	SightDist	PerpDist	Height	TreeSp
Koala 1	-27.64644	153.26359	07:51	15	9	11	<i>E. microcorys</i>

Notes

NKMP Methodologies



Line transects

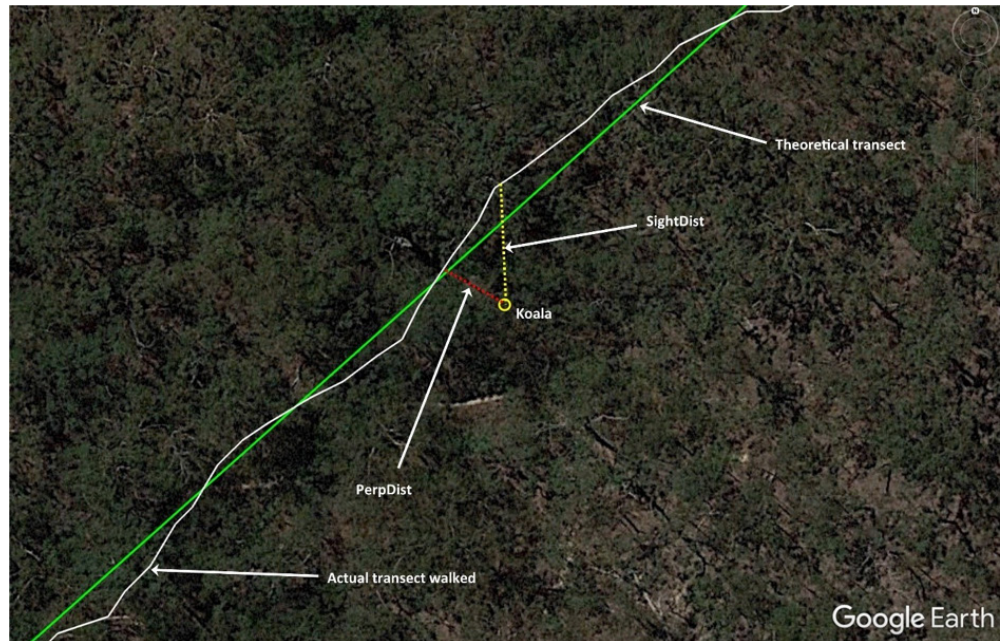
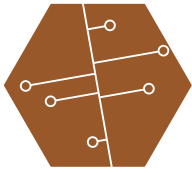


Figure 4: A map showing the method for estimating a koala's position without leaving the transect. Calculate perpendicular distance (red dotted line, which is perpendicular to the white, "actual" transect line) and sighting distance (yellow dotted line).

DATA COLLECTION AND RECORDS

If using the NKMP KoalaCounter app, all the relevant details will be stored in the app as you go and uploaded to the cloud automatically. If you are using paper records, the next page has an example of a data sheet that could be used to record the relevant data.

NKMP Methodologies



Line transects

SOME EXTRA TIPS

Walking transects that go off-trail can be hard work and are sometimes not doable for safety or logistic reasons. If there are trails available, it makes good sense to use them where possible. However, consider the impact on the data you are collecting and how representative it will be. If you only ever survey along a road or track, you are essentially carrying out a survey of koalas that are near roads or tracks, not necessarily giving the full picture of where koalas are present in the broader habitat.

If you are not following the NKMP or some other sampling design, think carefully about where you choose to survey. Typically, people tend to look for koalas in places where they think they are likely to find them. To get a clear picture of where koalas are in your landscape and what their population numbers are, you should consider surveying a range of different habitats that may have koalas but also may not. Often, confirming that there are no koalas in an area where nobody has looked before is more valuable than confirming the presence of koalas in places where they are well known to occur.

When spotlighting at night in forested areas, insects can be attracted to your light in great numbers. If you are looking up searching for koalas, there is a good chance that something will fly into your eye. Consider wearing some safety goggles and/or packing some eyewash in your first aid kit. Take short breaks occasionally where you turn your light off and let the insects disperse.

If working at night, bring a back-up headtorch in case batteries fail. Marking equipment like UHF radios or rangefinders with a bit of reflective tape is helpful if you drop them in the dark. Wearing some reflective item on your clothing will also help your colleague locate you if your light stops working.

ACKNOWLEDGEMENTS

The NKMP acknowledges input from a koala experts including the 120+ workshop participants who reviewed a range of koala survey and approaches as part of the 2023 National Koala Conference.