Litter Break-down

What is 'Break-down'?

'Break-down' is the same as 'decomposition' – when dead plant material rots and breaks apart and thus goes through the process of becoming soil.

Why is Litter Break-down important?

When plant litter decomposes, it contributes to soil health by returning nutrients back to the soil. This break-down process happens in part because bugs, fungi and tiny animals in the soil chew or dissolve the plant litter as food. If this isn't happening litter will sit on top of the soil without breaking down, a sign that parts of a healthy ground layer aren't present or abundant enough. Or perhaps the soil is too compacted to provide habitat for them, and the nutrients in the litter are not being returned to the soil.

How long does it take to measure?

About 10 minutes per site

When is it useful?

0 - 6+ years after change in management, though it may mostly respond early, and thus be most useful in the first 0-3 years.

How do I measure it?

Mark the toe of each boot with a pen or narrow strip of tape and start at the beginning of your survey line. Take steps toward the end marker of the line that are ~1 metre apart (so you should aim to take about 50 steps in total along the line). At each step, check to see if there is litter directly under the mark at the tip of your boot. If so, rate how well the litter is broken down. Use the numbered rating table and the associated guidance photos on the next page, and record the rating (that best represents the amount of Litter Break-down) in the box on your data sheet.

At the end, you need to calculate the average Litter Break-down for the whole site. Do this by adding all the numbers you recorded and divide by the number of times you found litter to rate. So if you recorded 1, 0, 2, 2, 3, 1 along your survey line, the average Litter Break-down score would be 9 (1+0+2+2+3+1) divided by 6 = 1.5.

Remember, if you use the Checking for Change BioCollect website to record and share your data (see 'Making Sense of the Numbers'), some of these calculations will be done for you.

Tips for success

You may feel uncertain of your judgements at first. Practice away from your survey line first to help you gain confidence in your ratings. Remember, what matters most is that you make the same judgements in your conservation and control sites so that they can be compared, not that you are 'accurate' or 'perfect'.

Rating	Description
0	Litter is loosely spread on the surface with few signs of decomposition and incorporation
1	Litter is broken down into small fragments and intimately in contact with soil; some fragments may be partially buried
2	Litter is in several distinct layers; some fungus is visible; the layer next to the soil is somewhat decayed
3	Litter has at least 3 layers or stages in decomposition ranging from fresh material on top to 20 mm or more of comprehensively decayed (very dark, with no identifiable fragments) next to the soil

Rating = 0 This leaf litter is loosely spread on the surface with few signs of decomposition or incorporation

Rating = 1 Litter is in the process of being broken down into small fragments - some fragments are partially buried

Rating = 2 Distinct layers - some fungus is visible (the white stuff on the underside of the top leaf layer) and the layer next to the soil is somewhat broken up into smaller pieces

Rating = 3 For 3 layers: fresh material on top and 20 mm + of comprehensively decayed material (very dark, with no identifiable fragments) next to the soil

These litter decomposition classes are from a monitoring procedure developed by CSIRO called Landscape Function Analysis (LFA). Other indicators such as litter cover and bare ground are also used in LFA to provide a framework for assesing the functionality of the soil and groundlayer processes.

Plant Types

Remember - If you CAN do some plant identification and feel confident you can recognise native from exotic species in the ground layer, you may choose to use the alternative indicator 'Native Plant Types'.

What are 'Plant Types'?

This is similar to the number of different species but is designed for people who aren't botanical experts and don't know how to precisely identify all the hundreds or even thousands of plant species they might find. Thus, a 'Plant Type' is simply a plant that looks different than the others based on the colour of the flower, the size and shape of the leaf, or maybe even how the plant grows (tall or short, many or single stemmed).

Why are 'Plant Types' important?

The number of plant species is a well-established indicator of a healthy site. Some species are very sensitive and will disappear from a site if it declines in health. Thus, more species generally means less disturbance and more natural processes. Native species are more important than exotics, but this kind of simple total count has still been shown to be useful.

How long does it take to measure?

About 20 minutes per site

There are 4 different native 'Plant Types' in this picture based on flowers alone, and probably about 6 native 'Plant Types' in total. See if you can count them yourself – this will help you 'get your eye in' for doing this on your own sites.

When is it useful?

Mostly 5-6+ years after a change in management, but measure it sooner than that too to help show trends that may become apparent by 5-6 years.

How do I measure it?

At the start of your survey line, touch your hands to your opposite elbows and lift your arms until they are in front of you, making a circle that you hold parallel to the ground. Tip your head just enough to allow you to look down through your arm circle at the ground. Within the circle you see through your arms, count the number of different Plant Types that are growing as part of the ground layer. Record that number on your data sheet.

At every 5th step after that (so 9 more times on a survey line), make the same circle with your arms and count any *new* Plant Types you didn't see in your previous circles. Record the number of new Plant Types on your data sheet.

At the end, to calculate the number of Plant Types for the whole site, simply add the numbers recorded at every 5th step along the whole survey line.

Tips for success

Without knowing the names of plants, it can be a bit hard to remember which plant types you saw along previous parts of your survey line. It can help to give them informal names and potentially scribble them down on a piece of scrap paper as you go. For example:

- "small yellow daisy-like flower"
- "tall wide-leaved grass"
- "big swishy grass with the spikey top"

It can be hard to see all the different Plant Types while you are standing up, so you may need to crouch down to look at the ground more closely. Before you crouch down, look through your arm circle and make a note of where the edges of your view actually are on the ground. This will help to ensure that even as you crouch down, you still know the boundaries within which you are counting Plant Types.

Put your hands on your elbows to make a circle to look through. This helps you define a small area you will look through in detail to count the number of Plant Types. Just make sure you do it the same way every time.

Cover of Native Perennials

Remember – This indicator is suitable for people who feel confident they can recognise native perennial grasses, even if they can't identify all the individual plant species

What is 'Cover of Native Perennials'?

When you look at the ground, how much of it is covered by native perennial grasses? These are grasses that persist throughout the year, often for many years and thus often have both old dry leaves and fresh new leaves together on the same plant.

This is in contrast to short lived annual grasses that usually only grow through spring and into summer then die off. You can view cover in two ways – based on the base of the plant (where all the leaves sprout from) or based on the foliage (in which you imagine all the leaves form a dome over the ground and any part of the ground underneath that dome is 'covered'). You can use either of these versions, or both.

Weeping Grass (Microlaena stipoides) is a long-lived (perennial) native grass with a well-developed root system. In contrast an exotic annual grass has small roots and can easily be pulled up. The red arrow indicates foliage cover while the yellow line is the base of the plant.

Why is it important?

Most of Australia's grassy ecosystems (grasslands, woodlands, savannas, etc.) are dominated by perennial grasses. Perennial grasses help protect soil from eroding, particularly during dry times. Agricultural activities often lead to a reduction in perennial grasses and a shift in the system toward annual plants – which exposes soils to drying and erosion. Thus, the functionality of natural systems is restored if native perennial grasses increase after human disturbance has reduced them. In general, 15% cover of base and 70% cover of foliage (the 'domes') is considered ideal.

How long does it take to measure?

About 10 minutes per site

When is it useful?

The 'foliage' version is useful any time from 0-6+ years after a change in management. The ''base' version (technically 'basal cover') changes more slowly and is thus more useful 5-6+ years after change in management but is arguably a better measure of true recovery. That's why both can be helpful.

How do I measure it?

Tip – have a look at the next page at the images which demonstrate the following guidelines.

Mark the toe of each boot with a pen or narrow strip of tape and start at the beginning of your survey line. Take steps toward the end marker of the line that are ~1 metre apart (so you should aim to take about 50 steps in total along the line). At each step, record whether there is native perennial plant cover directly under (for the base version) or either under or over (for

foliage or ‘dome’ version) the mark at the tip of your boot (by making a tick mark in the box on the data sheet).

At the end, to record the summary value for the whole site, calculate the % of Cover by Native Perennials by adding up the number of ticks (or ‘yes’ answers), dividing by the number of steps you took, and multiplying by 100. So if you recorded 15 ticks and took 50 steps, the % of Cover by Native Perennials would be 15/50 x 100 = 33.3%.

This is a tricky one! Here the boot has flattened the native Wallaby Grass (Austrodanthonia spp) foliage but is not yet directly over the butt. Just another 5mm further and the butt would have been recorded! Instead, this is recorded as a ‘yes’ for foliage cover but a ‘no’ for butt cover.

Remember, if you use the Checking for Change BioCollect website to record and share your data (see ‘Making Sense of the Numbers’), some of these calculations will be done for you.

Here the Weeping Grass foliage is quite short and lawn-like and growing directly up out of the butt or basal cover. So this point will be recorded as a ‘yes’ for both the butt and the foliage cover versions of this indicator.

Tips for success

The butts of perennial grasses are often quite solid and stick up out of the ground a bit, making them awkward to step on. Ensure when you take steps along your survey line, you put your boot down wherever your step takes you, even if the ground is uneven because you are stepping on a native perennial plant. If you don’t, you will end up unconsciously avoiding this ‘rough’ ground and under-estimating perennial cover.

This boot step point would be recorded for ‘foliage cover’ only, as the boot is actually on bare ground beneath the leaves. Remember - don’t avoid stepping on grasses, even if they are bulky and tall, as that will influence your results and under-estimate perennial cover.

Bird Types

Remember – This indicator is suitable for people who feel confident they can listen and look for different birds on their sites, even if they can't identify all the different species.

What are 'Bird Types'?

This is similar to the number of different species but is designed to be a bit simpler – for people who may have an eye or ear for birds but aren't expert birdwatchers. Thus, a 'Bird Type' is a bird that you believe is a different species because it looks or sounds different than the others.

Why are Bird Types important?

Birds depend on healthy plants and insect populations to provide habitat and food. Because many species are relatively mobile, they may be among the first animals to return to a site after the habitat they need improves. Birds are also relatively easy to see and hear and different species often look and sound quite different. So they are ideal for a wide range of people to monitor.

How long does it take to measure?

Approx. 10 minutes

A good pair of binoculars will help you see birds better, though many birds will only be heard.

When is it useful?

Mostly 5-6+ years after a change in management, but measure it sooner than that to help show trends that may be apparent by 6 years.

How do I measure it?

The best time for finding birds is early in the morning shortly after dawn until around 9.30am in calm clear weather. Go to the centre of your site and count all the different types of birds you either see or hear within the site over a 10 minute period. Record the total number of Bird Types you counted on your data sheet.

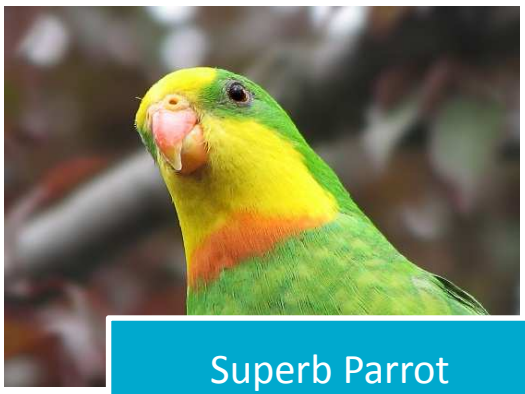
Tips for success

Remember to look and listen high up in the trees and on the ground as well as around your eye level.

It's important NOT to count birds you see or hear *outside* of the site. So don't just count everything – take a moment to think about whether it was in or out.

One challenge with recording Bird Types instead of species is that males and females, and adults and juveniles often look different so you may count the same 'type' more than once because of this. That's OK – remember that accuracy is less important than making the *same types of decisions* in the conservation and control sites each year so they can be compared.

Of course, if you are an experienced birdwatcher, you can record the actual species present on your site.



Superb Parrot

Spotted Pardalote

Galah

Sacred Kingfisher

Superb Fairy-wren

Sulphur-crested Cockatoo

These Australian birds are coloured very differently, however from a distance it is often difficult to see even these bright colours easily. So instead, pay attention to the fact they have different body and bill sizes and shapes and different length tails to help recognise the different 'types'. Bird identification guides can also be purchased at most bookstores and online and many birding websites have online free identification guides and images as well.

Native Plant Types

Remember – This indicator is suitable for people who feel confident they can recognise native plant species relative to exotics/weeds, including wildflowers and other annuals, even if they can't identify all the individual plant species.

What are 'Native Plant Types'?

If a 'Plant Type' is a plant that looks different than the others based on the colour of the flower, the size and shape of the leaf, or maybe even how the plant grows (tall or short, many or single stemmed), then a 'Native Plant Type' is simply a plant which looks different than the others that you feel fairly confident is a native plant.

Why is it important?

The number of plant species is a well-established indicator of a healthy site. Some species are very sensitive and will disappear from a site if it declines in health. Thus, more species generally means less disturbance and more natural processes. Increases in Native Plant Types are a stronger indicator of improvement than Plant Types, which can include increases in the number of different weeds as well as native plants. If you feel confident you can distinguish between native and exotic plants, this is the better indicator to use.

How long does it take to measure?

About 20 minutes per site

When is it useful?

0 - 6+ years after change in management.

How do I measure it?

At the start of your survey line, touch your hands to your opposite elbows and lift your arms until they are in front of you, making a circle through which you can look down at just part of the ground. Within the circle you see through your arms, count the number of different Native Plant Types that are growing as part of the ground layer. Record that number on your data sheet.

At every 5th step after that (so 9 more times on a survey line), make the same circle with your arms and count any NEW Native Plant Types you didn't see in your previous circles. Record the number of new Native Plant Types on your data sheet.

At the end, to calculate the number of Native Plant Types for the whole site, simply add the numbers recorded at every 5th step along the whole survey line.

Tips for success

Many of the exotic plants present will be common weeds such as Paterson's Curse, flatweed or annual grasses such as Brome and Wild Oats. In contrast, many of the native plants are uncommon so a native plant and weed ID book is helpful. If you know your common weeds, you could just assume that an uncommon unknown plant is native, as long as you do that at both your conservation and control sites.

Many ground layers are covered in weedy exotic annual grasses such as brome, wild oats, rye grass and silvergrass. Annual exotic grasses are often bright green, only present in spring and have small roots that can easily be pulled out, unlike perennial grasses.

Put your hands on your elbows to make a circle to look through. This helps you define a small area you will look through in detail to count the number of Native Plant Types. Just make sure you do it the same way every time.

Tips for success continued….

Note that if you aren't sure about recognising the difference between native and exotic plants, you should use the simpler 'Plant Types' indicator. You could also invest in a native plant and weed identification book or seek identification resources online.

However there will always be unknown plants and even a professional botanist will have the problem of finding unknown plants or knowing whether they are native or exotic! So, what is the best way to manage this? The golden rule is to be consistent – that is, make a decision on what to call or classify it and keep it as consistent as possible over time, including between your conservation and control sites.

Number of Bugs

What is 'Number of Bugs'?

It is the number of individual bugs we can see with our naked eyes found living in the leaf litter. 'Bugs' includes the whole variety of invertebrates that you are likely to notice. It may include spiders, ants, cockroaches, beetles, millipedes and worms. Note that we mean total number of individuals, not the number of different types.

Counting the number of individual ants, spiders, beetles, and other 'bugs' may provide some indication of whether a site's capacity to capitalise on good rainfall years is increasing. Spider image © Bryce McQuillan.

Why is Number of Bugs important?

As they reproduce rapidly, and at least some of them are very mobile in the landscape, and they are a group that can recover faster than most. Also they play a key role in breaking down leaf litter and thus maintaining soil structure and health. Many also help control pests and serve as food for many other species.

How long does it take to measure?

About 10-15 minutes per site

When is it useful?

This may be most useful in particularly good rainfall years. We currently think that sites that are improving show a greater short-term increase in bugs (compared to control sites) when conditions are relatively wet, suggesting greater functionality in the system. But numbers appear to return to low levels during dry periods. Collecting information on this each year and adding a note about whether it's a wet, average, or dry year could help us learn more.

How do I measure it?

At the starting marker of your survey line and at every 5th step along the survey line, bend down, reach in front of your boots, and scrape any leaf litter toward you from an area about the size of both your boots (approx. 25cm x 20cm). As you scrape, count the number of bugs seen scurrying away. Replace any litter afterwards.

Tips for success

Even if there isn't much or any leaf litter, you should still scrape the ground because it will disturb any bugs that might be hiding there, giving you a chance to count them.

It's important to use your fingers to really move the litter and plants and properly disturb the bugs all the way down to the soil layer. So don't be squeamish. If you are concerned about bites, wear thin gloves like rubber kitchen gloves.

Also, if you are using this indicator along with a few others, just make sure you don't do it after doing something else that might have already disturbed your bugs. See 'Using Multiple Indicators' for some ideas on how to avoid this.

Gently scrape leaf litter toward you across an area about the size of both of your boots to count the number of bugs you see scurrying way. Wear light rubber kitchen gloves if you wish to protect your hands.

Using Multiple Indicators

You are likely to want to use more than one indicator. Because most of them are recorded along your 50 metre survey line, it doesn't make sense to walk the line separately to collect information on each indicator. Instead, you can walk the line once and end up with all the information you need at the end. Here are our suggestions about how to do that most efficiently.

Note that if you are using a few but not all of these indicators, you can still follow these suggestions for the indicators that are relevant to you. The instructions below are intended to be used in combination with the more thorough information provided for each indicator in the previous factsheets.

1. If using **Bird Types**, do that first from the middle of your site. If your survey line runs through the middle of your site, be careful not to trample the plants you will be looking at later. Instead, just stand a bit off to the side of the survey line.

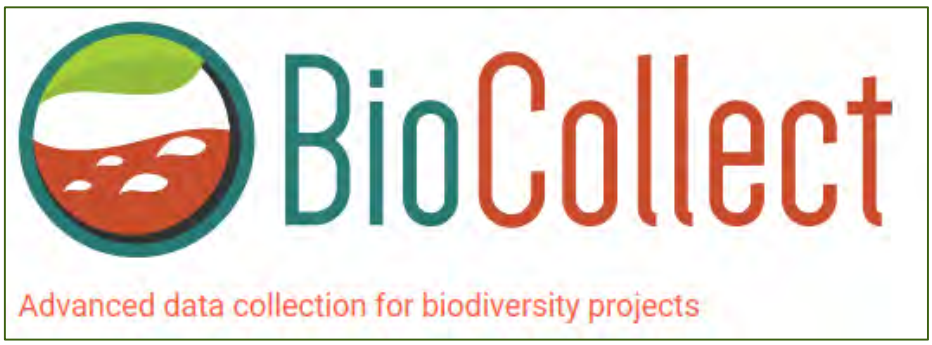
2. Start the survey line work from step 0 (the marker at the start). If using all the indicators, do the boot mark measures first at step 0:
   - ✓ Is there **Not Bare Ground** under the tip of your boot mark (in other words, anything except bare ground)? If so, mark it on your data sheet with a tick or a 'yes'
   - ✓ If there is litter under the tip of your boot mark, gently measure and record **Litter Depth**, then determine the rating for **Litter Break-down** and record that on your data sheet (take care not to disturb the litter too much if you plan to count Number of Bugs later)
   - ✓ If there is a native perennial grass butt under the tip of your boot mark, note that on your data sheet for **Cover of Native Perennials (butts)**
   - ✓ If there is any foliage of a native perennial grass hanging over your boot such that the tip of your boot mark would be under an imaginary dome, encompassing an individual perennial grass, place a tick or a 'yes' on your data sheet for **Cover of Native Perennials (foliage)**

3. If using the Plant Type indicators or Number of Bugs, do these next at step 0 (the start of your survey line):
   - ✓ Make your arm circle and count either the number of **Plant Types** or the number of **Native Plant Types** you can see within it and record on your data sheet
   - ✓ Reach down and scrape the litter in front of your boots to count **Number of Bugs**, return the litter, and record the number of bugs you counted on your data sheet

4. Move to Step 1 along the survey line and repeat the instructions in #2 above. Keep doing this for each of your ~1 metre long strides until you reach the end marker.

5. If using the Plant Type indicators or Number of Bugs, repeat the instructions in #3 above only at every fifth boot step along your survey line (so steps #5, 10, 15, 20, etc.).

Recording and Sharing Data using BioCollect



Why use BioCollect?

BioCollect (www.ala.org.au/biocollect/) is a tool developed by the Atlas of Living Australia to support data storage and sharing for anyone working with field data, especially citizen scientists. It is free to use. To help you, we have set up a project at http://tinyurl.com/checking4change, provided resources to help you contribute, and provided a place for you to enter survey data. This allows the data to be securely stored and accessed across the whole project. We encourage you to take advantage of what BioCollect has to offer.

Specifically, by entering your data in BioCollect, you will be able to:

- have BioCollect calculate some of the whole site values for you
- have your data safely stored somewhere
- look at your own data anytime so your monitoring efforts can help you make decisions about your management
- share your data with other Checking for Change users to gain insights into regional or state-scale improvement

At the Checking for Change BioCollect website, you can click on 'Resources' to access this Guide, helpful videos of how to use the methods, and access our companion guide on the scientific research that underpins these methods ('**Checking for Change: the science behind practical monitoring of ecological improvement**'). You can also click on 'Blog' to read any news or updates from us.

We encourage all Checking for Change users to make use of BioCollect, as the more users we have, the more regional and state-scale data we will have. This ensures your monitoring efforts have the potential to make a difference not just to your own management but to the decisions and actions taken at regional, state, and even federal levels. The more we participate, the more potential understanding and benefit we can gain.

TECHNICAL NOTE for professionals:

The Checking for Change BioCollect site is also a valuable resource for you, even though it is listed under 'Citizen Science' projects. By catering for basic users but still making it suitable for all users, we are able to collate data from all users in one location, making it much more likely that sufficient data for reporting at regional, state and even federal levels may be available. Thus, there are compelling reasons for professionals to enter their data in BioCollect, not just citizen scientist landholders.

It is also easy to set up a project in BioCollect. So if you are running a program in which you are encouraging or requiring all your landholders to use Checking for Change, you could choose to set up your own Checking for Change BioCollect project. The data forms and resources could all be duplicated from our 'parent' BioCollect site, greatly reducing your work in setting up systems to receive and collate data. This would automatically give you a single, safe repository for all your program-specific Checking for Change data, which could be used all by itself or combined with data from other programs entered in the general Checking for Change project.

How to enter and share data in BioCollect

Everything you need can be found at the Checking for Change BioCollect website: http://tinyurl.com/checking4change. You will need to sign up as a registered user. This is easy to do by clicking on 'Get Started' or trying to log in to the Atlas of Living Australia.

You should then be able to use the 'Blog' tab to access any news or updates from us. The 'Resources' tab provides access to videos, data sheets, indicator factsheets, etc. to support your monitoring. The 'Survey' tab is where you will find electronic data forms to enter your monitoring data. Collect the information on paper out in your paddocks and then enter the basic information requested on the electronic form as soon as you can. The form will automatically calculate some of the basic whole-of-site numbers for you and additional functions may be added in the future. The 'Data' tab then allows you to search for and see any data you have entered as well as data entered by other users in the project.

As the numbers are best interpreted through graphs (or statistical analyses for professionals), you may then need to copy or download data from BioCollect to be able to graph or analyse it (see 'Making Sense of the Numbers' below.

Notes on Recording Latitude and Longitude

All data entered in BioCollect needs to be 'geo-referenced' – to have a latitude and longitude recorded for the start of the survey line (Step 0). This makes the information much more valuable as it can be associated with a particular region or state to help us learn about and report on what is working in different parts of Australia. When registering for BioCollect, you agree to share this information about your sites. If you choose not to share because of privacy concerns, you can still use Checking for Change but you will simply have to record and interpret the information yourself, just for your sites. You won't be able to gain benefits from learning from others' sites and your monitoring efforts will not be able to contribute to larger scale learnings. Thus, we encourage you to share the location of your site.

If you have one, a GPS is often the easiest way to determine the latitude and longitude of the start of your survey line (Step 0). Ensure the datum is set to GDA94/WGS84 and record the latitude ^{o}S and longitude ^{o}E in decimal degrees to four decimal places (the format DDD.DDDD).

Mobile smart phones all have geo-locators inside them so it is also possible to get the coordinates from your mobile phone. Here is a website that explains some options for how to do this: http://www.online-tech-tips.com/computer-tips/find-longitude-latitude/. There are also apps available to help you do this.

Finally, you can also find the decimal degrees for the start of your survey line using Google Earth™. This is free software that shows aerial images across the world and includes the ability to zoom in and out, measure things, etc. It can be downloaded from: https://www.google.com/earth/. In Google Earth, simply zoom in to your site, recognising it from roads, patterns of tree cover, etc. Under the Tools menu select Options, then 3D view. There should be a small box titled 'Show lat/long'. Make sure the 'Decimal Degrees' is ticked. Under View, also check that the Status Bar is selected for viewing. You should now be able to move the cursor on top of the start of your survey line in the aerial image and see the latitude and longitude of that point in the Status Bar at the bottom of the screen.

While this may seem like a fair bit of trouble to go to, remember that you only have to do this once for each site (conservation or control) that you set up.

Making Sense of the Numbers

Compare conservation and control sites over time

The key to understanding the numbers is to look at changes over time at ***both*** the control site and the conservation site and look for an improvement at the conservation site. There some good reasons to do this:

1. Differences in the numbers from year to year might be fairly large due to seasonal conditions and / or varying numbers of kangaroo and wallabies. You are aiming to separate the year to year seasonal variation from the effects of your management. The control site enables you to do this, by looking are the differences in trends between the control and conservation sites.
2. By making comparisons between conservation and control sites, you don't need to worry as much about being perfectly accurate and precise in the numbers you collect. You just need to ensure that the same methods, judgements and decisions are being used at both conservation and control sites. What is important is the *differences over time* between your conservation and control sites, not the absolute values. This means we can still have confidence in the information even if it is collected by those with no technical training.
3. Finally, the other important reason to compare conservation and control sites is because 'improvement' may take many different forms. Conservation sites could be improving more than control sites, or they could be holding steady in their condition while control sites decline. In addition, all sites may be in decline (perhaps due to regional pressures beyond your ability to influence) but conservation sites could be declining more slowly than control sites. In all of these situations, there is evidence that management is working, at least to some degree, and you want to be able to learn about all these possibilities through your monitoring.

Options for interpreting the results

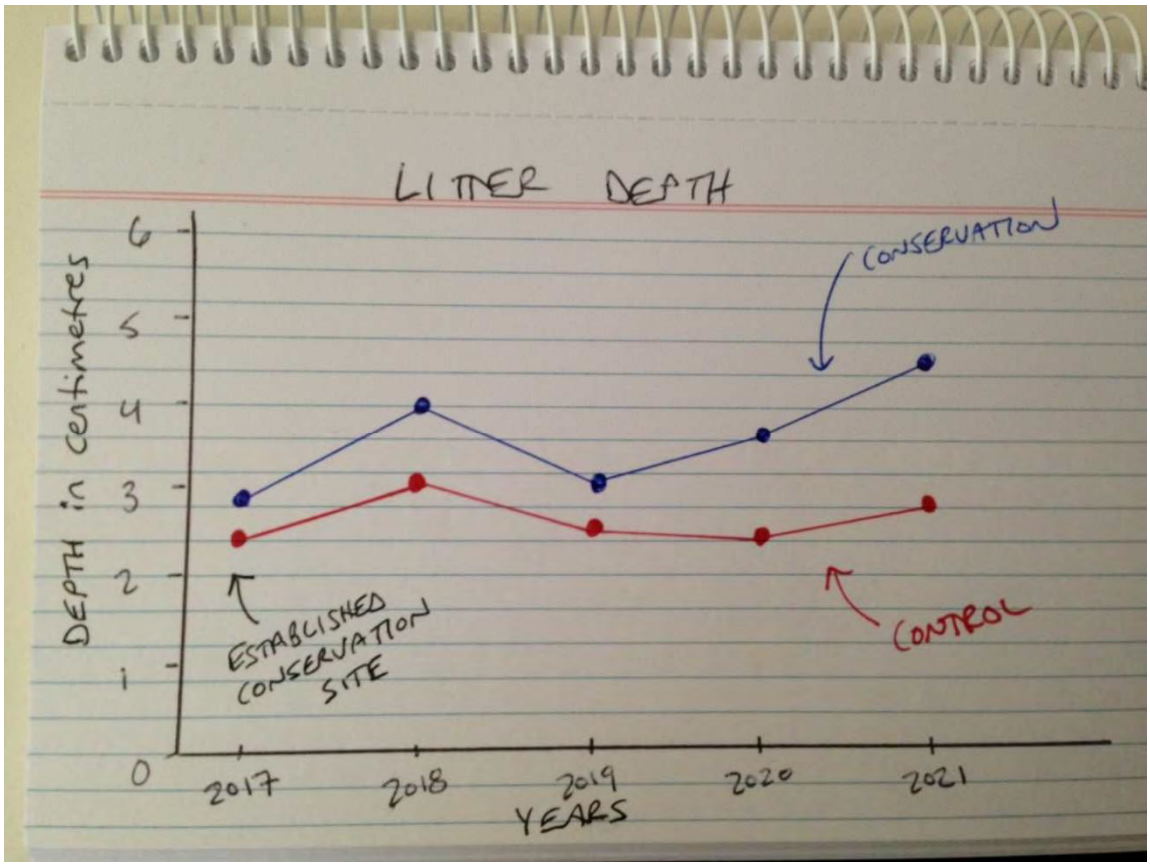
To help make these comparisons and judge for yourself whether conservation management is working, we suggest a few different ways to turn your information into graphs and to conduct statistical analyses if your skills permit. These methods differ depending on whether you are looking at a few pairs of conservation/control sites or whether you are looking at many pairs (for example, as part of a larger funding program or state-wide monitoring approach). They also differ depending on your fondness for calculations. Thus, pick the section heading below that best describes your situation to get the most targeted advice on making sense of your numbers.

Option 1: If you have data from just one or a few conservation/control site pairs and prefer to avoid maths at all costs…

The simplest solution to understand whether your management is working is to graph the numbers you collect each year. Use graph paper or just lined paper if you can't find graph paper. (Of course, you can also use software like Excel to make graphs if you prefer). Across the bottom of the graph, put the years from left to right and be sure to space them evenly. On the left side going from bottom to top, write numbers for a given indicator, trying to show the range of different numbers you might end up with each year for both conservation and control sites. Again, be sure to space them evenly. You will need a graph for each indicator you are using (and each pair of conservation and control sites).

Each year you collect information, put a dot directly above the year and directly to the right of the number you calculated for the whole site (from the bottom of your data sheet – see the Data Sheet section below). Use different colour pens for conservation and control sites. As you add dots each year, draw a straight line from the previous dot for that site to the new dot for that site. The picture below shows an example of one of these hand-drawn graphs with information from five years of Checking for Change.

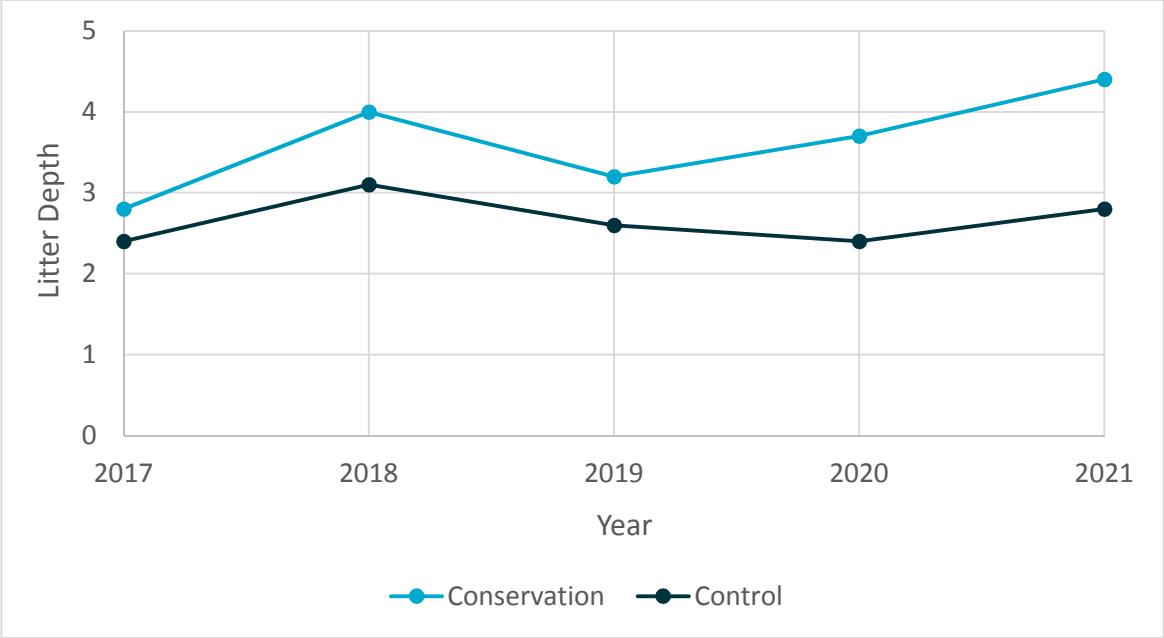
NB. Hand-drawn graphs can be just as effective at showing effects as computer-generated ones.



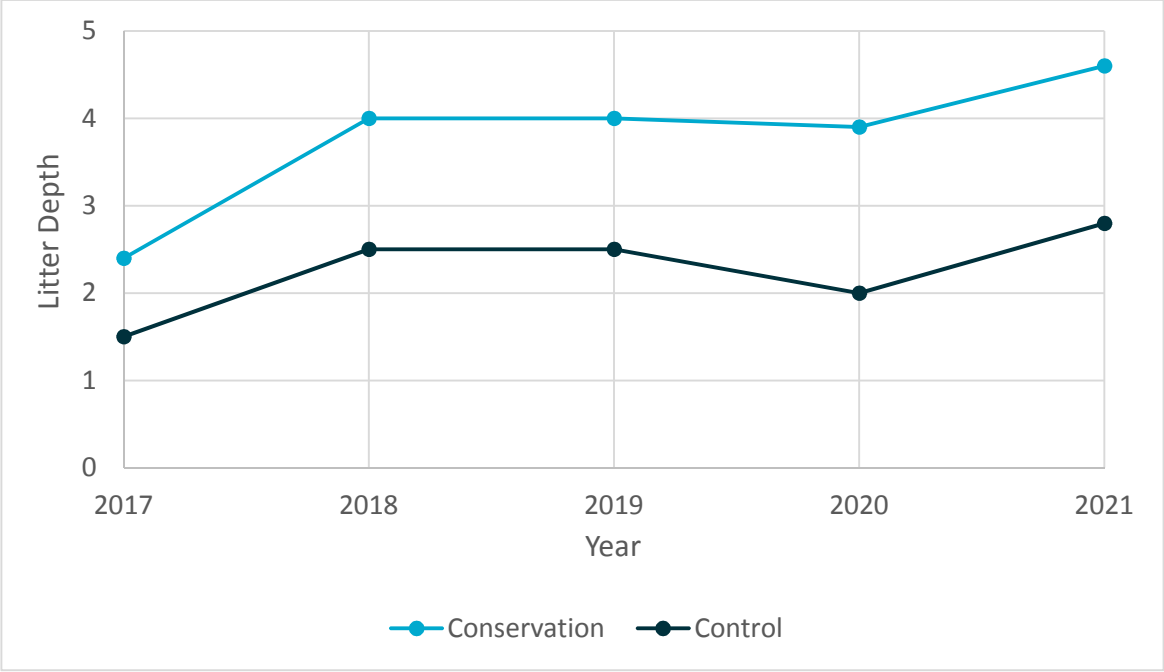
Once you have a few dots, you can begin to look for differences in the direction of the lines for conservation vs. control sites. In this hand-drawn graph above, the control site is staying about the same while the conservation site is improving (deeper litter).

Here are some examples of the different types of trends that indicate your management is helping:

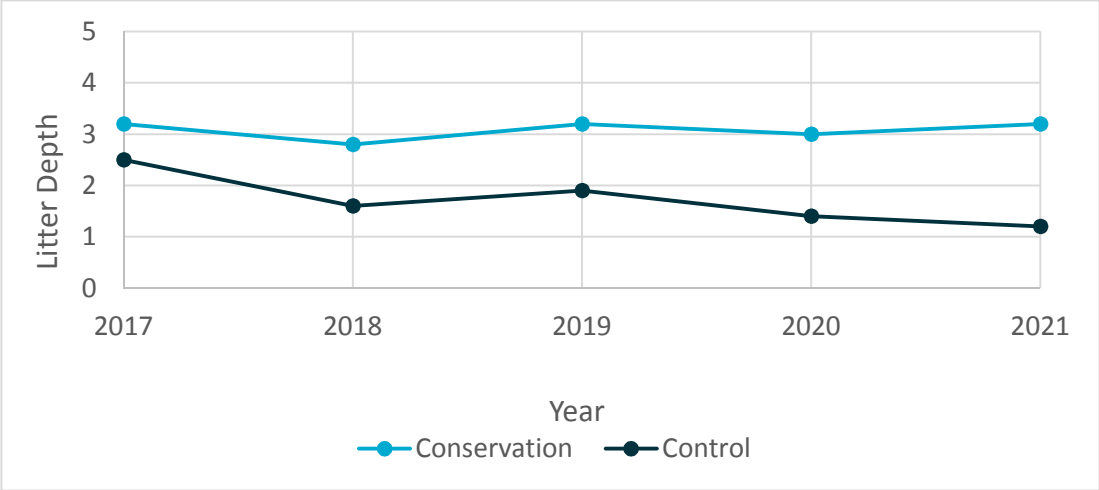
Conservation site improving while control is not



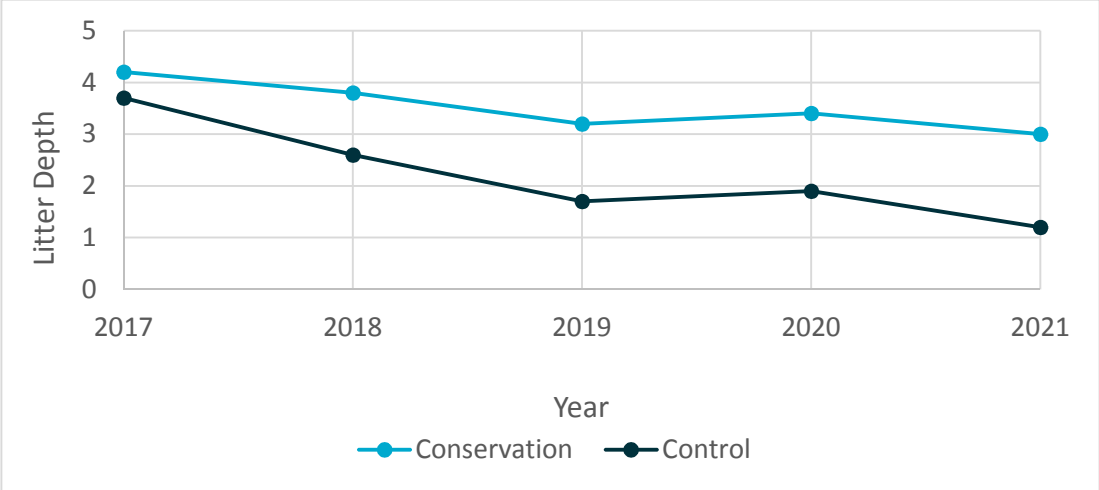
Conservation site improving more than control



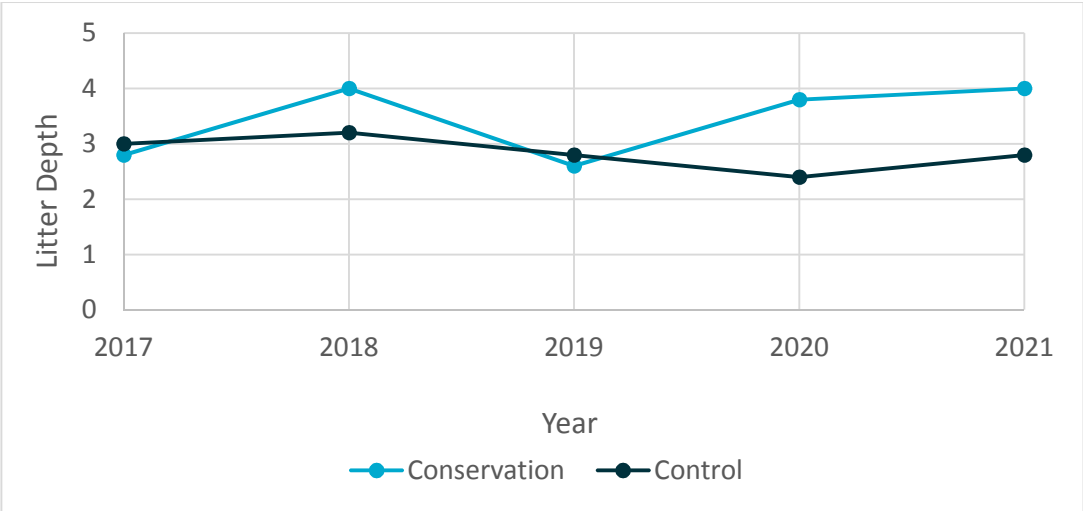
Conservation site holding steady while control declines



Conservation site declining but less than control

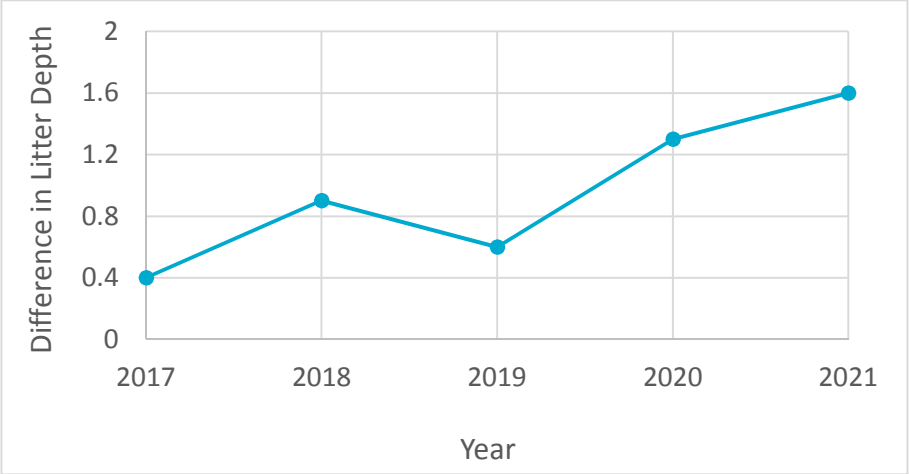


Note also that the **trends may look messier** than the example graphs shown above, and may be harder to judge. In the example below, the conservation site is improving while the control is not, but you have to look closely to see that.



Option 2: If you have data from just one or a few conservation/control site pairs and don't mind simple maths…

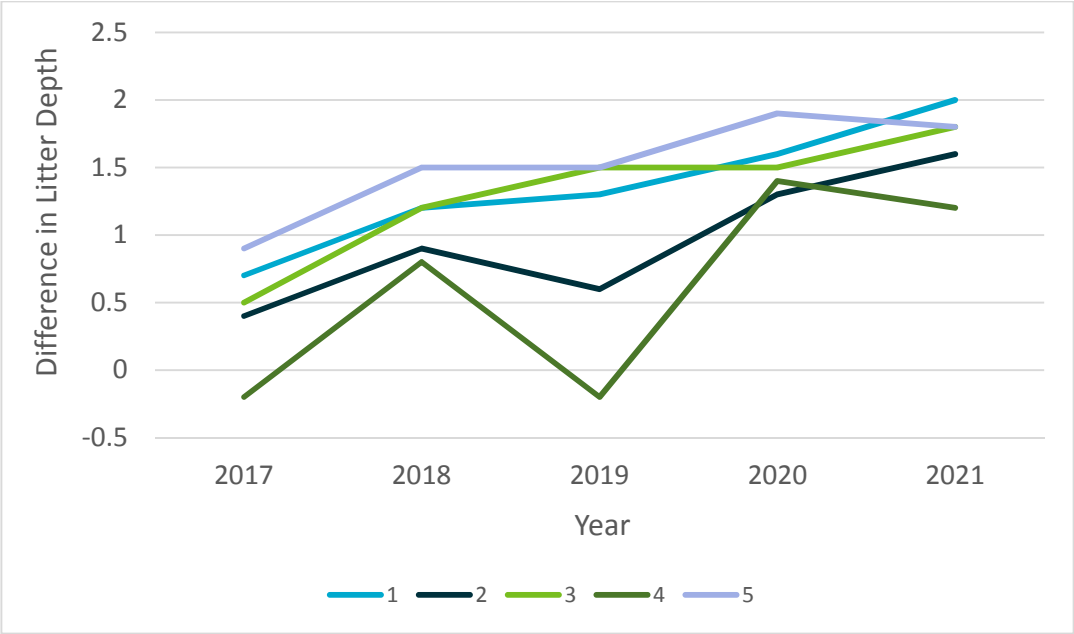
It can be easier to see the difference between conservation and control sites if you first calculate the difference in an indicator between each pair of sites each year (or use BioCollect to calculate it for you), and then graph that difference (instead of graphing conservation and control sites separately as above). Be sure to always subtract the value of the control site from the conservation site, and not the other way around. If you follow the instructions for graphing in Option 1 above (but just graph the one set of numbers – difference between each pair of conservation and control sites over time), you should end up with a graph that is quite easy to interpret. The only trend that indicates your management is helping to improve your conservation site is one in which the graph shows an upward trend in the difference between your conservation and control site over time, like this:



Option 3: If you have data from many conservation/control site pairs and like to avoid anything more than simple maths…

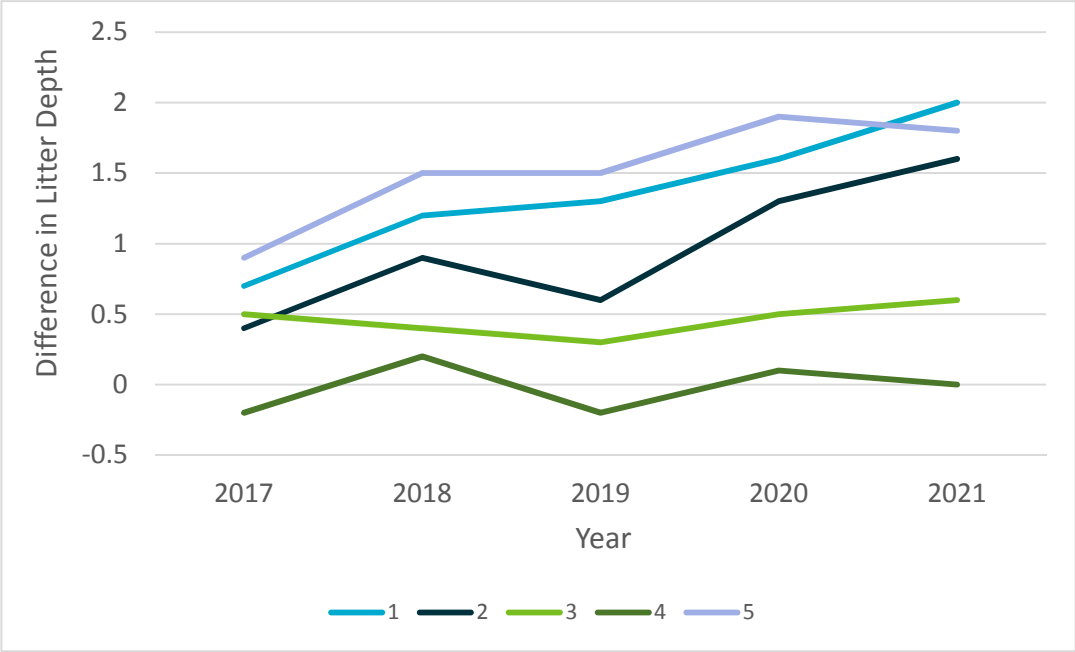
If you are looking at information from many site pairs, you may want to know overall whether your management approach is working? A separate graph for each pair of sites will not help in this case. Instead, you will want to include the numbers from all sites in one graph (for each indicator). Unfortunately, this is too messy to do without at least calculating the difference between each pair of conservation and control sites each year first.

So begin by following the instructions above for Option 2. Then graph the differences each year for each conservation/control site pair, using a different colour to represent each site pair (or another kind of clear label). The result might look something like this:



This example graph only shows five site pairs - you may have more, but this is the type of graph you might be looking to create, either by hand (which is very simple and effective) or using a software program like Excel.

The example graph above also shows the situation in which all conservation sites are improving relative to their associated control sites, clearly indicating that the conservation management approach is working. However, it may be more common to see a situation in which the approach appears to be working well on some sites, but less well or possibly not at all on others. Here is an example of what that might look like:



In these cases, you may decide that your conservation management is working overall as long as a majority of the site pairs show a trend toward improvement (i.e. a greater difference between conservation and control sites over time). You might also use this type of graph to identify

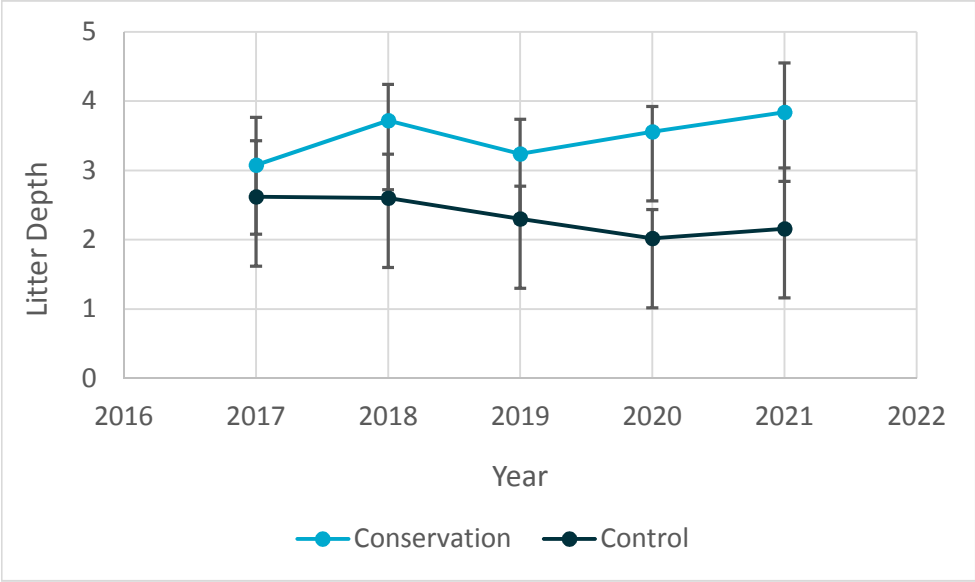
conservation sites that aren't improving relative to their controls (in the example graph above, numbers 3 and 4) and consider whether they differ in some consistent way from those that are improving. This can give insight into the particular conditions under which your conservation management actions do or do not work.

FOR PROFESSIONALS AND OTHER EXPERTS:

Option 4: If you have data from many conservation/control site pairs and are happy calculating summary statistics…

If you have data from many sites, then you may get a clearer picture of overall trends by calculating and graphing some simple summary statistics. For each year and each indicator, you will want to calculate a mean value across all of the control sites and a mean value across all of the conservation sites.

However, looking at mean values on their own can be misleading depending on the amount of variation you have among your sites. Therefore, you should also calculate standard deviations for each mean (which Excel and other software programs can do for you). By graphing these means with standard deviations across time you should be able to roughly assess whether differences in the means of conservation and control sites are increasing over time and whether that is truly a consistent pattern across sites because the standard deviations of conservation and control sites are becoming non-overlapping. The example graph below shows means (dots) and error bars (standard deviations) of conservation and control sites, with the standard deviations of the two becoming non-overlapping in 2020.



If you have access to some simple statistical software, then an even better approach is to produce box plots (also known as box-and-whisker diagrams) which provide an even better representation of the "noise" around mean values.

FOR PROFESSIONALS AND OTHER EXPERTS:

Option 5: If you have data from many conservation/control site pairs and are skilled in statistical analysis…

You will still want to begin by graphing your data to look for trends of change (see Option 4), but can then go further by calculating the statistical significance of these trends.

During the early years of your monitoring, you will not have enough data points across time to allow proper time-series analysis. One option at this stage is to use non-parametric tests (e.g., Wilcoxon rank sum tests) to test whether conservation and control sites differ in terms of the observed changes (data points would be differences within each site across years – i.e., most recent value of an indicator minus the original value of the indicator when you started monitoring for each of your sites).

A stronger approach is to use parametric analysis of covariance (ANCOVA) which has the advantage of allowing you to incorporate and control for the effects of other environmental factors which may vary across your sites – including things like average rainfall, temperature, vegetation types, etc. For our own analyses in testing these indicators, we used the most recent data for each indicator as the response variable with the first year of data included as a baseline predictor. We then performed all subsets regression for each indicator using site covariates (we had four of these) as candidate predictor variables plus the first year of baseline data as a forced predictor (i.e., always included). We then selected as the best model the one with the lowest Akaike Information Criteria scores corrected for small sample size (AIC_C). We then performed analysis of covariance (ANCOVA) to test for differences between conservation and control sites including all of the variables from this best model as covariates.

[Note: to satisfy some of the assumptions of these parametric tests, we had to transform data for some indicators. Transformations may not always fully deal with violated assumptions so a combination of ANCOVA and Wilcoxon rank sum tests can be helpful if the ANCOVA is not always possible to do appropriately.]

Once you have more than a few years of data, you can begin to employ other statistical approaches to model the observed changes in the different indicators over time and to test whether these changes differ between treatment and control sites.

Data Sheet for recording information

The following two pages provide a separate printable data sheet designed for recording these indicators while out in the paddock. One two-page sheet will be needed for each site (conservation and control) each year.

Full instructions for completing the data sheet are provided on the indicator factsheets. Note that ‘Step 0’ is the marker at the start of your survey line. Ideally, you then take 50 steps to reach the marker at the end of your survey line, but additional spaces are provided in case your steps are shorter than 1 metre and you end up taking a few more than 50. If you end up taking fewer steps than 50, that’s OK too – just record data for however many steps you take before reaching the end marker of your survey line.

Checking for Change – Data Sheet

Site Name: _____Recorded by: _____Date :_____

Lat/Long of Step 0 (in DDD.DDDD): _____ºS _____ºE

Control or Conservation Site? (circle)

If a conservation site, what year did conservation management start?_____

Name(s) of matching control or conservation site?_____

*Greyed out areas of columns without internal borderlines can be used for a description of the 'type' eg. small yellow flower or large black bird. The summary tally of numbers can be written at the bottom of the second page of the data sheet

Step #	Not Bare Ground	Litter depth (in cm)	Litter Break-down	* Plant Types (or Native Plant Types)	Cover of Native Perennials (Butts)	Cover of Native Perennials (Foliage)	* Bird Types	Number of Bugs
0								
1								
2								
3								
4								
5								
6								
7								
8								
9								
10								
11								
12								
13								
14								
15								
16								
17								
18								
19								
20								
21								
22								
23								
24								

25								
26								
27								
28								
29								
30								
31								
32								
33								
34								
35								
36								
37								
38								
39								
40								
41								
42								
43								
44								
45								
46								
47								
48								
49								
50								
51								
52								
53								
Calc-ulations	# ticks # steps	sum count	sum count		# ticks # steps	# ticks # steps		sum count
Whole site	%	(average)	(average)	(sum)	%	%	(total #)	(average)

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