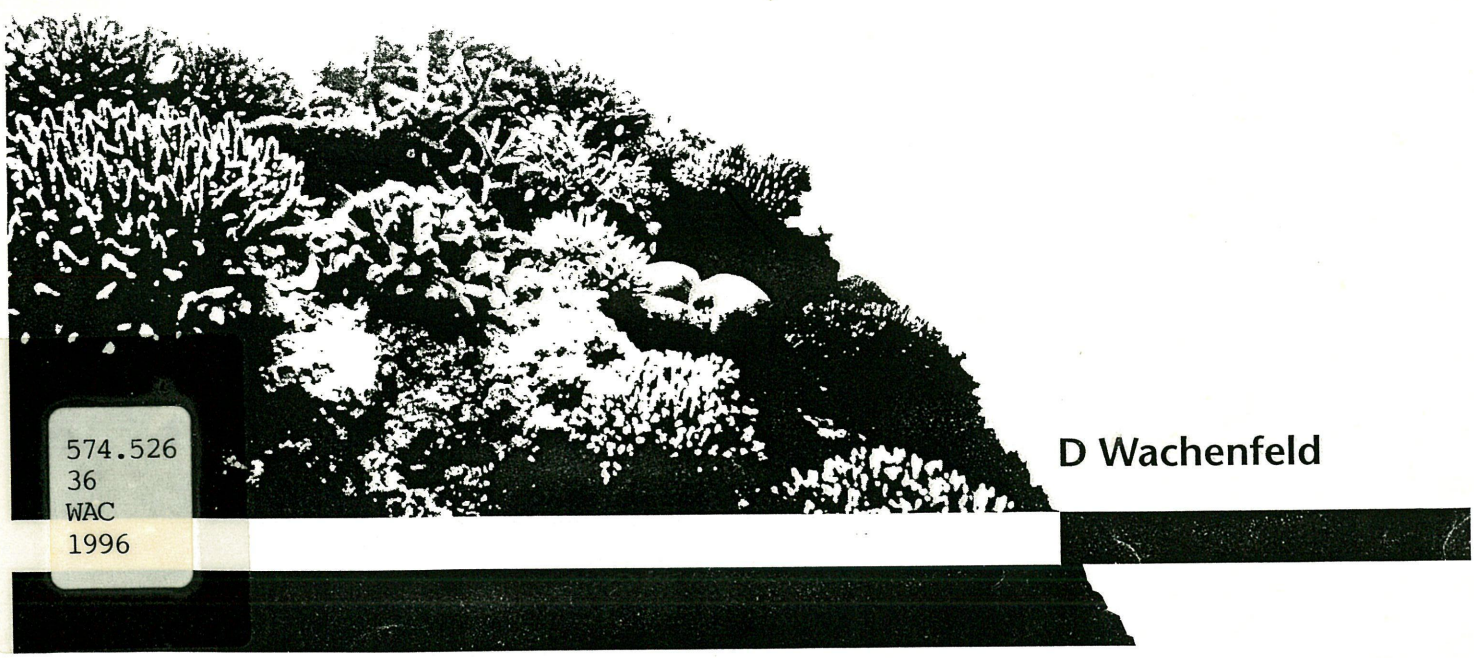
GREAT BARRIER REEF
MARINE PARK AUTHORITY

RESEARCH PUBLICATION No. 42

Standard Operational Procedure Video-monitoring of Sessile Benthic Communities



D Wachenfeld

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A REPORT TO THE GREAT BARRIER REEF MARINE PARK AUTHORITY

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GREAT BARRIER REEF
MARINE PARK AUTHORITY

PO Box 1379
Townsville Qld 4810
Telephone (077) 500 700

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1 Introduction

Information on changes in the abundance and distribution of organisms in the Great Barrier Reef Marine Park is essential for managers and scientists who wish to understand the ecological processes occurring on the reef and how these processes may be affected by human activities.

The Great Barrier Reef Marine Park Authority (GBRMPA) and the Australian Institute of Marine Science (AIMS) have jointly developed a strategy for the monitoring of long-term, regional changes in major biota and nutrients in the Great Barrier Reef Marine Park. The program was established with two broadscale objectives:

1 To detect and quantify major changes through time in the distribution and abundance of corals (and other dominant organisms), fishes, nutrients, and the crown-of-thorns starfish.

2 To provide managers (and other decision-makers) with information that is pertinent to assessing the 'health' of the Great Barrier Reef.

One subsection of this overall monitoring program is the monitoring of sessile benthos. This element of the monitoring program is designed to monitor broad inter-regional differences and to detect major changes at reef level. Currently, 56 reefs in the Great Barrier Reef Marine Park are monitored, with surveys carried out once per year. The AIMS/GBRMPA benthic monitoring program has three main objectives:

1 To detect and quantify major spatial and temporal changes in abundance of sessile benthos.

2 To determine the status of sessile benthic communities on selected reefs.

3 To quantify changes in the status of sessile benthic communities through time and interpret such changes in terms of 'reef health'.

Video equipment has been used increasingly to monitor abundance and distribution of benthic marine organisms in Australia and overseas. The AIMS/GBRMPA benthic monitoring program uses video techniques. GBRMPA recognises three main advantages of video techniques over traditional techniques in benthic monitoring:

1 Field work for video-monitoring can be carried out by personnel who are not expert in the taxonomy of benthic organisms.

2 Video-monitoring requires less field time than traditional techniques.

3 Video-monitoring provides a permanent record of the benthos that can be re-examined at any time in the future.

However, for certain groups of benthic organisms traditional monitoring techniques have the advantage that they allow higher taxonomic resolution than video-monitoring.

In addition to the AIMS/GBRMPA program, two other programs involving video-monitoring of benthos are coordinated by GBRMPA. Both of these programs are directed specifically towards monitoring locations that are subject to heavy human use (as opposed to the AIMS/GBRMPA program which is directed towards monitoring the Great Barrier Reef Marine Park in general).

The first of these programs is carried out by the regional offices of the Queensland Department of Environment (QDoE). Locations of significant management concern are selected for this video-monitoring program by QDoE and QDoE staff establish transects and carry out the videoing.

The other monitoring program involving video-monitoring is Commercial Activities Monitoring (CAM). This involves monitoring at specific sites associated with commercial developments involving structures and/or the possibility of significant impacts. Monitoring within CAM is usually undertaken by consultants and employs a 'Before and After Control and Impact' (BACI) experimental design. The exact monitoring technique used in CAM depends to some extent on the preference of the consultant involved, with both traditional and video-monitoring techniques currently in use.

This manual has been produced in order to introduce QDoE staff to the techniques of monitoring sessile benthos using video equipment. However, it may also be useful to other organisations or individuals with an interest in this subject.

The following methods have been adapted from those in the AIMS 'Standard Operational Procedure: Sessile Benthic Community Surveys Using the Video Technique' (by C.A. Christie and S.J. Neale).

2 Methods

2.1 Experimental Design

Locations for QDoE video-monitoring are normally chosen on the basis of management significance. Usually this means that locations selected are considered to be at risk of impact from human activities. One of the main aims of the monitoring is to detect whether or not significant changes in communities of sessile benthic organisms occur. If significant changes do occur, in order to attribute these changes to impact from human activity, it is necessary to compare results from allegedly impacted locations to results from non-impacted locations. In the terminology of experimental design, non-impacted locations are called reference locations. Reference locations must be chosen that are as similar as possible to potential impact locations in every respect except that of the potential impact. The long-term monitoring of reference locations, as well as potential impact locations, is essential to the process of inferring the likely cause(s) of any observed impact.

The exact experimental design to be employed at each location depends on the question being asked and the nature of the location, particularly the structure and total area of reef that is of interest. Therefore, experimental designs will vary from one situation to another. However, the default experimental design to be used in the QDoE video-monitoring program is that used by AIMS for their video-monitoring. This design comprises three sites at each location and five transects per site. Each transect is 50 m long and transects at one site should be separated by 5–15 m. All transects at one site should be closer to each other than to transects at any other site.

If this experimental design is not possible or appropriate at a particular location it is strongly recommended that advice on alternative designs be sought from GBRMPA's Research and Monitoring Section.

All transects must sample the specific habitat type of interest but, as far as possible, transects should be randomly located within that habitat type. The location of each transect should be decided roughly before the dive to establish them. The exact positions and orientations of transects will depend on the nature of the site. In order to minimise the risk of transects sampling different habitat types, it is often useful to have the transects follow a specific depth contour. Details on exactly how to establish transects are presented in the next section.

2.2 Establishment of Transects

The following equipment is required to establish five transects (i.e. one site):

10 star-pickets, 1 star-picket driver, 10 labels for star-pickets, 1 marker buoy, 20 steel reinforcing rods, 1 mallet, 5 50-m ropes marked every 10 m or 5 50-m measuring tapes, 1 underwater compass, 1 underwater slate.

This equipment list is repeated in appendix 1. This appendix can be used as a checklist in the field.

Star-pickets are made from a variety of materials and different materials are suited to different applications. As a general rule, glass reinforced thermoplastic polyester fencing posts are recommended. These have the advantage over metal star-pickets that they do not corrode and do not develop sharp edges that can cut divers and damage equipment. Plastic star-pickets can be obtained from Earthlite Queensland, 469 Greenwattle Street, Toowoomba, Qld 4350;

Tel: (076) 33 2600, Fax: (076) 33 2429; $3.30 per post, sold in units of ten. However, plastic star-pickets should not be used at locations of high wave action because when subjected to continual flexing they are prone to snapping at the point where they enter the substratum. At such locations, alternative markers, possibly metal star-pickets, should be considered.

Before the work to establish the transects begins, it is important to decide which side of the transect will be videoed. Once this has been decided, always ensure that you work on the other side of the transect to that which will be videoed. This ensures that any coral broken during the process of establishing the transects will not then be videoed.

At the spot chosen for the start of the first transect, a star-picket should be driven into the reef substratum. The star-picket should be marked with a label showing the site number, transect number and an 'S' (to indicate that this is the start of the transect). A surface marker buoy should then be attached to the reef near the star-picket. The bearing of the transect should be decided (usually by following a depth contour) and written down. A permanent record of all bearings should be kept in field notes. The rope or measuring tape should be attached to the star-picket and the first 10 m unwound along the bearing chosen. A steel reinforcing rod should be hammered into the reef 10 m from the star-picket. A further 10 m of rope/measuring tape should be unwound and the next reinforcing rod hammered into the reef. The rope/measuring tape must be kept in a straight line as it is unwound. This procedure should be repeated for the remaining two reinforcing rods. Finally, once the rope/measuring tape has reached 50 m, a second star-picket should be driven into the reef. This star-picket should also be marked with a label showing the site number, transect number and an 'E' (to indicate that this is the end of the transect).

This process (except for the attachment of the surface marker buoy, which only occurs for the first transect at each site) is repeated for each of the four remaining transects. The bearing and distance from the end of each transect to the start of the next is taken as the transects are laid out. Permanent records of all bearings and distances should be kept in field notes.

2.3 Preparation of Video Equipment in the Field

The following equipment is required for videoing of transects at one site:

1 Hi 8 video camera, 1 underwater housing, 1 wide angle conversion lens, 1 Hi 8 video tape (45 min of tape time is required per site to be videoed), 1 video battery charger, 1 video battery pack, 1 Cokin 81C 'Amber' filter for housing, 1 blower brush, lens cleaning tissue, lens cleaning fluid, 1 video head-cleaning cassette, 1 spare O-ring kit for housing, silicone O-ring grease, cotton-wool buds, instruction manuals for video camera and housing, 5 50-m ropes marked every 10 m or 5 50-m measuring tapes, 1 video data sheet, 1 25-cm distance rod.

This equipment list is repeated in appendix 2. This appendix can be used as a checklist in the field.

The exact location of each piece of equipment listed above will depend on whether the field work is entirely ship-based or land- and ship-based.

The preparation of this equipment is in two parts.

2.3.1 Recharging the Battery Packs

At the start of a trip and after each dive the battery packs must be recharged as follows:

1 After using a battery pack slide the indicator switch so that the red dot is visible. This indicates that the battery pack is not fully charged.

2 The battery pack must be fully discharged before recharging. If this is not done, the battery may develop a 'memory' of incomplete discharge, thus making it impossible to utilise the full charge capacity of the battery in the future. The method of discharging the battery pack will depend on the model of charger being used. Some chargers automatically fully discharge the battery pack before beginning to charge it. If the charger being used is not one of these, the battery pack will have to be discharged by using it in the video camera.

3 When the battery pack is fully charged, slide the indicator switch so that the red dot is no longer visible. The battery pack is now ready for use.

2.3.2 Preparing the Video Camera and Underwater Housing

The exact details of video camera and underwater housing preparation will depend on the makes and models being used. These details should be taken from the relevant instruction manuals. However, there are certain general comments that can be made:

1 A blower brush can be used to remove dust from the lenses and eye-pieces of both the camera and the housing (including the wide angle conversion lens). Lenses can be further cleaned using a small amount of cleaning fluid on a lens tissue: carefully wipe both sides of the lens in a circular motion from the centre of the lens to the edge.

2 Before each use of the housing, check that there are no cracks or scratches on the O-ring and clean it with a cloth. Also clean the O-ring groove on the housing by running a cotton-wool bud several times around the groove. Apply a small amount of O-ring grease (squeeze 2–3 mm from the tube) to the O-ring and spread this evenly by running the ring between thumb and index finger. Ensure that the O-ring is carefully replaced in its groove before use of the housing.

3 Before placing the camera into the housing ensure that a fully charged battery pack has been attached to the rear of the camera, a blank video tape (with the copy protect switch in the record position) has been inserted into the camera and the camera is on standby.

4 Camera focus and exposure should usually be left in automatic mode. However, in very poor visibility or when videoing a subject with low contrast (e.g. a sandy bottom) better results may be achieved with manual focusing. White balance and shutter speed can also be left in automatic, however, experience with your particular camera may lead you to select manual control under certain conditions. The faster the shutter speed, the better the quality of the still image when the video tape is analysed. A shutter speed of 1/125 second is usually sufficient.

5 If the transects to be videoed are in 7 m of water or deeper, then a Cokin amber filter should be attached to the wide angle conversion lens. This filter compensates for the absorption of red light by water and will provide colours that are more true to life on the video tape. In water shallower than 7 m the absorption of red light is not noticeable enough to warrant use of the filter.

At the start of each dive, before videoing any transect, ensure that the equipment is functioning properly:

1 Check the housing for leaks. Leaking is indicated by either the leak light (if your housing is fitted with one) or by bubbles coming from the housing itself (as opposed to accessories to the housing, such as handles).

2 If using a separate wide angle conversion lens, take off the lens to remove any air bubbles between the lens and the housing.

3 Check that the on/off, recording and zooming functions of the camera are working properly.

4 Ensure that the zoom function of the camera is set to full wide angle before videoing transects.

If the video housing is placed on the substratum during a dive, be careful that water movement due to current or waves does not move the housing and cause damage to the equipment. To prevent this, always put the lens cap on the camera before putting it down and always place the camera in a location protected from water movement such as a hole or depression in the reef.

2.4 The Videoing Process

Throughout the process of videoing the transect, it is absolutely essential for the diver not to set down on the substratum anywhere around the transect. If it is necessary to rest on the bottom for any reason, the diver must find a spot away from the transect.

Before videoing each transect, a 50 m rope or measuring tape should be unwound from one star-picket/reinforcing rod to the next, taking care to attach the rope or tape to each picket/rod in order to prevent bowing of the rope or tape in the current.

There are four main components in the process of videoing each transect: the Video Data Sheet, the panoramic shot, perpendicular videoing of the transect and oblique videoing of the transect. The exact order in which each of these elements is videoed is flexible. It will, in part, depend on the resources available in the field. If two cameras and two camera-people are available, this allows more flexibility in the order of videoing the different elements. What is absolutely essential is that no matter how many cameras are used or what order is chosen for videoing different components, every piece of video on every tape must be clearly identified on tape by use of the Video Data Sheet (see below).

2.4.1 The Video Data Sheet

The Video Data Sheet (VDS) is shown in appendix 3. At the beginning of the dive, date, reef number, reef name and camera-person should be filled in on the VDS. At the beginning of each transect, the appropriate site and transect numbers should be circled on the VDS. Any numbers circled from previous transects that are no longer appropriate should be clearly crossed out. **THE VDS SHOULD THEN BE VIDEOED FOR 10 SECONDS BEFORE COMMENCING THE TRANSECT.**

2.4.2 The Panoramic Shot

Video a panoramic shot of the area at the start of each transect. Start by videoing in the direction of the transect (showing the tape and the star-picket), video the reef around the start of the transect by turning clockwise through 360° and stop recording the panoramic shot when you get back to the original view. The panoramic shot should last approximately 30 seconds.

The emphasis of this shot should be the coral, fish and general reef structure of the area. Avoid videoing open water or a small area of the reef (less than 5 m radius) beneath you as this may not represent the overall reef area. Sudden changes in the distance from camera to subject will cause the image to be blurred due to the time needed for the autofocus to adjust. Blurring can be avoided by rotating through 360° slowly and steadily.

2.4.3 Perpendicular Videoing of the Transect

The transect is first videoed holding the camera perpendicular to the substratum. This is the video tape that will be used for quantitative analysis of benthos. Having the camera perpendicular to the substratum is important for the quantitative analysis because it removes parallax errors that occur when the camera is held at an angle other than 90° to the substratum.

Holding the housing perpendicular to the substratum such that the lens is 25 cm above the substratum, video the base of the star-picket for 10 seconds, move approximately 50 cm to one side of the star-picket and continue videoing parallel to the measuring tape or rope, keeping 50 cm to the side of it at all times. The side to which you move should have been decided before the transects were established and should be the opposite side to that used when establishing the transects (see above). Record whether videoing has occurred to the left or right of the transect on the VDS so that future videoing of the same transect can be done on the same side. Follow the depth contour between successive reinforcing rods. At the end of the transect move towards the final star-picket and video it for 10 seconds to indicate the end of the transect. Throughout the transect, the housing must be kept perpendicular to the substratum and the lens 25 cm above the substratum. A distance rod or chain of 25 cm may be used to help maintain the correct distance between lens and substratum.

Take approximately 4 minutes to film each 50 m transect. The exact time will vary depending on the complexity of the reef and the water conditions. It is most important to maintain a constant speed while videoing any single transect. Speed along a transect can be monitored by referring to the counter in the view-finder of the video camera and the reinforcing rods along the transect. It should take approximately 50 seconds to video the distance between two reinforcing rods.

The highly reflective nature of measuring tape can affect the exposure of the camera. If measuring tape is being used, either keep it out of view or use manual exposure settings to compensate for the reflectivity of the tape.

During videoing, the housing can be held with one hand while the other hand can be used for balance and to maintain position against a strong current or surge. If currents or surges make videoing difficult the camera can be paused periodically to enable you to regain balance and/or position. To do this successfully ensure that you start the video at the same point along the transect where you originally paused it. If you are uncertain as to the location of this point you should restart the transect from the beginning, using the VDS to make it clear that this is what you have done.

2.4.4 Oblique Videoing of the Transect

Return to the first star-picket and video the transect again. However, this time hold the camera pointing slightly down and ahead of you, at an angle of approximately 45° to the substratum. As a general rule, the camera should be held approximately 1 m above the substratum, however, the distance can be varied depending on water clarity and substratum character. Videoing the transect in this way provides a better overall impression of community structure and is particularly useful for illustrating changes in community structure that have been detected quantitatively from the video tape taken perpendicular to the substratum.

Having videoed the transect obliquely, the four-stage process is complete and can be started again with videoing the VDS for the next transect.

2.5 Post-dive Disassembly of Video Equipment

As for the preparation of the video camera and underwater housing, refer to the relevant instruction manuals for exact details on disassembly of equipment. However, note the following general points:

1 Before opening the housing, thoroughly rinse it in fresh water and dry it.

2 Immediately on removing the tape from the video camera, switch the copy protect switch to the 'save' position and label the tape with the date, location, site number(s) and transect number(s).

2.6 Video Log Sheet

The Video Log Sheet (VLS) is shown in appendix 4. For each video tape, one VLS should be filled in (or more than one if extra space is needed). The VLS should be filled in as soon as possible after the dive. All the details on the VLS should be filled in with particular attention being paid to Site Number, Transect Number and type of videoing (panoramic, perpendicular or oblique). This information should be entered in the Subject Detail section. VLSs will be kept on file with the video tapes at GBRMPA and the information will be used as a summary of the contents of each tape. In addition, the VLS will assist AIMS personnel in locating the portions of each tape that require analysis.

2.7 Analysis and Storage of Video Tapes

Upon completion of videoing at a location, all Hi 8 video tapes and relevant VLSs should be sent to GBRMPA. GBRMPA will organise appropriate analysis of the video tapes. The results of the analysis will be sent to the appropriate QDoE office and the video tapes and VDSs will be stored at GBRMPA. Whenever requested by QDoE, GBRMPA will supply VHS copies of Hi 8 tapes.

Checklist of equipment needed to establish five transects (i.e. one site):

10 star-pickets
1 star-picket driver
10 labels for star-pickets
1 marker buoy
20 steel reinforcing rods
1 mallet
5 50-m ropes marked every 10 m or 5 50-m measuring tapes
1 underwater compass
1 underwater slate

Checklist of equipment needed for videoing of transects at one site:

1 Hi 8 video camera
1 underwater housing
1 wide angle conversion lens
1 Hi 8 video tape (45 min of tape time is required per site to be videoed)
1 video battery charger
1 video battery pack
1 Cokin 81C 'Amber' filter for housing
1 blower brush
lens cleaning tissue
lens cleaning fluid
1 video head-cleaning cassette
1 spare O-ring kit for housing
silicone O-ring grease
cotton-wool buds
instruction manuals for video camera and housing
5 50-m ropes marked every 10 m or 5 50-m measuring tapes
1 video data sheet
1 25 cm distance rod

This page shows the Video Data Sheet, a copy of which should be taken on each dive and filled in as the transects are videoed. The VDS can either be photocopied onto underwater paper or manually copied onto an underwater slate.

QDoE VIDEO-MONITORING PROGRAM

DATE:

REEF NUMBER:

REEF NAME:

SITE 1 2 3

TRANSECT 1 2 3 4 5

CAMERA-PERSON:

COMMENTS:

This page shows the Video Log Sheet, one copy of which should be filled in for each video tape, as soon as possible after each dive.

Queensland Department of Environment: Video Log Sheet

Locality Name: Reef No: Tape ID: Date: Name: Wind:

Locality Description: Time Started: Time Finished: Visibility: Current:

Counter (mins:secs)	Subject Details	Key Words	Quality