Polecam

A polecam is a video camera attached to a pole that can be deployed to record underwater. It can be customised to provide live stream of the camera footage to the surface and can be used in shallow waters or lowered on a rope to deeper marine habitats.

This is a simplified version of a drop down video system that is relatively cheap to create and effective to capture marine biodiversity data within coastal habitats. A polecam is a remote survey technique as it will allow survey participants to view the seabed or marine life underwater on an electronic screen (such as a tablet or mobile phone), allowing identification of the marine life to be made from the footage made.

Unfortunately, polecams cannot be purchased off the shelf – they require you to source the components and to build the system. However, it benefits from being much cheaper than a DDV system and you can customise the system setup to your requirements.

▼ Polecam prepared for surveying from a kayak.

What you require

- An action video camera and robust underwater housing – we suggest a GoPro or SJCAM as these have apps that allow compatible live stream of the camera footage. Ensure camera and housing is depth rated to the planned deployment depth.
- Underwater light may be required.
- Underwater WiFi cable – this can be purchased online or you can research instructions to make your own.
- A pole to connect camera and lights to (and handlebar connectors) – This can be a long extendable pole for use on the surface or in shallow water (such as a swimming pool cleaning pole) or a short 1m pole that can be attached to rope for deep deployment (rope should be marked with length to estimate camera depth and the WiFi cable should be streamlined into the rope and/or pole).
- WiFi capable tablet or phone that is compatible with the action camera app.
- A waterproof cover for the tablet or phone.
- A tablet shade or hood maybe required to prevent glare from the sun – sun on the tablet can make it very difficult to see the screen.
- Tape or glue to connect WiFi cable to the camera and tablet/phone.

Operation

To use the polecam at shallow water depth (<5m), we suggest you use the camera on a long extendable pole.

To use the polecam at deeper water depths (>5m), we suggest you use the camera on a short pole attached to a rope for deployment. The polecam will move along the seabed by drifting with the deployment vessel, recording the seabed as it moves along. The depth of use will be limited to the camera housing depth rating and the length of WiFi cable used.

A GPS position can be generated by a hand-held GPS device or a GPS compatible tablet/smartphone. The depth of the camera can be estimated by knowing the length of pole and/or rope deployed.

Operating a polecam for marine survey work can be completed by one person, however we recommend a crew of three people. The roles to be covered include:

1. Operation – deploy the polecam and manage its depth (compulsory).
2. Marine life and seabed observer – fill in recording form.
3. Supervisor and data quality assurance – oversee survey and have attention to safety and logistics, maintain good data collection and applied methodology

Deployment

- A polecam can be deployed from the shore in shallow waters, from a kayak or a boat.
- The polecam should be carefully lowered into the water, keeping the camera away from any hard or sharp objects.
- Deployment from a boat - keep the polecam clear of the boat's propellers or jets and make sure that the captain of the boat knows when the polecam is about to be deployed.

Drop down video system

A drop down video system (DDV) is a marine survey equipment setup that is typically an underwater camera and lights on a robust sled/frame. DDV systems generally have a live stream of footage to the surface, built in depth sensors and lasers to provide a scale to estimate the field of view.

DDV systems are the preferred surveying technique for marine benthic habitats and are used as standard by professionals.

A DDV system is similar to the polecam in the same way that it can be deployed to the seabed as a remote survey technique. To allow survey participants to view the seabed or marine life underwater, an electronic screen (such as a laptop or tablet) should be connected to allow identification of the marine life to be made from the footage. However, a DDV system is more specialised, often with a GPS location and time stamp overlay on all footage recorded. The depth of use will be limited to the DDV manufacturer specifications. The system designed to be robust and has a frame to allow the system to be landed on the seabed to capture static video stills. DDV systems sometimes have a surface power supply that will power all electronics (such as the camera, lights, lasers) enabling you to survey for a long period without battery restrictions.

To purchase a DDV system, you will need to go to specialised underwater survey equipment supplier. They can advise on a DDV system setup based on your requirements and budget.

A GPS position can be generated by a hand-held GPS device or a GPS compatible tablet/ smartphone. The depth of the camera can be recorded accurately by notching the length of pole and/or rope deployed.

Operation

The DDV will move along the seabed by drifting with the deployment vessel, recording the seabed as it moves along.

A GPS position can be generated by connecting a GPS to the surface device (e.g laptop) which can be stamped on the video footage or by using a hand-held GPS device. The depth of the camera can usually be recorded from inbuilt depth sensors.

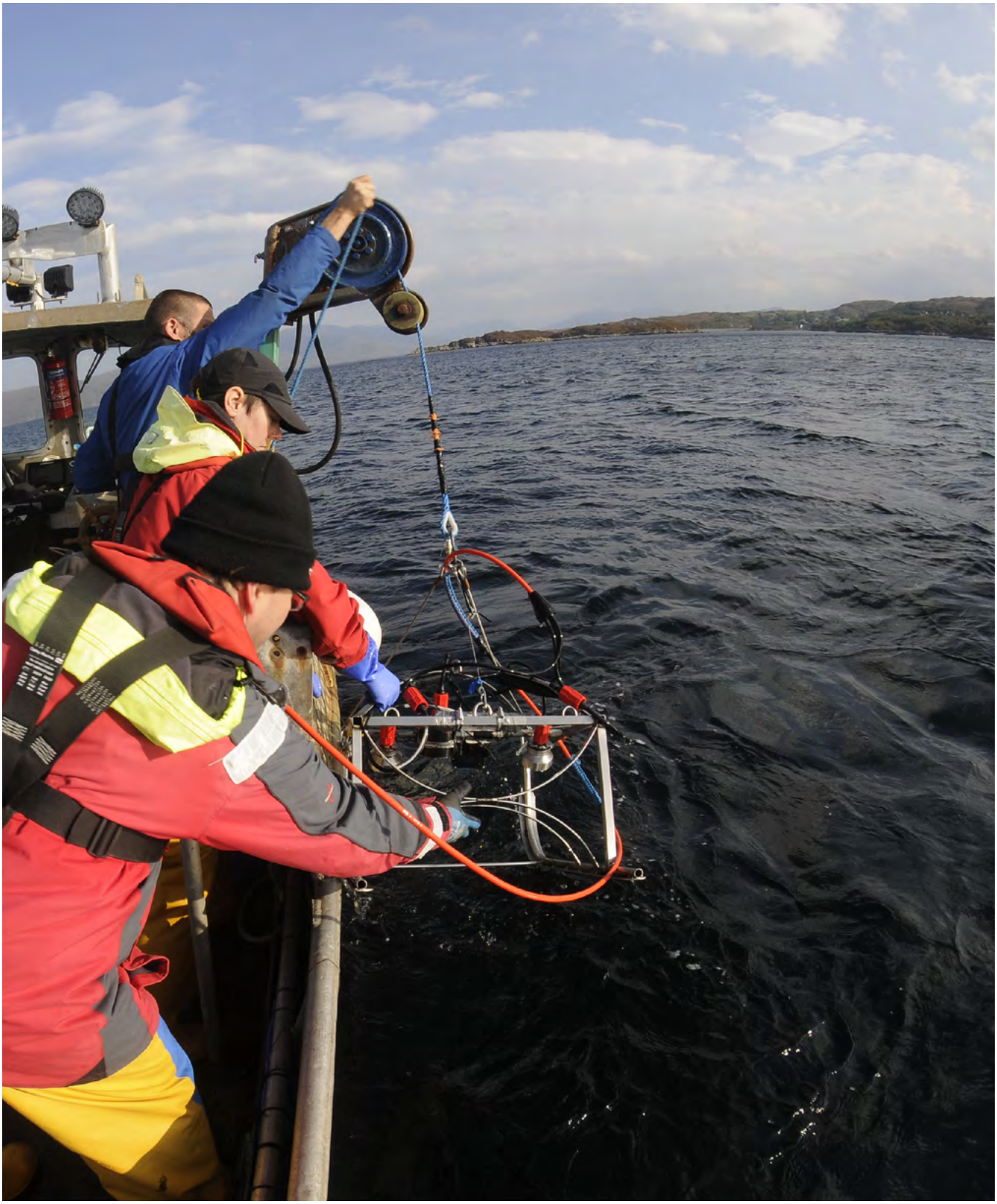
Operating a DDV for marine survey work will usually require a minimum crew of three people. The roles that typically need to be covered include:

1. Operation – deploy the DDV and manage its depth (compulsory).
2. Tether crew – maintain good tether management (compulsory).
3. Marine life and seabed observer – fill in recording form (compulsory).
4. Supervisor and data quality assurance – oversee survey and have attention to safety and logistics, maintain good data collection and applied methodology.

Deployment

- A DDV will need to be deployed from a boat. They typically require a deployment rope to avoid the tether taking the weight of the DDV system.
- The DDV should be carefully lowered into the water, keeping the camera away from any hard or sharp objects.
- Deployment from a boat - keep the DDV and tether clear of the boat's propellers or jets and make sure that the captain of the boat knows when the DDV is about to be deployed.

▼ **A drop down video system deployed from a boat.**



Remotely operated vehicle

A remotely operated vehicle (ROV) can be used to survey the seabed. They benefit from an increased manoeuvrability in the water compared to drop down video systems.

Operation

Operating an ROV for marine survey work will usually require a minimum crew of three people. The roles that typically need to be covered include:

1. Pilot – drive the ROV (compulsory).
2. Tether crew – maintain good tether management (compulsory).
3. Marine life and seabed observer – fill in recording form (compulsory).
4. Supervisor and data quality assurance – oversee survey and have attention to safety and logistics, maintain good data collection and applied methodology.

Tether management

Guidelines for good tether management:

- Keep the tether away from propellers or jets if you are operating on a boat.
- Keep the ROV away from boats that do not know that the ROV is in the water.
- Keep the tether away from sharp objects such as coral, rocks, etc.
- Do not deploy too much tether. Excess tether in the water will add drag to the ROV and increase the opportunity for the tether to get caught.
- Do not deploy the tether over sharp edges or rough ground.
- Do not step on the tether.

Deployment

- Keep lights switched off until the ROV is in the water.
- Do not launch the ROV near swimmers or divers.
- The ROV should be carefully lowered into the water, keeping the camera dome away from any hard or sharp objects. Do not drop the ROV into the water. If necessary, use a rope to lower it down.
- Do not launch in water that is too shallow to freely drive the ROV.
- Do not start the ROV propellers until it is in the water and the ROV is clear of obstructions and crew.

Shore deployment:

- Do not launch the ROV in heavy surf.
- You may need to walk the ROV into the water to get to a point where the water is deep enough to drive the ROV (you will require a wetsuit or drysuit).

Boat deployment:

- Keep the ROV and tether clear of the boat's propellers or jets.
- Make sure that the captain of the boat knows when the ROV is about to be launched.

Pilot guidance

- Pilot smoothly and on low speed when possible to maximize battery life.
- Do not pilot into a sandy bottom. If you do pilot into a sandy bottom, stop the ROV and allow it to float up to prevent sand from getting into the vertical thrusters.
- Avoid driving into seaweed and do not use an ROV to survey close to kelp beds or forests. Seaweed can get sucked into and stop the thrusters from spinning. In Scotland, Sea lace or Mermaid's tresses (*Chorda filum*) can be abundant in shallow water in summer and can be a problem if caught in ROV propellers. This seaweed has unbranched cord-like fronds and can grow to 8m long.
- Use a visual reference on descent and ascent to help the pilot navigate – such as a weighted line or anchor.

ROV direction in the water

An ROV will move through the water under the control of the pilot. However, tidal movement will also change the ROV's bearing. Tidal movement can change underwater as a result of underwater features and can have a large effect on the ROV movement.

If using the ROV to complete an underwater video transect survey (not recommended unless in optimal conditions), you should take a compass bearing from the static deployment boat to the ROV. To do this, the ROV should be brought to the surface at the end of the video transect, taking a heading at this point. If you suspect the ROV did not travel in a straight line transect, please record survey data using the underwater marine life observation survey methods.

▼ **Shore deployment of an ROV from a beach in Skye.**

Dive Mode			
	Manual	**Maintain a Heading**	**Depth Hold**
Description	In manual mode the ROV pilot has full control over manoeuvring the ROV in the water. This gives the pilot control to move around the seabed both vertically and horizontally, and will require a skilled pilot. This mode is best used if you want to fully explore the seabed without being stuck to the limits of moving in a straight line. Using an underwater GPS or estimating GPS coordinates for features will provide a georeferenced image to document your marine life findings.	Many versions of ROV's have built-in dive modes that can be used to maintain a set course - sometimes called a 'stabilisation mode'. The pilot can still manoeuvre the ROV vertically in the water column, allowing the pilot to maintain an appropriate distance from the seabed however, the ROV will maintain a set heading unless commanded to turn. This mode is particularly useful when manoeuvring over a seabed that is increasing or decreasing in depth.	It can be useful to survey along underwater depth contours when surveying as it's likely that the seabed is exposed to the same environmental conditions which can create a similar habitat and species composition. On seawalls and underwater drop-offs the seabed depth can decrease rapidly. Using a depth hold mode will make it easier to control the ROV. For surveying a seawall, it is useful to gain data on marine life that occurs at a fixed depth band (i.e. survey the seawall at increments in depth band, such as 10m, 20m, and 30m).
When to use	Exploring a seabed with underwater navigation features (such as a bay, headland, ridge or mooring). **Underwater marine life observation survey** – To record what you see, follow the marine life observation survey methodology.	Exploring an unknown area or an area of seabed without distinguishable features to assist navigation. **Underwater video transects survey** – Completing survey video transects should maintain a set direction throughout the transect recording. Please refer to considerations for ROV direction in the water above.	Surveying a steep seawall or areas of seabed with a rapid depth drop.

ROV GPS Positional Data

Underwater GPS system

GPS signals from satellites do not penetrate underwater. However, it is possible to collect this information using a 'wet-connect GPS' system that can calculate an ROV's position underwater.

The ideal set-up would be for the ROV to have positional GPS data overlay while underwater to provide detail on the ROV's exact position underwater. A coordinate file showing the ROV track should be stored for each survey. However, an ROV underwater wet-connect GPS systems is a specialised piece of equipment and are generally expensive to fit.

ROV estimated GPS calculation

It is possible to estimate GPS using a calculation taking into account ROV depth, compass bearing to the ROV and the length of tether deployed.

Using the depth of the ROV, length of tether and the ROV heading from the deployment boat, trigonometry can be used to estimate the location of the ROV.

To minimise error in the estimation, slack and curvature in the tether should be minimised when recording tether length. Where possible, the ROV should be used in a mode to maintain a constant heading to reduce GPS positional error.

Important! A GPS estimate will not be 100% accurate.

Requirements:

1. GPS fix of the deployment site (such as vessel or shore) –**in decimal degrees (DD)**
2. ROV depth
3. Length of tether deployed
4. Compass bearing from the deployment site (such as vessel or shore) to the ROV

Image quality

The key to image quality

For using polecam, drop down video (DDV) systems and remotely operated vehicles (ROV).

Technology –

1. **Camera quality**

   We recommend using a good quality camera with good video resolution. Using cameras underwater will require a robust underwater housing that can withstand a degree of knocks and salt water.

2. **Resolution of video**

   For best quality, cameras that can record HD (1080 x 1920) resolution and 30fps is sufficient. Using 60fps will provide additional quality for video frame stills from the footage.

3. **Lighting**

   Colour (especially red) is not visible using only natural light underwater, so underwater lights are required to get a clear image of the seabed. Lights should be wide angle to provide even lighting across the whole frame (avoid focussed spot lights).

4. **Camera angle**

   For most purposes it is best if the camera is pointed forward at about 45 degrees– about half-way between straight down and straight forward. Pointing the camera straight down would make the image appear to move very quickly and everything would look 'flat' (without depth), whereas pointing directly forward would mean insufficient detail of the seabed would be visible.

Technique – The way in which the camera or ROV is moved is of critical importance to be able to identify species and habitats. Techniques include:

1. **Height above seabed**

   Generally the closer the camera to the seabed the better the video quality. However, it is recommended to maintain the camera at 30cm-1m off the seabed for optimum image quality. It is also useful to vary the distance at times, and to record the camera lifting off the seabed at the end, because images from higher up can be used to see the wider habitat.

2. **Slow speed**

   The camera should move at a very slow pace, the slower the better! This should be below 1 knot, preferably 0.6 knot or lower. At faster speeds the image will be very blurred and make identification difficult.

3. **Regular stops**

   Regularly landing on the seabed for 2 to 3 seconds will provide static close-ups of the seabed substrate and species. Using this is particularly important if the camera speed is relatively high.

GPS device

A global positioning system (GPS) is used to figure out exactly where you are on the surface of the earth. It works by receivers (such as mobile phones or GPS devices) calculating the distance to three or more satellites to accurately determine your position.

How will a GPS device help me survey the sea?

A GPS device will enable you to:

- Determine the location of marine features.
- Determine the size of habitats.
- Map habitat and species distribution.
- Revisit a marine feature for monitoring.

What devices can I use to determine my GPS location?

- Most smartphones have built in GPS capability.
- Purpose built hand-held GPS devices.
- Boats will have a GPS device on board.
- For using a drop down video system (DDV), a plug in GPS receiver can be connected to the surface control computer.
- Remotely Operated Vehicles (ROVs) can be fitted with a special underwater GPS system.

For operation instructions, please refer to the user manual of the GPS device.

Coordinate system and map datum

Coordinates are specific to the map datum used. Datum's may be global, meaning they represent the whole earth or local, representing a specific orientation by ellipsoid best fit to an area of earth. The global datum that is most widely used is the World Geodetic System (**WGS84**) – this is the same datum as Google Earth.

The recommended setting for your GPS device or mapping software is WGS84.

The coordinate system used is **latitude and longitude**. The latitude (abbreviation: **Lat**) is the horizontal map coordinate (how far North or South you are) while the longitude (abbreviation: **Long**) is the vertical map coordinate (how far East or West you are). Latitude and Longitude coordinate can be expressed in different formats. All are equally valid and it is also possible to convert coordinates between formats but we recommend you stick to consistently using the same format.

It is recommended to use decimal degrees.

(Example: 57.493723, -4.201847)

This is because decimal degrees is the accepted format for marine data. If it is logistically easier to record in another format, then this must be converted into decimal degrees and filled in on the survey form. You will find a conversion tool easily online.

The MEDIN marine data standard requires all GPS data in the format of WGS84 and decimal degrees. This is to ensure a standardised framework for all marine data, making marine surveys results easier to use and compare findings. If you record the GPS position in any other coordinate system (such as National Grid Reference (NGR)), then this **must** be converted into WGS84 in decimal degrees.

You must state if you have converted the coordinate system from any other format (NGR) to WGS84, providing details.

The same latitude and longitude coordinates in different formats:

Decimal Degrees (DD): (our preferred format)

57.493723, -4.201847

Degrees and Decimal Minutes (DDM):

57°29.6234'N 4°12.1108'W

Degrees, Minutes and Seconds (DMS):

57°29'37.4"N 4°12'06.7"W

GPS for habitat mapping

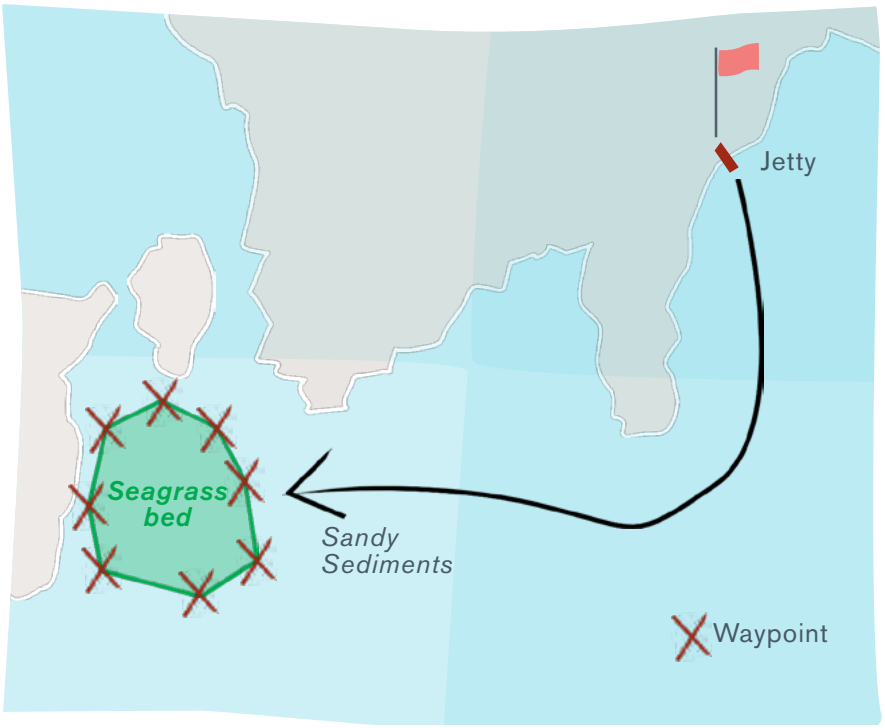
GPS tracking

GPS can be used while surveying on a boat to track the movements of the vessel for the survey. It can also be used to track individual survey station transect locations along the full route. The tracks can be displayed against a map backdrop using mapping software or Geographic Information Systems (GIS). Tracking software may also available for smartphones with GPS capability. There is often a set mode that can be turned-on on a GPS device.

Waypoints

When surveying, positions (such as survey stations and features) can be stored as waypoints. This is often a one-click button on a GPS device. You can assign a name to the waypoint when storing the position.

It is recommended to give waypoints consistent names that indicate what they represent and record these in the survey recording forms.



▲ **Example sketch map where the boundary of a seagrass bed is mapped.**

Permanent monitoring stations

To measure changes over time, you can either sample the same part of a site in a permanent monitoring station, or you can survey a wider area using a randomly selected set of survey points. When you survey using a permanent monitoring station, the difference in the results can be linked to environmental and/or community interaction change, while random sampling is more complicated. When using random sampling, the difference in results will often require the use of statistics for comparisons whereas permanent monitoring stations have a smaller reliance on statistics to detect a trend.

Community long-term monitoring

Permanent monitoring stations offer the greatest amount of information, consistency, repeatability and reliability.

Permanent monitoring stations should be selected using a random selection process within your target habitat to ensure they are truly representative – objective not subjective.

Marking stations

Permanent monitoring stations can be marked so that the transect line, quadrats or photographic equipment can be placed as close as possible to the same position on each visit. There are different techniques that can be used to mark stations; this can include marking bare bedrock with paint or hammering stainless steel stakes, rod or star pickets into the substrate. Using stakes, rods or pickets will provide something for your transect line to attached to and follow to ensure the transect line is in the exact same position as previous visits.

Finding permanent monitoring stations

1. Sketch maps of the area with the stations marked on with reference to features, compass bearing and line of sight with the surrounding area.
2. Using a GPS device to relocate the stations using the Latitude and Longitude coordinates from previous visits. Please ensure you use the same datum, such as WGS84.
3. Station markings – such as paint, rods, stakes or star pickets.

Advantages:

- Once set up, repeat monitoring is easy
- Easier to detect trends in the data to interpret results

Limitations:

- Can be time consuming and expensive to set up
- Unless clearly marked it can be difficult to find stations and waste survey time

Note: Some of the change detected in your results may be a result of human error, this should be acknowledged. However, the impact of human error can be minimised by complying with the quality control guidelines within the getting started chapter, page 16.