



About This Method



This document helps you to monitor aquatic animals with Baited Remote Underwater Video Systems (BRUVS). This method has been adapted from: [Baited Remote Underwater Video Systems](#), M. Heupel & C. Simpfendorfer; [Standard Operating Procedures: Fish Cameras – Baited Remote Underwater Video \(BRUV\)](#), C. Whitcraft. You can find more information on the Monitoring Country website: monitoringcountry.org.au or scan the QR code.



This method has three parts: **1. Get Ready**, **2. Out on Country** and **3. Back in the Office**. Each part can be undertaken separately but you must complete all three parts to finish the method. At the end of the document, you will find guidance for all the gear you need - [Gather Your Gear – Complete List](#).

We recommend you read the whole document before you start.

Part 1: Get Ready



GATHER YOUR GEAR



Equipment required for this part:

- Tablets/phones with:
 - ability to take photos
 - data collection and navigation apps
- Laptop/computer with software for:
 - mapping
- GPS device (recommended)
- Tools to construct BRUVS
- Permanent marker

One set of this equipment for each BRUV:

- Underwater camera – charge ready for use and check that it has:
 - Memory/SD card installed
- Spare memory/SD cards
- Spare batteries or battery extender
- Waterproof camera housing





ENVIRONMENTAL MONITORING METHOD:

Monitoring Aquatic Animals with BRUVS

- BRUVS frame
- Bait arm
- Bait bag
- Rope
- Surface float
- Weight

KEEP IN MIND

Why?

Make sure there is a clear [monitoring question](#) and that the [method](#) you have selected will answer the monitoring question.

If this is the first time you are monitoring, you will need to [design the survey](#): what are you monitoring, where will you survey, and when and how often you will survey?

When?

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

If you are new to building BRUVS allow for up to 60 minutes to construct one unit.

Who?

 1 ranger/staff to plan and prepare



Training and skills

Staff involved in planning are trained and competent in:

- Mapping software (like QGIS or Google Earth) and/or [monitoring point generator](#)
- Navigation systems (like Avenza app or GPS device)
- Data collection systems (like Fulcrum app or paper datasheets)
- Identifying aquatic animals from video footage
- Setting up underwater cameras
- Constructing BRUVS

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Monitoring Aquatic Animals with BRUVS



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 done this monitoring before, it is best to do the surveys at the same time and same sites so that you can compare the data to previous surveys and see if there have been changes.


1. Plan which dates you will conduct surveys (deploy BRUVS)
 - Calculate total survey time by multiplying how long BRUVS will be deployed by the number of sites. Add travel, construction, deployment, and retrieval time
 - Consider weather and seasonality (wind, rain, temperature) and how these might impact surveys (boating conditions, underwater visibility, safety)
2. Decide on how long each BRUV will be deployed for i.e. deployment or sampling time
 - BRUVS are usually deployed for 60-90 minutes at each site that is surveyed
3. Decide on what water quality measurements you need to take to answer your monitoring question/s
 - Water turbidity and depth are recommended.
 - If you don't have a device for measuring turbidity (submersible meter or Secchi disk), you can attach a fixed scale to the BRUVS and estimate turbidity visually in videos
 - Optional measurements: salinity, temperature, pH, dissolved oxygen, current velocity and direction.
4. Gather species of interest [records in your area](#) and identify where potential species of interest habitat is.
 - Such as from Traditional Owners, Atlas of Living Australia (ALA) or government databases.



ENVIRONMENTAL MONITORING METHOD:

Monitoring Aquatic Animals with BRUVS



- If information for species or groups on your Country aren't well known, consider doing a pilot study to determine when, where, and how you should survey
5. Use the [monitoring point generator](#) or mapping software to select your sites
 - Consider what groups you are targeting; sharks and rays, fishes, turtles etc, and each group's habitat preferences or specific locations
 - Spacing between BRUVS varies depending on the groups or species of interest; from as small as 100 metres apart up to 1 kilometre or more apart
6. Give each site a unique name, and export and save the location data in your data management system
 - Such as, abbreviated wetland name followed by a number (e.g. Big Wetland has sites BW01, BW02...)
7. Prepare maps of sites and load sites onto navigation devices
8. Prepare a short guide that shows which habitats to deploy BRUVS
 - If you are targeting a species, the BRUVS should be put in their preferred habitat
 - If you are doing general monitoring, the BRUVS need to be put in a variety of habitats
 - The **Out on Country** team will use this information to decide exactly where the BRUVS will be deployed at each site
9. Plan how you will record information on Country (electronic data forms or paper datasheets)
10. Plan your [data management system](#) (how you will store site and video data)
-  11. 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 water turbidity and depth sounder devices may be suitable to buy
12. Charge electronic devices (tablets/phones, power banks, GPS, cameras) and batteries

Train



1. Check the **Training and skills** requirements for **Get Ready**, **Out on Country** and **Back in the Office** steps and arrange any training or expertise that you need.
2. Run everyone involved in the survey through the plan.
 - Be clear on how many people will be involved, what everyone will be doing, and what they will need to do the survey.
3. Prepare guides for identifying species of interest
 - ID books or apps can be used instead, but a short guide that is specific to your area/species makes it quicker and easier to check when out on Country.



ENVIRONMENTAL MONITORING METHOD:

Monitoring Aquatic Animals with BRUVS

- Guides can be loaded onto tablets/phones or printed and laminated.
4. Run a training session for all rangers involved in the survey to learn or refresh:
 - a. How to use the devices (like tablets/phones and GPS)
 - b. How to use data collections apps and record data
 - c. How to identify species of interest and their habitats
 - d. How to construct and deploy BRUVS

Construct and prepare BRUVS

1. Make the BRUVS (see the following tutorials)
 - a. [MarAlliance Technical Video Series: How to Construct a Baited Remote Underwater Video \(BRUV\) - YouTube](#)
 - b. [How to make a Baited Remote Underwater Video Camera \(BRUV\) for CHEAP! | Capture AMAZING footage \(youtube.com\)](#)
 - c. Stereo BRUVS [Video demonstrating how to set-up, deploy and operate a Baited Remote Underwater Video System. \[Training Video\] \(oceanbestpractices.org\)](#)
- If you are making more than 1 BRUVS, make sure they all identical with the same measurements
2. Charge and check the settings on the camera(s)
 - Make sure the date and time are correct
3. Give each camera a unique name (e.g. BRUVS01) and write it on the case in permanent marker.
4. Label the camera's SD cards with the same name as the camera it will be put into.

Next Section – Part 2: Out on Country



ENVIRONMENTAL MONITORING METHOD:

Monitoring Aquatic Animals with BRUVS



Part 2: Out on Country



GATHER YOUR GEAR



One set of this equipment for each team:

- Tablets/phones
- Power bank (optional)
- GPS device and spare batteries (recommended)
- Reference documents or field guides:
 - Species, groups, and/or habitats of interest
- BRUVS – constructed and ready to be deployed
- Multiparameter water quality meter (optional)
- Depth sounder (or other method to measure deployment depth)
- Slate/whiteboard and marker
- Boat or kayak that can be safely used to deploy and collect BRUVS
- Safety equipment for boat and water-based fieldwork

One set of this equipment for each site:

- 1 kg of bait for each BRUV (per site)
 - Bait used can depend on the species or groups of interest but is usually crushed or minced oily fish

KEEP IN MIND



When?

Check that the wind, weather, tide and seasonal conditions will be suitable and safe for boat and water-based fieldwork.

Make sure you have enough time to do the work – consider how many sites you plan to monitor and how many BRUVS you will deploy each day.



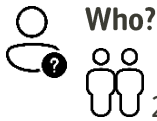
Where

Make sure you know exactly where (i.e. the habitat type) BRUVS need to be deployed at each site.



ENVIRONMENTAL MONITORING METHOD:

Monitoring Aquatic Animals with BRUVS



Who?



2-3 people per team including a boat operator and BRUVS handlers



Training and skills

Make sure everyone knows the plan.

Field staff are trained and competent in:

- Navigation systems (like Avenza app or GPS device)
- Data collection systems (like Fulcrum app or paper datasheets)
- Safety protocols for working on boats and water
- Preparing and deploying BRUVS
- Using underwater cameras
- Using water turbidity meters

ACTIONS



Check that your electronic devices (tablets/phones, power banks, GPS, batteries, cameras) are charged before you head out.




Deploy BRUVS

1. Choose the exact location within the site to deploy the BRUVS
 - Refer to the short guide that shows which habitats to deploy BRUVS
 - For targeting a species, you should choose location within the habitat they prefer.
 - For general monitoring, choose locations in different habitat types.
2. Give the location a unique name
 - Such as, use the site name followed by a number or letter (e.g. BW01_a)
3. Use the depth sounder to measure the water depth
4. Use the water turbidity meter to measure turbidity
 - You can also choose to take other water quality measurements like salinity, temperature, pH, dissolved oxygen, current velocity and direction.
5. Record **BRUVS deployment data**
6. Prepare the BRUVS
 - a. Attach ropes and floats to the BRUVS
 - b. Fill the bait container with ~1 kg of prepared bait
 - c. Turn on, set to record and attach the camera to the BRUVS frame




ENVIRONMENTAL MONITORING METHOD:

Monitoring Aquatic Animals with BRUVS

7. Write the waterbody, site and location name(s), camera ID, date and time on the slate/whiteboard
8. Hold the slate/whiteboard in front of the camera so that it is recorded
9. Lower the BRUVS into the water
10. Record the exact location of the BRUVS on the GPS
-  11. Record **BRUVS deployment data**
12. Move at least 200 m away from where the BRUVS was deployed so that the animal behaviour is not disturbed by your presence.
 - BRUVS are usually deployed for 60-90 minutes

Collect BRUVS

1. Once the deployment/sampling time is over, return to the BRUVS location
2. Pull up the BRUVS using the attached rope
3. When the BRUVS is on the boat (or shore), remove and turn off the camera, then store it in a safe place
-  4. Record **BRUVS collection data**

RECORD DATA

Data to record when deploying BRUVS

What to record	Required?	Notes
<i>Information to record about each BRUVS deployed</i>		
Project name	Yes	Make it clear which project this data belongs to and its purpose
Personnel	Yes	Record the name of the people who deployed the BRUVS - this is helpful if any questions come up about the data
Waterbody name	Yes	Name of the main waterbody (e.g. Big Wetland)
Site name	Yes	Name of the site within the main waterbody (e.g. BW01)
Location name	Yes	Name of the exact BRUVS location within the site (e.g. BW01_a)
Habitat type	Yes	Describe the habitat type of the BRUVS deployment location
Water depth	Yes	Record the depth of the water, in metres (m)
Turbidity	Yes	Record the turbidity reading, in NTU
Dissolved oxygen	Optional	Record the dissolved oxygen reading, in mg/L or %
Water temperature	Optional	Record the water temperature reading, in °C
pH	Optional	Record the pH reading, 0-14

ENVIRONMENTAL MONITORING METHOD:

Monitoring Aquatic Animals with BRUVS

Conductivity	Optional	Record the conductivity reading, in $\mu\text{S}/\text{m}$
Location coordinates	Yes	Record an accurate location (using a handheld GPS if possible) (latitude and longitude or eastings and northings)
Deployment date	Yes	Record the date the BRUVS was deployed
Deployment time	Yes	Record the time the BRUVS was deployed
Camera ID	Yes	Record the name written on the camera
SD card ID	Yes	Record the name written on the SD card. This should match the camera ID.
Bait	Yes	Type and weight, in kilograms (kg), of bait used
Water and weather conditions	Optional	Describe the conditions during BRUVS deployment
Site observations	Optional	Record any observations of target 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.



Data to record when collecting BRUVS

What to record	Required?	Notes
<i>Information to record about each BRUVS collected</i>		
Date BRUVS retrieved	Yes	Record the date the BRUVS was retrieved
Time BRUVS retrieved	Yes	Record the time the BRUVS was retrieved
Notes about deployment and collection	Optional	

Next section – **Part 3: Back in the Office**



Part 3: Back in the Office



GATHER YOUR GEAR



Equipment required for this part:

- Tablets/phones (or paper datasheets) that you used to record data
- Data management system
- Laptop or computer with software for:
 - Spreadsheets
 - Mapping
 - Playing videos
- BRUVS cameras

KEEP IN MIND



When?

Always try to complete this work as soon as you can after returning from your time on Country so that video footage doesn't get lost or deleted.



Who?



At least 1 person to manage the data and analyse videos



Training and skills

Staff managing data are trained and competent in:

- Mapping software (like QGIS or Google Earth)
- Spreadsheet software (like Microsoft Excel)
- Data collection systems (like Fulcrum app or paper datasheets)
- Data management systems (like databases, cloud storage and external hard drives)
- Identifying species and habitat types from videos
- Using video playback software



Monitoring Aquatic Animals with BRUVS



ACTIONS



Upload and enter the data

1. On a computer/laptop, create a project folder and name it something that makes it easy to recognise (for example 'IPAName_BRUVS')
2. Within the project folder, create and name a folder for each waterbody (for example 'BigWetland')
3. Within the waterbody folder, create and name a folder for each site (like 'BW01')
4. Within the site folder, create and name a folder for each location that had a BRUVS deployed (like 'BW01_a')
5. Download the videos from each SD card into the appropriate folder.
 - Double check the **deployment and collection data** and/or the first frames of the video when the slate board is in shown to make sure you have the correct SD card.
6. Rename the video with the location name, deployment date and time (like 'BW01_a_20240626_0615')
7. Upload the project folder with the videos to your data management system.
8. Upload the **deployment and collection data** to your data management system.
 - Recommended: get someone else to proof the data to check for mistakes.
9. Upload any other photos or videos taken during the survey to your data management system.



Process the data (watch the videos)

These steps use the MaxN method (the maximum number of animals visible at any one time)

1. For each BRUVS, enter this information into a spreadsheet:
 - a. Site and location names
 - b. Deployment date and start and finish times
 - c. Habitat type
 - d. Water visibility (estimate or enter the turbidity measurement)
2. Play the video and identify all the species that you see
3. For each species:
 - e. Count the number of individuals seen in any single frame.
 - f. Keep track of the highest number of individuals seen, this is the MaxN
 - g. Enter into the spreadsheet the video timestamp for the MaxN
 - h. Enter into the spreadsheet the sex, size and age category for all individuals
4. Upload the completed spreadsheet to your data management system

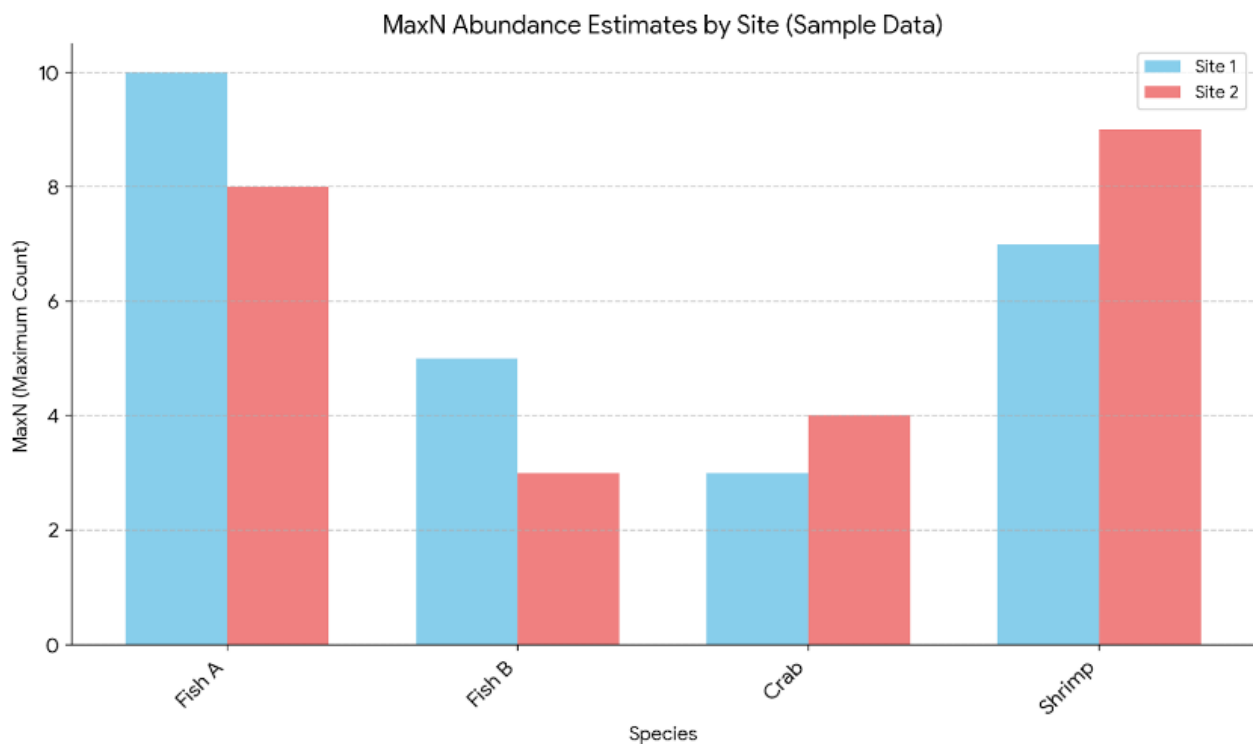
ENVIRONMENTAL MONITORING METHOD:

Monitoring Aquatic Animals with BRUVS



✓ Analyse and report on the data

1. Record a summary of what you did and why, any observations (like weather conditions), anything that went wrong or didn't work, and things that worked well.
2. Using the data in the spreadsheet, make a simple graph to show the MaxN for each species at each site or habitat type.
 - MaxN is a measure of relative abundance.
 - This shows you the differences in abundance between site.
3. Combine the site data for each species and make a simple graph to show the MaxN between different species
 - This shows you the difference in abundance between species.



Example graph of MaxN of different fish species by site. This example shows the relative abundance (MaxN) of 4 species recorded at Site 1 and Site 2. (Image created with assistance from Bard, a large language model by Google AI).

4. Use the mapping software to create a map of your sites and where species of interest were detected (or not detected which, can also be interesting)
5. Discuss with the ranger team or community the results of the monitoring, any reasons for the number of species or individuals between sites, and if there have been any changes to previous years.

Monitoring with BRUVS

Get Ready

On Country

In Office

Gear List

12



National Environmental Science Program

We acknowledge Aboriginal and Torres Strait Islanders as the Traditional Owners and Custodians of Country and recognise their continuing connection to and stewardship of land, water, and sea. We honour their culture, customs, and community. We pay our respects to their Ancestors, Elders, and future leaders.



ENVIRONMENTAL MONITORING METHOD:

Monitoring Aquatic Animals with BRUVS

- Consider whether trends might be related to your management (e.g. fencing to protect freshwater turtle, no fishing areas) to check how well management is working, or if you need to make adjustments.
6. Share the data according to any data sharing or funding agreements you have made

Next section – Full Equipment List

Monitoring with BRUVS

Get Ready

On Country

In Office

Gear List

13



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ENVIRONMENTAL MONITORING METHOD:

Monitoring Aquatic Animals with BRUVS



Gather Your Gear – Complete List



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

Gear List	Required?	Get Ready	On Country	In Office
Tablets/phones: <ul style="list-style-type: none"> Ability to take photos Apps for data collection (like Fulcrum) and navigation (like Avenza) 	✓	✓	✓	✓
Laptop or computer with software for: <ul style="list-style-type: none"> Mapping (like QGIS or Google Earth) Spreadsheets (like Microsoft Excel) 	✓	✓	✓	✓
GPS device & spare batteries	Recommended	✓	✓	
Power bank	Recommended		✓	
Permanent marker	✓	✓		
Tools to make BRUVS	✓	✓		
BRUVS, made up of: <ul style="list-style-type: none"> Underwater camera with SD card and batteries Spare memory and SD cards Waterproof camera housing BRUVS frame Bait arm Bait bag Rope Surface float 	✓	✓	✓	✓
Weight				
BRUVS habitat type deployment reference documents and/or field guides	✓		✓	
Bait (crushed or minced oily fish) <ul style="list-style-type: none"> 1kg per BRUVS/site 			✓	
Water quality meter			✓	
Depth sounder			✓	
Slate/whiteboard & marker			✓	
Boat or kayak			✓	
Safety equipment for boat and water-based fieldwork			✓	
Data management systems (like cloud storage)	✓			✓