Cardno Ecology Lab

Shaping the Future

Marine and Freshwater Studies

Ex-HMAS Adelaide Artificial Reef

Reef Community Monitoring

Survey 3

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Cover Image: Ex-HMAS Adelaide reef assemblage, May 2011. Photographer, Brendan Alderson (Cardno Ecology Lab).

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Executive Summary

Cardno (NSW/ACT) trading as Cardno Ecology Lab Pty Ltd was commissioned by the Department of Primary Industries – Catchments and Lands, to undertake the post-scuttling environmental monitoring for the Ex-HMAS Adelaide artificial reef and dive site.

A comprehensive environmental assessment has been undertaken for the project in accordance with state and federal environmental legislation. This included approval under the NSW *Environmental Planning and Assessment Act 1979* (EP&A Act) and obtaining an Artificial Reef (or Sea Dumping) Permit issued under the *Environment Protection (Sea Dumping) Act 1981* from the federal Department of Sustainability, Environment, Water, Population and Communities (DSEWPaC). A condition of the Permit is that the Department of Primary Industries – Catchments and Lands must implement the proposed Long Term Monitoring and Management Plan (LTMMP) prepared in March 2011.

This Progress Report outlines the methodology and findings of Reef Community Monitoring Survey 3 (**Table ES 1**), the third of eight reef community surveys required as part of the LTMMP. These surveys are carried out on a quarterly basis. The aims of the reef community survey as outlined in the LTMMP were to gain an understanding of:

- Types of flora and fauna assemblages present;
- Rate of development of fouling assemblages and how they change over time;
- Variation in the rates at which assemblages develop on different surfaces of the vessel; and
- Presence of introduced or pest species.

Field surveys were carried out on 3 and 4 May 2012. Survey methods involved using divers to take photoquadrats and under water video on different parts of the ship. Photoquadrats were analysed for percentage cover of encrusting biota using Coral Point Count with Excel extensions (CPCe) and compared with the baseline and previous Monitoring Surveys. Underwater video footage was reviewed and also used to describe the encrusting reef assemblage.

Analysis of photoquadrats taken from different parts of the ship showed that the number of individual taxa or groups of taxa (32 recorded) was similar to that of previous surveys, although several taxa not previously recorded were observed in the current survey.

The most abundant group throughout the survey were serpulid worms and barnacles associated with an encrusting algal matrix. Other taxa/groupings that were well represented during the third survey included the ascidian *Herdmania momus*, a matrix of serpulid polychaete worms and a turfing brown algae with a sediment/serpulid matrix. Taxa/groupings not previously documented on the ship included an encrusting coralline algae, a red filamentous algae, the ascidian *Botryloides magnicoecum*, filamentous/turfing brown algae, and an unidentified hydroid. Some species of bryozoan, barnacles, algae and sponges that were present in the previous survey were not recorded in the current survey.

Analysis of spatial differences and comparison through time indicated that the assemblage recorded on the ship one year post-scuttling was significantly different to that in previous surveys, although the effect of time was not consistent among parts of the ship. Similar to previous surveys, orientation appeared to be an important factor in structuring the reef assemblage. Neither time nor position (depth and/or aspect) independently caused significant differences to assemblages associated with the ship, however, there was a significant interaction between time and transect which indicated that the effect of time on assemblages was dependent on the location of the transect. On the deck of the vessel, significant differences were evident in assemblages sampled at the bow, midships and stern and between port and starbord transects. These differences were consistent for monitoring Surveys 2 and 3.

Inspection of the fixed point photos indicated that the encrusting layer has become thicker on certain parts of the ship since the previous survey. All surfaces were covered with an encrusting assemblage of bryozoans, sponges, serpulids and barnacles. Railings, ladders, door frames were also covered in a thick layer of large ascidians, hydroids, anemones and mobile invertebrates such as gastropod molluscs and crabs. *Ecklonia radiata* and red branching algae has continued to grow substantially on parts of the ship since the previous survey.

Fish abundance and species richness observed around the Ex-HMAS Adelaide does not appear to have increased substantially since the previous survey, although several new species including half-banded sea perch (*Hypoplectrodes maccullochi*), old wife (*Enoplosus armatus*), silver drummer (*Kyphosus sydneyanus*), silver trevally (*Pseudocaranx dentex)* and crimson banded wrasse (*Notolabrus gymnogenis)* were recorded.

Several of the species observed were of recreational or commercial importance. The eastern blue groper (*Archoerodus viridis*) (observed in Monitoring Surveys 1, 2 and 3) is protected under the NSW *Fisheries Management Act 1994*. No introduced marine pests were observed during the survey.

Table ES1: Summary of Reef Community Sampling Carried Out To-Date

Survey	Sampling Dates	Timeframe
Baseline	18 April and 30 May 2011	1 week post-scuttling
Monitoring Survey 1	11 and 13 October 2011	6 months post-scuttling
Monitoring Survey 2	14 and 16 February 2012	10 months post-scuttling
Monitoring Survey 3	3 and 4 May 2012	1 year post scuttling

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Glossary

Artificial Reef	A structure or formation placed on the seabed for the purpose of increasing or concentrating populations of marine plants and animals or for the purpose of being used in human recreational activities.
CPCe	Coral Point Count with Excel Extensions. A software package used to analyse cover of encrusting organisms and corals.
DSEWPaC	Department of Sustainability, Environment, Water, Population and Communities
EP&A Act	Environmental Planning & Assessment Act 1979
LAT	Lowest Astronomical Tide
Epiphytic	Growing on the surface of.
LTMMP	Long Term Monitoring and Management Plan
Introduced Marine Pest	Introduced marine pests are species moved to an area outside their natural range, generally by human activities, and that threaten the environment, human health or economic values.
PCoA	Principle Coordinates Analyses
PERMANOVA	Permutational Analysis of Variance. A statistical routine run in Primer-E.
SIMPER	Similarity Percentage. A statistical routine run in Primer-E.

1 Introduction

1.1 Background and Aims

Cardno (NSW/ACT) trading as Cardno Ecology Lab Pty Ltd was commissioned by the Department of Primary Industries – Catchments and Lands to undertake the post-scuttling environmental monitoring for the Ex-HMAS Adelaide artificial reef and dive site.

The Ex-HMAS Adelaide was gifted from the Australian to the NSW Government for the specific purpose of scuttling the ship as an artificial reef off the Central Coast of NSW. A comprehensive environmental assessment was undertaken for the project in accordance with state and federal environmental legislation. This included approval under the NSW *Environmental Planning and Assessment Act 1979* (EP&A Act) and obtaining an Artificial Reef (or Sea Dumping) Permit issued under the *Environment Protection (Sea Dumping) Act 1981* from the federal Department of Sustainability, Environment, Water, Population and Communities (DSEWPaC).

Sea Dumping Permits ensure that appropriate sites are selected, materials are suitable and appropriately prepared, that there are no significant adverse impacts on the marine environment and that the reef does not pose a danger to marine users. A condition of the Permit is that the Department of Primary Industries – Catchments and Lands must implement the proposed Long Term Monitoring and Management Plan (LTMMP) which was prepared in March 2011.

The LTMMP covers environmental and structural monitoring for the first five years post-scuttling and forms the basis for ongoing monitoring and maintenance over the operational life of the vessel as a dive site, which is estimated to be 40 years. The frequency of monitoring and the methodologies used will be reviewed periodically during the life of the Plan. The scope of work to be carried out by Cardno Ecology Lab is for a two year period post-scuttling, which follows on from initial baseline investigations carried out by Worley Parsons in April/May 2011. It includes the following environmental monitoring components:

- Reef communities;
- Sediment quality; and
- Bioaccumulation studies.

This Progress Report outlines the methodology and findings for the third of eight reef community surveys. These surveys are to be carried out on a quarterly basis.

The aims of the reef community monitoring survey, as outlined in the LTMMP, is to gain an understanding of:

- Types of flora and fauna assemblages present;
- Rate of development of fouling assemblages and how they change over time;
- Variation in the rates at which assemblages develop on different surfaces of the vessel; and
- Presence of introduced or pest species.

This progress report outlines the following:

- Description of sampling dates, times, weather conditions and tidal height;
- Description of the methods used including the position of the fixed transects and photoquadrats;
- Results including interpretation of video footage, fixed point photographs and CPCe analyses;
- Statistical analyses of photoquadrats over time and spatially;
- Identification of fish, threatened or protected species and any introduced or marine pest species observed during the survey;
- Discussion of findings; and
- Reports of any condition or occurrence that may influence results of the study.

1.2 Study Site and Vessel

The Ex-HMAS Adelaide artificial reef and dive site is located within Bulbaring Bay, approximately 1.87 km offshore from Avoca Beach. The ship lies at a depth of approximately 32 m to 34 m of water at Lowest Astronomical Tide (LAT) and is embedded 1 m – 2 m into the flat, sandy, seabed. This will be verified as part of the 12 month structural inspection.

There is a minimum of 6 m of sand overlying bedrock. The vessel is orientated with the bow facing into the prevailing ESE swell direction (Figure 1). Approximate depths to various levels on the ship from Lowest Astronomical Tide (LAT) are shown in Figure 2.

The ship is 138.1 m in length, with a beam of 14.3 m and an original displacement of 4,200 tonnes. The hull is made of steel and the superstructure of aluminium alloy. Heights are approximately 12 m to the main deck, 18 m to the bridge, 24 m to the top of the foremast (the mast closest to the bow), and 39 m to the top of the mainmast (NSW Government 2011).

Preparation for scuttling involved the removal of the main mast structures for safety and navigation reasons and stripping of machinery, hatches and any items that could pose a risk to divers or the environment. Potential contaminants such as fuels, oils, heavy metals, batteries and electrical items containing polychlorinated biphenols (PCBs) were removed. Diver access holes were cut into the sides of the hull, floors and ceilings to allow extra vertical access between decks and also to allow light to penetrate. Further holes were also made to allow air to escape during the scuttling process (NSW Government 2011).

The Ex-HMAS Adelaide was prepared to meet DSEWPaC standards which were specified during the months of preparation prior to scuttling. DSEWPaC had conducted a series of inspections to confirm that its detailed requirements were achieved. The original clean-up process included removing loose or flaking paint in accordance with DSEWPaC's requirements.

1.3 Previous Surveys

1.3.1 Baseline Survey

The Ex-HMAS Adelaide was scuttled on the 13 April 2011. A baseline investigation of reef communities was carried out between the 18 April and 30 May 2011 (Worley Parsons 2011), immediately post-scuttling. In accordance with the methodology outlined in the LTMMP, underwater video and still photography was taken along horizontal and vertical transects of the ship using divers. These were sampled as follows:

- Horizontal Hull = 6 transects in total (3 x 100 m transects along the starboard and port planes).
- Vertical Hull = 4 transects in total (2 x starboard (stern and bow), 2 x port (stern and bow)).
- Horizontal Deck = 6 transects in total (2 x 50 m transects at the bow, mid ship and stern).

Qualitative surveys of the superstructure were also undertaken.

As expected, marine growth on the vessel was minimal, consisting of green foliose algae and calcareous casings of serpulid polychaete worms, although these were thought to have colonised the lower part of the vessel's hull while docked for preparation prior to scuttling. A light covering of algae and bryozoans was noted on the horizontal (deck) surface of the vessel approximately two weeks post-scuttling, otherwise the superstructure was bare. Three species of juvenile fish including blennies (Blenniidae), goatfish (Mullidae) and bannerfish (Chaetodontidae) were recorded around the vessel although their abundance was not reported.

As for the current study, SCUBA divers were limited to working to a maximum depth of 30 m (as per Australian Standard AS 2815: Training and Certification of Occupational Divers) and as the lowest point of the vessel sits at approximately 33.9 m (LAT), samples could not be collected from the bottom section of the hull. Horizontal transects along the hull were within 1 m of each other and did not provide the vertical spread across the hull as intended. Furthermore, in adverse weather conditions, horizontal surveys of the hull proved difficult due to surges and time restrictions. An alternative design to that specified within the LTMMP was therefore recommended whereby six additional transects (50 m length) were taken on the deck of the ship which is at approximately 28 m LAT, and can therefore be sampled at all tides. In summary, the following recommendations were made for future monitoring surveys:

- Horizontal Hull transects be limited to a single 100 m transect along the horizontal plane on either side of the vessel; and
- Additional vertical transects be taken on either side of the super structure.

Adjustments to the sampling methodology from that outlined in the LTMMP were therefore made to subsequent monitoring surveys. Additional transects were added to the superstructure to provide a greater vertical range, while some of the deeper horizontal transects were not surveyed. The sampling design was modified to allow for more robust statistical analyses to be undertaken.

1.3.2 Monitoring Survey 1

Following the baseline survey, the first monitoring survey was carried out over a two-day period on 11 and 13 October 2011. Analysis of photoquadrats taken from different parts of the ship indicated that at approximately six months post-scuttling, spatial differences in community assemblages were evident. This was particularly apparent among transects sampled from the deck (horizontally orientated) and hull (vertically orientated) surfaces, which were significantly different from each other, mainly due to differences in abundance of serpulid and serpulid/barnacle matrices. Visual comparison of photoquadrats between the baseline and monitoring survey 1 showed that the majority of the ship's surface had changed from being virtually bare to completely covered in encrusting organisms including serpulid polychaetes, barnacles, ascidians, encrusting algae, bryozoans and hydroids.

Fish abundance and diversity observed around the Ex-HMAS Adelaide had also increased substantially. A total of three species; from three families were initially observed in the baseline survey. A total of 19 species from 16 families were observed during the first monitoring survey. The most common species of fish were eastern fortesque (*Centropogon australis*) and yellowtail scad (*Trachurus novaezelandiae*), but also observed were a mixture of resident reef-associated species and transient visitors which are typical of temperate natural reef habitats. No introduced marine pests or species that are protected under conservation legislation were observed during the first survey.

1.3.3 Monitoring Survey 2

Approximately 10 months post-scuttling, there was a small increase in the number of individual taxa or groups of taxa and including red and brown algae, anemones and sponges not previously recorded. Throughout the ship a matrix of barnacles, sediment and brown filamentous algae provided the greatest coverage followed by a matrix of serpulid tubes covered with trapped sediment and turfing brown algae. Large barnacles, sediment, brown filamentous algae and the brown macroalgae *Ecklonia radiata*, had the next greatest percentage cover. Analysis of spatial differences and comparison through time indicated that the assemblage recorded on the ship in February 2012 was significantly different to that in October 2011, although the effect of time was not consistent among parts on the ship. Fish abundance and species richness observed around the Ex-HMAS Adelaide did not appear to have increased since the previous survey, although several new species including tarwhine (*Rhabosargus sarba*), girdled scalyfin (*Parma unifasciata*) and yellowtail kingfish (*Seriola lalandi*) were recorded, some of which were likely to be seasonally abundant at the time of survey.

1.3.4 Summary of Sampling to Date

Table 1: Summary of Reef Community Sampling Carried Out To-Date

Survey	Sampling Dates	Timeframe
Baseline	18 April and 30 May 2011	1 week post-scuttling
Monitoring Survey 1	11 and 13 October 2011	6 months post-scuttling
Monitoring Survey 2	14 and 16 February 2012	10 months post-scuttling
Monitoring Survey 3	3 and 4 May 2012	1 year post scuttling

Boundary of Dive Site	Easting (MGA 94)	Northing (MGA 94)
A	356428.713	6296117.693
B	356538.438	6296341.142
C	356850.615	6296188.618
D	356742.410	6295963.310

Figure 1: Location of Ex-HMAS Adelaide Artificial Reef and Dive Site. The approximate location and orientation of the ship is indicated by the yellow line.

2 Study Methods

2.1 Field Methods

2.1.1 Photoquadrats

Line transects were demarcated along vertical and horizontal planes of the ship on the hull, superstructure and deck. These transects were based on those used for the previous monitoring survey. Cable ties used in the baseline survey to mark transects were located to ensure the same transects were sampled. Fluorescent pink flagging tape was also added to help locate the same transects in future surveys where needed. Within each line transect, replicate photoquadrats (50 x 50 cm) were taken to sample reef assemblages colonising different parts of the ship. In total, 82 photoquadrats and 16 line transects were sampled. These included:

Horizontal Hull

- x 2 transects in total: (1 x 100 m transects along the starboard and port planes).
- x 12 photoquadrats in total (x 6 photoquadrats along each side).

Vertical Hull

- x 4 transects in total: (portside stern x 1), (portside bow x 1), (starboard stern x 1), (starboard bow x 1),
- x 20 photoquadrats in total (x 5 photoquadrats along each vertical transect).

Vertical Superstructure

- x 4 transects in total: (portside stern x 1), (portside bow x 1), (starboard stern x 1), (starboard bow x 1),
- x 20 photoquadrats in total (x 5 photoquadrats along each vertical transect).

Deck

- x 6 transects in total (2 x 50 m transects at the bow, 2 x mid ship and 2 x stern).
- x 30 photoquadrats in total (x 5 per transect).

The approximate locations of all transects are indicated on **Figure 2**.

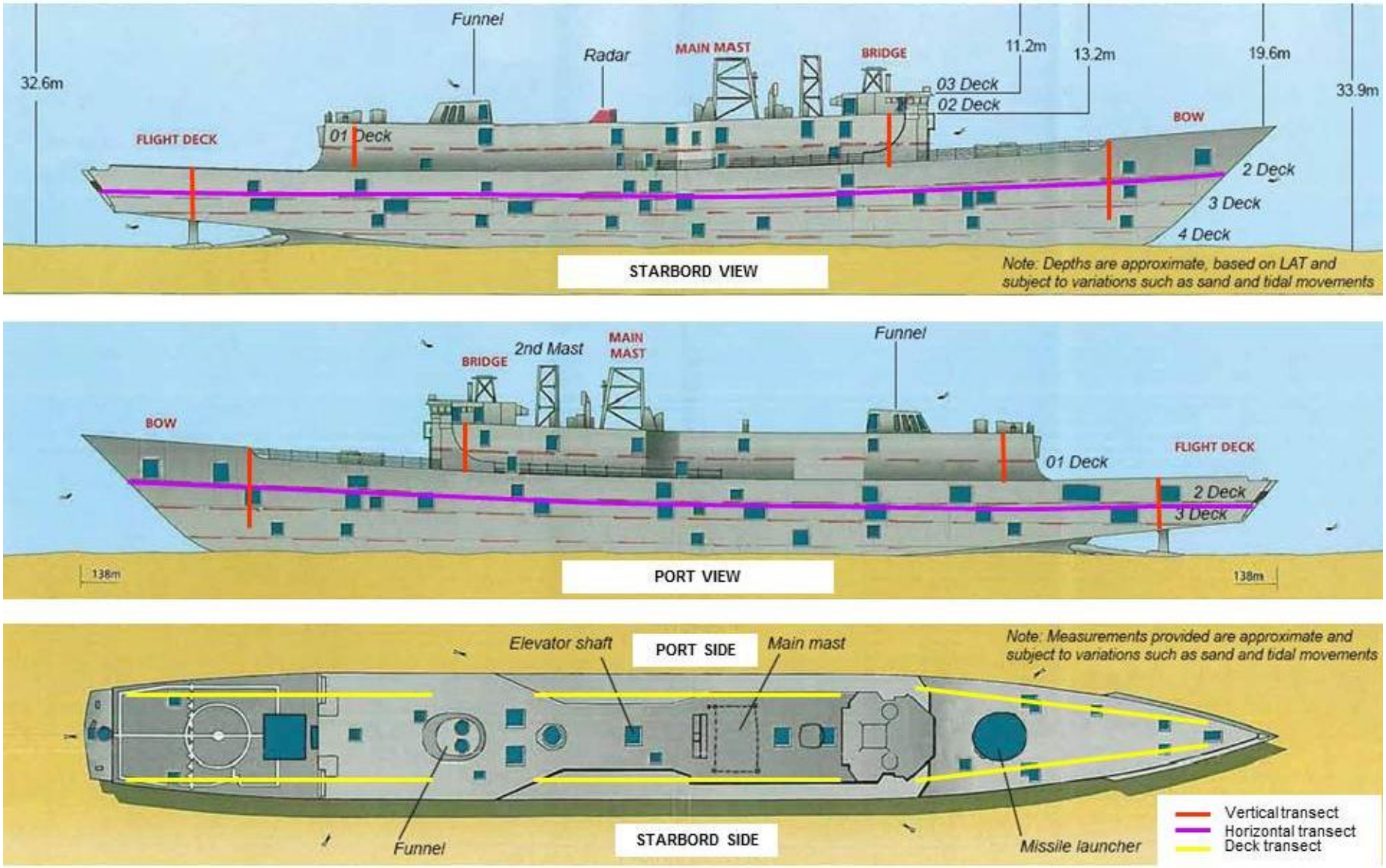

Figure 2: Plans of the Ex-HMAS Adelaide and Positions of the Reef Community Survey Sampling Transects.

Photoquadrats were acquired at regular intervals along each transect. For the vertical transects this was approximately every 0.5 metres. This was originally every metre, however, the 30 m depth limit for divers meant the number of replicate photoquadrats was restricted, therefore photoquadrats were taken every 0.5 metres.

For horizontal hull transects this was approximately every 6 m and for the deck and superstructure every 10 m (consistent with earlier surveys). Photographs were taken with a Canon G12 digital still camera which provides high quality (10MP) photographs. Photographs of individual taxa were taken to aid in identification and the interpretation the video transects and photoquadrats. Fish species encountered were also photographed where possible.

2.1.2 Fixed Point Photographs

Photographs were taken at 10 fixed point locations. This is to provide a qualitative record of changes to reef assemblages over time. These locations were marked with luminous flagging tape and locations noted to assist in identifying these points in future surveys. Notes were taken on the exact location, distance from the structure or reference point and depth at which the photographs were taken (**Appendix A**).

2.1.3 Video Transects

Video footage covered the same transects used for the photoquadrat survey. Divers used underwater scooters, enabling them to maintain a constant slow speed and depth while filming along the proposed transects. Video was taken on Canon G12 still cameras set to HD video mode or a Sony miniDV HD camcorder. The video footage was taken at approximately 1 – 2 m from the vessel and angled at approximately 45° towards the vessel. This allowed the benthic community to be seen clearly in the foreground of the footage, while also capturing fish swimming in the background.

2.2 Analysis

2.2.1 Photoquadrats

Photographs were reviewed immediately after collection to ensure they were of suitable quality to meet the long term outcomes of the study. Where necessary, photographs were colour-corrected using Adobe Photoshop which helped filter out the green light and bring out natural colours.

Photoquadrats were analysed for percentage cover of encrusting biota (algae, bryozoans, sponges, sessile invertebrates, etc.) using Coral Point Count with Excel extensions (CPCe) (Kohler and Gill 2006). A 'virtual' photoquadrat scaled to 50 x 50 cm was digitally overlaid on each of the 82 frames (Figure 3). Within each photoquadrat, 100 points were placed on a 10 x 10 grid and the taxon, matrix or substratum under each point was identified visually. The total number of each was used as an estimate of percentage cover. Still photographs of different taxa were then compiled to prepare a project-specific Biota Identification Manual and project coral code file for use with CPCe. Identifications were made to the highest taxonomic level practical, although it should be recognised that at this early stage of colonisation, species level identification of many encrusting organisms such as sponges, bryozoans and ascidians was not feasible without further laboratory identification. In many instances, groups were described as an encrusting 'matrix' or were based on morphological characteristics such as colour or growth form. Examples of the matrix categories assigned included:

- Serpulid matrix = serpulid tubes, sediment and fine brown filamentous algae;
- Barnacle matrix = *Balanus* spp. sediment and fine brown filamentous algae;
- Large barnacle matrix = large barnacles, sediment and brown filamentous algae; and
- Serpulid/barnacle matrix = Mixture of serpulid tubes and barnacles with a layer of encrusting red algae.

QA/QC checks of CPCe files and identifications were made to minimise the potential for user bias in visual identification and to ensure the accuracy and repeatability of methods.

Analyses carried out included:

1. General findings;
2. Analysis of spatial variation in reef communities; and
3. Analyses of temporal variation in reef communities using a qualitative approach.

General Findings

General findings included a list of species, taxa or groups identified, a description of the groups identified and general trends in total percentage cover.

Spatial and Temporal Analyses

Variation in reef assemblages on different parts of the ship and over time were analysed using multivariate and univariate statistical techniques as appropriate. Due to the existing design of the sampling program (pre-determined by the LTMMP and the baseline survey) this was separated into different analyses. As data for the baseline survey was limited, no time comparisons were made between the baseline and Monitoring Survey 1. Time was added as a factor in the current analyses to investigate both spatial and temporal trends between Monitoring surveys 2 and 3. The four null hypotheses tested were:

1. No significant differences in reef assemblage structure between deep and shallow vertical transects or among times.

2. No significant differences in reef assemblage structure between port and starboard vertical transects or among times.

The design to test these hypotheses was as follows:

- Time (Survey 1/Survey 2): fixed, orthogonal;
- Depth (shallow/deep): fixed, orthogonal;
- Aspect (port/starboard): fixed, orthogonal;
- Transect: nested (depth x aspect), random.

This design compared vertical transects among the superstructure (i.e. port bow, port stern, starbord bow and starbord stern) and vertical hull at the same positions at two times.

3. No significant differences in reef assemblage structure between horizontally orientated (i.e. deck) surfaces and vertically orientated (hull) surfaces or among times.

The design to test these hypotheses was as follows:

- Time (Survey 1/Survey 2): fixed, orthogonal;
- Orientation (deck/hull): fixed, orthogonal;
- Aspect: (port/starboard): fixed, orthogonal.

This design compared transects from the deck (stern and mid, port and starbord) with the two horizontal transects along the ship's hull at the two previous times.

4. No significant differences in reef assemblage structure among positions (deck surface only) or among times.

The design to test these hypotheses was as follows:

- Time (Survey 2/Survey 3): fixed, orthogonal;
- Position (bow, mid-ships, stern): fixed, orthogonal;
- Aspect (port/starboard): fixed, orthogonal.

This design compared all transects sampled along the deck surfaces of the ship at two times.

Statistical analysis of photoquadrat data was done using PERMANOVA+ (based on Bray-Curtis similarity matrices) in PRIMER v6. This is a permutational approach to analysis of variance (ANOVA) that is superior to traditional methods (Anderson *et al.* 2008) in that there is no assumption of normality in the data and designs can be unbalanced (e.g. different numbers of replicate samples at different places or times) if necessary. The approach yields exact tests for each level of an experimental design and is robust to differences among variances. As transformation of data to achieve normality was unnecessary, percentage data were not transformed. This also avoids problems with the transformation commonly applied to percentage data that have been recently identified (Warton and Hui 2011).

Multivariate data were represented graphically using Principles Coordinates Analysis (PCoA), a generalised form of Principal Components Analysis which complements the permutational ANOVA procedure (Anderson et al. 2008). Similarity Percentage Analysis (SIMPER) was used to identify those taxa, or groups of taxa contributing most to dissimilarities between assemblages.

Differences in the dispersion of data between surveys were examined using the PERMDISP routine in Permanova+. This routine is used to separate the effects of differences in dispersion of points within clusters from differences in the relative positions of the clusters (Anderson et al. 2008).

Where appropriate, further univariate analyses were done using PERMANOVA+ (based on Euclidian distance) to investigate the abundance of species or taxa contributing the most to the spatial variability of samples.

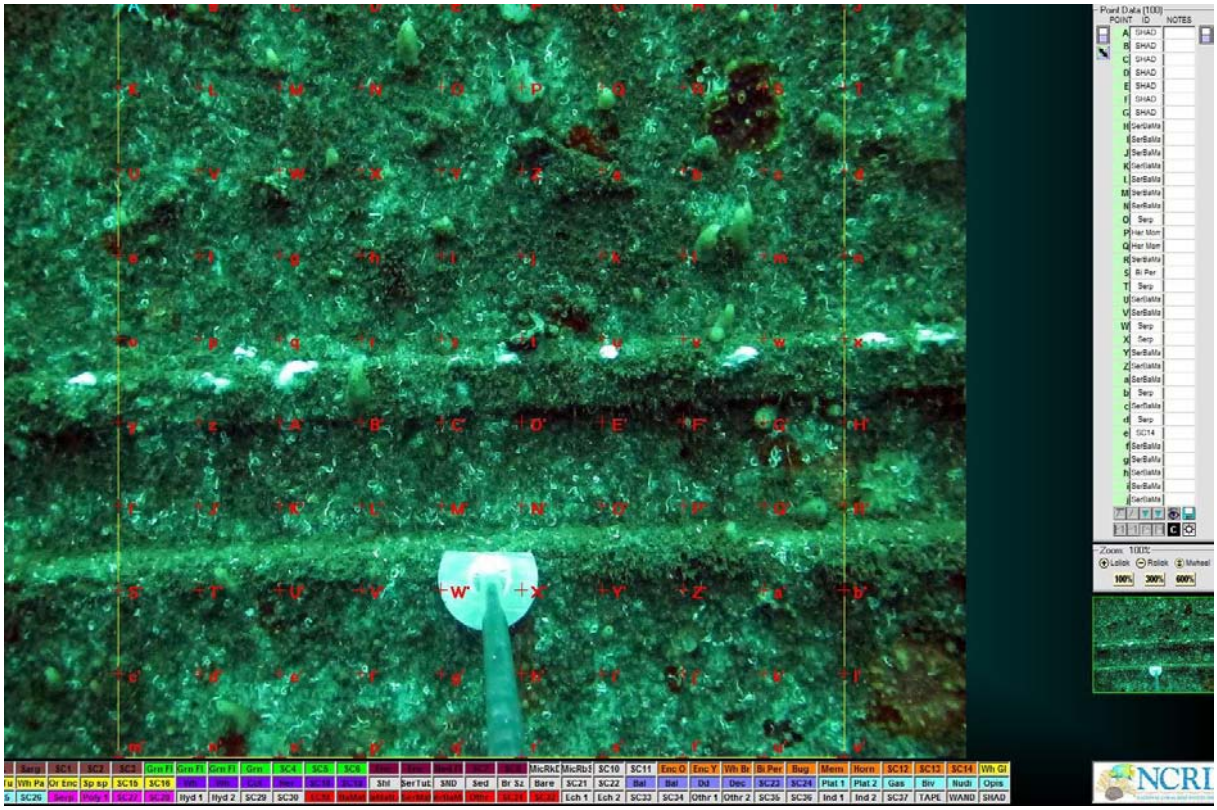

Figure 3: Screenshot of the CPCe Photoquadrat Analyses Frame with a Virtual 10 x 10 Grid Overlayed.

2.2.2 Fixed Point Photographs

Fixed point photographs were qualitatively evaluated and compared to photos taken in similar locations during the baseline survey. It is noted, however, that due to difficulty in finding many of the original fixed points, direct comparisons were not made. Direct comparisons at the exact fixed points will be used for comparison in future surveys.

2.2.3 Video Transects

Video footage was reviewed and used to describe the encrusting reef community colonising the hull, deck and superstructure. Categories included: sessile invertebrates, mobile invertebrates, aquatic vegetation and fish. Identifications were done to the highest taxonomic level practical.

Fish observed were identified and added to the master species list for all surveys to date. Notes were made on the abundance of fish observed but no quantitative assessment of the fish assemblage associated with the ship was made in this survey.

Species of particular interest, i.e. that were observed in abundance or that were possible pests/introduced species were identified for further investigation. In future reef community surveys specimens will be brought back to the laboratory for identification.

3 Results

3.1 Photoquadrats

3.1.1 General Findings

In total, 31 categories were identified from the 82 quadrats. These included various types of barnacles, serpulid polychaete worms, brown algae, encrusting bryozoans, solitary ascidians, sponges and anemones among others. The most abundant group throughout the survey were serpulid worms and barnacles associated with an encrusting algal matrix. Other taxa/groupings that were well represented during the third survey included the ascidian *Herdmania momus*, a serpulid matrix and a turfing brown algae with a sediment/serpulid matrix. Several taxa/groupings not previously documented on the ship, but were recorded during monitoring survey 3, included an encrusting coralline algae, a red filamentous algae, the ascidian *Botryloides magnicoecum*, an unidentified filamentous/turfing brown algae, and an unidentified hydroid. Some species of bryozoan, barnacles, algae and sponges that were present in the previous survey were not recorded in the current survey. A summary of all taxa and groups of taxa identified in the analyses of photoquadrats for the current survey is given in **Appendix B**.

Comparisons of photoquadrats among the baseline, Monitoring Survey 1 and Monitoring Survey 2 and Monitoring Survey 3 are presented in Plates 1 – 16.

3.1.2 Spatial and Temporal Variation in Reef Communities

Overall, the assemblage sampled at Survey 3 was significantly different to those sampled during both Survey 1 and Survey 2 (**Appendix C**; **Appendix D**), although these differences were not obvious within the PCoA (**Figure 4**). The two axes used to construct the PCoA explained only around 52 % of the total variability of the system, so therefore, may not have captured the prominent patterns within the multivariate data cloud. The taxa/groupings that best described the differences in assemblage structure between Survey 3 and the previous survey (Survey 2) included serpulid worms and barnacles with encrusting algal matrix, serpulid matrix, turfing brown algae with sediment and serpulid matrix, and *Herdmania momus* (**Appendix E**). With the exception of the serpulid matrix, all the above mentioned taxa/groupings increased in cover from Survey 2 to Survey 3 (**Appendix E**). PERMDISP indicated that the variation among samples observed during Survey 3 had significantly decreased compared to that observed in Survey 2 (**Appendix F**).

Orientation

Assemblages on the hull and deck surfaces varied significantly, but patterns were not consistent through time (**Appendix C**). Pair-wise tests indicated that this was due to differences between the deck and hull surfaces occurring for both Surveys 2 and 3 as well as between Surveys for assemblages associated with the hull of the ship (**Appendix D**). This is illustrated in the corresponding PCoA (**Figure 5**). SIMPER analyses indicated that the difference in assemblages between the deck and the hull in Survey 2 was mainly due to an overall greater percentage cover of serpulid matrix, turfing brown algae and *Herdmania momus* on the hull compared to the deck of the ship (**Appendix E**). A greater cover of turfing brown algae/ sediment/ serpulid matrix on the deck compared to the hull also contributed to the dissimilarity of assemblages between the hull and deck in Survey 2. Significant differences in assemblages between the hull and deck during Survey 3 were mainly due to a greater presence of ascidians (*Herdmania momus*) and serpulid worms, barnacles and an encrusting algal matrix on the hull of the ship and a greater cover of turfing brown algae/sediment/serpulid matrix on the deck of the ship. Significant differences in assemblages on the hull of the ship between Surveys 2 and 3 were mainly due to an increase in cover of turfing brown/ sediment/ serpulid matrix and an associated decrease in the categories of serpulid matrix and turfing brown algae (**Appendix E**). PERMDISP indicated that dispersion among samples taken from the hull and deck surfaces between survey times was not significantly different (i.e. the variability between survey times was similar) (**Appendix F**).

Depth and Aspect

Neither time nor position (depth and/or aspect) independently caused significant differences to assemblages associated with the ship. However, there was a significant interaction between time and transect (Appendix C), which indicated that the effect of time on assemblages was dependent on the location of the transect (i.e. deep or shallow, port or starboard). Pair-wise tests indicated that assemblages sampled from the deep starboard side

bow transect, the deep starboard side stern transect, the shallow port side bow transect, the shallow port side stern transect and the shallow starboard side stern transect differed significantly between the Surveys 2 and 3 (Appendix D). In addition, assemblages sampled from the deep port side of the ship during Survey 2 were significantly different between the bow and the stern, and assemblages sampled from the port side of the ship during Survey 3 (both shallow and deep areas) were also significantly different between bow and stern. This is graphically illustrated in the PCoA (Figure 6) which shows separation of these groups between times and among positions.

There appeared to be an increase in cover of serpulid/ barnacle/ encrusting algal matrix between Surveys 2 and 3 for most of the comparisons found to be significant with the pair-wise tests. Other taxa/groupings that also contributed to the differences between Surveys 2 and 3 included the ascidian *Herdmania momus* and the matrix consisting of large barnacle/ sediment/ brown filamentous algae, although no consistent patterns in their change of cover between the two surveys were apparent (**Appendix E**). *Herdmania momus* and various matrices consisting of serpulid worms, barnacles and algae were generally the best contributors to the differences between the transects situated at the bow and stern on various parts of the ship during both Surveys 2 and 3 (**Appendix E**). PERMDISP indicated that dispersion among samples (i.e. variability) between survey times was significantly lower during Survey 3 compared to that measured during Survey 2 (**Appendix F**).

Deck Position (Bow, Midships, Stern)

Species assemblages on the deck surfaces of the ship varied significantly between Surveys 2 and 3, regardless of their position (bow, mid, stern) or aspect (port or starboard side). Assemblages also varied significantly among the different positions on the ship (bow, mid, stern) and these differences were consistent for both Surveys 2 and 3 and both sides of the ship (i.e. port or starboard). Likewise, the assemblages sampled on either side of the ship (port or starboard) differed significantly, irrespective of time or position (**Appendix C**). These patterns are evident within the PCoA (**Figure 7**). Pair-wise tests for the factor 'position' showed significant differences occurred between all levels (i.e. bow, mid and stern) (**Appendix D**). Temporal differences were generally due to the increased sedimentation and growth of turfing brown algae with the already present serpulid matrix (**Appendix E**). Barnacles and encrusting algae also increased in cover from Survey 2 to Survey 3. Differences between assemblages sampled from the bow compared to those sampled from the mid and stern positions were generally due to a greater cover of turfing brown algae, sediment and serpulid worms on the bow of the ship. Differences between assemblages sampled from the mid and stern positions of the ship were due to a greater cover of serpulid worms on the mid-section of the ship. Assemblages from the stern were generally much greater in cover of turfing brown and encrusting algae, sediment, barnacles and serpulid worms compared to assemblages sampled from the mid-section. It also appeared from SIMPER analyses that the starboard side of the ship generally had a greater cover of serpulid worms and serpulids associated with turfing brown algae and sediment (**Appendix E**). The variation among samples observed at the time of Survey 3 was not significantly different from that measured during Survey 2 (**Appendix F**).

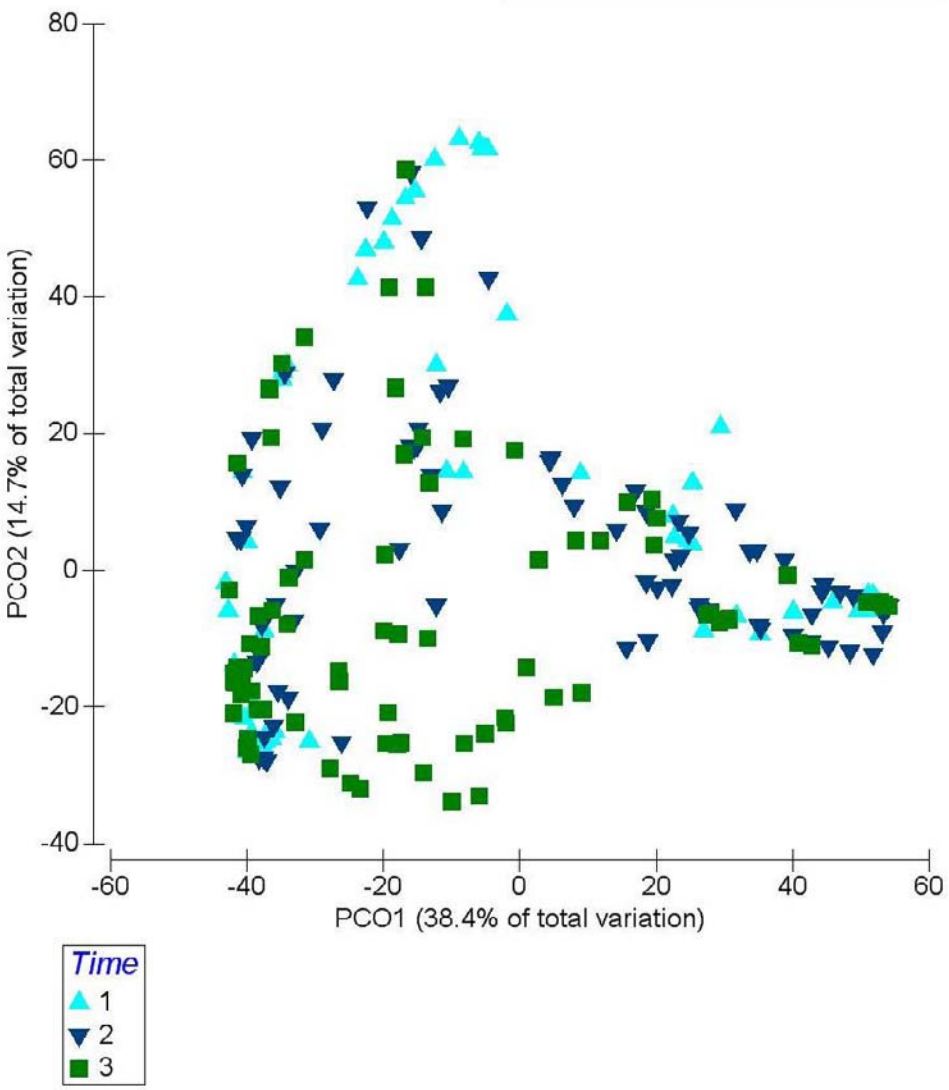

Figure 4: Principal Coordinates Analyses (PCoA) of Percent Cover of Encrusting Assemblages from Transects Taken at all Positions on the Ex-HMAS Adelaide for Surveys 1, 2 and 3.

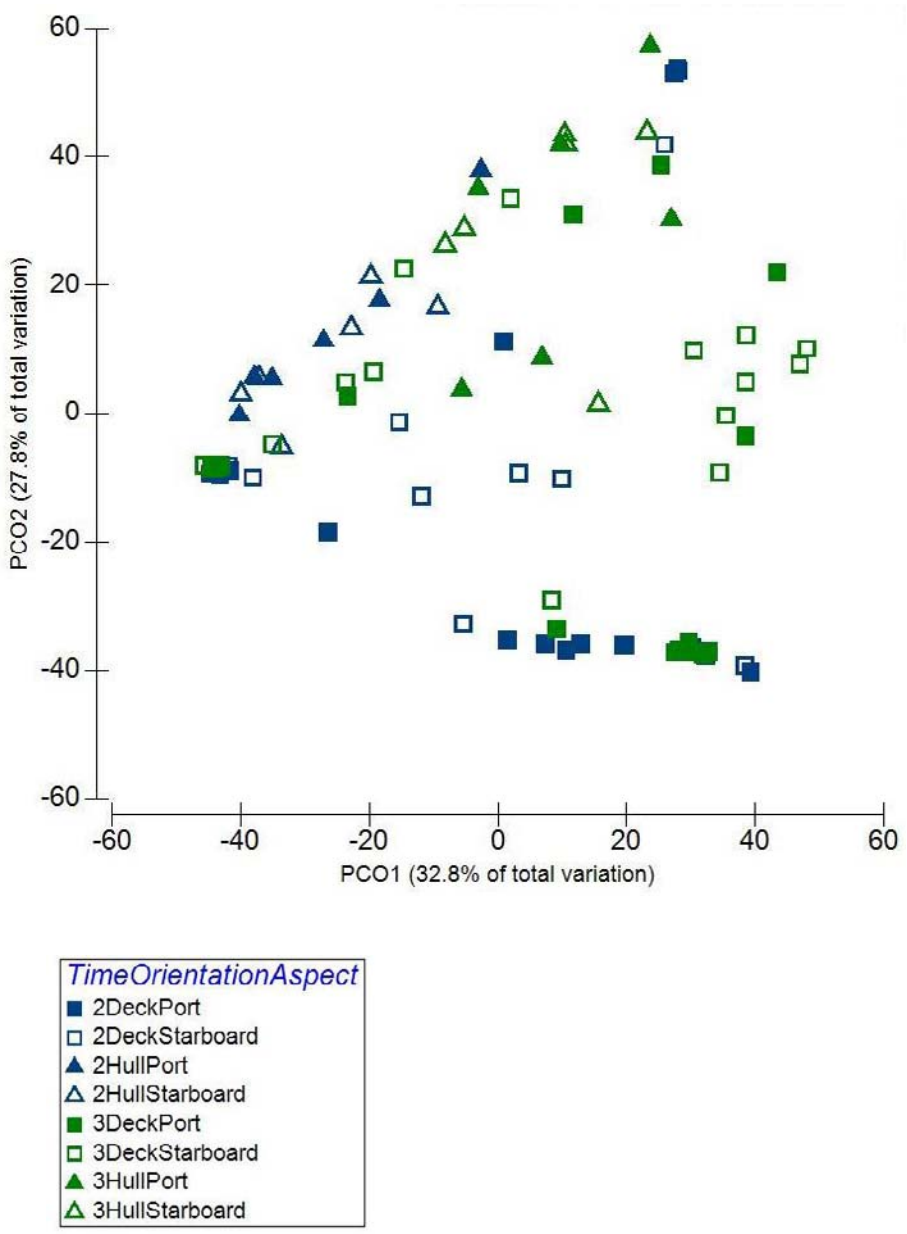

Figure 5: Principal Coordinates Analyses (PCoA) of Percent Cover of Encrusting Assemblages from Transects Taken on Hull and Deck Surfaces of the Ex-HMAS Adelaide for Surveys 2 and 3.

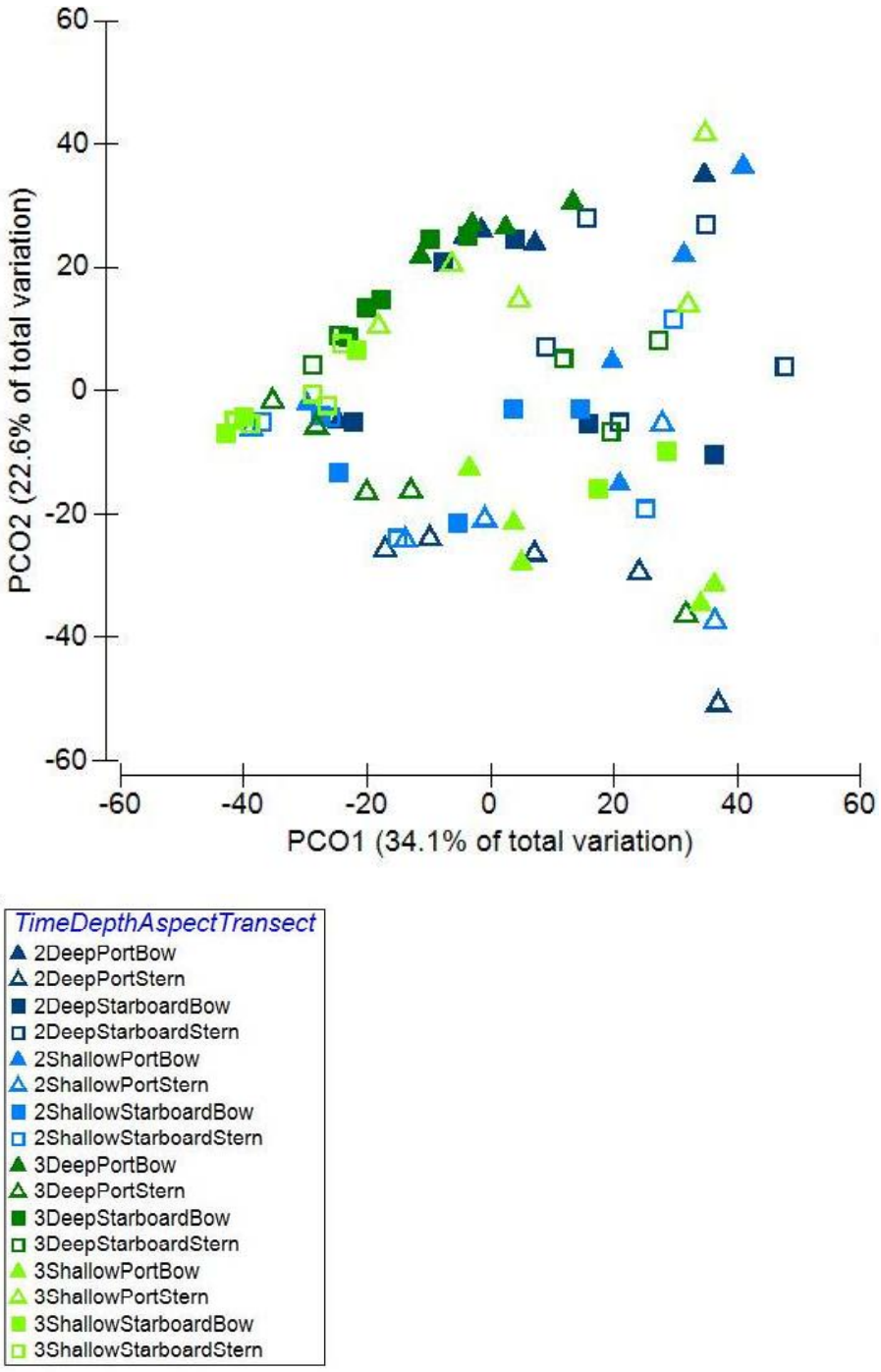

Figure 6: Principal Coordinates Analyses (PCoA) of Percent Cover of Encrusting Assemblages from Transects at Different Depths and Aspect on the Ex-HMAS Adelaide for Surveys 2 and 3.

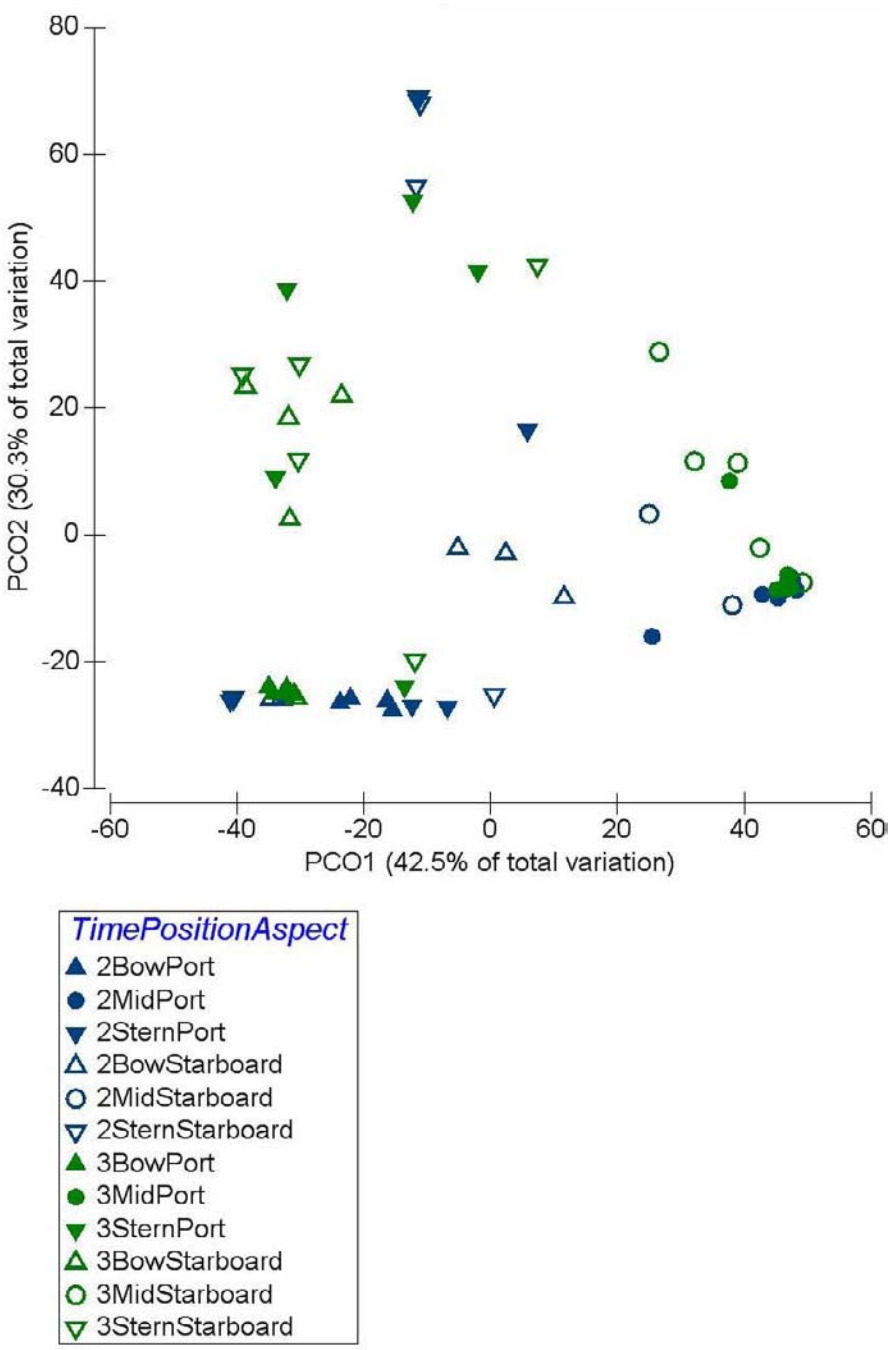

Figure 7: Principal Coordinates Analyses (PCoA) of Percent Cover of Encrusting Assemblages from Transects Taken at Different Positions on the Deck Ex-HMAS Adelaide for Surveys 2 and 3.

3.2 Fixed Photographs

Photographs taken from fixed locations are presented in **Appendix A.** Inspection of the fixed photos indicates that the encrusting layer has become thicker on parts of the ship since the previous survey.

All surfaces were covered with an encrusting assemblage of bryozoans, sponges, serpulids and barnacles. Railings, ladders, door frames were also covered in a thick layer of large ascidians, hydroids, anemones and mobile invertebrates such as gastropod molluscs and crabs. *Ecklonia radiata* and red branching algae has continued to grow substantially on parts of the ship since the previous survey.

Fish, including tarwhine (*Rhabdosargus sarba*) (Fixed Photo 1, Frame 3) and silver sweep (*Scorpis lineolata*) were clearly seen in several frames although mado (*Atypicthys strigatus*) were conspicuously abundant at the time of survey (e.g. Fixed Photo 3, Frame 3).

3.3 Video Transects

The results of observations made from video transects are summarised in **Table 2** below. A list of all fish observed during previous surveys and the current monitoring survey (Survey 3) are listed in **Table 3**. Species of recreational, commercial or conservation value are indicated.

Table 2: Summary of Observations of Attached Encrusting and Fish Assemblages Observed from Video Footage of the Ex-HMAS Adelaide in May 2012 (Survey 3).

Position	Description of Assemblage
Deck Port Bow	The railings had become heavily colonised with ascidians and brown algae with some sponges and branching red algae noted. Encrusting growth of turfing brown algae covered the flat areas of the deck while sessile invertebrates were absent on the majority of the deck. Mado (*Atypicthys strigatus*) were abundant, while leatherjackets (family Monacanthidae) and tarwhine (*Rhabdosargus sarba*) were also common.
Deck Port Mid	Turfing brown algae covered the deck while Kelp (*Ecklonia radiata*) and branching red algae formed conspicuous patches. An unknown bright white encrusting substance (observed in previous survey) remained present. The superstructure and areas of railing had become heavily colonised with ascidians and turfing brown algae. Schools of mado and tarwhine were common.
Deck Port Stern	The deck was predominantly covered in brown turfing algae and serpulid polychaete tubes with some sand although the reef assemblage on this part of the ship was relatively sparse compared to the midship deck. Silver trevally (*Pseudocaranx dentex*) was observed schooling around the deck.
Deck Starbord Bow	Encrusting growth of predominantly brown turfing/filamentous algae was abundant on the flat areas of the deck with patches of encrusting sponges. A school of silver trevally was observed. Tarwhine was observed feeding on the deck.
Deck Starbord Mid	Turfing/filamentous brown algae was abundant on the deck while Kelp (*Ecklonia radiata*) has now become established. Branching red algae and encrusting yellow sponges were also observed on the deck. The rails and other vertical / complex structure on the deck were heavily colonised by sessile invertebrates. Mado were abundant amongst complex structures and kelp patches. Patches of a bright white encrusting substance were again present.
Deck Starbord Stern	Encrusting growth of predominantly brown turfing/filamentous algae dominated the flat areas of the deck. Schools of tarwhine and silver sweep (*Scorpis lineolata*) were observed.
Horizontal Hull Port and Starbord	The hull has become colonised by sessile invertebrates on both the port and starbord aspects of the ship. These include ascidians (predominantly consisting of *Herdmania momus*) and a range of encrusting sponges. Eastern blue groper (*Achoerodus viridis*) and red morwong (*Cheilodactylus fuscus*) were observed swimming alongside the hull.

Vertical Hull Bow	Ascidians were prevalent on the hull of the ship, while barnacles, various encrusting and papillate sponges were also observed.
Vertical Hull Stern	The cover consisted of predominantly of ascidians, sponges and barnacles.
Vertical Hull Superstructure	The cover consisted of predominantly a combination of ascidians, sponges and barnacles.

Table 3: Species of Fish Observed in Association with the Ex-HMAS Adelaide Artificial Reef between April/May 2011 and February 2012. (*) = recreationally important species, (+) = commercially important species, (#) = species of conservation significance.

Family	Species Name	Common Name	Baseline Survey (April/May 2011)	Survey 1 (October 2011)	Survey 2 (February 2012)	Survey 3 (May 2012)
Aulopidae	*Aulopus purpurrissatus*	Sergeant baker		●	●	●
Scorpaenidae	*Centropogon australis*	Eastern fortesque		●	●	●
Scorpaenidae	*Scorpaena cardinalis*	Red rock cod		●	●	
Dinolestidae	*Dinolestes leweni*	Longfin pike		●		
Carangidae	*Trachurus novaezelandiae*	Yellowtail scad+		●		
Carangidae	*Seriola lalandi*	Yellowtail kingfish			●	●
Sparidae	*Pagrus auratus*	Snapper (juv)*+		●	●	●
Sparidae	*Rhabdosargus sarba*	Tarwhine			●	●
Mullidae	*Parupeneus spilurus*	Blackspot goatfish	●			
Chaetodontidae	*Hemiochus* sp.	Bannerfish	●	●		
Scorpididae	*Scorpis lineolata*	Silver sweep*		●	●	●
Microcanthidae	*Atypicthys strigatus*	Mado		●	●	●
Microcanthidae	*Microcanthus strigatus*	Stripey		●	●	●
Cheilodactylidae	*Nemadactylus douglasii*	Blue morwong*		●	●	
Cheilodactylidae	*Cheilodactylus fuscus*	Red morwong		●	●	●
Latridiidae	*Latridopsis forsteri*	Bastard trumpeter		●	●	
Pomacentridae	*Parma microlepis*	White ear		●		
Pomacentridae	*Parma unifasciata*	Girdled scalyfin			●	
Labridae	*Achoerodus viridis*	Eastern blue groper#		●	●	●
Labridae	*Notolabrus parilus*	Brown spotted wrasse				●
Labridae	*Notolabrus gymnogenis*	Crimson banded				●

		wrasse				
Blenniidae	*Petroscirtes lupus*	Sabretooth blenny	●			
Monacanthidae	*Nelusetta ayraudi*	Chinaman leather jacket*+		●	●	●
Monacanthidae	*Meuschenia trachylepis*	Yellowfin leatherjacket				●
Monacanthidae	*Meuschenia sp.*	Unidentified leatherjacket				●
Tetraodonitdae	*Dicotlichthys punctulatus*	Three-bar porcupinefish		●		
Enoplosidae	*Enoplosus armatus*	Old wife				●
Kyphosidae	*Kyphosus sydneyanus*	Silver drummer				●
Lutjanidae	*Pseudocaranx dentex*	Silver trevally				●
Serranidae	*Hypoplectrodes maccullochi*	Half-banded sea perch				●

4 Discussion

4.1 Encrusting Biota

The colonisation of the Ex-HMAS Adelaide, approximately one year post- scuttling, has been substantial and the early colonising assemblage that has formed is consistent with observations on similar artificial structures on the east coast of Australia and abroad.

Approximately one to two weeks post-scuttling, the extent of colonisation on the ships surface was limited to an algal film and some spirorbid polychaete casings (likely to have appeared during the ships time at dock prior to scuttling). The rate of colonisation was rapid within the first few months but approximately one year on, the taxon richness appears to have stabilised at around 31 to 32 different taxa (or categories). The entire ships surface is now encrusted with a calcareous layer of serpulid polychaete tubes and/or barnacles on top of which various algae, hydroids, sponges and ascidians have overgrown. Video footage shows that this layer has become notably thicker on more complex structures such as railings, ladders and door frames for example. Several taxa not previously recorded were observed in the current survey which suggests that the assemblage is still developing. An increase to diversity within the first year of scuttling is consistent to what was observed for the Ex-HMAS Brisbane (Queensland) and the Ex-HMAS Swan (Western Australia)(Queensland EPA 2007, Morrison 2001). This would be expected as encrusting organisms create new and more heterogeneous habitat available for different species to occupy. Notwithstanding this, certain taxa recorded in the previous survey were not recorded in the current survey (for example, some bryozoans and sponges). There are several reasons as to why this may have occurred including:

- Overgrowth (from other organisms, hence certain taxa could not be seen in photoquadrats);
- Competition with other taxa (for food/attachment surface);
- Succession; or
- Because they occur in low abundance and were not recorded in photoquadrats.

The greatest coverage throughout the ships surface was a matrix of serpulid worms and barnacles associated with an encrusting algal matrix. Other taxa/groupings that were well represented during Monitoring Survey 3 included the ascidian *Herdmania momus*, a serpulid matrix and a turfing brown algae with a sediment/serpulid matrix. These encrusting matrices are likely to provide habitat for small invertebrates such as polychaetes, amphipod crustaceans and bivalves among others. Close up photographs showed that gastropod molluscs have also begun to inhabit the encrusting reef assemblage in places.

Analysis of photoquadrats taken from different parts of the ship indicated that species assemblages varied through time, but that these differences were not necessarily consistent among transects. It is likely that there are several bio-physical factors which are driving spatial and temporal differences in species assemblages. In the current and previous surveys, transects on the deck (horizontally orientated) were generally different from the hull (vertically orientated). These differences were mainly due to a greater presence of ascidians (*Herdmania momus*) and serpulid worms, barnacles and an encrusting algal matrix on the hull of the ship and a greater cover of turfing brown algae/sediment/serpulid matrix on the deck of the ship. As discussed in Monitoring Survey 2, it is possible that ascidians and barnacles tend to proliferate on more shaded portions of the ship or possibly where there is more current to improve feeding efficiency. A greater amount of sedimentation was generally observed on the deck surfaces in the current survey which may (among other things) contribute to differences in assemblages between vertical and horizontal surfaces (e.g. Glasby 2000 in Walker *et al.* 2007).

On the deck surfaces, position (bow, midship or stern) also appeared to be a factor in determining the reef assemblage. Given the length of the ship, this may be due to subtle differences in shading or currents. The midsection of the ship is also slightly raised in sections and may have more shading due to the superstructure.

4.2 Fish and Mobile Macroinvertebrates

One year post-scuttling, fish abundance and species richness observed around the Ex-HMAS Adelaide have increased substantially. Only three species; (blackspot goatfish, (*Parupeneus spilurus;* bannerfish, *Hemiochus* sp. and sabretooth blenny, *Petroscirtes lupus*) from three families, were initially observed in the baseline survey. In contrast, a total of 19 species from 13 families were observed during Monitoring Survey 3. This is probably a

function of the time available for species to recruit to the ship, but is also likely to be related to an increased amount of food becoming available as a consequence of the development of the reef assemblage.

While the number of taxa recorded in the previous three surveys has remained similar, the actual species composition has changed over time. None of the three species observed in the initial baseline survey were observed in the two previous surveys.

Species not previously recorded in earlier surveys include the half-banded sea perch (*Hypoplectrodes maccullochi*), old wife (*Enoplosus armatus*), silver drummer (*Kyphosus sydneyanus*), silver trevally (*Pseudocaranx dentex)* and crimson banded wrasse (*Notolabrus gymnogenis).* Similar to the previous survey, mado (*Atypicthys strigatus*) were observed in large schools and are commonly found in association with natural rocky reef habitat within the Terrigal area (e.g. Glasby 2009). Fish were generally observed around the superstructure at shallower depths. Fish observed in the present study are commonly found on natural rocky reefs in the greater Sydney region and were also recorded in baseline fish surveys of natural reefs located to the north and south of the proposed Ex-HMAS Adelaide artificial reef and dive site (Gladstone 2009). This is consistent with other studies which show that over time, fish assemblages colonising artificial reefs may become similar in species composition to neighbouring natural reefs (Clynick *et al*. 2008, Santos and Monteiro 2007, Relini *et al*. 2002.

5 Acknowledgements

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7 Plates

Deck, Port Bow

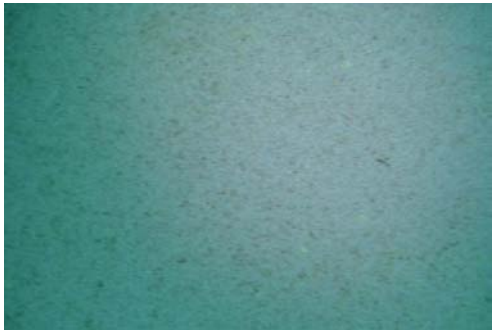
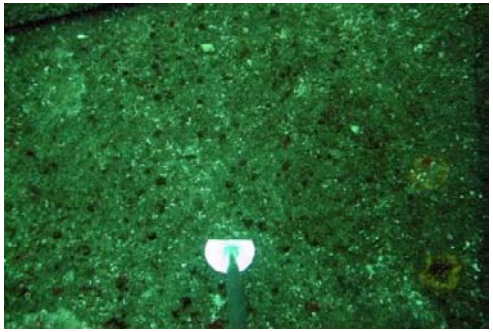
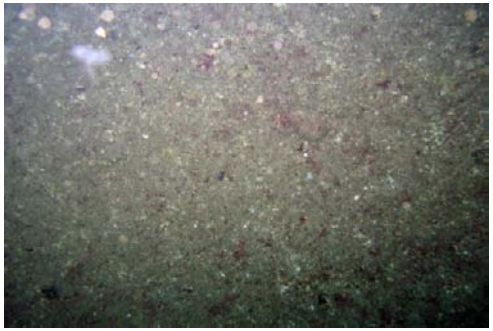
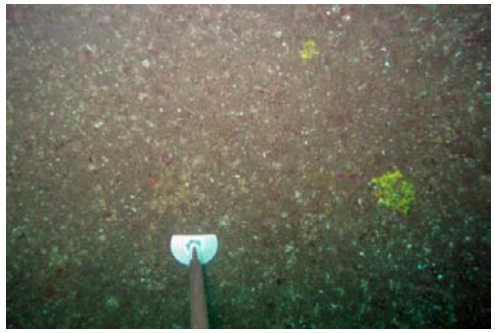
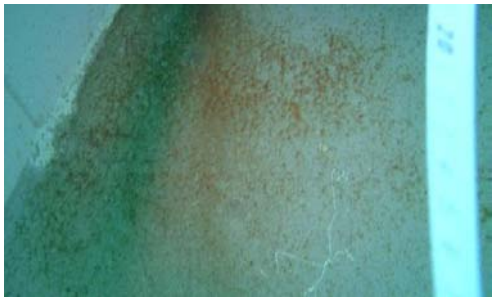
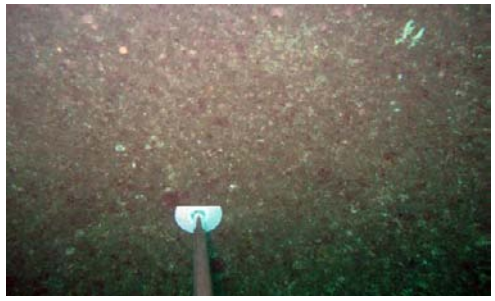
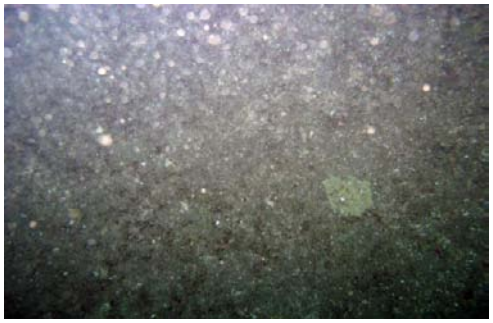
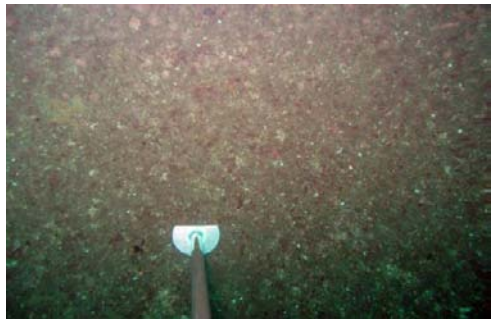
Baseline Survey (April/May 2011)	Monitoring Survey 1 (October 2011)	Monitoring Survey 2 (February 2012)	Monitoring Survey 3 (May 2012)
			
			
			

Plate 1: Deck port bow

Deck, Port Mid

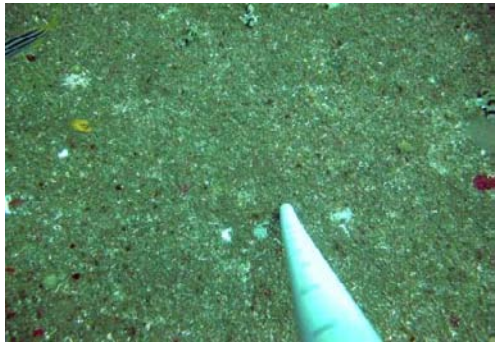
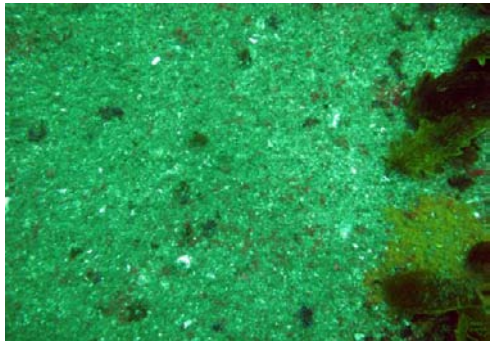
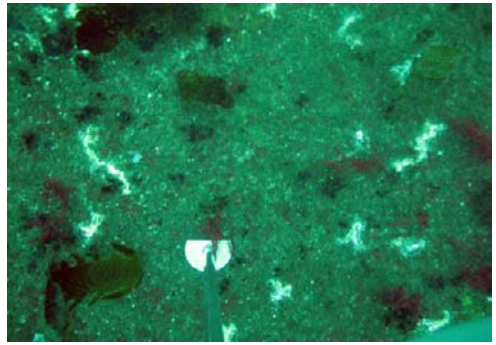
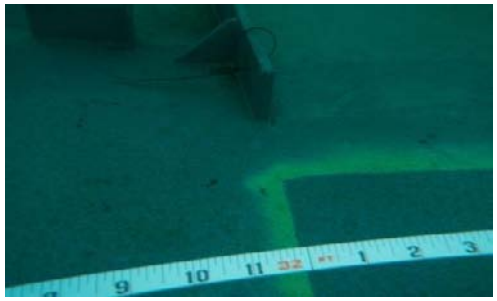
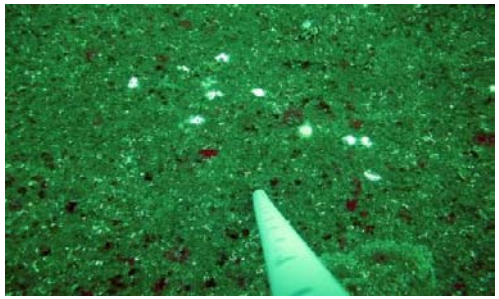
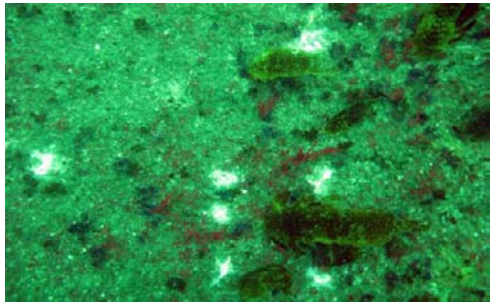
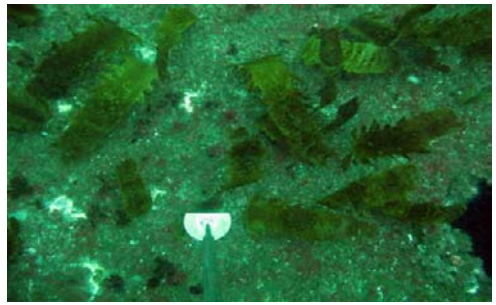
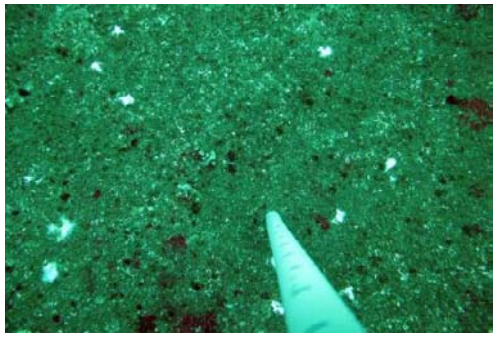
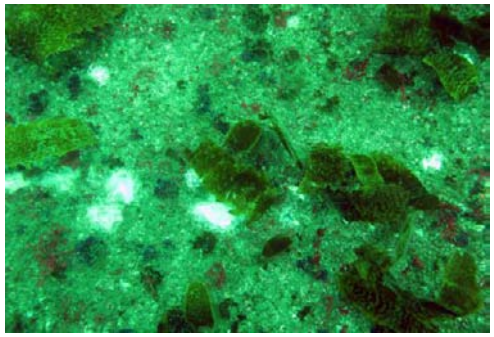
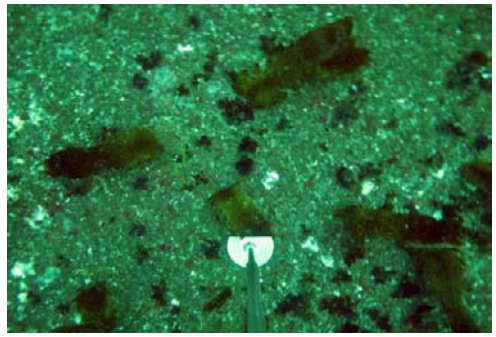
Baseline Survey (April/May 2011)	Monitoring Survey 1 (October 2011)	Monitoring Survey 2 (February 2012)	Monitoring Survey 3 (May 2012)
			
			
			

Plate 2: Deck Port Mid

Deck, Port , Stern

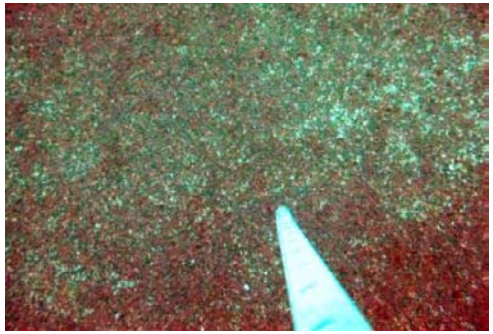
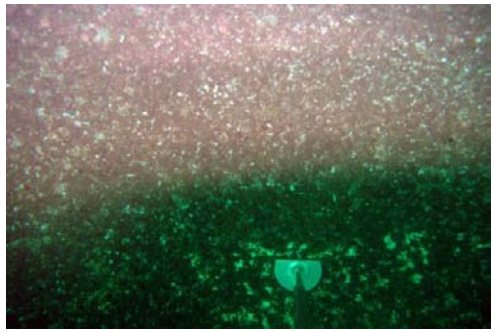
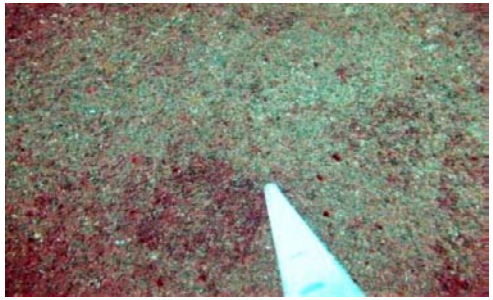
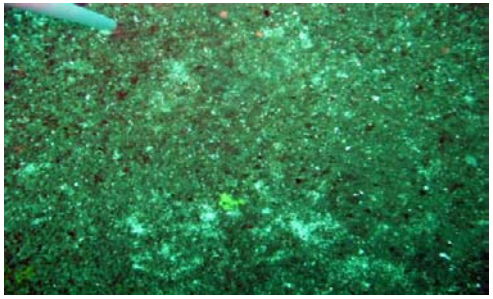
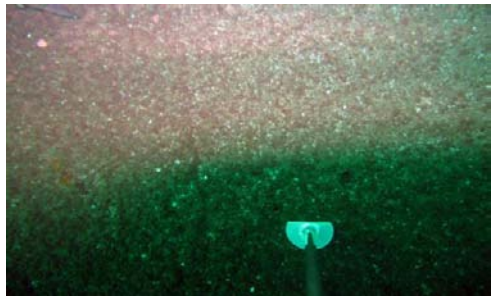
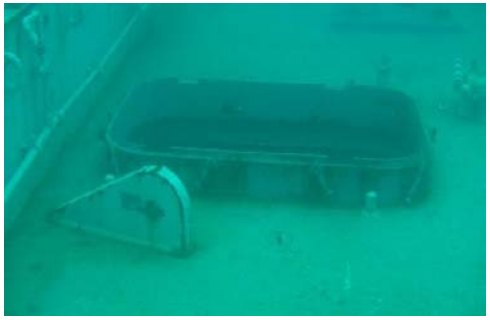
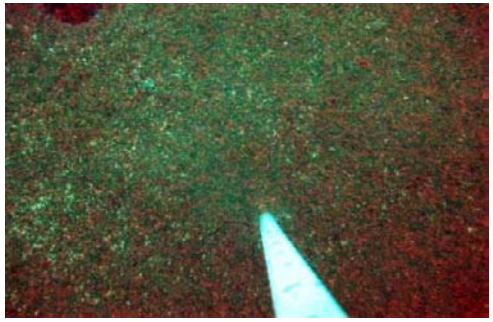
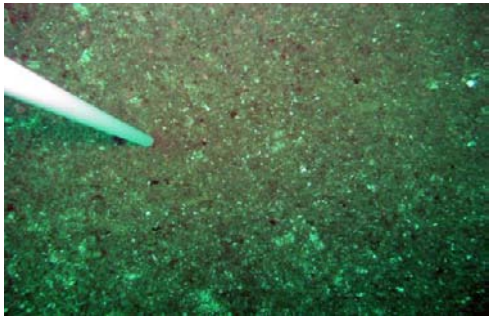
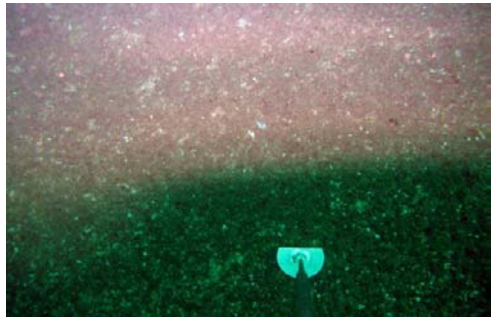
Baseline Survey (April/May 2011)	Monitoring Survey 1 (October 2011)	Monitoring Survey 2 (February 2012)	Monitoring Survey 3 (May 2012)
			
			
			

Plate 3: Deck Port Stern

Deck, Starbord, Bow

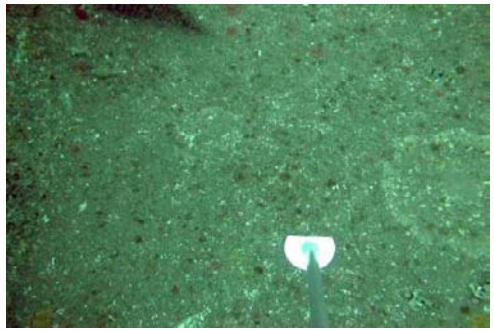
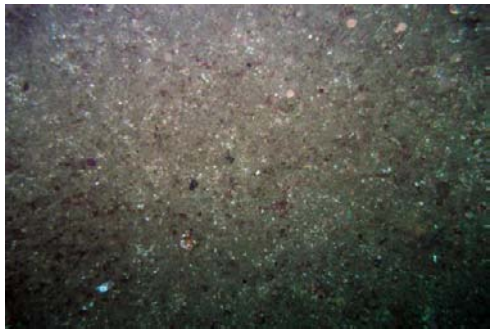
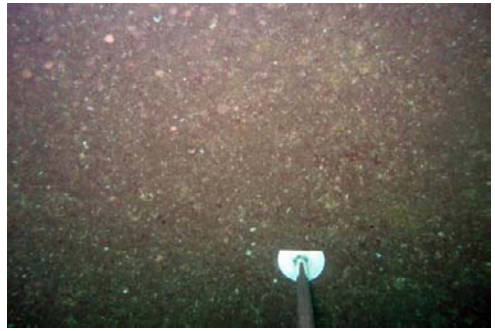
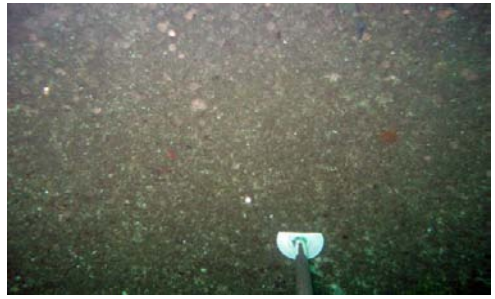
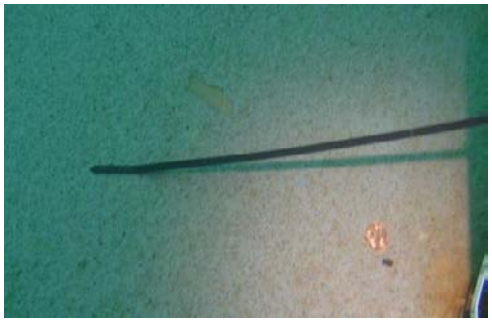
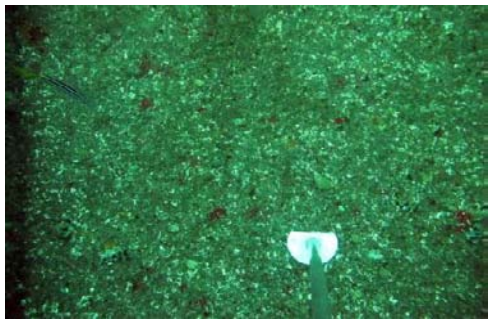
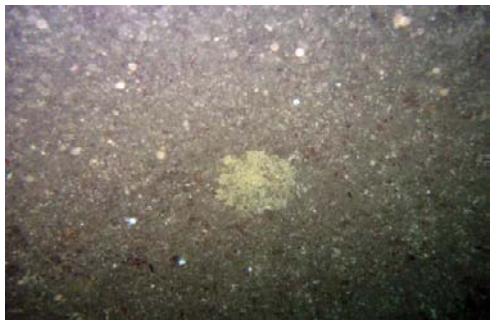
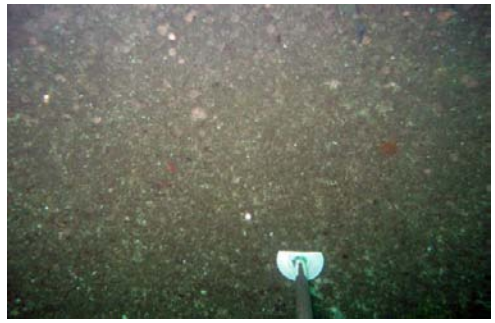
Baseline Survey (April/May 2011)	Monitoring Survey 1 (October 2011)	Monitoring Survey 2 (February 2012)	Monitoring Survey 3 (May 2012)
			
			
			

Plate 4: Deck Starbord Bow

Deck, Starbord, Mid

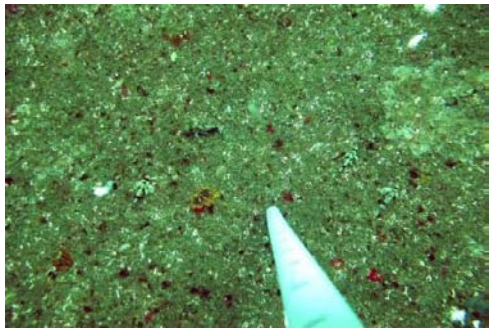
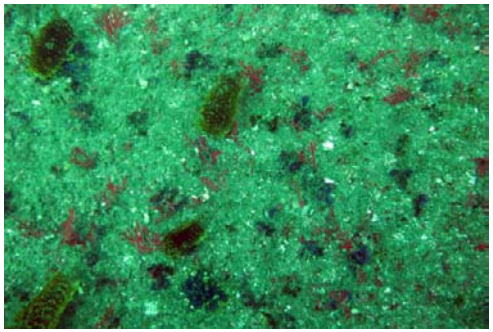
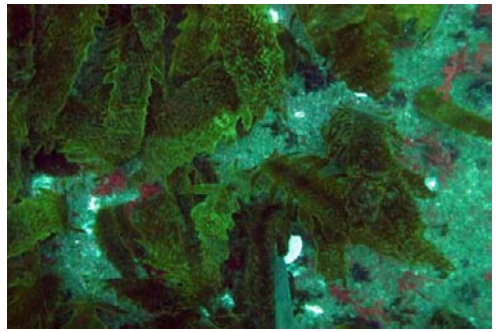
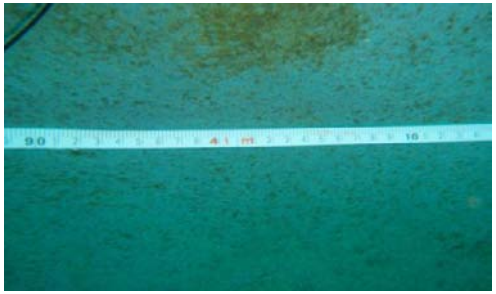
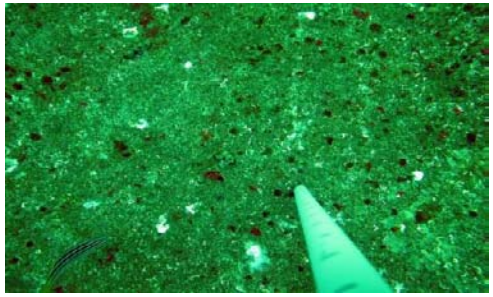
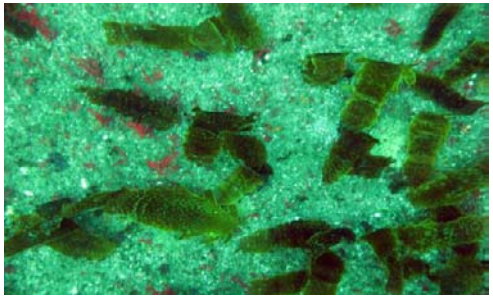
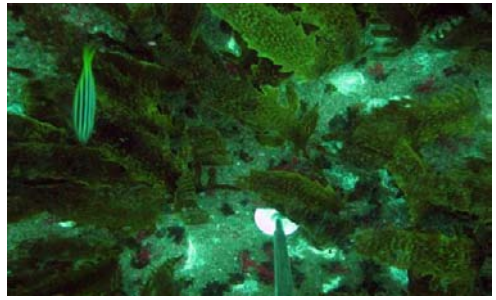
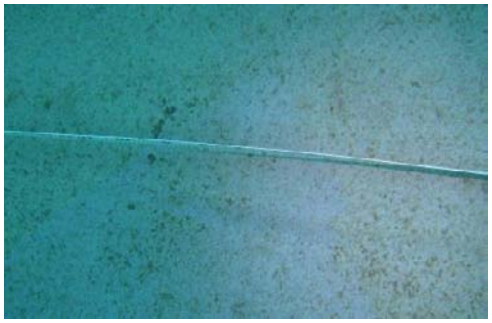
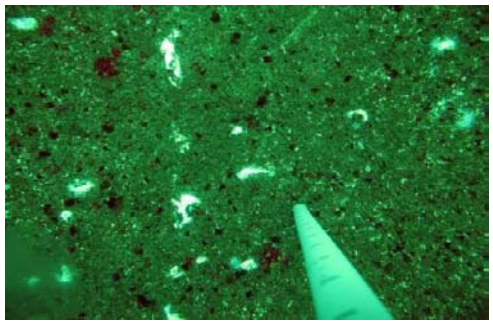
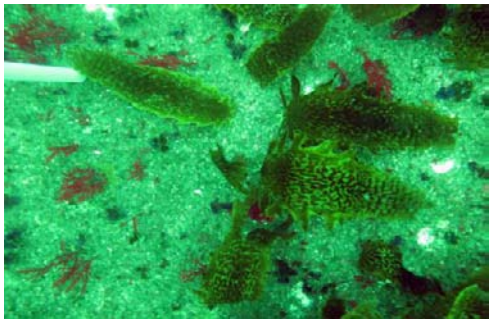
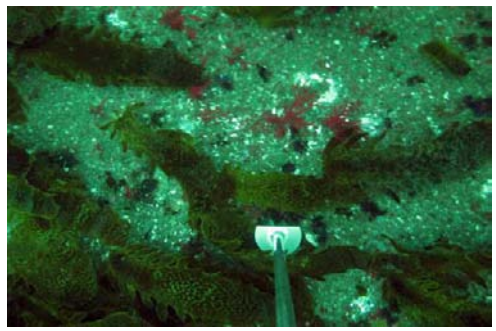
Baseline Survey (April/May 2011)	Monitoring Survey 1 (October 2011)	Monitoring Survey 2 (February 2012)	Monitoring Survey 3 (May 2012)
			
			
			

Plate 5: Deck Starbord Mid

Deck, Starbord, Stern

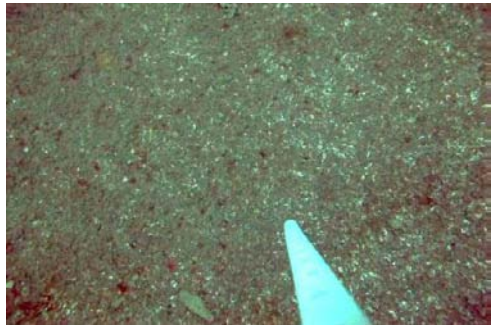
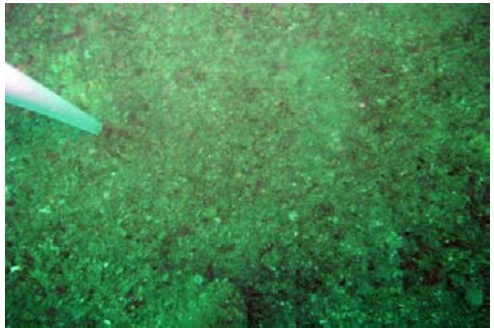
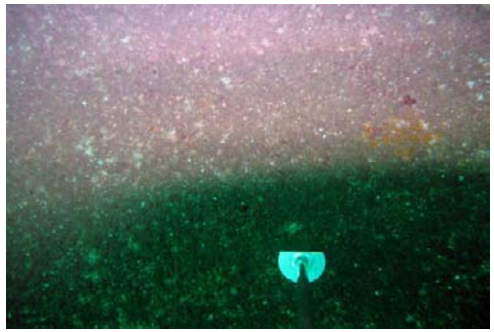
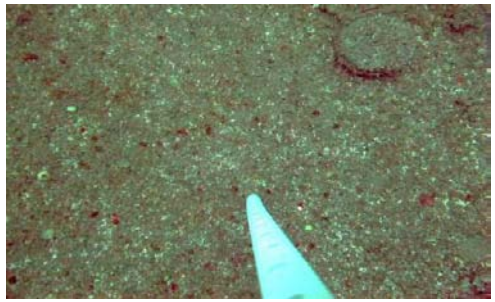
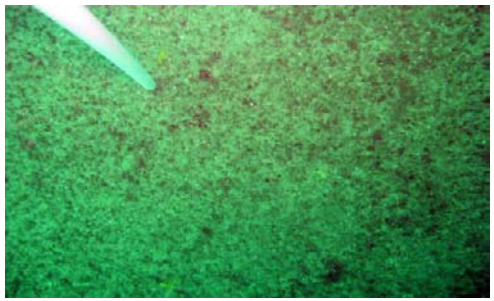
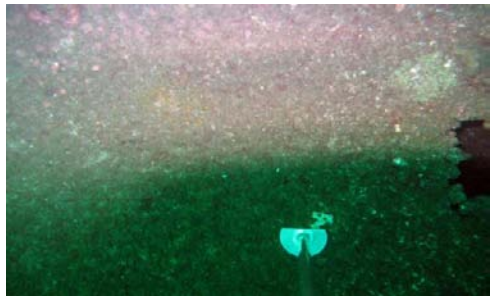
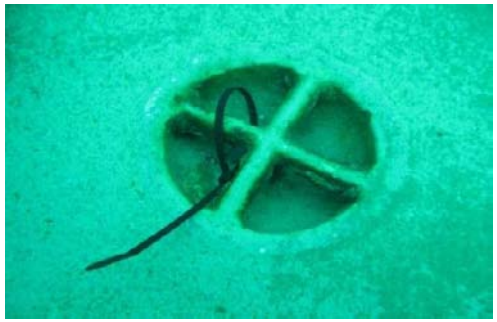
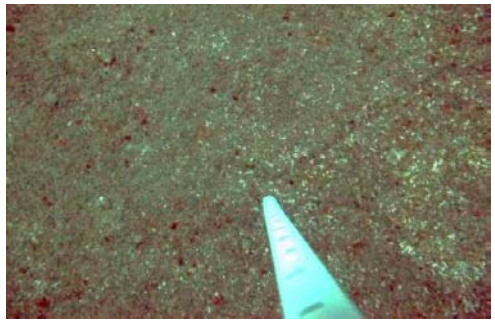
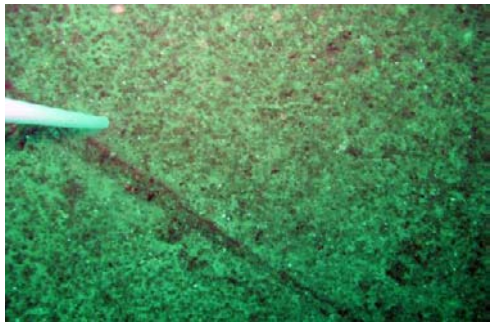
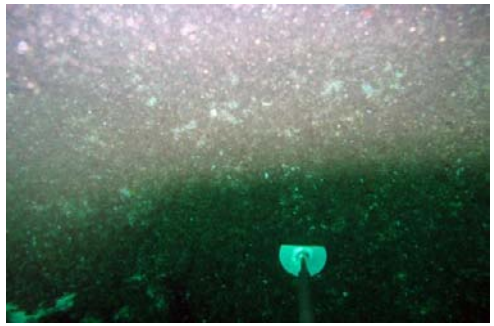
Baseline Survey (April/May 2011)	Monitoring Survey 1 (October 2011)	Monitoring Survey 2 (February 2012)	Monitoring Survey 3 (May 2012)
			
			
			

Plate 6: Deck Starbord Stern

Horizontal Hull Port

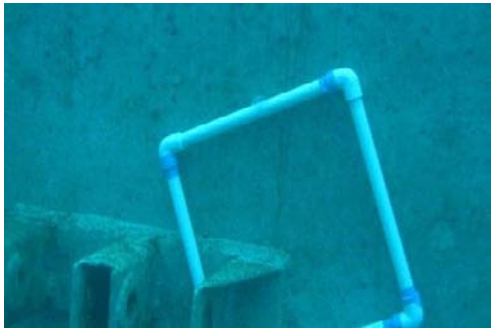
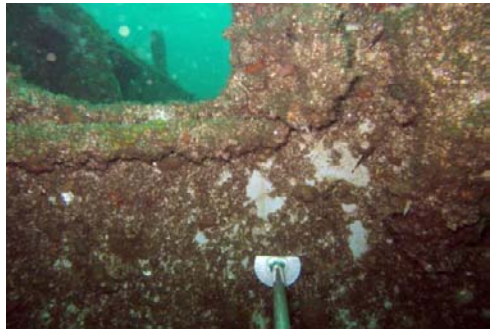
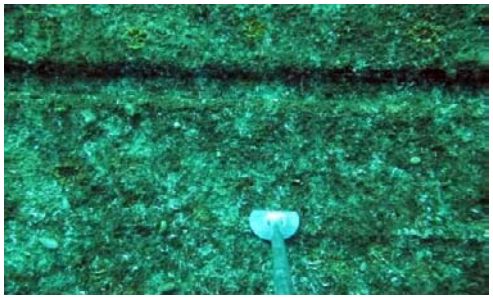
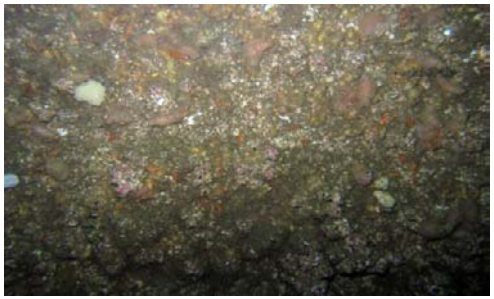
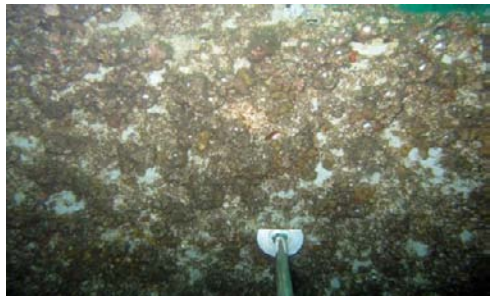
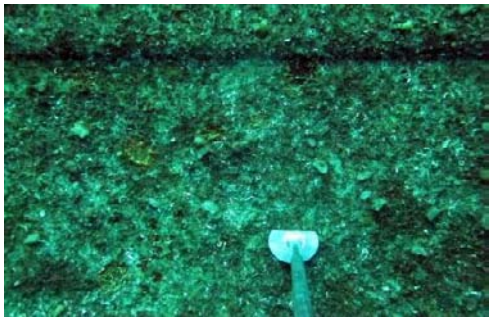
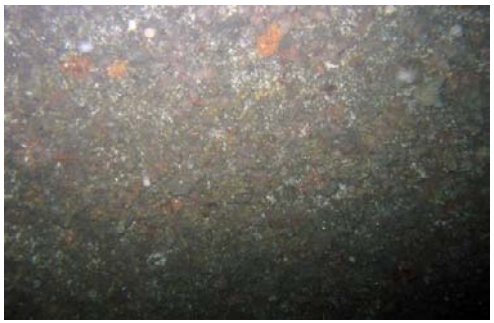
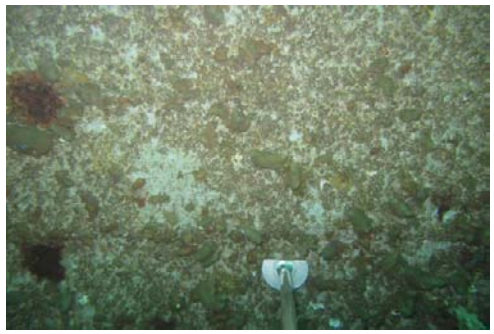
Baseline Survey (April/May 2011)	Monitoring Survey 1 (October 2011)	Monitoring Survey 2 (February 2012)	Monitoring Survey 3 (May 2012)
			
			
			

Plate 7: Horizontal Hull Port

Horizontal Hull Starbord

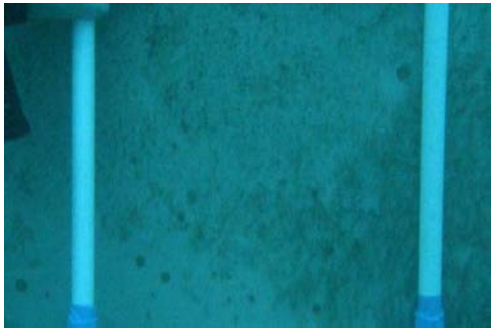
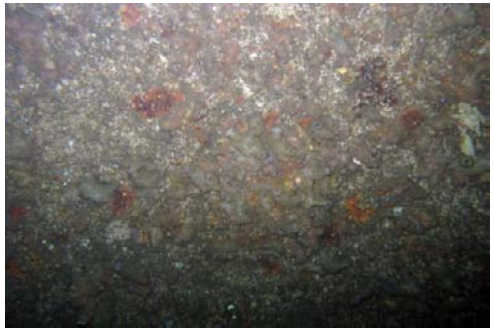
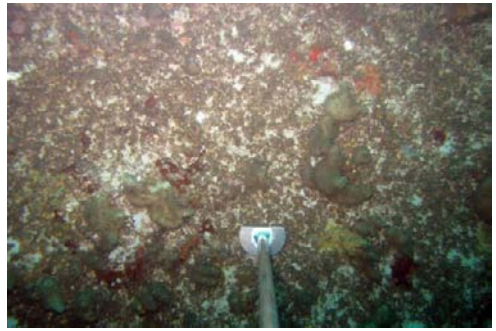
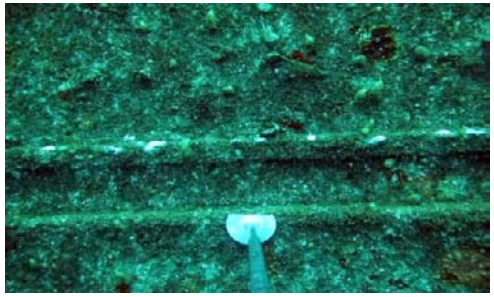
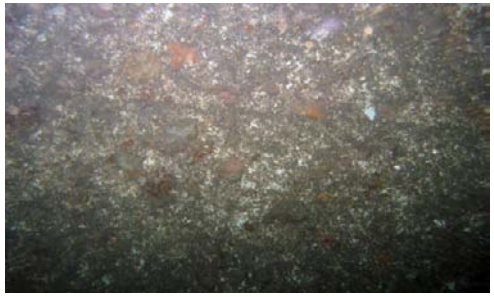
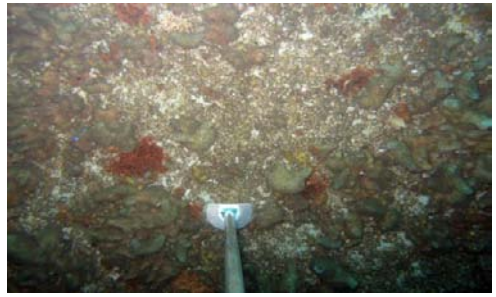
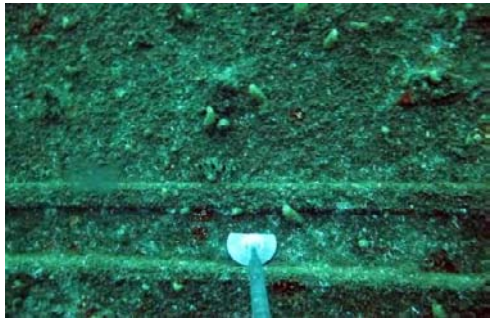
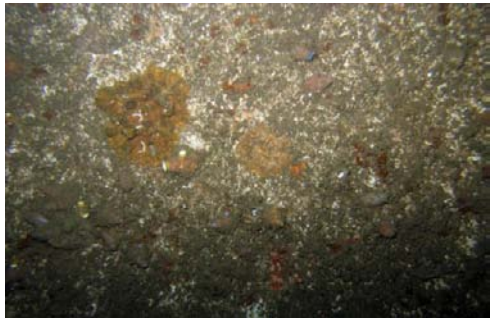
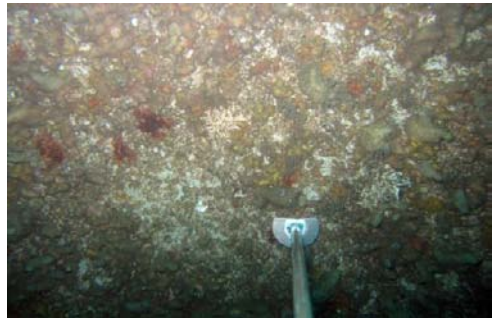
Baseline Survey (April/May 2011)	Monitoring Survey 1 (October 2011)	Monitoring Survey 2 (February 2012)	Monitoring Survey 3 (May 2012)
			
			
			

Plate 8: Horizontal Hull Starbord

Vertical Hull Port Bow

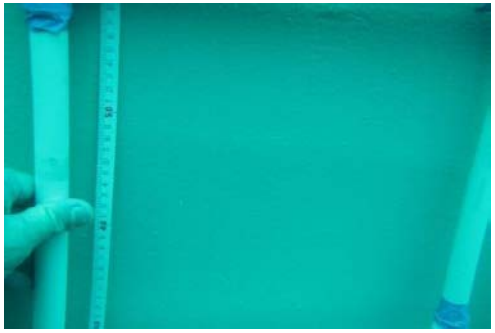
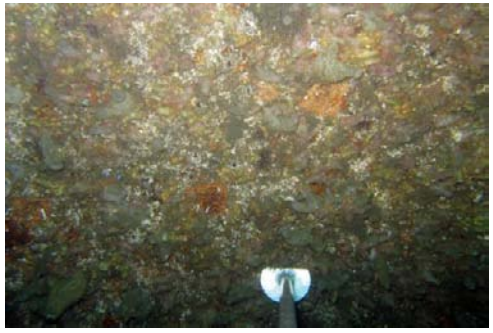
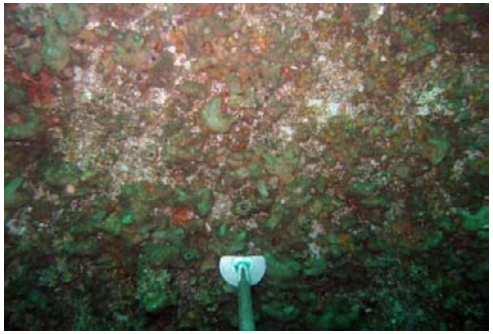
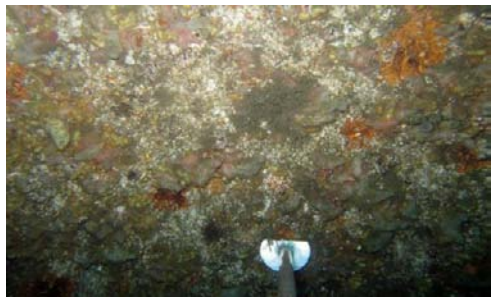
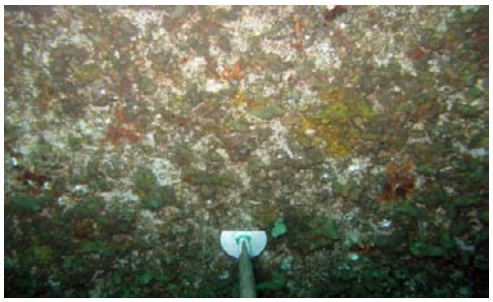
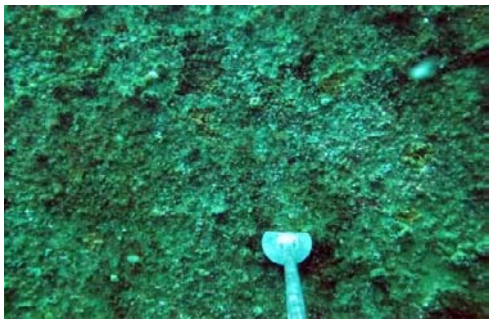
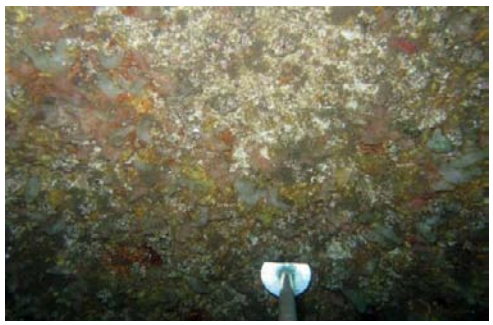
Baseline Survey (April/May 2011)	Monitoring Survey 1 (October 2011)	Monitoring Survey 2 (February 2012)	Monitoring Survey 3 (May 2012)
			
			
			

Plate 9: Vertical Hull Port Bow

Vertical Hull Port Stern

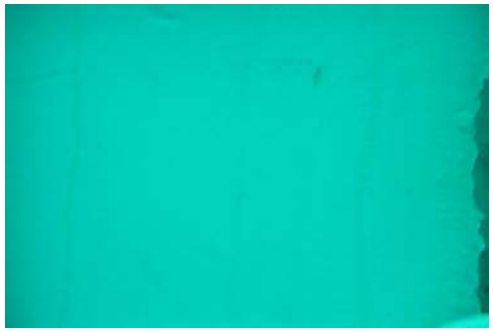
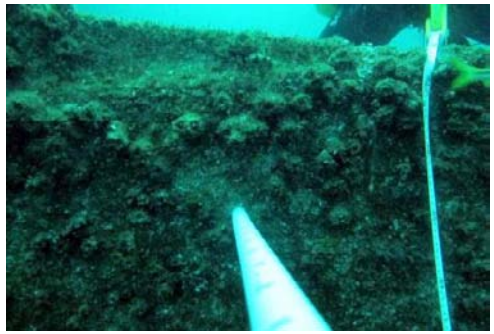
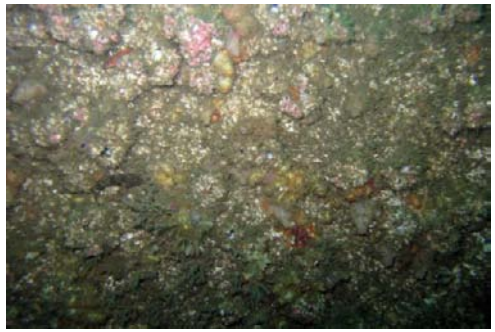
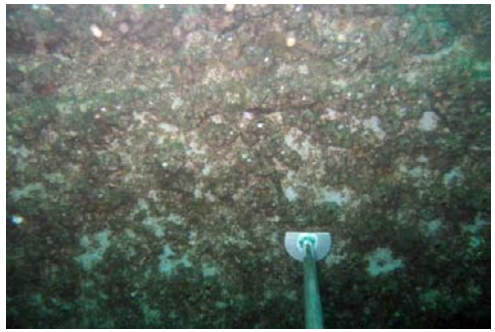
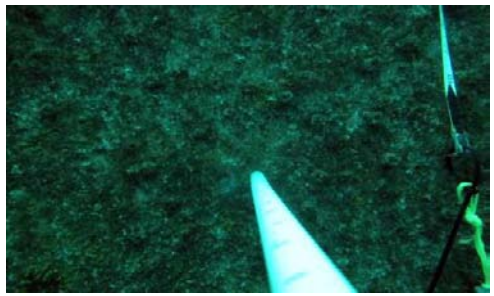
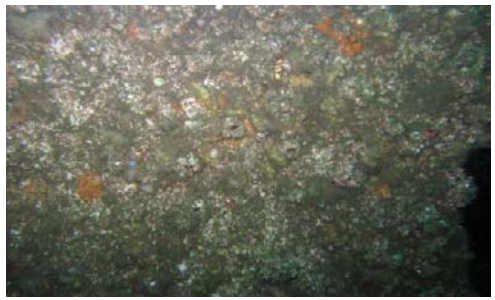
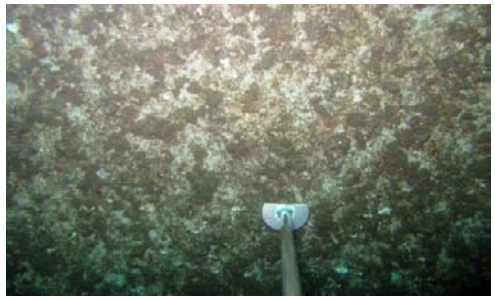
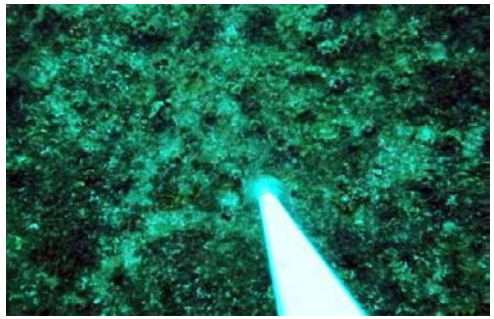
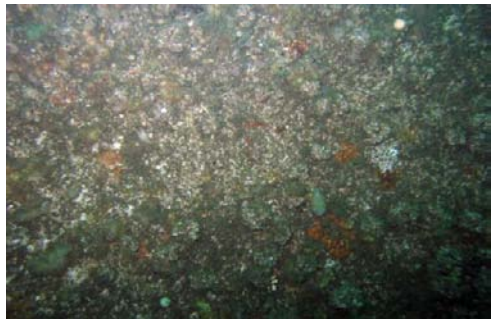
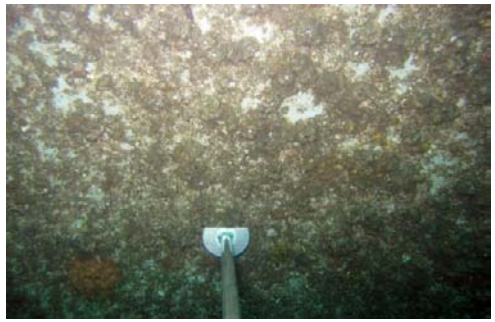
Baseline Survey (April/May 2011)	Monitoring Survey 1 (October 2011)	Monitoring Survey 2 (February 2012)	Monitoring Survey 3 (May 2012)
			
			
			

Plate 10: Vertical Hull Port Stern

Vertical Hull Starbord Bow

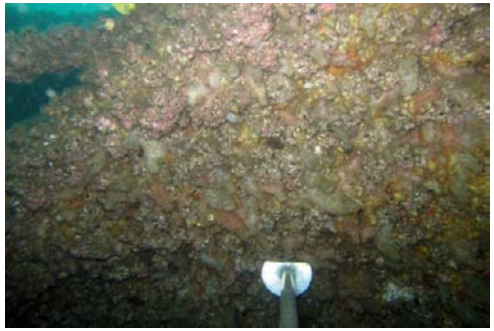
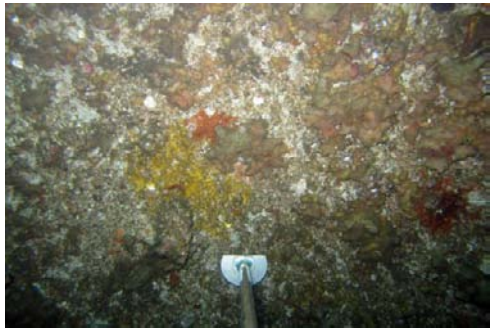
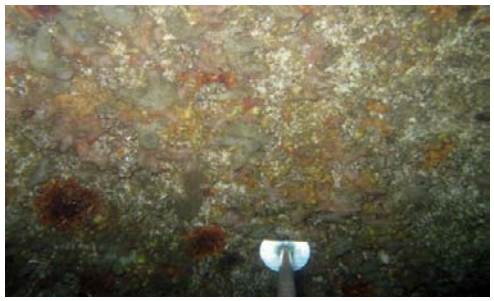
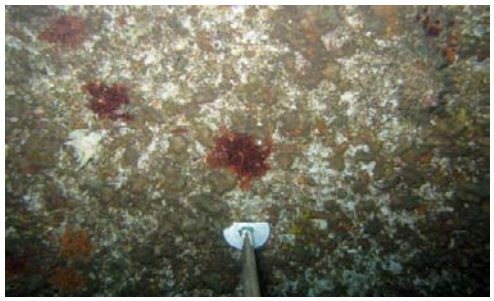
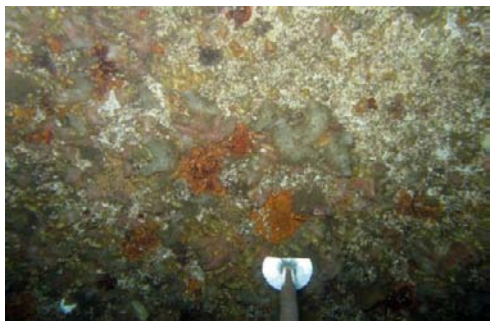
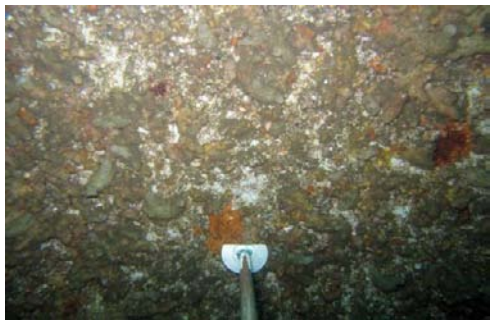
Baseline Survey (April/May 2011)	Monitoring Survey 1 (October 2011)	Monitoring Survey 2 (February 2012)	Monitoring Survey 3 (May 2012)
			
			
			

Plate 11: Vertical Hull Starbord Bow

Vertical Hull Starbord Stern

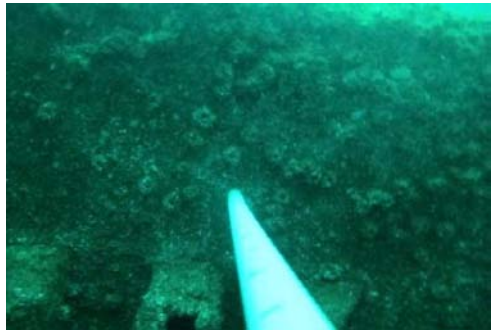
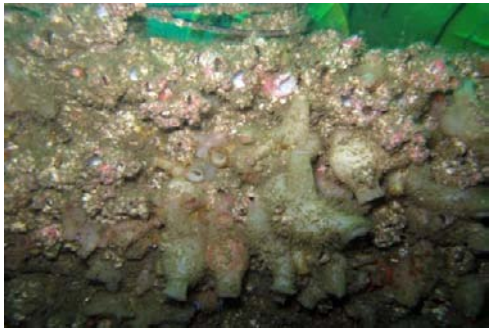
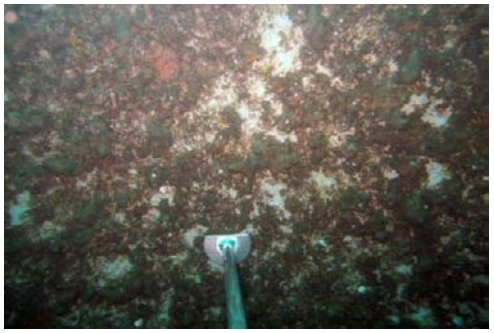
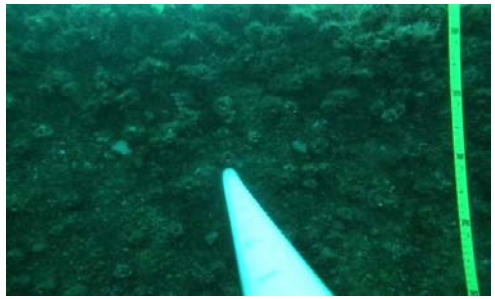
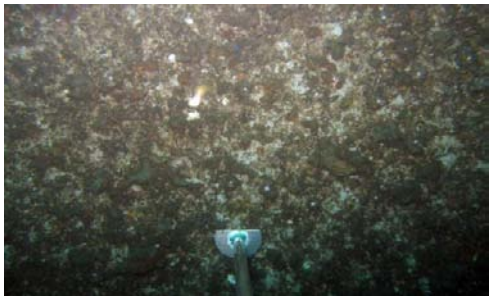
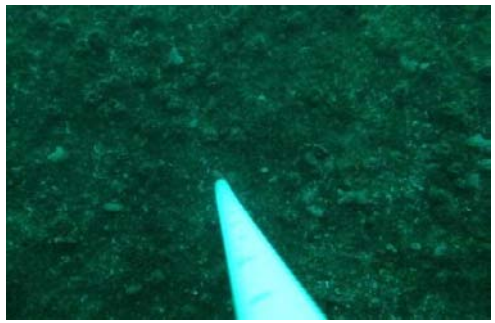
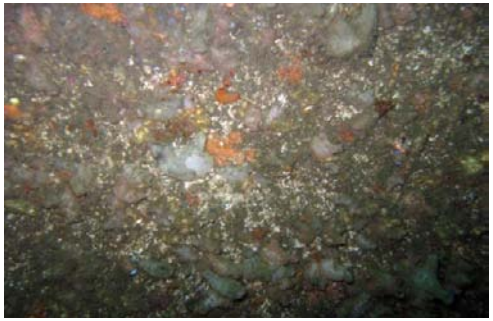
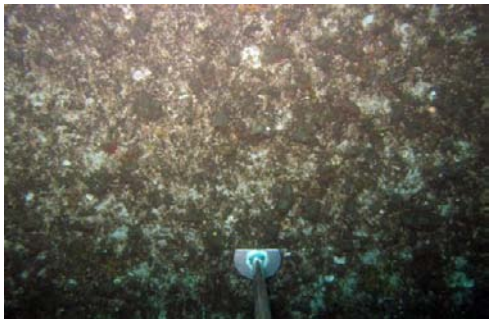
Baseline Survey (April/May 2011)	Monitoring Survey 1 (October 2011)	Monitoring Survey 2 (February 2012)	Monitoring Survey 3 (May 2012)
			
			
			

Plate 12: Vertical Hull Starbord Stern

Vertical Superstructure Port Bow

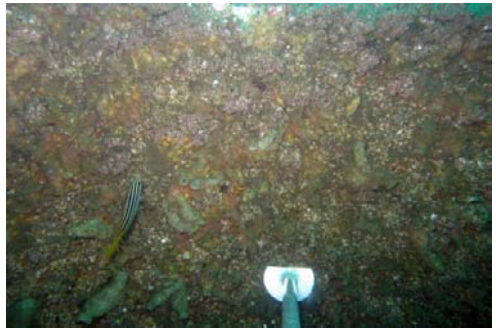
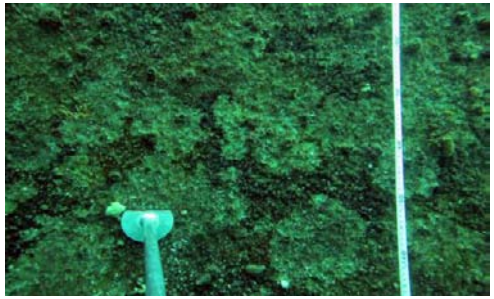
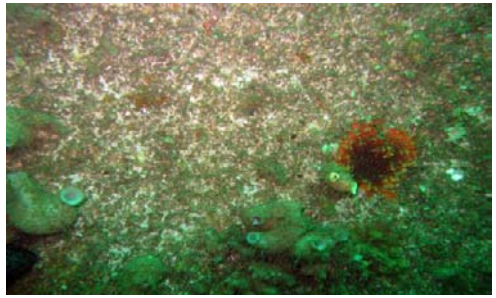
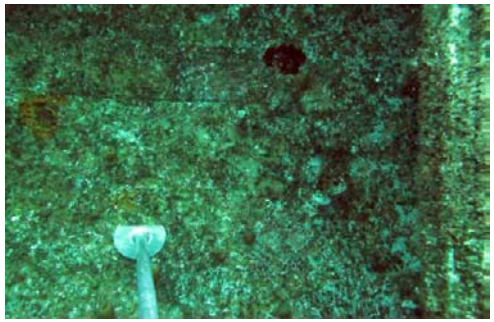
Baseline Survey (April/May 2011)	Monitoring Survey 1 (October 2011)	Monitoring Survey 2 (February 2012)	Monitoring Survey 3 (May 2012)
Not Sampled			
Not Sampled			
Not Sampled			

Plate 13: Vertical Superstructure Port Bow

Vertical Superstructure Port Stern

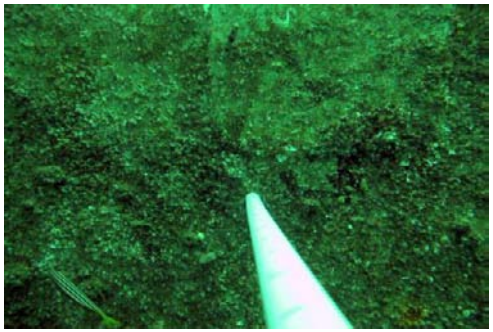
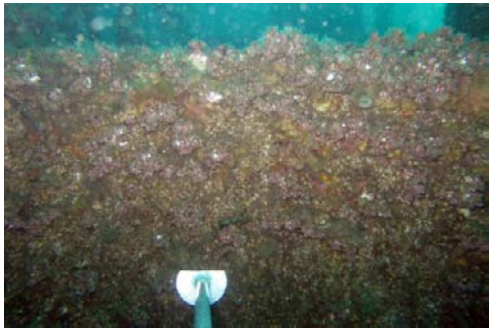
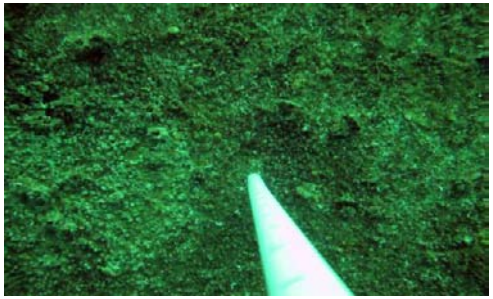
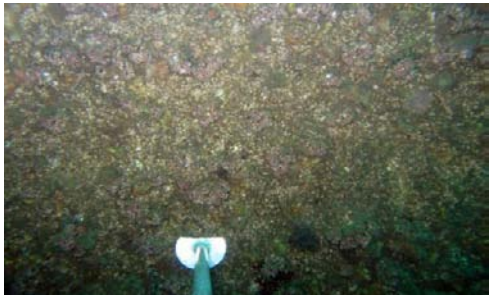
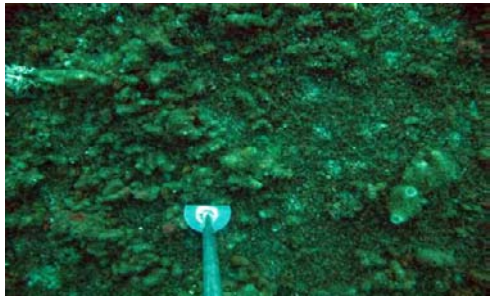
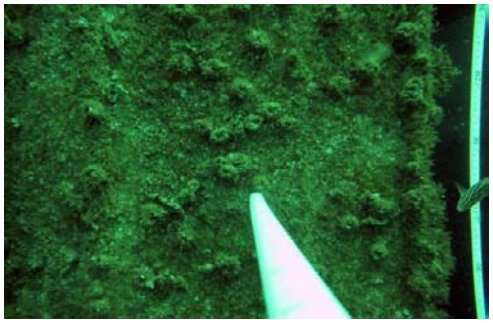
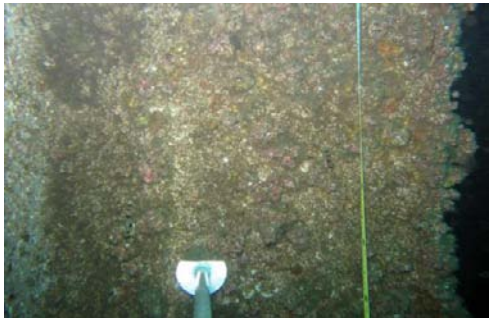
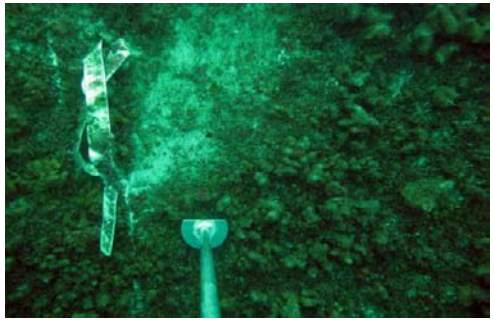
Baseline Survey (April/May 2011)	Monitoring Survey 1 (October 2011)	Monitoring Survey 2 (February 2012)	Monitoring Survey 3 (May 2012)
Not Sampled			
Not Sampled			
Not Sampled			

Plate 14: Vertical Superstructure Port Stern

Vertical Superstructure Starboard Bow

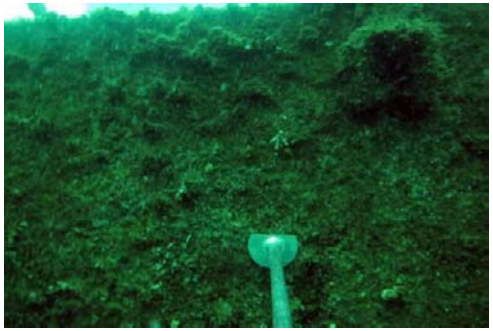
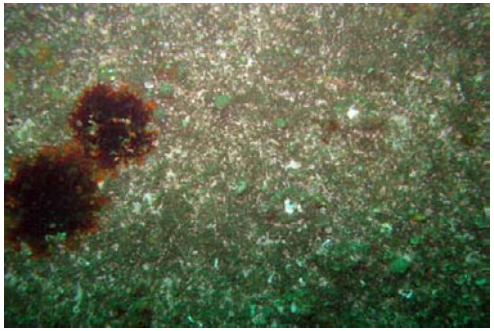
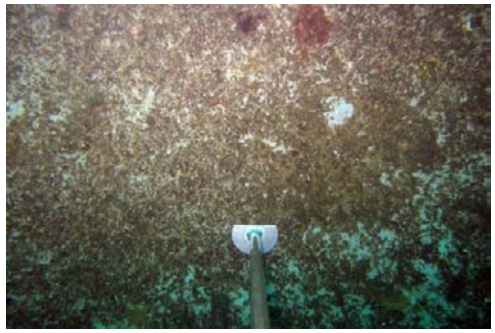
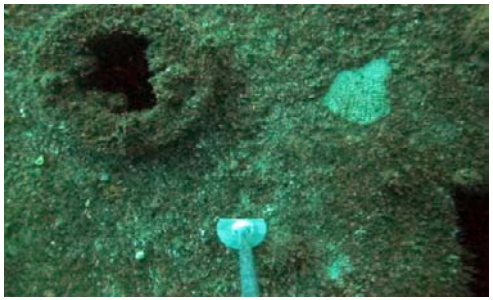
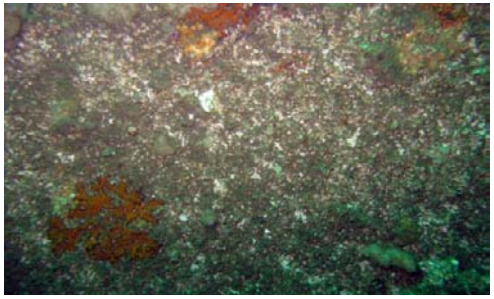
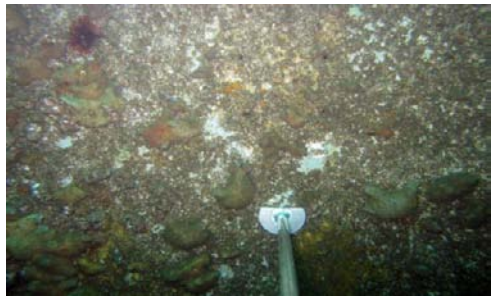
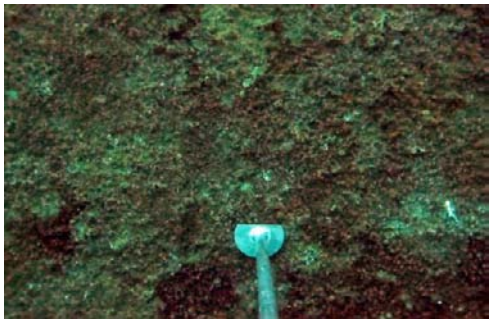
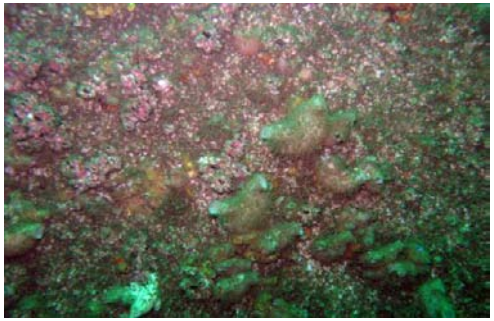
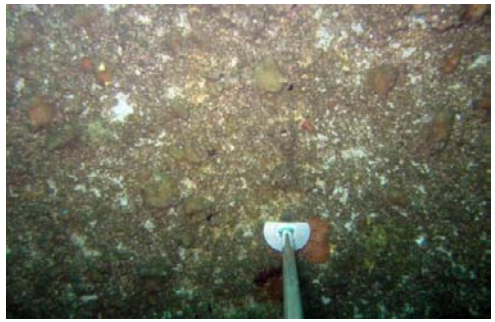
Baseline Survey (April/May 2011)	Monitoring Survey 1 (October 2011)	Monitoring Survey 2 (February 2012)	Monitoring Survey 3 (May 2012)
Not Sampled			
Not Sampled			
Not Sampled			

Plate 15: Vertical Superstructure Starboard Bow

Vertical Superstructure Starboard Stern

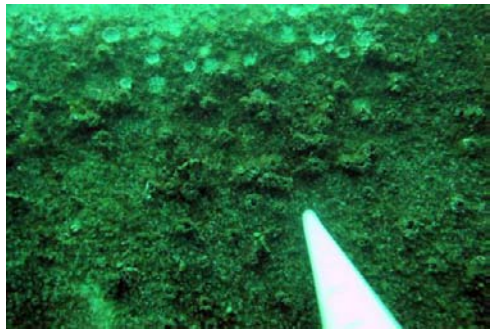
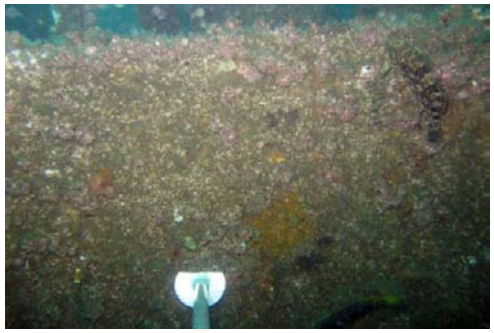
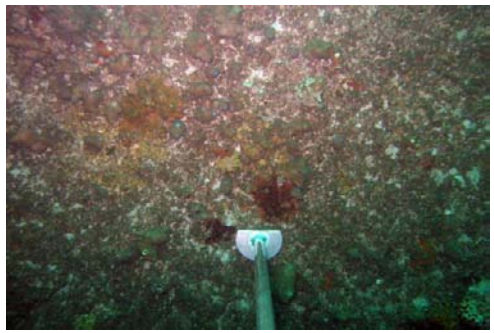
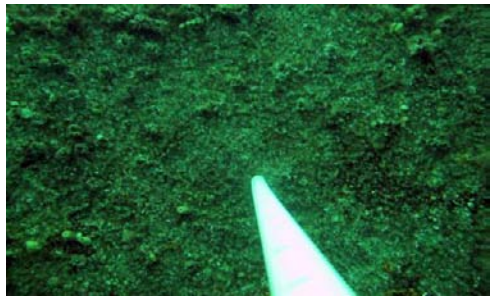
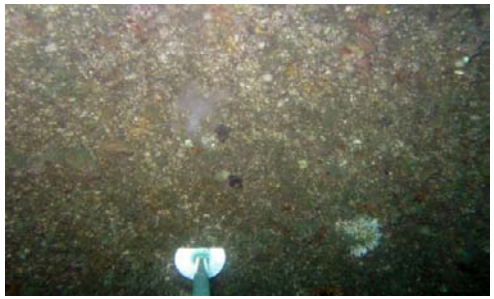
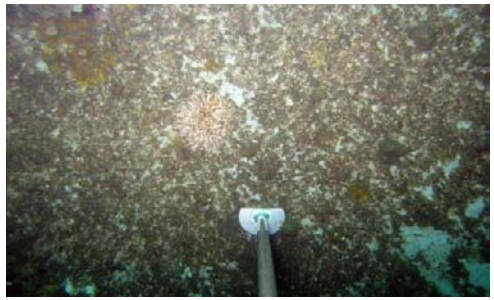
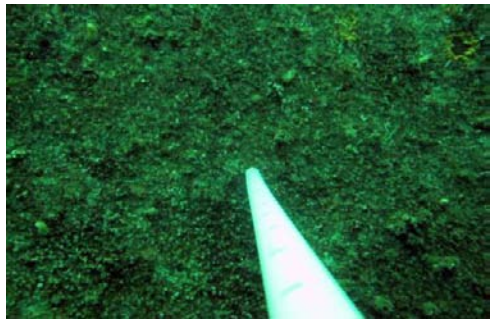
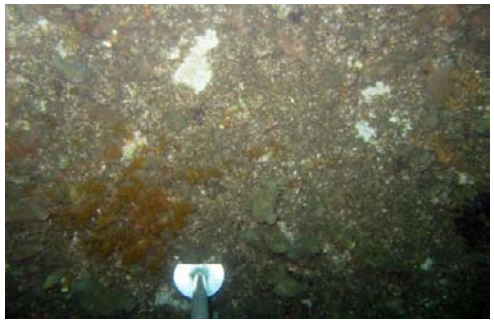
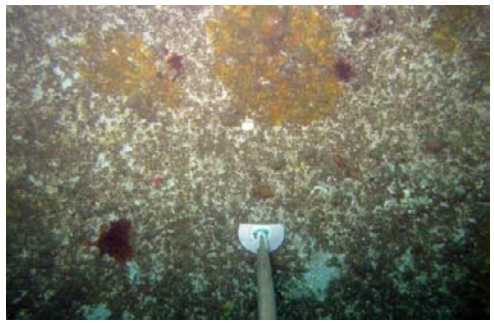
Baseline Survey (April/May 2011)	Monitoring Survey 1 (October 2011)	Monitoring Survey 2 (February 2012)	Monitoring Survey 3 (May 2012)
Not Sampled			
Not Sampled			
Not Sampled			

Plate 16: Vertical Superstructure Starboard Stern

8 Appendices

Appendix A: Fixed Photograph Locations.
Appendix B: Mean Percentage Cover (± Standard Error) of Reef Communities.
Appendix C: PERMANOVA of Reef Assemblages.
Appendix D: Pair-wise t-tests.
Appendix E: SIMPER Analyses
Appendix F: PERMDISP Analyses

Appendix A: Fixed Photo Locations and Descriptions

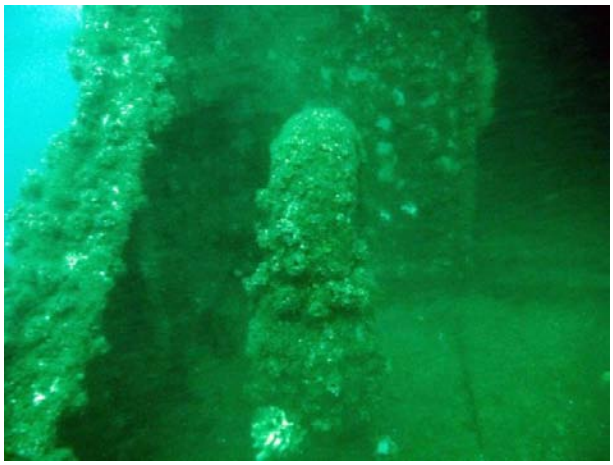
Fixed Photo: 1

Location: Flight deck port side between the hanger and hull. Photo taken standing 2 m towards the stern from the pipe.

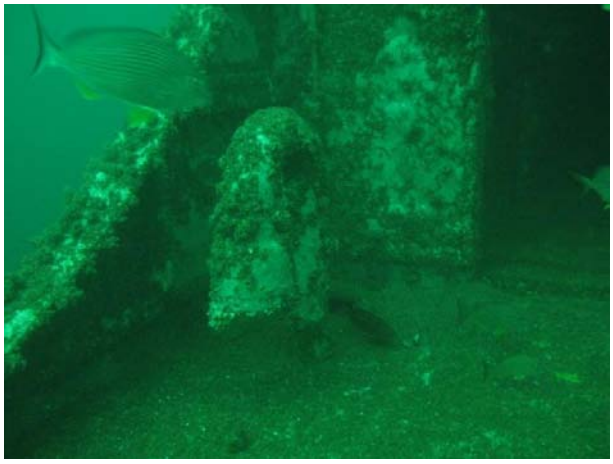
Depth: Approximately 27 m

Survey 1

Survey 2



Survey 3



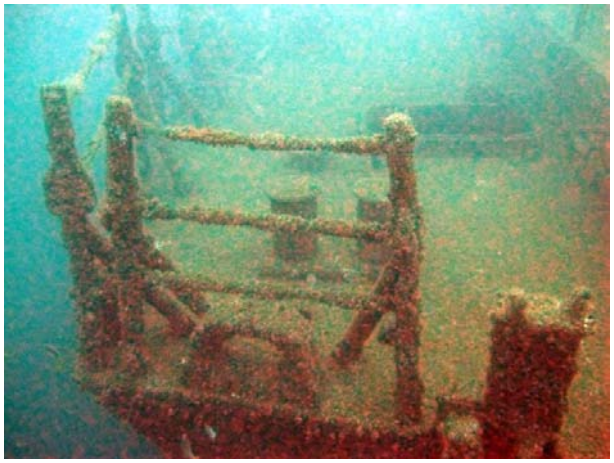
Appendix A: (Continued).

Fixed Photo: 2

Location: Back of the flight deck, starbord side. Photo taken swimming 2 m off and above the deck.

Depth: Approximately 27 m

Survey 1



Survey 2

Survey 3

Appendix A: (Continued).

Fixed Photo: 3

Location: Middle of the stern end of the top deck. Photo taken standing 2 m towards the bow from the pillar.

Depth: Approximately 23 m

Survey 1

Survey 2

Survey 3

Appendix A: (Continued).

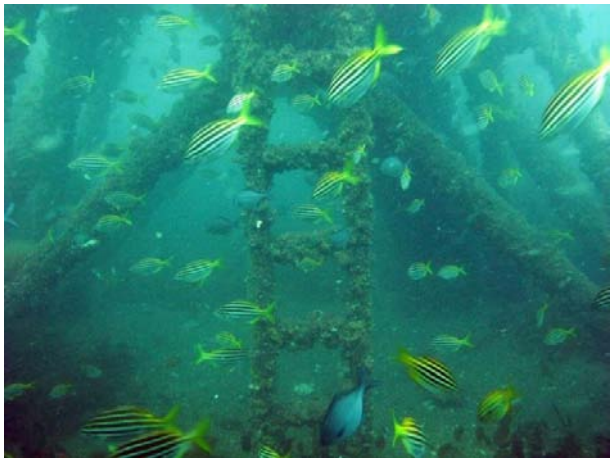
Fixed Photo: 4

Location: Middle of the the top deck. Photo taken standing 2 m towards the stern from the main mast.

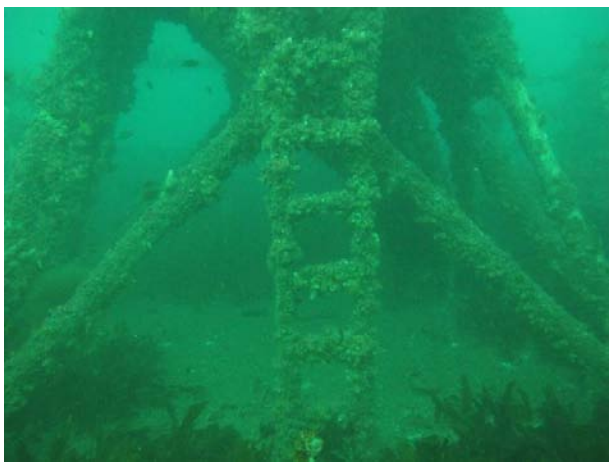
Depth: Approximately 23 m

Survey 1

Survey 2



Survey 3



Appendix A: (Continued).

Fixed Photo: 5

Location: Front of the main mast. Photo taken standing on top of the bridge facing the main mast.

Depth: Approximately 18 m

Survey 1

Survey 2

Survey 3

Appendix A: (Continued).

Fixed Photo: 6

Location: Port bollard between the bow and mid-ship on the front deck. Photo taken standing 2 m towards bridge facing the bow.

Depth: Approximately 26 m

Survey 1

Survey 2

Survey 3

Appendix A: (Continued).

Fixed Photo: 7

Location: Starbord vent on the bow deck. Photo was taken standing 2 m towards the centre of the deck.

Depth: Approximately 25 m.

Survey 1

Survey 2

Survey 3

Appendix A: (Continued).

Fixed Photo: 8

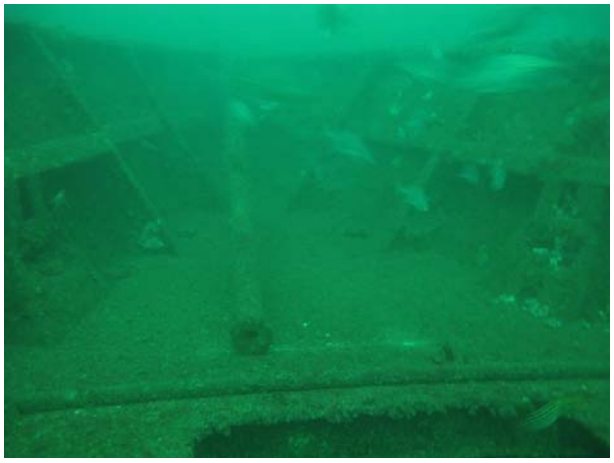
Location: Inside of bow. Photo was taken standing behind the cut out in the deck.

Depth: Approximately 25 m.

Survey 1

Survey 2

Survey 3



Appendix A: (Continued).

Fixed Photo: 9

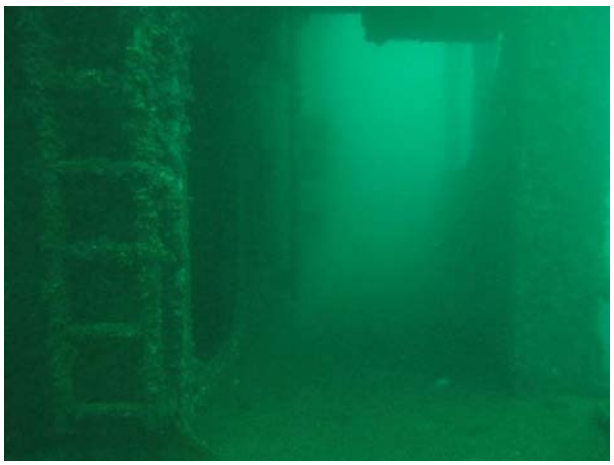
Location: Wall below the bridge on the starboard side. Photo was taken standing on the front deck 2 m in front of the ladder.

Depth: Approximately 26 m.

Survey 1

Survey 2

Survey 3



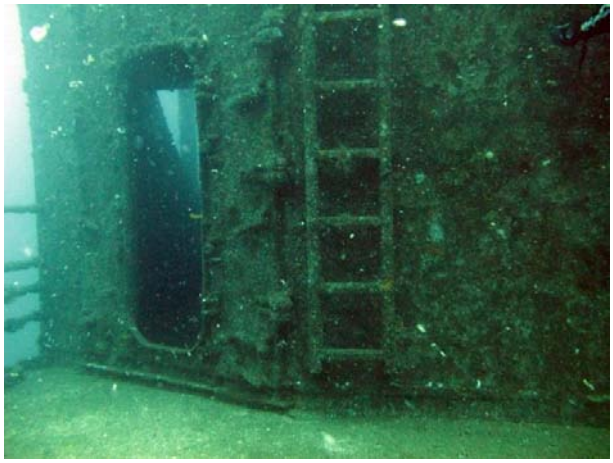
Appendix A: (Continued).

Fixed Photo: 10

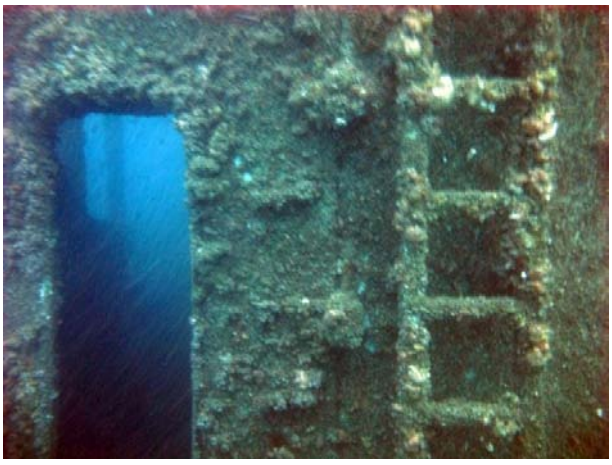
Location: Wall below the bridge on the port side. Photo was taken standing on the front deck 2 m in front of the ladder.

Depth: Approximately 26 m.

Survey 1



Survey 2



Survey 3

Appendix B: Mean percentage cover (± standard error) of reef communities for each transect analysed during survey 2.

	Deck Port Bow		Deck Port Mid		Deck Port Stern	
Categoreis	Mean	S.E.	Mean	S.E.	Mean	S.E.
PHAEOPHYTA						
Ecklonia radiata	0.00	0.00	21.23	4.20	0.00	0.00
Lobed Brown Algae	0.00	0.00	6.40	2.87	0.00	0.00
RHODOPHYTA						
Encrusting Red Algae	0.00	0.00	0.00	0.00	0.00	0.00
Encrusting Coralline	0.00	0.00	0.00	0.00	0.00	0.00
Red Filamentous	6.71	1.39	0.60	0.60	3.45	0.82
Thin Branching Red Algae	0.00	0.00	1.21	0.81	0.00	0.00
BRYOZOA						
Biflustra perfragilis	0.00	0.00	0.00	0.00	0.00	0.00
Encrusting Orange Bryozoan	0.00	0.00	0.00	0.00	0.00	0.00
Encrusting Yellow Bryozoan	0.00	0.00	0.00	0.00	0.00	0.00
White Branching Bryozoan	0.00	0.00	0.00	0.00	0.00	0.00
Triphyllozoan sp	0.00	0.00	0.00	0.00	0.00	0.00
SPONGE						
Orange Encrusting Sponge	0.81	0.38	0.00	0.00	0.00	0.00
White Encrusting Sponge	0.00	0.00	0.00	0.00	0.00	0.00
White Papillate Sponge	0.00	0.00	0.00	0.00	0.00	0.00
Yellow Encrusting Sponge	1.21	0.81	0.20	0.20	0.61	0.40
ASCIDIAN						
Herdmania momus	0.00	0.00	0.00	0.00	0.00	0.00
Botryloides magnicoecum	0.00	0.00	0.00	0.00	0.00	0.00
White Encrusting Solitary Ascidian	0.00	0.00	0.00	0.00	0.00	0.00
White Tubular Solitary Ascidian	0.00	0.00	0.00	0.00	0.00	0.00
ABIOTIC						
Bare Ships Surface	0.41	0.41	0.00	0.00	0.00	0.00
Brown Scuzz	0.00	0.00	0.00	0.00	0.00	0.00
CNIDARIAN						
Anthothoe albocincta	0.00	0.00	0.00	0.00	0.00	0.00
Hydroid 1	0.00	0.00	0.00	0.00	0.00	0.00
Hydroid 2	0.00	0.00	0.00	0.00	0.00	0.00
MATRIX						
Barnacle, Sediment, Brown Fil	0.00	0.00	0.00	0.00	0.00	0.00
Large Barnacle, Sediment,Brown Fil	0.00	0.00	0.00	0.00	0.00	0.00
Serpulid Barnacle and Encrusting Algae Matrix	0.00	0.00	0.00	0.00	47.94	13.72
Serpulid Matrix	15.24	0.85	67.15	6.36	19.95	5.59
Turfing Brown Algae Matrix	75.40	1.02	0.00	0.00	27.85	10.83
FISH MOBILE						
Fish Mobile	0.20	0.20	0.00	0.00	0.20	0.20
INDETERMINATE						
Unknown White Material	0.00	0.00	3.21	1.47	0.00	0.00
TAPE, WAND, SHADOW						
Shadow	0.20	0.20	0.20	0.20	0.00	0.00
Tape Measure in Frame	0.00	0.00	0.00	0.00	0.00	0.00
Camera Pole in Frame	1.40	0.40	0.00	0.00	1.80	0.37

Appendix B: (Continued).

	Deck Starbord Bow		Deck Starbord Mid		Deck Starbord Stern	
Categoreis	Mean	S.E.	Mean	S.E.	Mean	S.E.
PHAEOPHYTA						
Ecklonia radiata	0.00	0.00	51.80	10.70	0.00	0.00
Lobed Brown Algae	0.00	0.00	3.81	0.86	0.00	0.00
RHODOPHYTA						
Encrusting Red Algae	0.00	0.00	0.00	0.00	0.00	0.00
Encrusting Coralline	0.00	0.00	0.00	0.00	0.00	0.00
Red Filamentous	5.33	2.07	0.00	0.00	2.98	1.13
Thin Branching Red Algae	0.00	0.00	1.80	0.97	0.00	0.00
BRYOZOA						
Biflustra perfragilis	0.00	0.00	0.00	0.00	0.00	0.00
Encrusting Orange Bryozoan	0.00	0.00	0.00	0.00	0.00	0.00
Encrusting Yellow Bryozoan	0.00	0.00	0.00	0.00	0.00	0.00
White Branching Bryozoan	0.00	0.00	0.00	0.00	0.00	0.00
Triphyllozoan sp	0.00	0.00	0.00	0.00	0.00	0.00
SPONGE						
Orange Encrusting Sponge	0.45	0.28	0.00	0.00	0.46	0.46
White Encrusting Sponge	0.00	0.00	0.00	0.00	0.00	0.00
White Papillate Sponge	0.00	0.00	0.00	0.00	0.00	0.00
Yellow Encrusting Sponge	0.83	0.61	0.00	0.00	0.72	0.49
ASCIDIAN						
Herdmania momus	0.00	0.00	0.00	0.00	0.00	0.00
Botryloides magnicoecum	0.00	0.00	0.00	0.00	0.00	0.00
White Encrusting Solitary Ascidian	0.24	0.24	0.00	0.00	0.00	0.00
White Tubular Solitary Ascidian	0.00	0.00	0.00	0.00	0.00	0.00
ABIOTIC						
Bare Ships Surface	0.00	0.00	0.00	0.00	0.00	0.00
Brown Scuzz	0.00	0.00	0.00	0.00	0.00	0.00
CNIDARIAN						
Anthothoe albocincta	0.00	0.00	0.00	0.00	0.00	0.00
Hydroid 1	0.00	0.00	0.00	0.00	0.00	0.00
Hydroid 2	0.00	0.00	0.00	0.00	0.00	0.00
MATRIX						
Barnacle, Sediment, Brown Fil	0.00	0.00	0.00	0.00	0.00	0.00
Large Barnacle, Sediment,Brown Fil	0.00	0.00	0.00	0.00	0.00	0.00
Serpulid Barnacle and Encrusting Algae Matrix	30.47	8.16	7.87	6.47	41.53	7.45
Serpulid Matrix	14.87	2.26	33.31	9.36	23.88	4.49
Turfing Brown Algae Matrix	47.38	9.07	0.00	0.00	30.20	7.90
FISH MOBILE						
Fish Mobile	0.45	0.28	0.61	0.61	0.23	0.23
INDETERMINATE						
Unknown White Material	0.00	0.00	0.80	0.20	0.00	0.00
TAPE, WAND, SHADOW						
Shadow	3.60	3.36	0.00	0.00	7.20	3.14
Tape Measure in Frame	0.00	0.00	0.00	0.00	0.00	0.00
Camera Pole in Frame	1.80	0.49	0.40	0.24	3.20	0.20

Appendix B: (Continued).

	Horizontal Hull Port		Horizontal Hull Starbord		Vertical Hull Port Bow	
Categoreis	Mean	S.E.	Mean	S.E.	Mean	S.E.
PHAEOPHYTA						
Ecklonia radiata	0.00	0.00	0.00	0.00	0.00	0.00
Lobed Brown Algae	0.00	0.00	0.00	0.00	0.00	0.00
RHODOPHYTA						
Encrusting Red Algae	0.20	0.20	0.52	0.35	0.00	0.00
Encrusting Coralline	0.00	0.00	0.17	0.17	0.00	0.00
Red Filamentous	0.00	0.00	0.00	0.00	0.00	0.00
Thin Branching Red Algae	0.00	0.00	0.00	0.00	0.00	0.00
BRYOZOA						
Biflustra perfragilis	0.00	0.00	0.00	0.00	0.61	0.40
Encrusting Orange Bryozoan	0.17	0.17	2.05	0.84	1.64	0.78
Encrusting Yellow Bryozoan	0.67	0.50	0.85	0.49	0.62	0.42
White Branching Bryozoan	0.00	0.00	0.00	0.00	0.41	0.25
Triphyllozoan sp	0.17	0.17	0.17	0.17	0.00	0.00
SPONGE						
Orange Encrusting Sponge	1.04	0.52	0.51	0.35	0.00	0.00
White Encrusting Sponge	0.00	0.00	0.00	0.00	0.00	0.00
White Papillate Sponge	0.00	0.00	0.17	0.17	0.00	0.00
Yellow Encrusting Sponge	0.00	0.00	0.51	0.35	0.00	0.00
ASCIDIAN						
Herdmania momus	17.81	7.37	22.29	8.38	45.49	5.44
Botryloides magnicoecum	0.00	0.00	0.00	0.00	0.20	0.20
White Encrusting Solitary Ascidian	0.00	0.00	0.17	0.17	0.00	0.00
White Tubular Solitary Ascidian	0.00	0.00	0.00	0.00	0.00	0.00
ABIOTIC						
Bare Ships Surface	6.82	2.20	1.20	0.49	0.41	0.41
Brown Scuzz	0.67	0.50	0.00	0.00	0.00	0.00
CNIDARIAN						
Anthothoe albocincta	0.00	0.00	0.00	0.00	0.00	0.00
Hydroid 1	0.00	0.00	0.51	0.51	0.00	0.00
Hydroid 2	0.00	0.00	0.00	0.00	0.00	0.00
MATRIX						
Barnacle, Sediment, Brown Fil	0.00	0.00	0.00	0.00	0.00	0.00
Large Barnacle, Sediment,Brown Fil	1.18	1.18	0.00	0.00	0.20	0.20
Serpulid Barnacle and Encrusting Algae Matrix	50.34	4.30	32.12	8.12	42.42	5.05
Serpulid Matrix	10.82	3.68	36.02	8.55	7.79	3.54
Turfing Brown Algae Matrix	10.11	6.48	2.74	2.16	0.20	0.20
FISH MOBILE						
Fish Mobile	0.00	0.00	0.00	0.00	0.00	0.00
INDETERMINATE						
Unknown White Material	0.00	0.00	0.00	0.00	0.00	0.00
TAPE, WAND, SHADOW						
Shadow	2.50	2.50	0.00	0.00	1.40	0.68
Tape Measure in Frame	0.00	0.00	0.00	0.00	0.00	0.00
Camera Pole in Frame	0.67	0.21	2.33	0.33	1.20	0.20

Appendix B: (Continued).

	Vertical Hull Port Stern		Vertical Hull Starbord Bow		Vertical Hull Starbord Stern	
Categoreis	Mean	S.E.	Mean	S.E.	Mean	S.E.
PHAEOPHYTA						
Ecklonia radiata	0.00	0.00	0.00	0.00	0.00	0.00
Lobed Brown Algae	0.00	0.00	0.00	0.00	0.00	0.00
RHODOPHYTA						
Encrusting Red Algae	0.00	0.00	0.20	0.20	0.00	0.00
Encrusting Coralline	0.00	0.00	0.00	0.00	0.00	0.00
Red Filamentous	0.00	0.00	0.00	0.00	0.00	0.00
Thin Branching Red Algae	0.00	0.00	0.00	0.00	0.00	0.00
BRYOZOA						
Biflustra perfragilis	0.41	0.41	2.63	1.31	0.00	0.00
Encrusting Orange Bryozoan	0.61	0.25	1.22	0.75	0.41	0.25
Encrusting Yellow Bryozoan	0.21	0.21	2.23	1.13	0.21	0.21
White Branching Bryozoan	0.00	0.00	0.00	0.00	0.00	0.00
Triphyllozoan sp	0.00	0.00	0.00	0.00	0.00	0.00
SPONGE						
Orange Encrusting Sponge	0.41	0.41	0.00	0.00	0.40	0.40
White Encrusting Sponge	0.00	0.00	0.00	0.00	0.00	0.00
White Papillate Sponge	0.00	0.00	0.20	0.20	0.00	0.00
Yellow Encrusting Sponge	0.00	0.00	0.00	0.00	0.00	0.00
ASCIDIAN						
Herdmania momus	5.32	1.70	32.82	5.60	22.50	4.31
Botryloides magnicoecum	0.00	0.00	0.20	0.20	0.00	0.00
White Encrusting Solitary Ascidian	0.00	0.00	0.00	0.00	0.20	0.20
White Tubular Solitary Ascidian	0.00	0.00	0.00	0.00	0.00	0.00
ABIOTIC						
Bare Ships Surface	2.45	0.94	0.41	0.41	3.06	1.54
Brown Scuzz	0.00	0.00	0.00	0.00	1.01	0.64
CNIDARIAN						
Anthothoe albocincta	0.20	0.20	0.00	0.00	0.00	0.00
Hydroid 1	0.00	0.00	0.00	0.00	0.00	0.00
Hydroid 2	0.00	0.00	0.20	0.20	0.00	0.00
MATRIX						
Barnacle, Sediment, Brown Fil	0.00	0.00	0.00	0.00	0.00	0.00
Large Barnacle, Sediment,Brown Fil	20.54	10.70	0.20	0.20	12.21	7.88
Serpulid Barnacle and Encrusting Algae Matrix	66.00	8.53	58.47	4.35	59.38	12.53
Serpulid Matrix	2.23	1.48	0.40	0.25	0.61	0.61
Turfing Brown Algae Matrix	1.62	1.62	0.80	0.80	0.00	0.00
FISH MOBILE						
Fish Mobile	0.00	0.00	0.00	0.00	0.00	0.00
INDETERMINATE						
Unknown White Material	0.00	0.00	0.00	0.00	0.00	0.00
TAPE, WAND, SHADOW						
Shadow	0.20	0.20	0.00	0.00	0.20	0.20
Tape Measure in Frame	0.00	0.00	0.00	0.00	0.00	0.00
Camera Pole in Frame	2.00	0.63	1.40	0.40	1.41	0.25

Appendix B: (Continued).

	Vertical Super Port Bow		Vertical Super Port Stern		Vertical Super Starbord Bow	
Categoreis	Mean	S.E.	Mean	S.E.	Mean	S.E.
PHAEOPHYTA						
Ecklonia radiata	0.00	0.00	0.00	0.00	0.00	0.00
Lobed Brown Algae	0.00	0.00	0.00	0.00	0.00	0.00
RHODOPHYTA						
Encrusting Red Algae	1.40	0.98	0.20	0.20	0.40	0.40
Encrusting Coralline	0.00	0.00	0.00	0.00	0.00	0.00
Red Filamentous	0.00	0.00	0.00	0.00	0.00	0.00
Thin Branching Red Algae	0.00	0.00	0.00	0.00	0.00	0.00
BRYOZOA						
Biflustra perfragilis	0.40	0.24	0.00	0.00	1.21	0.38
Encrusting Orange Bryozoan	0.00	0.00	0.80	0.58	0.81	0.38
Encrusting Yellow Bryozoan	0.00	0.00	0.00	0.00	1.41	0.94
White Branching Bryozoan	0.00	0.00	0.40	0.40	0.00	0.00
Triphyllozoan sp	0.00	0.00	0.00	0.00	0.00	0.00
SPONGE						
Orange Encrusting Sponge	0.00	0.00	0.00	0.00	0.20	0.20
White Encrusting Sponge	0.00	0.00	0.00	0.00	0.00	0.00
White Papillate Sponge	0.00	0.00	0.00	0.00	0.40	0.25
Yellow Encrusting Sponge	0.00	0.00	0.00	0.00	0.80	0.37
ASCIDIAN						
Herdmania momus	11.02	1.76	33.84	4.46	6.24	3.63
Botryloides magnicoecum	0.00	0.00	0.00	0.00	0.00	0.00
White Encrusting Solitary Ascidian	0.20	0.20	0.00	0.00	0.20	0.20
White Tubular Solitary Ascidian	1.20	0.49	0.00	0.00	0.00	0.00
ABIOTIC						
Bare Ships Surface	0.00	0.00	2.72	2.25	2.22	1.25
Brown Scuzz	0.00	0.00	4.84	4.84	2.62	2.16
CNIDARIAN						
Anthothoe albocincta	0.00	0.00	0.00	0.00	0.00	0.00
Hydroid 1	0.00	0.00	0.00	0.00	0.00	0.00
Hydroid 2	2.20	2.20	0.80	0.58	0.00	0.00
MATRIX						
Barnacle, Sediment, Brown Fil	0.00	0.00	12.60	6.04	0.00	0.00
Large Barnacle, Sediment,Brown Fil	46.90	10.07	7.40	3.03	1.40	0.98
Serpulid Barnacle and Encrusting Algae Matrix	35.27	7.69	35.20	8.17	80.29	5.53
Serpulid Matrix	0.00	0.00	1.20	0.97	1.80	1.80
Turfing Brown Algae Matrix	0.20	0.20	0.00	0.00	0.00	0.00
FISH MOBILE						
Fish Mobile	1.20	1.20	0.00	0.00	0.00	0.00
INDETERMINATE						
Unknown White Material	0.00	0.00	0.00	0.00	0.00	0.00
TAPE, WAND, SHADOW						
Shadow	0.20	0.20	0.00	0.00	0.00	0.00
Tape Measure in Frame	0.00	0.00	1.00	1.00	0.00	0.00
Camera Pole in Frame	0.00	0.00	0.00	0.00	0.40	0.24

Appendix B: (Continued).

	Vertical Super Starbord Stern	
Categoreis	Mean	S.E.
PHAEOPHYTA		
Ecklonia radiata	0.00	0.00
Lobed Brown Algae	0.00	0.00
RHODOPHYTA		
Encrusting Red Algae	0.41	0.41
Encrusting Coralline	0.00	0.00
Red Filamentous	0.00	0.00
Thin Branching Red Algae	0.00	0.00
BRYOZOA		
Biflustra perfragilis	1.86	0.68
Encrusting Orange Bryozoan	4.74	2.52
Encrusting Yellow Bryozoan	1.03	0.56
White Branching Bryozoan	0.82	0.82
Triphyllozoan sp	0.21	0.21
SPONGE		
Orange Encrusting Sponge	0.82	0.51
White Encrusting Sponge	0.41	0.41
White Papillate Sponge	0.00	0.00
Yellow Encrusting Sponge	0.21	0.21
ASCIDIAN		
Herdmania momus	7.84	3.33
Botryloides magnicoecum	0.00	0.00
White Encrusting Solitary Ascidian	0.00	0.00
White Tubular Solitary Ascidian	0.00	0.00
ABIOTIC		
Bare Ships Surface	2.68	0.53
Brown Scuzz	0.00	0.00
CNIDARIAN		
Anthothoe albocincta	0.00	0.00
Hydroid 1	0.00	0.00
Hydroid 2	0.00	0.00
MATRIX		
Barnacle, Sediment, Brown Fil	0.00	0.00
Large Barnacle, Sediment,Brown Fil	0.82	0.60
Serpulid Barnacle and Encrusting Algae Matrix	76.49	3.12
Serpulid Matrix	1.44	1.44
Turfing Brown Algae Matrix	0.00	0.00
FISH MOBILE		
Fish Mobile	0.21	0.21
INDETERMINATE		
Unknown White Material	0.00	0.00
TAPE, WAND, SHADOW		
Shadow	0.00	0.00
Tape Measure in Frame	0.00	0.00
Camera Pole in Frame	3.00	0.00

Appendix C: Permutational Analysis of Variance of Percent Cover of Reef Assemblages Sampled in Reef Monitoring Surveys 2 and 3. *P*-values highlighted in bold are significant. RED = Redundant term. A term becomes redundant if a lower order interaction including that term is significant. Res = Residual. This term is a measure of the variation in the data not explained by the variation attributed to the main factors in the experimental model (i.e. Time, Orientation etc. and their associated interactions).

1. All Positions over Time (Times 1,2 and 3)

Source	df	SS	MS	F	*P*
Time	2	68436	34218	11.951	**0.0002**
Residual	243	6.9577E5	2863.2		
Total	245	7.642E5			

2. Orientation (Deck/Hull) and Time

Source	df	SS	MS	F	*P*
Time	1	17806	17806	8.5347	**RED**
Orientation	1	32798	32798	15.721	**RED**
Aspect	1	1924.9	1924.9	0.92262	0.4248
Time x Orientation	1	7509.1	7509.1	3.5992	**0.0076**
Time x Aspect	1	1400.3	1400.3	0.67119	0.6076
Orientation x Aspect	1	1742.2	1742.2	0.83506	0.4828
Time x Position x Aspect	1	453.11	453.11	0.21718	0.9398
Residual	76	1.5856E5	2086.3		
Total	83	2.1972E5			

3. Depth, Aspect and Time

Source	df	SS	MS	F	*P*
Time	1	8964.7	8964.7	2.878	0.0814
Depth	1	3963.3	3963.3	0.92686	0.5022
Aspect	1	3013.9	3013.9	0.70483	0.6696
Time x Depth	1	1532.7	1532.7	0.49204	0.6776
Time x Aspect	1	2433.1	2433.1	0.7811	0.5094
Depth x Aspect	1	7589	7589	1.7748	0.2002
Transect (Depth x Aspect)	4	17104	4276	3.3168	**0.0002**
Time x Depth x Aspect	1	1280.1	1280.1	0.41097	0.7044
Time x Transect (Depth x Aspect)	4	12460	3114.9	2.4162	**0.0016**
Res	64	82509			
Total	79	1.4085E5			

Continued.

Appendix C: Continued.

4. Deck Position (Bow, Mid, Stern) and Time

Source	df	SS	MS	F	*P*
Time	1	5678.1	5678.1	4.7346	**0.003**
Position	2	63915	31957	26.648	**0.0002**
Aspect	1	4217.9	4217.9	3.5171	**0.0172**
Time x Position	2	4527.4	2263.7	1.8876	0.0688
Time x Aspect	1	1401.8	1401.8	1.1689	0.3104
Position x Aspect	2	3163.3	1581.7	1.3189	0.239
Time x Position x Aspect	2	3033	1516.5	1.2645	0.2572
Residual	48	57565			
Total	59	1.435E5			

Appendix D: Pairwise tests of reef assemblages of fish for significant terms. Significant results in bold.

Orientation

Term 'TixPo' for pairs of levels of factor 'Position'

Within level '2' of factor 'Time'

Groups	t	P(perm)	Unique perms
Deck, Hull	3.2225	**0.0002**	4988

Within level '3' of factor 'Time'

Groups	t	P(perm)	Unique perms
Deck, Hull	2.9752	0.0002	4986

Term 'TixPo' for pairs of levels of factor 'Time'

Within level 'Deck' of factor 'Position'

Groups	t	P(perm)	Unique perms
2, 3	1.5509	0.059	4988

Within level 'Hull' of factor 'Position'

Groups	t	P(perm)	Unique perms
2, 3	3.4239	**0.0002**	4995

Depth/Aspect

Term 'TixTr(DexAs)' for pairs of levels of factor 'Time'

Within level 'Deep' of factor 'Depth'
Within level 'Port' of factor 'Aspect'
Within level 'Bow' of factor 'Transect'

Groups	t	P(perm)	Unique perms
2,3	0.42456	0.7218	126

Within level 'Deep' of factor 'Depth'
Within level 'Port' of factor 'Aspect'
Within level 'Stern' of factor 'Transect'

Groups	t	P(perm)	Unique perms
2,3	1.4477	0.1166	126

Continued

Appendix D:Continued

Depth/Aspect

Term 'TixTr(DexAs)' for pairs of levels of factor 'Time'

Within level 'Deep' of factor 'Depth'
Within level 'Starbord' of factor 'Aspect'
Within level 'Bow' of factor 'Transect'

Groups	t	P(perm)	Unique perms
2,3	1.529	**0.0094**	126

Within level 'Deep' of factor 'Depth'
Within level 'Starbord' of factor 'Aspect'
Within level 'Stern' of factor 'Transect'

Groups	t	P(perm)	Unique perms
2,3	1.6971	0.0186	126

Within level 'Shallow' of factor 'Depth'
Within level 'Port' of factor 'Aspect'
Within level 'Bow' of factor 'Transect'

Groups	t	P(perm)	Unique perms
2,3	1.9294	**0.0068**	126

Within level 'Shallow' of factor 'Depth'
Within level 'Port' of factor 'Aspect'
Within level 'Stern' of factor 'Transect'

Groups	t	P(perm)	Unique perms
2,3	1.6841	**0.0262**	126

Within level 'Shallow' of factor 'Depth'
Within level 'Starbord' of factor 'Aspect'
Within level 'Bow' of factor 'Transect'

Groups	t	P(perm)	Unique perms
2,3	1.4144	0.088	126

Continued

Appendix D:Continued

Depth/Aspect

Term 'TixTr(DexAs)' for pairs of levels of factor 'Time'

Within level 'Shallow' of factor 'Depth'
Within level 'Starbord' of factor 'Aspect'
Within level 'Stern' of factor 'Transect'

Groups	t	P(perm)	Unique perms
2,3	1.6558	**0.034**	126

Depth/Aspect

Term 'TixTr(DexAs)' for pairs of levels of factor 'Transect'

Within level '2' of factor 'Time'
Within level 'Deep' of factor 'Depth'
Within level 'Port' of factor 'Aspect'

Groups	t	P(perm)	Unique perms
Bow, Stern	2.5151	**0.0078**	126

Within level '2' of factor 'Time'
Within level 'Deep' of factor 'Depth'
Within level 'Starbord' of factor 'Aspect'

Groups	t	P(perm)	Unique perms
Bow, Stern	1.48	0.1084	126

Within level '2' of factor 'Time'
Within level 'Shallow' of factor 'Depth'
Within level 'Port' of factor 'Aspect'

Groups	t	P(perm)	Unique perms
Bow, Stern	1.1428	0.2308	126

Within level '2' of factor 'Time'
Within level 'Shallow' of factor 'Depth'
Within level 'Starbord' of factor 'Aspect'

Groups	t	P(perm)	Unique perms
Bow, Stern	1.0164	0.4632	126

Continued

Appendix D:Continued

Depth/Aspect

Term 'TixTr(DexAs)' for pairs of levels of factor 'Transect'

Within level '3' of factor 'Time'
Within level 'Deep' of factor 'Depth'
Within level 'Port' of factor 'Aspect'

Groups	t	P(perm)	Unique perms
Bow, Stern	2.4747	**0.0096**	126

Within level '3' of factor 'Time'
Within level 'Deep' of factor 'Depth'
Within level 'Starbord' of factor 'Aspect'

Groups	t	P(perm)	Unique perms
Bow, Stern	1.3147	0.176	126

Within level '3' of factor 'Time'
Within level 'Shallow' of factor 'Depth'
Within level 'Port' of factor 'Aspect'

Groups	t	P(perm)	Unique perms
Bow, Stern	2.5615	**0.0088**	126

Within level '3' of factor 'Time'
Within level 'Shallow' of factor 'Depth'
Within level 'Starbord' of factor 'Aspect'

Groups	t	P(perm)	Unique perms
Bow, Stern	1.2003	0.385	126

Continued

Appendix D:Continued

Position on Deck

Term Time

Groups	t	P(perm)	Unique perms
2, 3	2.1759	**0.0012**	4986

Term 'Postion'

Groups	t	P(perm)	Unique perms
Bow, Mid	2.1759	**0.0012**	4986
Bow, Stern	2.9565	**0.0008**	4993
Mid, Stern	5.113	**0.0002**	4991

Appendix E : Results of SIMPER analyses of reef assemblages of fish sampled in The Ex-Hmas Adelaide Articial Reef Community Sampling event 3. Cut off for percentage contribution is 90 %. Note that only relevant SIMPER results have been included in this Appendix.

Time

Groups 1 & 2
Average dissimilarity = 80.91

Species	Group 1 Av.Abund	Group 2 Av.Abund	Av.Diss	Diss/SD	Contrib%	Cum.%
Serpulid matrix	34.83	19.95	21.8	1.09	26.95	26.95
Serpulid barnacle and encrusting algae matrix	24.36	20.39	17.79	1	21.99	48.94
Large barnacle,sediment,brown fil	17.19	5.49	11.24	0.67	13.89	62.83
Herdmania momus	0.25	11.47	6.6	0.7	8.15	70.99
Turfing brown, sediment and serpulid matrix	0	10.62	5.94	0.42	7.34	78.32
Turfing brown algae	0.18	7.03	4.1	0.62	5.07	83.39
Serpulid polychaete	2.56	0.19	1.57	0.68	1.95	85.34
Ecklonia radiata	0.46	2.17	1.47	0.35	1.82	87.15
Encrusting red algae	2.17	0.27	1.3	0.4	1.6	88.76
Hydroid 1	0.78	0.61	0.89	0.34	1.1	89.86
Red branching algae	0	1.33	0.83	0.37	1.03	90.88

Groups 1 & 3
Average dissimilarity = 79.53

Species	Group 1 Av.Abund	Group 3 Av.Abund	Av.Diss	Diss/SD	Contrib%	Cum.%
Serpulid barnacle and encrusting algae matrix	24.36	35.58	20.37	1.25	25.61	25.61
Serpulid matrix	34.83	12.73	19.93	1.06	25.06	50.67
Large barnacle,sediment,brown fil	17.19	4.71	10.69	0.66	13.45	64.12
Herdmania momus	0.25	13.03	7.43	0.77	9.34	73.46
Turfing brown, sediment and serpulid matrix	0	11.66	6.55	0.51	8.23	81.69
Ecklonia radiata	0.46	4.45	2.75	0.33	3.46	85.15
Serpulid polychaete	2.56	0	1.5	0.71	1.88	87.03
Encrusting red algae	2.17	0.23	1.25	0.41	1.58	88.61
Bare ships surface	0.25	1.59	1.04	0.56	1.31	89.92
Encrusting orange bryozoan	0.56	0.86	0.68	0.57	0.85	90.77

Groups 2 & 3
Average dissimilarity = 74.34

Species	Group 2 Av.Abund	Group 3 Av.Abund	Av.Diss	Diss/SD	Contrib%	Cum.%
Serpulid barnacle and encrusting algae matrix	20.39	35.58	19.32	1.26	25.98	25.98
Serpulid matrix	19.95	12.73	12.65	0.98	17.02	43
Turfing brown, sediment and serpulid matrix	10.62	11.66	10.56	0.67	14.21	57.21
Herdmania momus	11.47	13.03	9.55	1	12.84	70.05
Large barnacle,sediment,brown fil	5.49	4.71	5.12	0.57	6.89	76.94
Turfing brown algae	7.03	0	3.98	0.63	5.35	82.29
Ecklonia radiata	2.17	4.45	3.55	0.4	4.78	87.08
Barnacle,sediment,brown fil	1.35	0.77	1.13	0.22	1.52	88.6
Bare ships surface	0.17	1.59	1.03	0.56	1.38	89.98
Encrusting orange bryozoan	1.19	0.86	0.89	0.76	1.2	91.18

Appendix E:Continued

Orientation

Groups 2Deck & 2Hull
Average dissimilarity = 76.84

Species	Group 2Deck Av.Abund	Group 2Hull Av.Abund	Av.Diss	Diss/SD	Contrib%	Cum.%
Serpulid matrix	32.26	39.4	17.77	1.3	23.12	23.12
Turfing brown, sediment and serpulid matrix	29.03	0	15.62	0.86	20.33	43.46
Turfing brown algae	0	23.33	13.88	1.32	18.07	61.53
Herdmania momus	0.13	18.3	10.3	1.5	13.41	74.93
Serpulid barnacle and encrusting algae matrix	11.72	3.71	7.82	0.51	10.17	85.1
Ecklonia radiata	5.82	0	3.15	0.52	4.1	89.21
Red branching algae	3.59	0	2.12	0.77	2.76	91.96

Groups 2Deck & 3Deck
Average dissimilarity = 66.53

Species	Group 2Deck Av.Abund	Group 3Deck Av.Abund	Av.Diss	Diss/SD	Contrib%	Cum.%
Turfing brown, sediment and serpulid matrix	29.03	29.95	19.55	1.19	29.39	29.39
Serpulid matrix	32.26	26.36	15.68	1.2	23.56	52.95
Serpulid barnacle and encrusting algae matrix	11.72	20.72	14.78	0.88	22.22	75.18
Ecklonia radiata	5.82	12.17	8.43	0.68	12.67	87.85
Red branching algae	3.59	0	2.04	0.78	3.07	90.91

Groups 2Hull & 3Deck
Average dissimilarity = 78.63

Species	Group 2Hull Av.Abund	Group 3Deck Av.Abund	Av.Diss	Diss/SD	Contrib%	Cum.%
Turfing brown, sediment and serpulid matrix	0	29.95	16.04	1.02	20.4	20.4
Serpulid matrix	39.4	26.36	15.23	1.51	19.36	39.76
Turfing brown algae	23.33	0	12.67	1.47	16.11	55.87
Serpulid barnacle and encrusting algae matrix	3.71	20.72	11.18	0.91	14.22	70.09
Herdmania momus	18.3	0	9.54	1.65	12.14	82.22
Ecklonia radiata	0	12.17	6.71	0.56	8.53	90.75

Groups 2Deck & 3Hull
Average dissimilarity = 80.55

Species	Group 2Deck Av.Abund	Group 3Hull Av.Abund	Av.Diss	Diss/SD	Contrib%	Cum.%
Serpulid barnacle and encrusting algae matrix	11.72	30.74	20.41	1.31	25.34	25.34
Turfing brown, sediment and serpulid matrix	29.03	3.54	17.07	0.93	21.19	46.53
Serpulid matrix	32.26	14.42	16.1	1.16	19.98	66.51
Herdmania momus	0.13	20.17	12.04	1.08	14.94	81.45
Ecklonia radiata	5.82	0	3.45	0.51	4.29	85.74
Bare ships surface	0	4.3	2.79	0.92	3.46	89.21
Red branching algae	3.59	0	2.37	0.74	2.94	92.14

Appendix E:Continued

Groups 2Hull & 3Hull
Average dissimilarity = 69.43

Species	Group 2Hull Av.Abund	Group 3Hull Av.Abund	Av.Diss	Diss/SD	Contrib%	Cum.%
Serpulid matrix	39.4	14.42	17.72	1.44	25.51	25.51
Serpulid barnacle and encrusting algae matrix	3.71	30.74	15.94	1.42	22.96	48.47
Turfing brown algae	23.33	0	14.4	1.38	20.73	69.2
Herdmania momus	18.3	20.17	10.5	1.4	15.13	84.33
Bare ships surface	0.08	4.3	2.55	0.99	3.67	88
Turfing brown, sediment and serpulid matrix	0	3.54	2.37	0.69	3.41	91.42

Groups 3Deck & 3Hull
Average dissimilarity = 72.61

Species	Group 3Deck Av.Abund	Group 3Hull Av.Abund	Av.Diss	Diss/SD	Contrib%	Cum.%
Turfing brown, sediment and serpulid matrix	29.95	3.54	17.08	1.08	23.53	23.53
Serpulid barnacle and encrusting algae matrix	20.72	30.74	16.06	1.34	22.11	45.64
Serpulid matrix	26.36	14.42	11.31	0.95	15.57	61.21
Herdmania momus	0	20.17	11.01	1.17	15.16	76.37
Ecklonia radiata	12.17	0	7.35	0.55	10.12	86.5
Bare ships surface	0.07	4.3	2.47	1	3.4	89.9
Red Filamentous Algae	2.96	0	1.72	0.93	2.37	92.28

Depth/Aspect

Groups 2DeepPortBow & 2DeepPortStern
Average dissimilarity = 67.15

Species	Group 2DeepPortBo	roup 2DeepPortSte	Av.Diss	Diss/SD	Contrib%	Cum.%
	Av.Abund	Av.Abund				
Herdmania momus	39.3	3.16	21.79	1.77	32.46	32.46
Large barnacle,sediment,brown fil	0	26.3	15.5	2.34	23.08	55.54
Serpulid barnacle and encrusting algae matrix	34.3	30.1	14.19	1.13	21.13	76.67
Serpulid matrix	8.48	0	5.01	0.87	7.46	84.13
Hydroid 1	2.02	5.72	3.96	0.68	5.9	90.03

Groups 3DeepPortBow & 3DeepPortStern
Average dissimilarity = 54.75

Species	Group 3DeepPortBo	roup 3DeepPortSte	Av.Diss	Diss/SD	Contrib%	Cum.%
	Av.Abund	Av.Abund				
Herdmania momus	45.49	5.54	23.18	2.73	42.33	42.33
Serpulid barnacle and encrusting algae matrix	42.57	53.41	16.54	2.03	30.22	72.55
Large barnacle,sediment,brown fil	0.25	9.74	5.81	1.22	10.61	83.16
Serpulid matrix	7.87	2.56	4.11	1.05	7.5	90.66

Appendix E:Continued

Groups 3ShallowPortBow & 3ShallowPortStern
Average dissimilarity = 65.18

	Group 3ShallowPortBow	Group 3ShallowPortSt				
Species	Av.Abund	Av.Abund	Av.Diss	Diss/SD	Contrib%	Cum.%
Large barnacle,sediment,brown fil	46.9	3.8	22.93	2.13	35.18	35.18
Herdmania momus	11.02	33.84	12.67	2.12	19.44	54.62
Serpulid barnacle and encrusting algae matrix	26.27	31.6	12.51	1.29	19.2	73.82
Barnacle,sediment,brown fil	0	12.6	6.83	0.99	10.48	84.29
Brown Scuzz	0	4.84	2.83	0.49	4.35	88.64
Hydroid 2	2.2	0.8	1.72	0.63	2.63	91.28

Groups 2DeepStarboardBow & 3DeepStarboardBow
Average dissimilarity = 42.59

	Group 2DeepStarboardBow	Group 3DeepStarboard				
Species	Av.Abund	Av.Abund	Av.Diss	Diss/SD	Contrib%	Cum.%
Serpulid barnacle and encrusting algae matrix	30.88	58.58	16.14	1.44	37.9	37.9
Herdmania momus	25.68	32.82	10.84	1.35	25.45	63.35
Large barnacle,sediment,brown fil	11.76	0.22	5.9	0.5	13.85	77.2
Biflustra perfragilis	3.24	2.7	1.49	1.62	3.49	80.69
Encrusting yellow bryozoan	0.76	2.55	1.35	1.07	3.16	83.85
Turfing brown algae	2.3	0	1.31	2.26	3.07	86.92
Hydroid 1	2.02	0	1.19	1.43	2.8	89.72
Encrusting orange bryozoan	2.52	1.46	1.18	1.44	2.77	92.5

Groups 2DeepStarboardStern & 3DeepStarboardStern
Average dissimilarity = 54.29

	Group 2DeepStarboardStern	Group 3DeepStarboardS				
Species	Av.Abund	Av.Abund	Av.Diss	Diss/SD	Contrib%	Cum.%
Serpulid barnacle and encrusting algae matrix	17.3	45.04	17.82	1.37	32.82	32.82
Large barnacle,sediment,brown fil	18.2	12.21	10.73	1.12	19.77	52.59
Herdmania momus	36.96	22.5	9.42	1.48	17.34	69.93
Turfing brown algae	13.8	0	7.66	1.18	14.12	84.05
Serpulid matrix	7.2	0.72	3.97	0.75	7.32	91.37

Groups 2ShallowPortBow & 3ShallowPortBow
Average dissimilarity = 78.55

	Group 2ShallowPortBow	Group 3ShallowPortB				
Species	Av.Abund	Av.Abund	Av.Diss	Diss/SD	Contrib%	Cum.%
Large barnacle,sediment,brown fil	0.6	46.9	29.38	2.09	37.39	37.39
Serpulid barnacle and encrusting algae matrix	21.46	26.27	17.36	1.35	22.1	59.5
Herdmania momus	19.78	11.02	9.69	1.12	12.34	71.84
Serpulid matrix	10.1	0	5.59	0.53	7.12	78.95
Barnacle,sediment,brown fil	8.98	0	4.74	0.49	6.04	84.99
Turfing brown algae	6.5	0	3.71	1.14	4.72	89.71
Hydroid 2	0	2.2	1.94	0.45	2.47	92.18

Appendix E:Continued

Groups 2ShallowPortStern & 3ShallowPortStern
Average dissimilarity = 66.56

Species	Group 2ShallowPortStoup 3ShallowPortSt Av.Abund	 Av.Abund	Av.Diss	Diss/SD	Contrib%	Cum.%
Serpulid barnacle and encrusting algae matrix	38.88	31.6	17.8	1.38	26.73	26.73
Herdmania momus	5.08	33.84	16.28	2.72	24.45	51.19
Barnacle,sediment,brown fil	13.14	12.6	11.38	1.02	17.1	68.29
Large barnacle,sediment,brown fil	17.18	3.8	8.73	1.26	13.11	81.4
Turfing brown algae	8.42	0	4.77	2.16	7.17	88.56
Brown Scuzz	0	4.84	2.99	0.47	4.5	93.06

Groups 2ShallowStarboardStern & 3ShallowStarboardStern
Average dissimilarity = 49.17

Species	Group 2ShallowStarboard Av.Abund	3ShallowStarboard Av.Abund	Av.Diss	Diss/SD	Contrib%	Cum.%
Serpulid barnacle and encrusting algae matrix	39.82	76.52	24.71	1.15	50.25	50.25
Herdmania momus	6.46	7.91	4.48	1.28	9.12	59.37
Turfing brown algae	7.68	0	4.19	1.08	8.53	67.9
Large barnacle,sediment,brown fil	5.04	1.06	2.81	0.68	5.71	73.61
Encrusting orange bryozoan	2.12	5.02	2.3	0.81	4.68	78.29
Bare ships surface	0.44	3.2	1.64	2.16	3.33	81.62
Biflustra perfragilis	1.9	2.15	1.37	1.56	2.78	84.4
Orange filamentous	1.78	0	1.27	0.49	2.57	86.98
Serpulid matrix	0.68	1.44	1.07	0.66	2.19	89.16
Encrusting red algae	1.42	0.52	0.81	1.17	1.64	90.8

Position on Deck

Groups 2 & 3
Average dissimilarity = 66.53

Species	Group 2 Av.Abund	Group 3 Av.Abund	Av.Diss	Diss/SD	Contrib%	Cum.%
Turfing brown, sediment and serpulid matrix	29.03	29.95	19.55	1.19	29.39	29.39
Serpulid matrix	32.26	26.36	15.68	1.2	23.56	52.95
Serpulid barnacle and encrusting algae matrix	11.72	20.72	14.78	0.88	22.22	75.18
Ecklonia radiata	5.82	12.17	8.43	0.68	12.67	87.85
Red branching algae	3.59	0	2.04	0.78	3.07	90.91

Groups Port & Starboard
Average dissimilarity = 65.88

Species	Group Port Av.Abund	Group Starboard Av.Abund	Av.Diss	Diss/SD	Contrib%	Cum.%
Turfing brown, sediment and serpulid matrix	35.03	23.95	20.08	1.2	30.48	30.48
Serpulid matrix	34.07	24.56	15.98	1.15	24.26	54.74
Serpulid barnacle and encrusting algae matrix	11.29	21.15	14.13	0.82	21.44	76.19
Ecklonia radiata	5.88	12.11	8.21	0.72	12.46	88.65
Red branching algae	2.23	1.36	1.81	0.63	2.74	91.39

Appendix E:Continued

Groups Bow & Mid
Average dissimilarity = 81.24

Species	Group Bow Av.Abund	Group Mid Av.Abund	Av.Diss	Diss/SD	Contrib%	Cum.%
Turfing brown, sediment and serpulid matrix	55.97	0.75	29.66	2.22	36.51	36.51
Serpulid matrix	16.81	53.02	22.39	1.65	27.56	64.08
Ecklonia radiata	0.15	26.84	15.14	1.21	18.64	82.72
Serpulid barnacle and encrusting algae matrix	7.63	1.97	4.69	0.55	5.77	88.49
Red branching algae	2.13	3.21	2.41	0.89	2.96	91.45

Groups Bow & Stern
Average dissimilarity = 58.35

Species	Group Bow Av.Abund	Group Stern Av.Abund	Av.Diss	Diss/SD	Contrib%	Cum.%
Turfing brown, sediment and serpulid matrix	55.97	31.75	22.36	1.38	38.32	38.32
Serpulid barnacle and encrusting algae matrix	7.63	39.07	20.94	1.09	35.9	74.22
Serpulid matrix	16.81	18.11	8.9	1.19	15.25	89.47
Red Filamentous Algae	2.54	1.75	1.67	0.94	2.86	92.33

Groups Mid & Stern
Average dissimilarity = 82.51

Species	Group Mid Av.Abund	Group Stern Av.Abund	Av.Diss	Diss/SD	Contrib%	Cum.%
Serpulid matrix	53.02	18.11	22.24	1.47	26.95	26.95
Serpulid barnacle and encrusting algae matrix	1.97	39.07	20.4	1.08	24.73	51.68
Turfing brown, sediment and serpulid matrix	0.75	31.75	16.72	1.07	20.26	71.94
Ecklonia radiata	26.84	0	14.74	1.2	17.87	89.81
Lobed brown algae	3.42	0	2.04	0.77	2.47	92.28

Appendix F : Distance based test for homogeneity of multivariate dispersion between survey times 2 and 3. Significant results in bold

All Sites (Time)

P(perm)	**0.0002**	
Groups	t	P(perm)
(1,2)	6.47E-02	0.9494
(1,3)	3.8052	**4.00E-04**
(2,3)	3.7691	**1.20E-03**

Orientation

P(perm):	0.2836	
Groups	t	P(perm)
(2,3)	1.17	0.2718

Depth/Aspect

P(perm):	**0.0448**	
Groups	t	P(perm)
(2,3)	2.3918	**4.44E-02**

Position on Deck

P(perm):	0.243	
Groups	t	P(perm)
(2,3)	1.3532	0.24