Cardno Ecology Lab

Shaping the Future

Marine and Freshwater Studies

Ex-HMAS Adelaide Artificial Reef

Reef Community Monitoring

Survey 10

Job Number: EL1112024 M

Prepared for: Department of Primary Industries – Catchments and Lands

March 2014

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Cover Image: Black banded sea perch (*Hypoplectrodes nigroruber*). Chris Roberts (Cardno Ecology Lab).

Document Control

Report Number	Status	Date	Author		Reviewer	
EL1112024 M	Draft	21.03.14	Kate Reeds	KAR	Dr Lachlan Barnes	LB
EL1112024 M	Final	31.03.14	Kate Reeds	KAR	Dr Lachlan Barnes	LB

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 10 (**Table ES 1**), as required as part of the LTMMP. Surveys have been carried out on a quarterly basis since the scuttling of the ship in April 2011. The scope of work to be carried out by Cardno Ecology Lab was initially for a two year period post-scuttling (a total of eight reef community surveys), however, as the LTMMP is currently under review, a ninth and tenth reef community surveys have taken place in the interim. This Progress Report outlines the methodology and findings of Reef Community Survey 10 (Survey 10).

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 done as part of Survey 10 were carried out on 3rd and 4th March 2014. Survey methods involved using divers to take photoquadrats and under water video transects 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 previous Monitoring Surveys. Underwater video footage was reviewed and also used to describe the encrusting reef assemblage and fish species present.

Over the four month period between Surveys 9 (carried out in October 2013) and 10, the total percent cover of serpulid, barnacles and turfing algae, solitary ascidians and tiny orange anemones has increased, whereas the large barnacle matrix, early colonising matrix, red encrusting algae and brown filamentous algae/hydroid have all decreased in total percentage cover. The percent cover of algal and bryozoan groups has also decreased whereas there has been an increase in sponges, ascidians and cnidarians (particularly anemones). Despite these changes, analysis of photoquadrats taken from different parts of the ship showed that the number of individual taxa or groups of taxa (32 recorded in total) was similar to Survey 9 and that the assemblages sampled in the two surveys were not significantly different.

The most abundant category identified in Survey 10 in terms of total percentage cover was an encrusting matrix of serpulid polychaete worms, barnacles and turfing algae (serpulid/barnacle matrix), which was also the most abundant category in the previous survey. Other numerically abundant categories included solitary ascidians, the conglomeration of large barnacles, sediment and brown filamentous algae, tiny orange anemones (*Corynactis* sp.), 'early colonising matrix', red encrusting algae and brown filamentous algae/hydoid.

As for previous surveys, analysis of photoquadrats showed a strong and recurrent pattern of assemblages occurring on horizontally orientated (deck) surfaces being different in composition from the vertically orientated (hull) assemblage mainly due to a greater percent cover of serpulid, barnacle and encrusting algal matrix, red encrusting algae and *Ecklonia radiata* on the deck than on the hull and a greater percent cover of large barnacle, sediment and brown filamentous algae matrix, solitary ascidians, tiny orange anemones and early colonising matrix on the vertically orientated hull surfaces. No obvious patterns relating to depth or deck position were evident, although in general, the assemblage associated with the mid deck was characterised by *Ecklonia radiata* and red encrusting algae. No known pest species were recorded during the survey.

The number of fish species observed by divers and from video and fixed photos has generally increased since scuttling of the ship in April 2011, but has remained similar for the past four surveys (between 25 and 26 species recorded in total). A wobbegong shark (*Orectolobus* sp.) and black reef leatherjacket (*Eubalichthys bucephalus*) were both recorded for the first time during Survey 10. Both are commonly found on coastal reefs along the New South Wales Coast.

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	03 and 04 May 2012	1 year post scuttling
Monitoring Survey 4	27 July 2012	1 year 3 months post scuttling
Monitoring Survey 5	31 October and 01 November 2012	1 year 6 months post scuttling
Monitoring Survey 6	16 and 17 January 2013	1 year 9 months post scuttling
Monitoring Survey 7	29 and 30 April 2013	2 years post scuttling
Monitoring Survey 8	16 and 17 July 2013	2 years 3 months post-scuttling
Monitoring Survey 9	16 and 21 October 2013	2 years 6 months post-scuttling
Monitoring Survey 10	03 and 04 March 2014	2 years 11 months 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
Epifauna	Animals that live on the surface of the seabed
Epiphytic	Growing on the surface of.
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.
Macroinvertebrate	Organisms associated with sediment and retained in a sieve of 0.5 to 1.0 mm
LAT	Lowest Astronomical Tide
LTMMP	Long Term Monitoring and Management Plan
PCoA	Principle Coordinates Analyses
PERMANOVA	Permutational Analysis of Variance. A statistical routine run in Primer-E.
SIMPER	Similarity Percentage Analysis. 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 and a review is currently underway. It includes the following environmental monitoring components:

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

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, however, during this interim review period, the scope has been extended to include additional surveys. This Progress Report outlines the methodology and findings for the tenth reef community survey to continue surveys which have been carried out on a quarterly basis since April 2011.

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.

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 Ex-HMAS Adelaide 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 from the keel 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, 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 cover, 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 Monitoring Survey 3

The colonisation of the Ex-HMAS Adelaide, approximately one year post- scuttling, was substantial and the assemblage that had formed was consistent with observations on similar artificial structures on the east coast of Australia and abroad. 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 was the serpulid polychaete, barnacle and encrusting algal matrix. Several new taxa/groups were also recorded. Analysis of spatial differences and comparison through time indicated that the assemblage recorded on the ship was significantly different to that in previous surveys, although the effect of time was not consistent among parts of the ship. The encrusting layer had become notably thicker on certain parts of the ship since the previous survey. Kelp (*Ecklonia radiata*) and red branching algae had continued to grow substantially on parts of the ship (particularly the mid deck) since the previous survey. Fish abundance and species richness observed around the Ex-HMAS Adelaide had not increased substantially since the previous survey, although several new species were recorded.

1.3.5 Monitoring Survey 4

Fifteen months post-scuttling the entire ship was covered with an encrusting layer of serpulid polychaete tubes, barnacles, encrusting bryozoans, sponges and ascidians among other groups. Taxa/groupings that were well represented during the fourth survey included the ascidian *Herdmania momus,* large barnacle, sediment and brown filamentous algae matrix and turfing brown algae, sediment and serpulid matrix. New taxa included an orange colonial ascidian (likely to be *Botryloides leachi*) and a purple sponge, although these groups were present in low abundances. Overall, there appeared to be a transition from an assemblage numerically

dominated by an encrusting serpulid matrix to that dominated by barnacles and ascidians. Analysis of spatial differences and temporal comparison indicated that the assemblage recorded on the ship was significantly different to that in previous surveys, although there were similarities in some of the spatial patterns with orientation continuing to be an important factor in structuring the reef assemblage. Inspection of the fixed photos indicated that the encrusting layer had become marginally thicker on certain parts of the ship such as ladders and railings, but not on others. Fish abundance and species richness decreased in comparison with the earlier monitoring survey although two new species (batfish (*Platax* sp.) and dusky flathead (*Platycephalus fuscus*)) were recorded in survey 4.

1.3.6 Monitoring Survey 5

Survey 5 showed that the number of individual taxa or groups of taxa of sessile benthic biota had increased since previous surveys, although the assemblage was becoming less variable and more uniform over the ship as a whole. Similar taxa to those observed in the previous survey were recorded, with the serpulid, barnacle and encrusting algal matrix being numerically abundant, although there appeared to have been an increase in the percent cover of *Ecklonia radiata*, large barnacles and the bryozoan *Biflustra perfragilis*. Several taxa/groupings not previously documented on the ship included two new categories of colonial ascidians and a polyplacophoran (chiton). Analysis of spatial differences and comparison through time indicated that the assemblage recorded on the ship 18 months post-scuttling was significantly different to that in previous surveys, although there were similarities in some of the spatial patterns. Orientation continued to be an important factor in structuring the reef assemblage, with deck and hull surfaces being consistently different. Reef assemblages on the deck surfaces of the ship also varied consistently through time, with position (bow, mid ship or stern) being an important factor, although this was also dependent on whether transects were on the port of starboard side of the ship. Fish abundance and species richness had generally increased during Survey 5 compared to previous surveys and several new species were observed. These included eastern hula fish (*Trachinops taeniatus*), schooling bannerfish (*Heniochus diphreutes*), blotched hawkfish (*Cirritichthys aprinus*), eastern kelpfish (*Chironemus marmoratus*), rock cale, (*Crinodus lophodon*), comb wrasse (*Coris picta*) and six spined leatherjacket (*Meuschenia freycineti*). A pair of eastern blue groper (*Archoerodus viridis*) was also observed during this survey.

1.3.7 Monitoring Survey 6

Although the number of epibenthic taxa, or groupings of taxa recorded during survey 6 (approx. 21 months post scuttling) had decreased slightly since the previous survey, the general pattern of assemblages becoming less variable throughout time was still apparent. Again, the serpulid, barnacle and encrusting algal matrix was numerically dominant, although a noticeable increase in cover of encrusting bryozoans and sponges was apparent. As for previous surveys, the ascidian, *Herdmania momus* and the common kelp, *Ecklonia radiata* were well represented on the ships surface. A number of taxa not previously recorded in other surveys were observed, including white tubular sponges, unidentified globular ascidians and numerous dead barnacles. In terms of spatial and temporal patterns, orientation (i.e. deck vs hull surfaces), depth (i.e. superstructure vs hull) and position (i.e. bow vs mid-ships vs stern) were again key factors in structuring the reef assemblage associated with the ship. Fish abundance and species richness was similar between surveys 5 and 6, although a new species of leatherjacket (*Eubalichthys mosaicus*) was observed.

1.3.8 Monitoring Survey 7

The assemblage sampled in Survey 7 was similar to that observed in the previous survey with the serpulid, barnacle and encrusting algal matrix being numerically abundant, but with notable increases in the percent cover of bare surface, large barnacle/sediment and brown filamentous algae matrix, and serpulid matrix. Other taxa/groupings that were well represented during the survey (and have been abundant in previous surveys) included the ascidian *Herdmania momus,* and the common kelp *Ecklonia radiata*. Categories that decreased between Monitoring Surveys 6 and 7 were encrusting red algae, white papillate sponge, the laced bryozoan *Biflustra perfragilis* and encrusting orange bryozoan. New taxa recorded in Survey 7 included a small orange anemone and two unidentified solitary ascidians. Orientation continued to be an important factor in structuring the reef assemblage on the ship, although differences were not consistent for both Surveys 6 and 7. Depth was not found to be a significant factor in structuring assemblages associated with the vertical surfaces of the superstructure and the hull. Reef assemblages on different sections of the deck (i.e. bow mid ship and stern) also varied from one another, although differences were not consistent through time. A total of 26 species of fish,

including six new species (Gunther's butterflyfish (*Chaetodon guentheri*), magpie morwong (*Cheilodactylus vestitus*), southern fusilier (*Paracaesio xanthurus*), Gunther's wrasse (*Pseudolabrus guntheri*), luculentus wrasse (*Psuedolabrus luculentus*), and the black-banded sea perch (*Hypoplectrodes nigroruber*), were recorded during Survey 7.

1.3.9 Monitoring Survey 8

In general, similar taxa to those observed in the previous survey were recorded in Survey 8, with the serpulid, barnacle and encrusting algal matrix being numerically most abundant, followed by the conglomeration of large barnacles, sediment and brown filamentous algae and the solitary ascidian *Herdmania momus*. As for previous surveys, analysis of photoquadrats showed a strong and recurrent pattern of assemblages occurring on horizontally orientated (deck) surfaces being different in composition from the vertically orientated (hull) assemblage. Deck position (i.e. bow, mid ship and stern) also appeared to be a significant factor whereas depth was not. Some less abundant taxa of soft corals, hydroids and other unidentified algae were observed growing on the deck and superstructure, but were not captured within the photoquadrat survey as they were sparsely distributed. This highlights the importance of using a variety of sampling techniques to gain a better understanding of the overall species diversity rather than reliance upon a single method. In total, 26 species of fish, including several species not previously observed, were recorded during Survey 8. New species identified included a Port Jackson shark (*Heterodontus portusjacksoni*), samson fish (*Seriola hippos*), moon wrasse (*Thalassoma lunare*), eastern wirrah (*Acanthistius ocellatus*), rainbow runner (*Elagatis bipinnulata*) and one spot puller (*Chromis hypsilepis*). Several migrating whales and a pod of dolphins were also observed by divers during the field survey.

1.3.10 Monitoring Survey 9

Analysis of photoquadrats showed that the number of individual taxa or groups of taxa (33 recorded in total) was similar to Survey 8 and that the assemblages sampled in the two surveys were not significantly different. Similar taxa to those observed in the previous survey were recorded in Survey 9, with the serpulid, barnacle and encrusting algal matrix being numerically most abundant, followed by an early colonising matrix, the conglomeration of large barnacles, sediment and brown filamentous algae and solitary ascidians. Two new species (an echinoderm and colonial ascidian) were also recorded by divers in Survey 9, but were not captured in any photoquadrats. As for previous surveys, analysis of photoquadrats showed that assemblages occurring on horizontally orientated (deck) surfaces were very different in composition from the vertically orientated (hull) assemblage. Deck position (i.e. bow, mid ship and stern) also appeared to be a significant factor in determining epibenthic assemblage composition, whereas depth was not. The number of fish species observed has remained the same (26 species in total) from Surveys 8 and 9. No new species of fish were observed, however, a pair of cuttlefish (*Sepia* sp.) was filmed near the wheelhouse of the ship camouflaged against the deck.

A summary of sampling dates and surveys carried out to date is provided in **Table 1**:

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	03 and 04 May 2012	1 year post scuttling
Monitoring Survey 4	27 July 2012	1 year 3 months post scuttling
Monitoring Survey 5	31 October and 01 November 2012	1 year 6 months post scuttling
Monitoring Survey 6	16 and 17 January 2013	1 year 9 months post scuttling
Monitoring Survey 7	29 and 30 April 2013	2 years post scuttling
Monitoring Survey 8	16 and 17 July 2013	2 years 3 months post-scuttling
Monitoring Survey 9	16 and 21 October 2013	2 years 6 months post-scuttling
Monitoring Survey 10	03 and 04 March 2014	2 years 11 months 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. 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 on port and starboard aspects).
- x 30 photoquadrats in total (x 5 per transect).

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

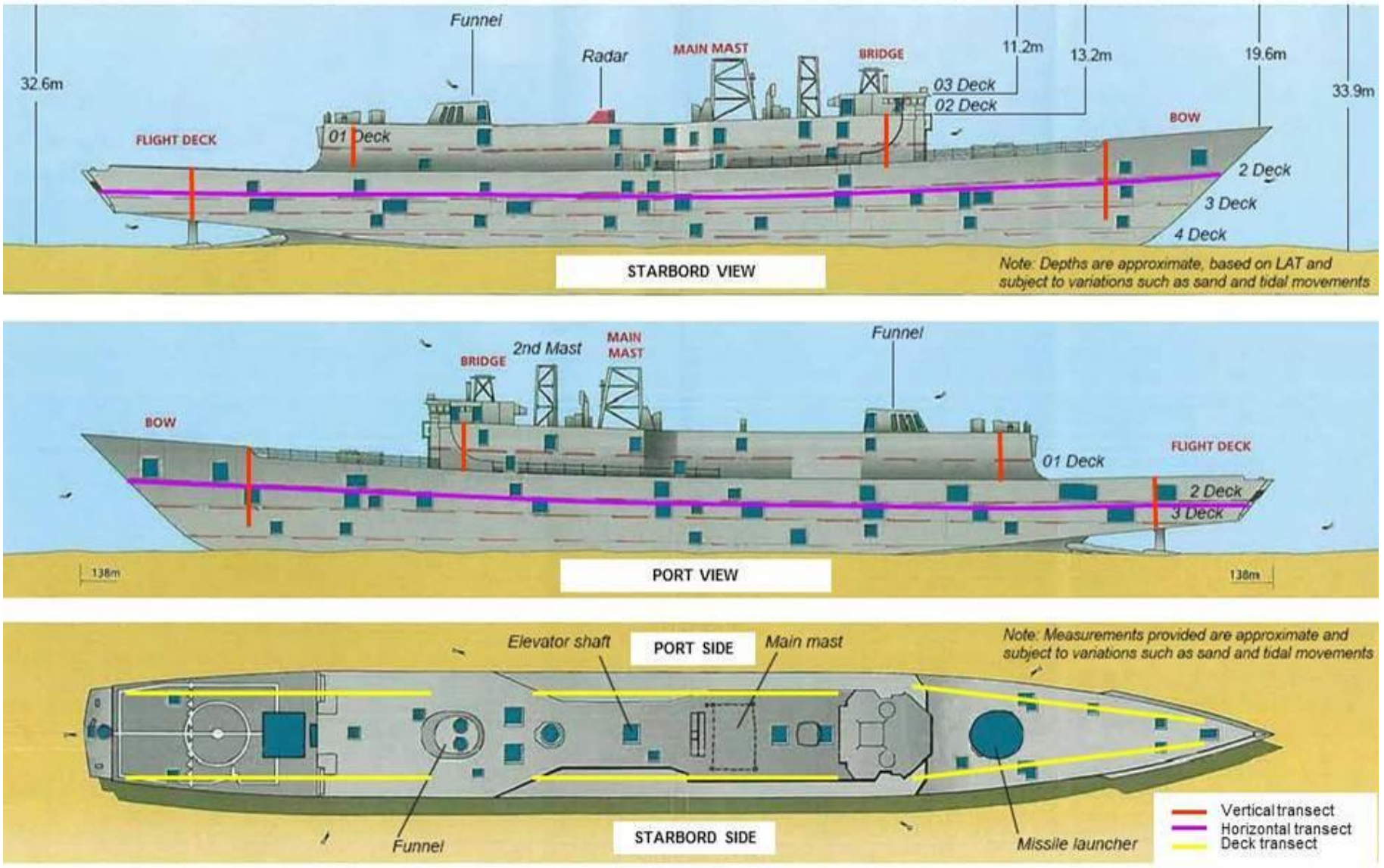

Figure 2: Plans of the Ex-HMAS Adelaide and Positions of the Reef Community Survey Sampling Transects.

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 of 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 was to provide a qualitative record of changes to reef assemblages over time. 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 with 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. The total number of each taxon/group 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 species level identification of many encrusting organisms such as sponges, bryozoans and ascidians may not be 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.

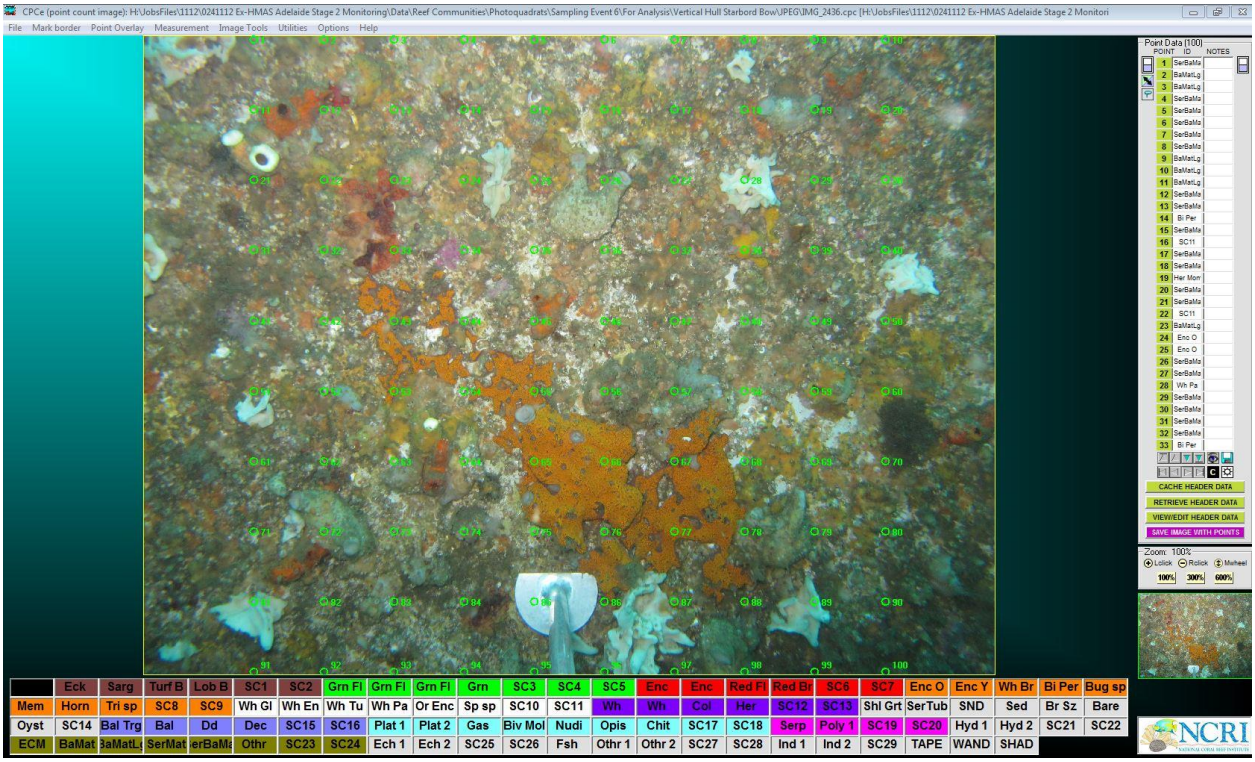

Figure 3: Screenshot of the CPCe Photoquadrat Analyses Frame with a Virtual 10 x 10 Grid Overlayed.

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 statistical techniques. 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 subsequent analyses to investigate both spatial and temporal trends between the current and preceeding surveys, in this case, Surveys 9 and 10. The four null hypotheses tested were:

1. No significant differences in reef assemblage structure among all survey times.

The design to test this hypothesis was as follows:

- Time (Surveys 1 - 10): fixed, orthogonal;

This design compared reef assemblage structure among the nine sampling surveys to date (regardless of their spatial positioning on the ship). Note that for this ninth survey, mean, total percentage cover per survey was used due to the large data set.

2. No significant differences in reef assemblage structure between horizontally orientated (i.e. deck) surfaces and vertically orientated (hull) surfaces on both the port and starboard sides of the ship between times.

The design to test these hypotheses was as follows:

- Time (Survey 9/Survey 10): fixed, orthogonal;

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

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

3. No significant differences in reef assemblage structure between deep and shallow vertical transects on both the port and starboard sides of the ship between times.

The design to test these hypotheses was as follows:

- Time (Survey 9/Survey 10): fixed, orthogonal;
- Depth (shallow/deep): fixed, orthogonal;
- Aspect (port/starboard): fixed, orthogonal;
- Transect: nested (depth x aspect), random.

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

4. No significant differences in reef assemblage structure among positions (deck surface only) on both the port and starboard sides of the ship between times.

The design to test these hypotheses was as follows:

- Time (Survey 9/Survey 10): 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). Although the CPCe coral code file used in Survey 9 was the same as for previous surveys, categories were grouped into broader classifications for purpose of the statistical analysis to reduce the chance of inconsistencies and subjectivity in identifications due to variability in photographic quality or colour across surveys.

Multivariate data were represented graphically using Principle 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).

2.2.2 Fixed Point Photographs

Photographs were taken at 10 fixed point locations. This was to provide a qualitative record of changes to reef assemblages over time. Notes were taken on the exact location, distance from the structure or reference point, and depth at which the photographs were taken.

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 during 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.

2.3 Limitations

- Photographic quality and hence the ability to accurately identify taxa was dependent on the conditions at the time of sampling. Good quality photoquadrats may therefore result in the identification of a greater number of taxa than would be the case for photoquadrats where visibility was poor;
- Certain taxa were harder to distinguish and identify than others, potentially resulting in a bias towards more conspicuous species. Sponges, bryozoans and colonial ascidians were often difficult to distinguish from one another;
- Only organisms visible on the surface of the encrusting layer were recorded in photoquadrats. Organisms living embedded within or beneath the encrusting layer may therefore be under represented;
- Fish observations carried out as part of these surveys were not quantitative and should be treated as indicative only.

3 Results

3.1 Photoquadrats

3.1.1 General Findings

In total, 32 categories/groups of taxa were identified from the 82 quadrats that were sampled during Survey 10 (**Appendix B**). The most abundant category identified in Survey 10 in terms of total percentage cover was an encrusting matrix of serpulid polychaete worms, barnacles and turfing algae (serpulid/barnacle matrix), which was also the most abundant category in the previous survey and contributed to over 70% of cover of the total area sampled. Other categories contributing greater than 1% of total mean percent cover included solitary ascidians, including *Herdmania momus* and other taxa (10.1%), the conglomeration of large barnacles, sediment and brown filamentous algae (large barnacle matrix) (5.0%), tiny orange anemones (*Corynactis* sp.) (4.2%), 'early colonising matrix' (3.3%), red encrusting algae (2.0%) and brown filamentous algae/hydroid (1.2%).

Over the four month period between Surveys 9 and 10, the total percent cover of serpulid, barnacles and turfing algae, solitary ascidians and tiny orange anemones has increased, whereas the large barnacle matrix, early colonising matrix, red encrusting algae and brown filamentous algae/hydroid have all decreased in total percentage cover. Overall, the percent cover of algal and bryozoan groups has also decreased whereas there has been an increase in sponges, ascidians and cnidarians (particularly anemones).

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 from the Baseline and Monitoring Surveys 1-10 are presented in **Plates 1 – 16**.

3.1.2 Spatial and Temporal Variation in Reef Communities

All Times (Surveys 1-9)

Overall, time was a significant factor in terms of explaining variability in reef assemblages associated with the ship (**Appendix C**). Pair-wise tests indicated that the assemblages recorded differed significantly among surveys with the exceptions of Surveys 2 and 3, 4 and 7, 4 and 8, 5 and 6, 7 and 8 and Surveys 9 and 10 (**Appendix D**). **Figure 4** also shows that approximately 68.9% of the total variation among samples was explained by the two axes within the PCoA. This difference is further explained by the significant PERMDISP result for the factor 'Time' which shows greater variability (or dispersion) among transects in Surveys 1-3 and less variability (i.e. greater clustering of points) in Surveys 4-10 (**Figure 4**, **Appendix F**).

Time, Orientation (deck and hull) and Aspect (port and starboard)

The assemblage of sessile invertebrates found on horizontal deck surfaces was consistently different from that of the vertical hull surfaces in both Surveys 9 and 10 (**Appendix C**). This difference is clear from the grouping of points in the PCoA which explains 75.8% of the total variation among samples (**Figure 5)**. Aspect (i.e. port vs starboard) also influenced the composition of reef assemblages associated with the deck and hull but these patterns were not consistent through time (**Appendix D**).

SIMPER analyses indicated that differences in the average percent cover of serpulid, barnacle and encrusting algal matrix, large barnacle, sediment and brown filamentous algae matrix, solitary ascidians, tiny orange anemones, red encrusting algae, early colonising matrix and *Ecklonia radiata* contributed to over 86% of the dissimilarity in community composition between the deck and hull surfaces. This was due to a greater percent cover of serpulid, barnacle and encrusting algal matrix, red encrusting algae and *Ecklonia radiata* on the deck than on the hull and a greater percent cover of large barnacle, sediment and brown filamentous algae matrix, solitary ascidians, tiny orange anemones and early colonising matrix on the vertically orientated hull surfaces (**Appendix E**).

PERMDISP for the factor orientation was not significant, indicating that the differences in orientation (between hull and deck) and time were due to actual spatial/temporal differences and not dispersion among samples (**Appendix F**).

Time, Depth (shallow and deep) and Aspect (port and starboard)

No clear patterns in assemblage structure relating to time, depth or aspect were evident, although there was a significant interaction at the level of transects. These were not, however, consistent through time, between depths or aspect (**Figure 6, Appendix C**). Pair wise tests showed that significant differences between deep and shallow transects occurred at the bow and stern on the starboard side of the ship during Survey 9 but were only evident at the port bow in Survey 10 (**Appendix D**). SIMPER analyses indicated that these differences were due to variability in the percent cover of large barnacle, sediment and brown filamentous algae matrix, early colonising matrix, solitary ascidians, serpulid, barnacle and encrusting algae matrix, although no consistent patterns were observed relating to depth (**Appendix E**).

No significant difference in the dispersion of samples within each survey was evident for the significant interaction term (**Appendix F**).

Time, Position (bow, mid ship, stern) and Aspect (port and starboard)

Significant differences in sessile reef assemblages among the three positions on the ship's deck surface (i.e. bow, mid ship or stern) were detected, although these were not consistent with Time or Aspect (**Appendix C**). Pair-wise tests indicated that during Survey 9, the mid ship assemblage was different to that of the bow and stern on both the starboard and port sides of the ship (**Appendix D**). SIMPER analyses indicated that these differences were mainly due to a greater percent cover of red encrusting algae and *Ecklonia radiata* at the mid ship than stern or bow (**Appendix E**). During Survey 10, the bow assemblage was different from the stern and mid ship assemblage, but only on the port side and the mid ship assemblage differed from the bow and stern, but only on the starboard side (**Appendix D**). SIMPER analyses indicated that portside variation was due to greater percent cover of serpulid barnacle and encrusting algae matrix at the bow and the absence of encrusting red algae. Differences among positions on the starboard side of the deck were mainly due to a greater percent cover of *Ecklonia radiata* and red encrusting algae at the mid ship and a lower percent cover of serpulid, barnacle and encrusting algae matrix (**Appendix E**).

This is illustrated in the corresponding PCoA plot which shows that approximately 84.4% of the total variation among samples could be explained by the two axes in the ordination (**Figure 7**). The PCoA also shows that the variability among replicate samples was greater for the mid-ship position compared with either the bow or the stern positions (**Figure 7**). This pattern was further highlighted within the PERMDISP results, with highly significant differences in the dispersion of samples detected for the interaction term (**Appendix F**).

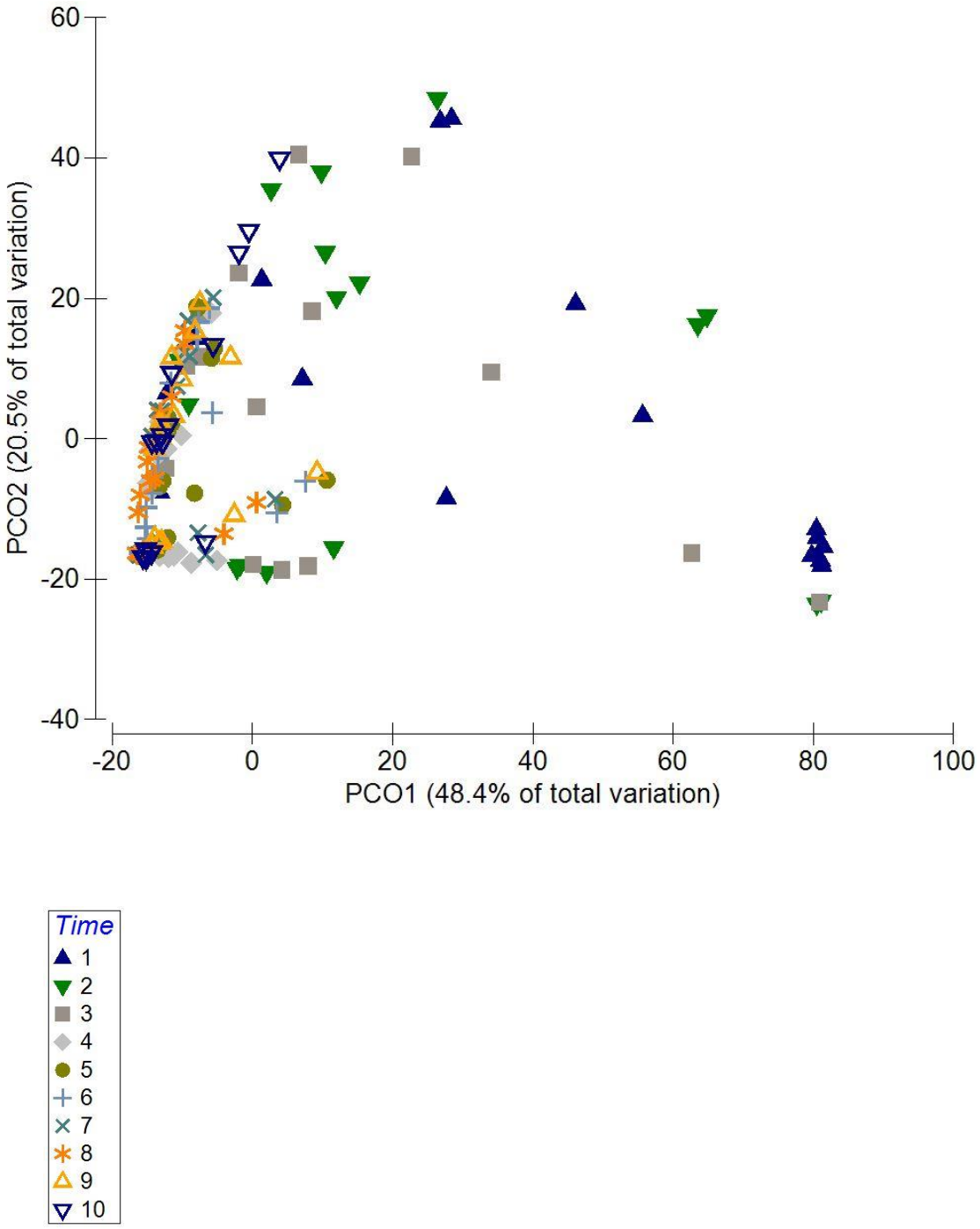

Figure 4: Principal Coordinates Analyses (PCoA) of Percent Cover of Encrusting Assemblages from Transects Taken at all Positions on the Ex-HMAS Adelaide for Surveys 1 to 10.

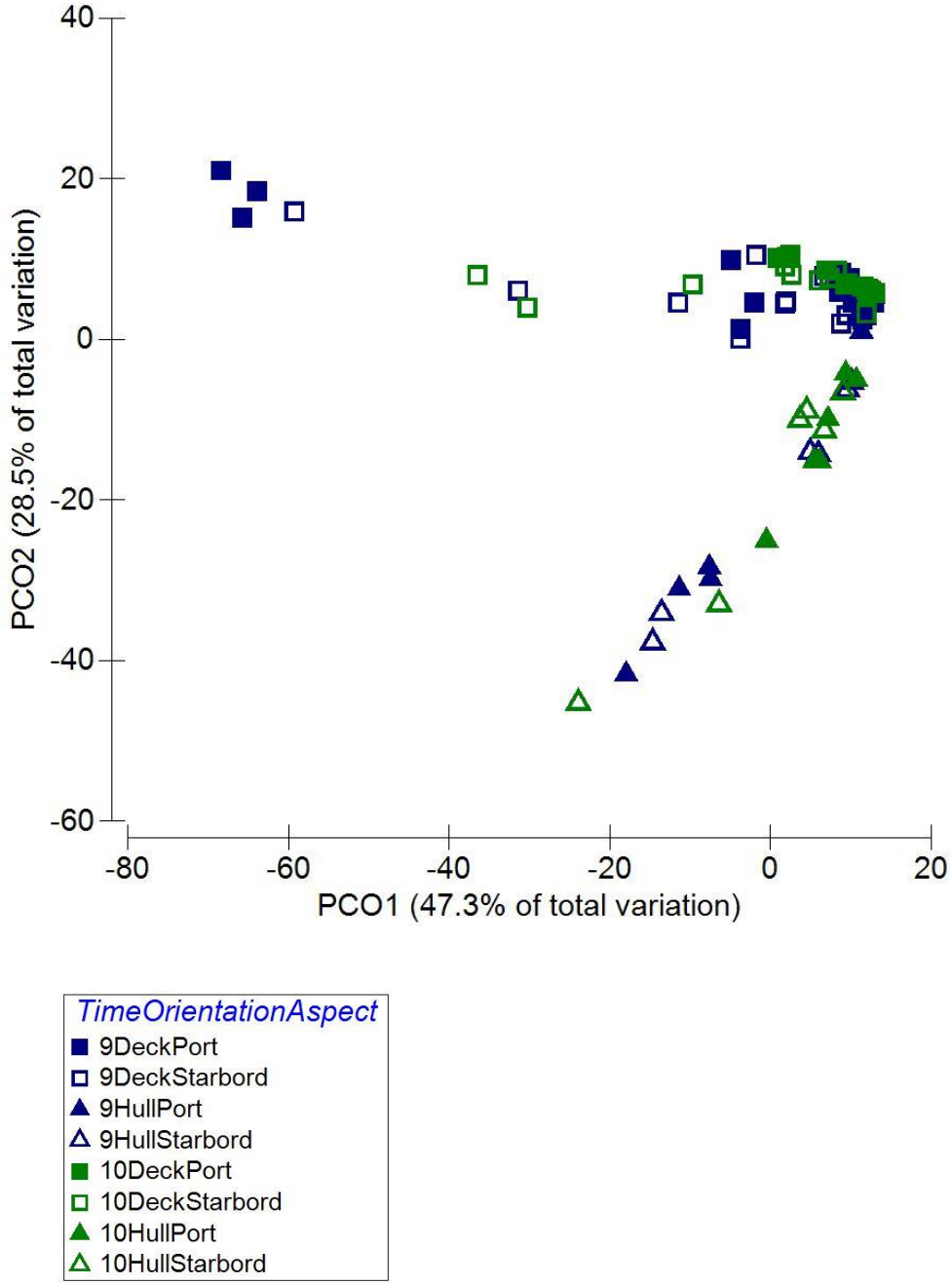

Figure 5: Principal Coordinates Analyses (PCoA) of Percent Cover of Encrusting Assemblages from Transects Taken on Hull and Deck Surfaces of the Ex-HMAS Adelaide for Surveys 9 and 10.

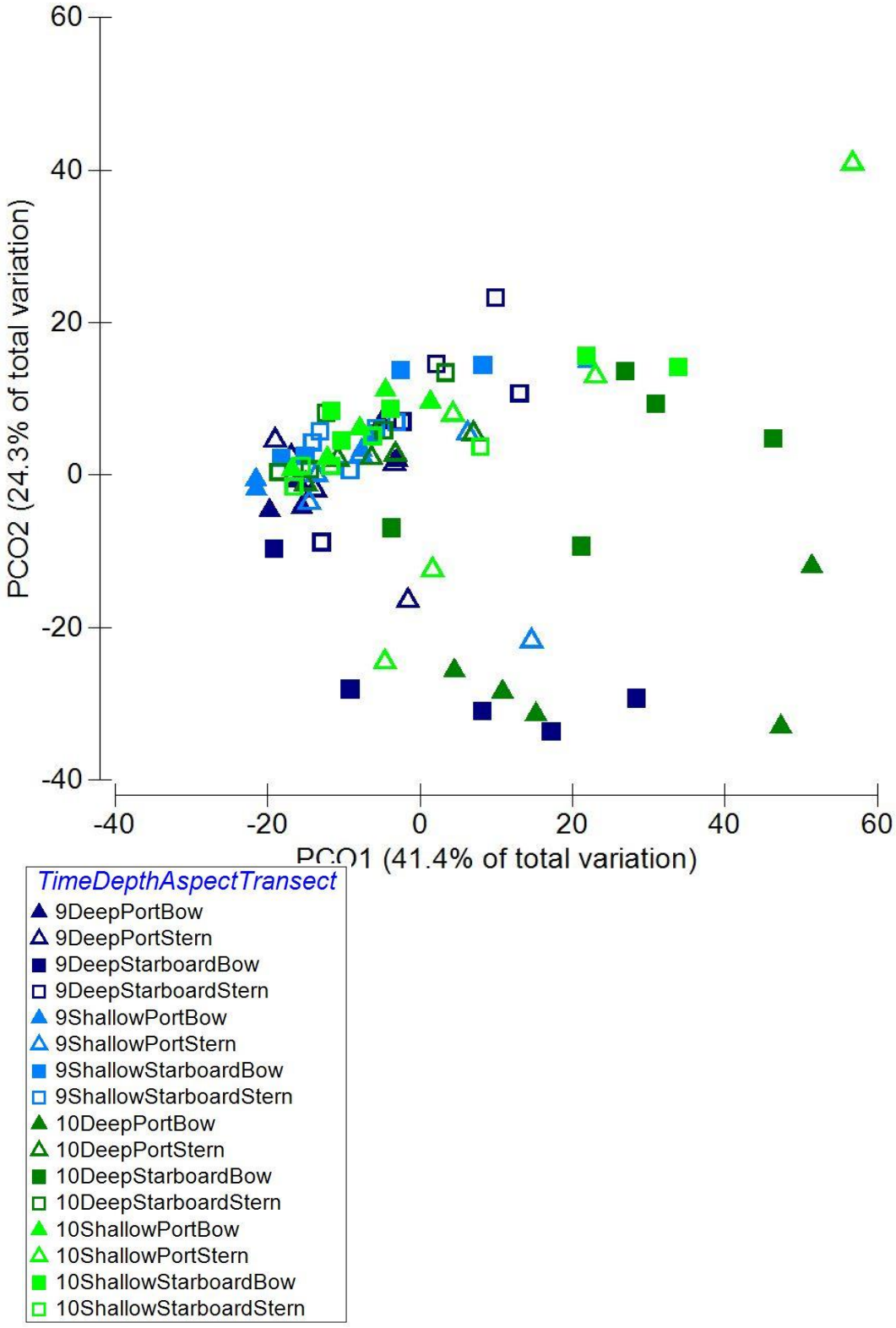

Figure 6: Principal Coordinates Analyses (PCoA) of Percent Cover of Encrusting Assemblages from Transects at Different Depths and Aspect on the Ex-HMAS Adelaide for Surveys 9 and 10.

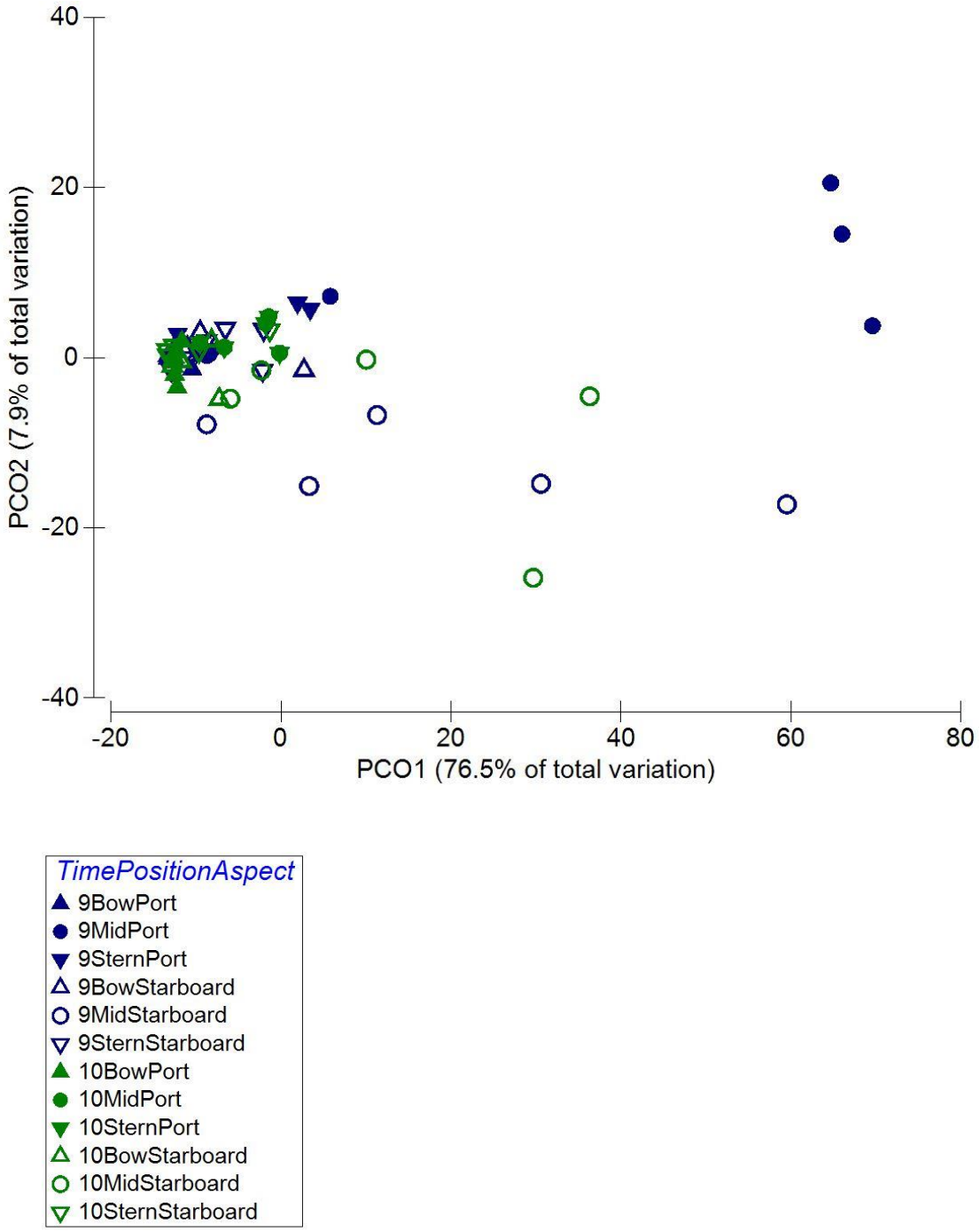

Figure 7: Principal Coordinates Analyses (PCoA) of Percent Cover of Encrusting Assemblages from Transects Taken at Different Positions on the Deck Ex-HMAS Adelaide for Surveys 9 and 10.

3.2 Fixed Photographs

Photographs taken from fixed locations are presented in **Appendix A.** Overall the encrusting assemblage does not appear to have changed significantly over the past four months between Survey 9 and 10 and remains to consist of a thick encrusting layer over more complex structures such as ladders, railings and masts and to a lesser extent on deck surfaces.

3.3 Video Transects

The results of observations made from video transects are summarised in **Table 2** below. All fish species observed during previous surveys and the current monitoring survey (Survey 10) are listed in **Table 3**. Species of recreational, commercial or conservation value are also indicated. A total of 25 species of fish including two not previously recorded during the monitoring program (wobbegong (*Orectolobus* sp.) and black reef leatherjacket, (*Eubalichthys bucephalus*)) were identified.

Table 2: Summary of Observations of Attached Encrusting and Fish Assemblages Observed from Video Footage of the Ex-HMAS Adelaide in March 2014 (Survey 10).

Position	Description of Assemblage
Deck Port Bow	The deck surface was encrusted with a uniform assemblage of small barnacles, encrusting algae, hydroids and fine filamentous algae. Erect red and white, tubular solitary sponges and white papillate encrusting sponges and orange encrusting sponge were also conspicuous. Eastern hulafish (*Trachinops taeniatus*), schools of tarwhine (*Rhabdosargus sarba*), yellowtail kingfish (*Seriola lalandi*), silver drummer (*Kyphosus sydneyanus*), white ear (*Parma microlepis*), Eastern blue groper (*Achoerodus viridis*), black reef leatherjacket (*Eubalichthys bucephalus*), and silver trevally (*Pseudocaranx dentex*) were all observed.
Deck Port Mid	As per previous surveys, kelp (*Ecklonia radiata*) remained present in this area. The majority of the deck was otherwise heavily encrusted with barnacles, encrusting red algae, hydroids and fine filamentous algae, with patches of white encrusting sponges. Yellowtail kingfish, girdled scalyfin (*Parma unifasciata*), tarwhine, schools of Eastern hulafish, old wife (*Enoplosus armatus*), red morwong (*Cheilodactylus fuscus*), six-spined leatherjacket (*Meuschenia freycineti*), silver trevally, magpie morwong (*Cheilodactylus vestitus*), and Eastern blue groper were observed in this area.
Deck Port Stern	The deck was predominantly covered in serpulid tubes, barnacles, encrusting algae, fine filamentous algae and a fine layer of sediment. Tubular solitary sponges and white papillate encrusting sponges were conspicuous on the deck surface. A wobbegong (*Orectolobus sp.*) and silver drummer were observed close to the deck surface.
Deck Starboard Bow	As with previous surveys, encrusting growth included barnacles, algae and hydroids with patches of encrusting sponges. A fine layer of sediment was noted on the surface. Solitary, tubular, red, pink and white sponges were observed on the deck. Tarwhine, stripey and Eastern hulafish were present in schools. Red morwong, rock cale, Eastern red scorpioncod (*Scorpaena cardinalis*), white ear, eastern blue groper, crimson banded wrasse (*Notolabrus gymnogenis*), yellow-fined leatherjacket, black reef leatherjacket, silver drummer and blotched hawkfish were observed.
Deck Starboard Mid	As per previous surveys, the majority of the deck was encrusted with barnacles, encrusting algae, hydroids, fine red filamentous algae and small branching hard corals. There were also large amounts of kelp (*Ecklonia radiata*). A layer of fine sediment was noted on the surface. Rock cale, a kelp associated species, was present in this area. Tarwhine, crimson banded wrasse, brown spotted wrasse (*Notolabrus parilus*), six-spined leatherjacket, yellowtail kingfish, silver sweep (*Scorpis lineolatus*), Eastern blue groper, girdled scalyfin and old wife were recorded.

Deck Starboard Stern	Small barnacles, encrusting algae, hydroids, fine filamentous algae and white encrusting sponges were abundant on flat areas of the deck. A fine layer of sediment was noted on the surface. Tarwhine, eastern hula fish and silver trevally were present in schools. Rock cale (*Crinodus lophodon*), Eastern blue groper and Eastern red scorpioncod were also recorded.
Horizontal Hull Port and Starboard	The hull remains colonised by sessile invertebrates, particularly ascidians, on both the port and starboard sides. As with previous surveys, these included various ascidians such as *Herdmania momus*, large barnacles and encrusting sponges and bryozoans. Tiny orange anemones (*Corynactis* sp.) have also become conspicuous forming a thin layer over barnacles. Growth still appeared thickest around the gunwale and around the edges of holes in the hull. Otherwise, the hull remained heavily encrusted with serpulid worm tubes covered with small barnacles, encrusting algae, hydroids and fine filamentous algae. The white papillate bryozoan (*Triphyllozoan* sp.) was conspicuous in distinct colonies. Yellowtail kingfish, stripey (*Microcanthus strigatus*) and tarwhine were observed swimming alongside the hull.
Vertical Hull Bow	Similar to previous surveys, large globular ascidians and barnacles were the most prevalent encrusting biota on the hull of the ship. Various encrusting and papillate sponges and bryozoans remained. Tiny orange anemones (*Corynactis* sp.) have also become conspicuous on this part of the ship. Growth appeared thickest around edges of holes in the hull. Eastern hulafish, six-spined leatherjacket, yellowtail kingfish and white ear were observed.
Vertical Hull Stern	As with previous surveys, ascidians and large barnacles were more prevalent on the hull of the ship, in comparison to the deck surfaces, while bryozoans, sponges and occasional clumps of bryozoans were also observed. The vertical plane of the hull was otherwise encrusted with a layer of barnacles, encrusting algae, hydroids, a fine, filamentous or turfing algae and tiny orange anemones. A blue morwong (*Nemadactylus douglasii*) was observed alongside the hull.
Vertical Hull Superstructure	Ascidians, bryozoans, barnacles, encrusting algae, hydroids, fine filamentous algae and sheets of tiny orange anemones were observed on the superstructure.

Table 3: Species of Fish Observed in Association with the Ex-HMAS Adelaide Artificial Reef between April/May 2011 and March 2014. (*) = recreationally important species, (+) = commercially important species, (#) = species of conservation significance. (x) =No Code.

Family	Species Name	Common Name	Species Number (Hutchins & Swainston)	Baseline Survey (April/May 2011)	Survey 1 (October 2011)	Survey 2 (February 2012)	Survey 3 (May 2012)	Survey 4 (August 2012)	Survey 5 (October 2012)	Survey 6 (January 2013)	Survey 7 (April 2013)	Survey 8 (July 2013)	Survey 9 (October 2013)	Survey 10 (March 2014)
Heterodontidae	*Heterodontus portusjacksoni*	Port Jackson shark	4									●		
Orectolobidae	*Orectolobus* sp.	Wobbegong shark	x											●
Aulopodidae	*Aulopus purpurrissatus*	Sergeant baker	83		●	●	●		●	●		●	●	
Scorpaenidae	*Centropogon australis*	Eastern fortesque	166		●	●	●							
Scorpaenidae	*Scorpaena cardinalis*	Eastern red scorpioncod	176		●	●			●		●	●	●	●
Platycephalidae	*Platycephalus fuscus*	Dusky flathead*+	203					●						
Serranidae	*Acanthistius ocellatus*	Eastern wirrah	211									●		
Serranidae	*Hypoplectrodes maccullochi*	Half-banded sea perch	225				●	●			●	●		
Serranidae	*Hypoplectrodes nigroruber*	Black-banded sea perch	227								●		●	
Plesiopidae	*Trachinops taeniatus*	Eastern hulafish	246						●	●	●	●	●	●
Dinolestidae	*Dinolestes lewini*	Longfinned pike	263		●			●					●	
Carangidae	*Pseudocaranx dentex*	Silver trevally	292				●	●	●		●	●	●	●
Carangidae	*Trachurus novaezelandiae*	Yellowtail scad+	294		●			●				●		
Carangidae	*Seriola lalandi*	Yellowtail kingfish*#	298			●	●		●	●	●	●	●	●
Carangidae	*Seriola hippos*	Samson Fish*	300									●		
Carangidae	*Elagatis bipinnulata*	Rainbow runner	303									●		
Sparidae	*Pagrus auratus*	Snapper (juv)*+	310		●	●	●		●	●	●			
Sparidae	*Rhabdosargus sarba*	Tarwhine*	311			●	●	●	●	●	●	●	●	●
Lutjanidae	*Paracaesio xanthurus*	Southern fusilier	320								●			
Mullidae	*Parupeneus spilurus*	Blackspot goatfish	323	●					●	●	●	●	●	
Kyphosidae	*Kyphosus sydneyanus*	Silver drummer*	346				●						●	●
Scorpididae	*Atypicthys strigatus*	Mado	349		●	●	●	●			●			
Scorpididae	*Microcanthus strigatus*	Stripey	350		●	●	●							●
Scorpididae	*Scorpis lineolatus*	Silver sweep*	353		●	●	●			●	●	●	●	●
Ephippidae	*Platax* sp.	Batfish	355					●					●	●
Chaetodontidae	*Heniochus diphreutes*	Schooling bannerfish	372	●	●				●			●		
Chaetodontidae	*Chaetodon guentheri*	Gunther's butterflyfish	358								●			
Enoplosidae	*Enoplosus armatus*	Old wife	376				●	●			●		●	●
Pomacentridae	*Parma microlepis*	White ear	388		●			●	●	●	●	●	●	●
Pomacentridae	*Parma unifasciata*	Girdled scalyfin	393			●			●	●	●	●	●	●
Pomacentridae	*Chromis hypsilepis*	One-Spot Puller	396									●		
Cirritidae	*Cirritichthys aprinus*	Blotched hawkfish	406						●	●	●	●	●	●
Chironemidae	*Chironemus marmoratus*	Eastern kelpfish	411						●					
Aplodactylidae	*Crinodus lophodon*	Rock cale	415						●		●	●	●	●
Cheilodactylidae	*Cheilodactylus fuscus*	Red morwong*	416		●	●	●	●	●	●	●	●	●	●
Cheilodactylidae	*Nemadactylus douglasii*	Blue morwong*	424		●	●				●	●		●	●
Cheilodactylidae	*Cheilodactylus vestitus*	Magpie morwong	421								●		●	
Latridiidae	*Latridopsis forsteri*	Bastard trumpeter	427		●				●	●	●	●	●	
Labridae	*Achoerodus viridis*	Eastern blue groper	438		●	●	●	●	●	●	●		●	●
Labridae	*Coris picta*	Comb wrasse	446						●					
Labridae	*Notolabrus gymnogenis*	Crimson banded wrasse	481				●		●	●			●	●
Labridae	*Notolabrus parilus*	Brown spotted wrasse	483				●							●
Labridae	*Psuedolabrus luculentus*	Luculentus wrasse	487								●	●		●
Labridae	*Thalassoma lunare*	Moon wrasse	505									●		
Blenniidae	*Petroscirtes lupus*	Brown sabretooth blenny	532	●						●				
Blenniidae	*Parablennius intermedius*	Horned blenny	x											
Monacanthidae	*Monacanthus chinensis*	Fan belly leatherjacket*	636						●					
Monacanthidae	*Meuschenia freycineti*	Six-spined leatherjacket*	643						●		●	●	●	●
Monacanthidae	*Meuschenia trachylepis*	Yellow-finned leatherjacket*	646				●		●	●	●	●	●	●
Monacanthidae	*Nelusetta ayraudi*	Chinaman leather jacket*+	648		●	●	●							
Monacanthidae	*Eubalichthys mosaicus*	Mosiac leatherjacket*	652							●				
	Eubalichthys bucephalus	Black reef leatherjacket	649											●
Monacanthidae	*Meuschenia spp.*	Unidentified leatherjackets	x				●	●	●					
Tetraodonitdae	*Dicotlichthys punctulatus*	Three-bar porcupinefish	682		●				●	●				●
Sepiidae	*Sepia* sp.	Cuttlefish	x										●	
Total Number of Tax	**Total Number of Taxa**			**3**	**17**	**14**	**19**	**13**	**23**	**19**	**26**	**26**	**26**	**25**

4 Discussion

4.1 Encrusting Biota

Results of Survey 10 indicate that subtle changes in the percentage cover of different groups have continued to occur (e.g. a reduction in the percent cover of algae, bryozoans, bare surfaces and early colonising matrices and increases in sponges, ascidians and cnidarians). These changes are not, however, obvious from visual inspections of fixed photos and video footage and overall, the reef assemblage associated with the ship during Survey 10 (carried out two years and 11 months post-scuttling), was similar to that of Survey 9. Since scuttling, the assemblages observed have become well established and less variable in space and time.

Only one new category (a translucent anemone) was observed in photoquadrats from Survey 10 and several categories observed in previous surveys were not observed in the current survey. This may be because numerically abundant species are over growing or out-competing less prevalent groups. Very few crustacean and gastropod groups have been observed throughout the monitoring program. It is likely that these groups are well camouflaged or hidden within cracks and crevices among the encrusting matrix, influencing the ability to be detected in photoquadrats rather than occurring in low abundance.

Tiny orange anemones (*Corynactis* sp.) were again prevalent over vertically orientated surfaces growing over the top of the encrusting matrix but were not recorded on the deck. As for previous surveys, analysis of photoquadrats showed a strong and recurrent pattern of assemblages occurring on horizontally orientated (deck) surfaces being different in composition from the vertically orientated (hull) assemblage. Deck surfaces were characterised by serpulid, barnacle and encrusting algal matrix and the presence of *Ecklonia radiata and red encrusting algae*, while the hull was characterised by large barnacles, high numbers of large solitary ascidians (including *Herdmania momus*), orange encrusting sponges and orange colonial ascidians. As discussed in previous monitoring surveys, it is possible that ascidians, anemones and large barnacles tend to proliferate on more shaded portions of the ship or possibly where there is more current to improve feeding efficiency, whereas *Ecklonia* and red encrusting algae occur where light availability is optimal.

Depth nor deck position (i.e. bow, mid ship and stern) were significant factors influencing assemblage composition in Survey 10 whereas deck position was in Surveys 8 and 9. This suggests that the assemblage associated with the deck surface has become less variable between Surveys 9 and 10. No known pest species were recorded during the survey.

4.2 Fish, Macroinvertebrates and Megafauna

The number of fish species observed by divers and from video and fixed photos has generally increased since scuttling of the ship in April 2011, but has remained similar for the past four surveys (between 25 and 26 species). New species recorded in Survey 10 included a wobbegong shark (*Orectolobus* sp.) and black reef leatherjacket (*Eubalichthys bucephalus*). Both are commonly found on coastal reefs along the New South Coast.

5 Acknowledgements

This report was written by Kate Reeds and reviewed by Dr. Lachlan Barnes. Field work was done by Brendan Alderson, David Cummings, Daniel Pygas and Michael Takach. Cardno Ecology Lab thanks Terrigal Dive Centre and McLennans Diving Services in assisting with this survey.

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7 Plates

Deck, Port Bow

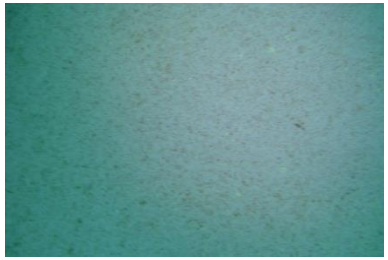
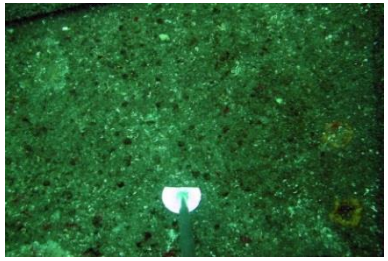
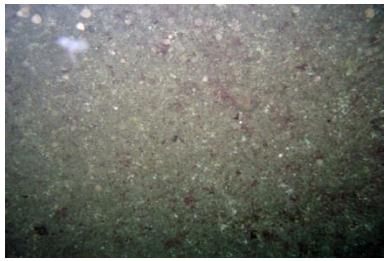
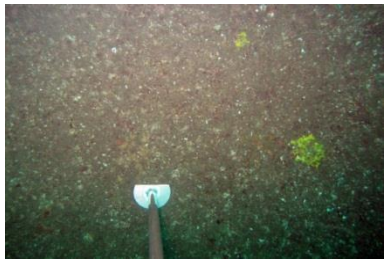
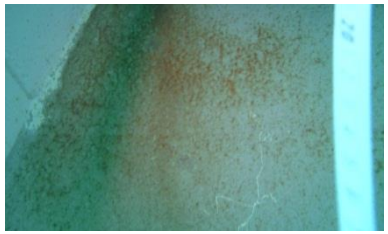
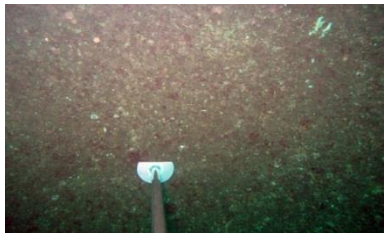
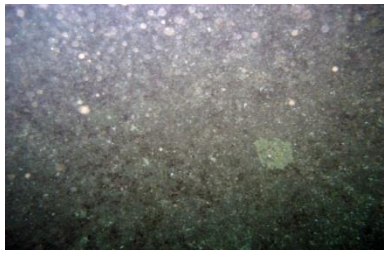
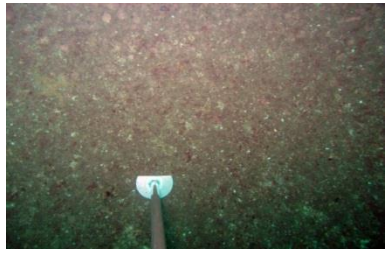
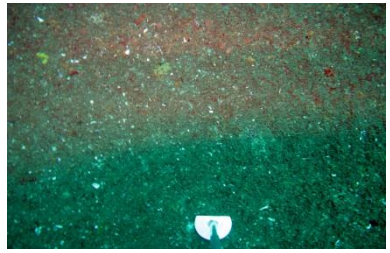
Baseline Survey (April/May 2011)	Monitoring Survey 1 (October 2011)	Monitoring Survey 2 (February 2012)	Monitoring Survey 3 (May 2012)	Monitoring Survey 4 (August 2012)
				
				
				

Plate 1: Deck port bow

Deck, Port Bow

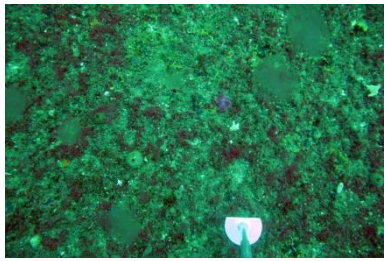
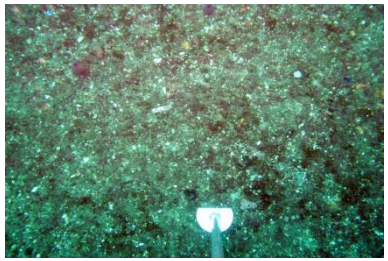
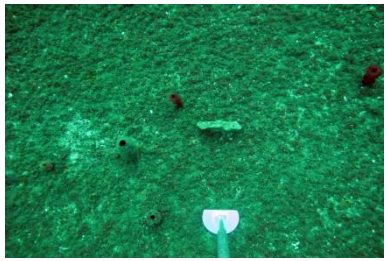
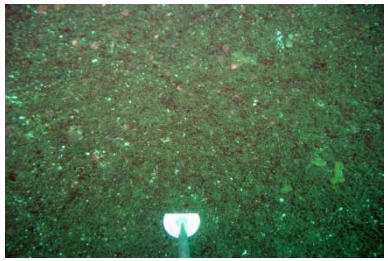
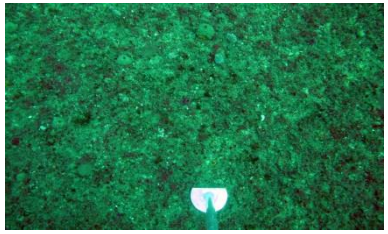
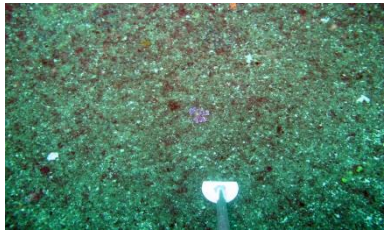
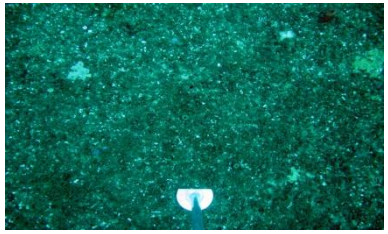
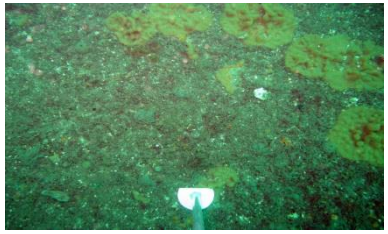
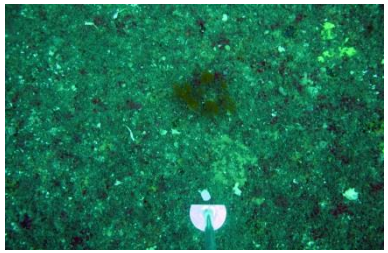
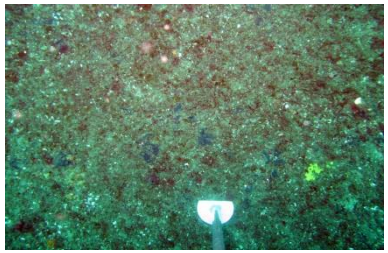
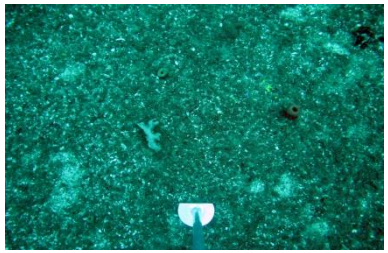
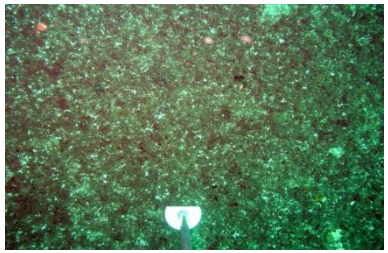
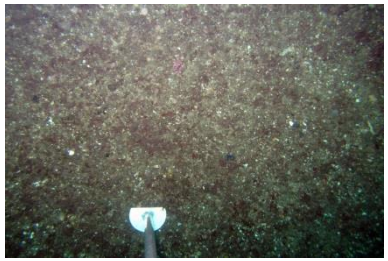
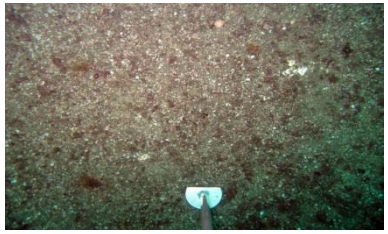
Monitoring Survey 5 (October/November 2012)	Monitoring Survey 6 (January 2013)	Monitoring Survey 7 (April 2013)	Monitoring Survey 8 (July 2013)	Monitoring Survey 9 (October 2013)
				
				
				

Plate 1 Continued: Deck port bow

Deck, Port Bow

Monitoring Survey 10
(March 2014)





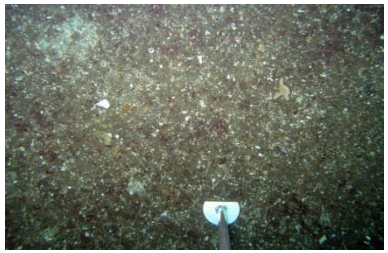


Plate 1 Continued: Deck port bow

Deck, Port Mid

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	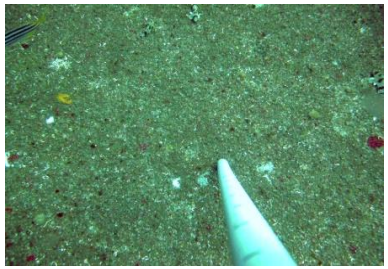	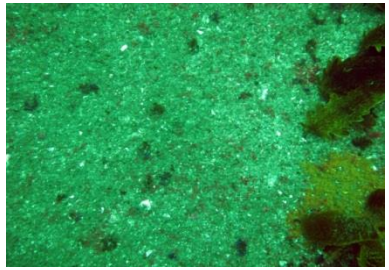	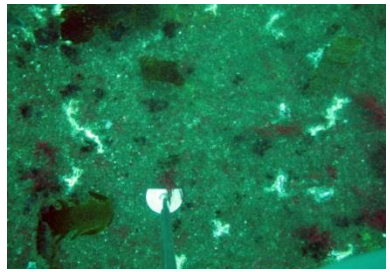	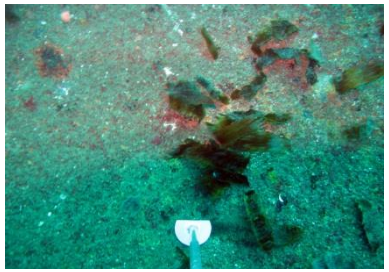
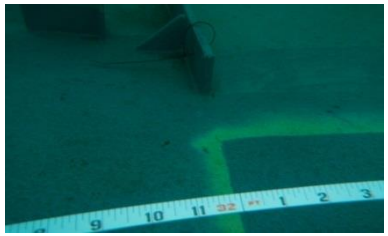	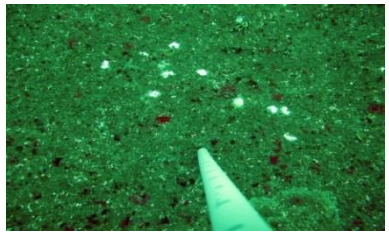	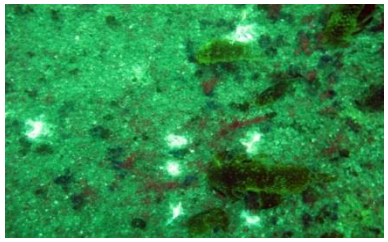	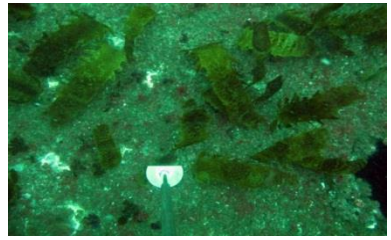	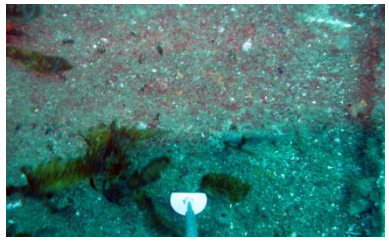
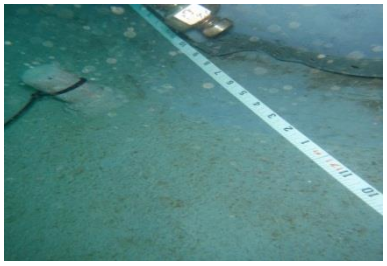	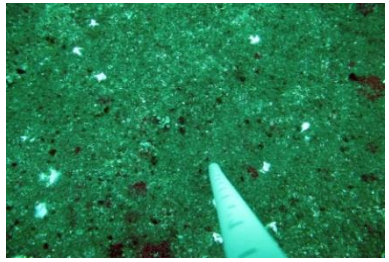	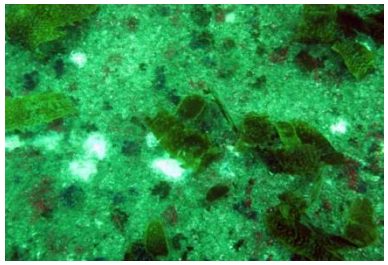	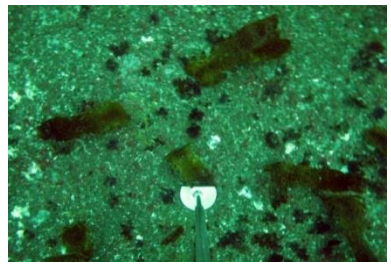	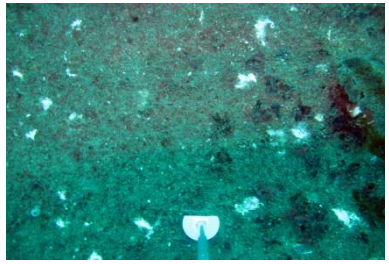

Plate 2: Deck Port Mid

Deck, Port Mid

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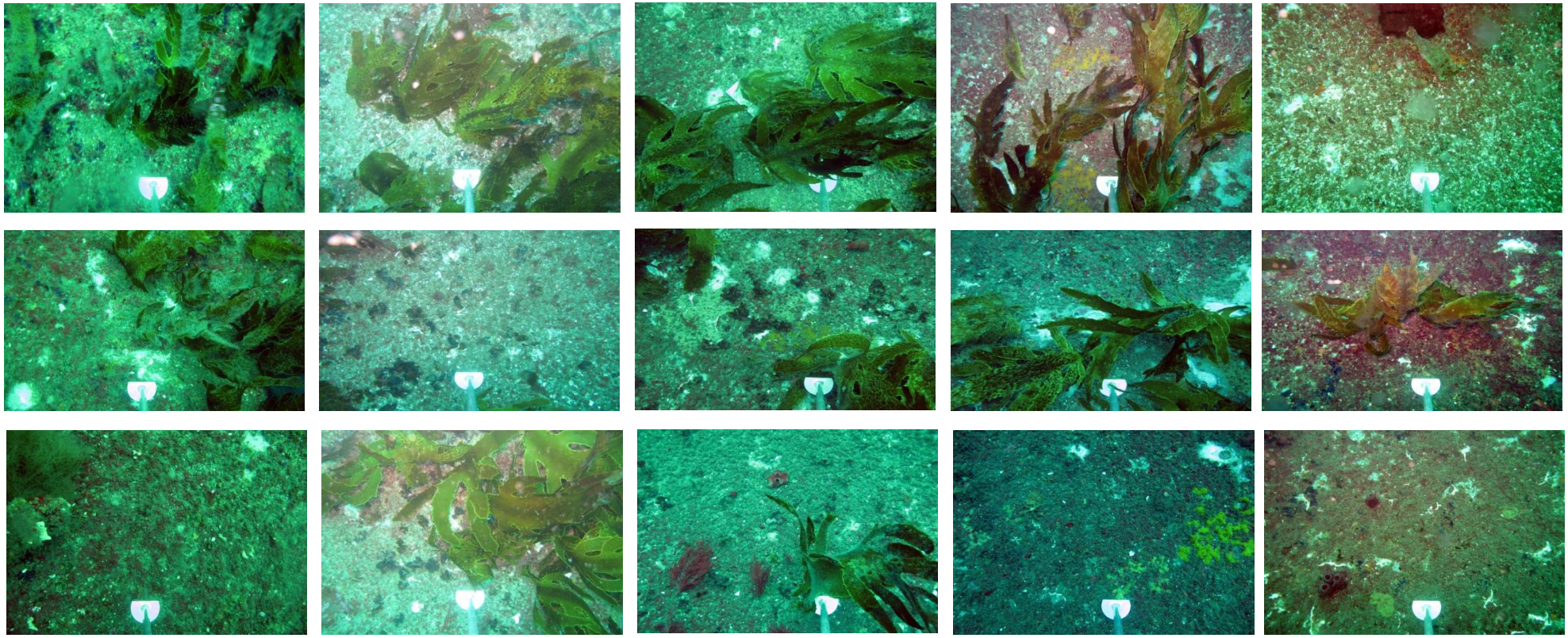
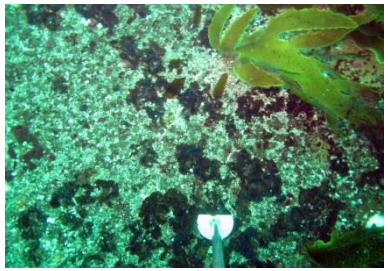
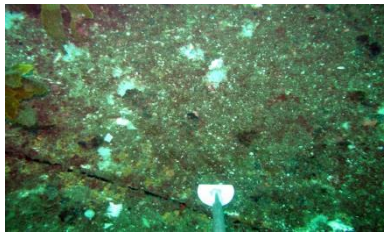


Plate 2 Continued: Deck Port Mid

Deck, Port Mid

Monitoring Survey 10
(March 2014)





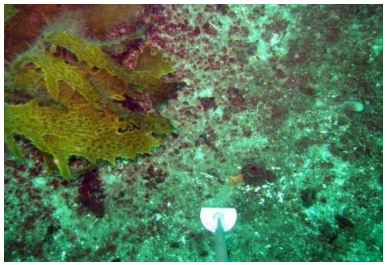


Plate 2 Continued: Deck Port Mid

Deck, Port , Stern

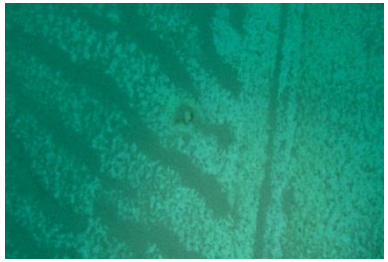
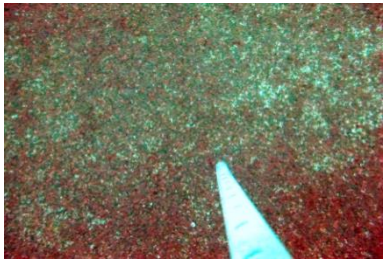
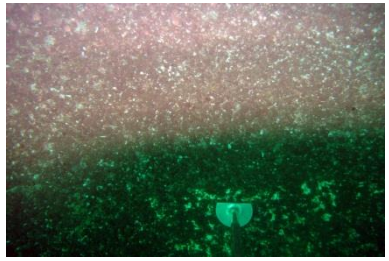
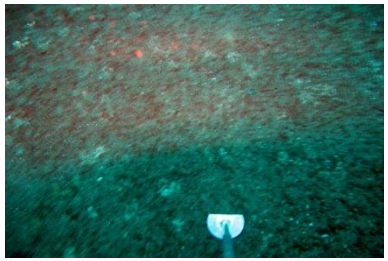
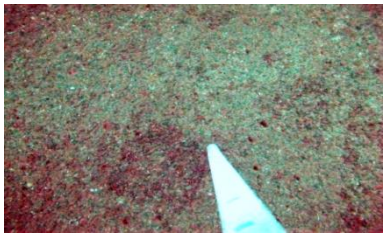
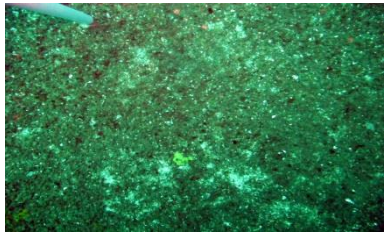
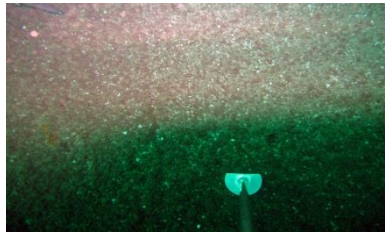
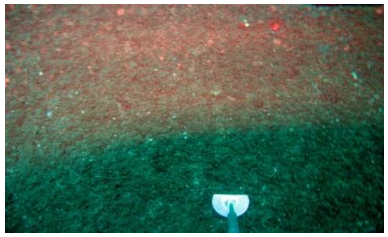
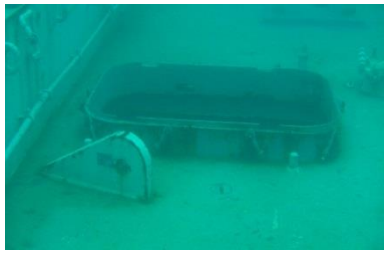
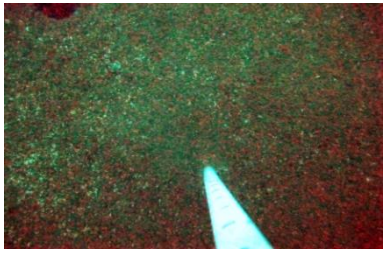
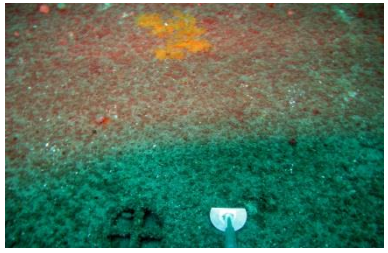
Baseline Survey (April/May 2011)	Monitoring Survey 1 (October 2011)	Monitoring Survey 2 (February 2012)	Monitoring Survey 3 (May 2012)	Monitoring Survey 4 (August 2012)
				
				
				

Plate 3: Deck Port Stern

Deck, Port, Stern

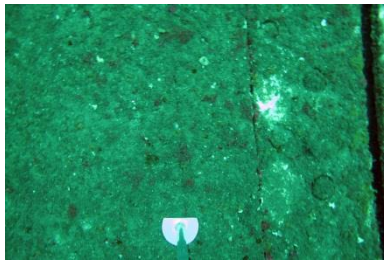
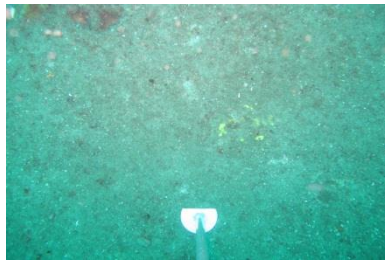
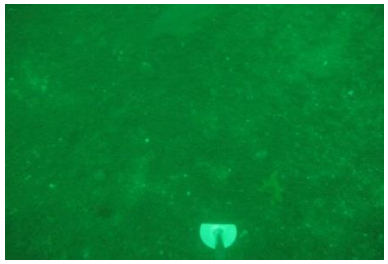
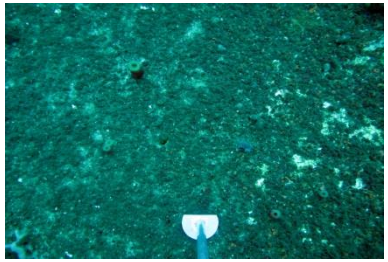
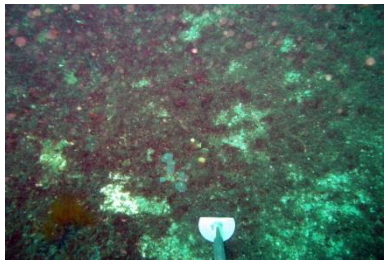
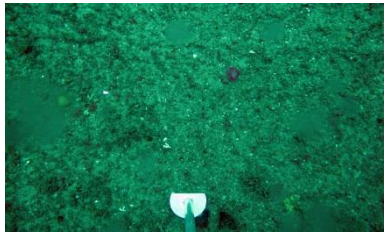
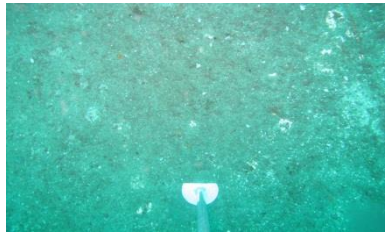
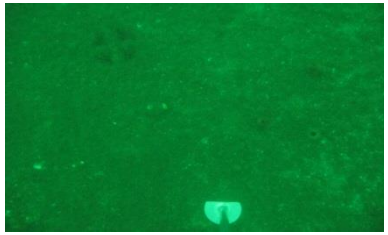
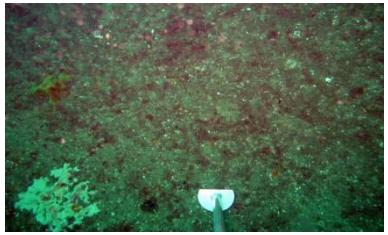
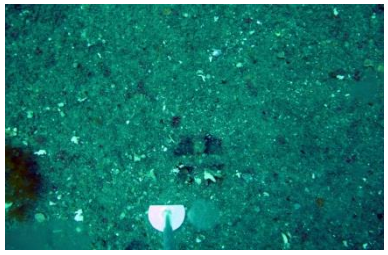
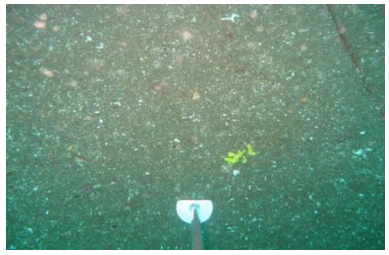
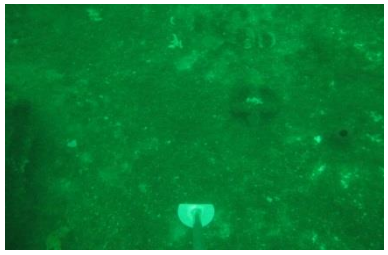
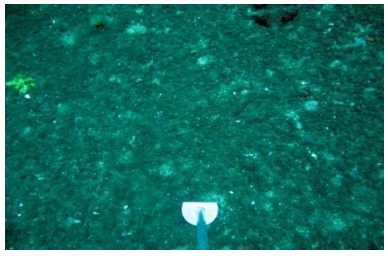
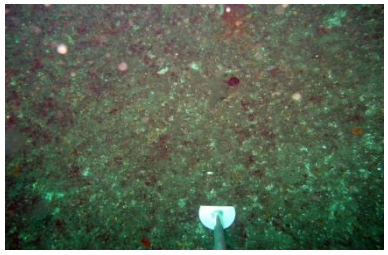
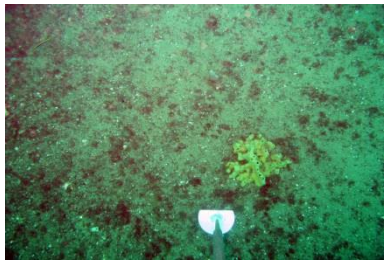
Monitoring Survey 5 (October/November 2012)	Monitoring Survey 6 (January 2013)	Monitoring Survey 7 (April 2013)	Monitoring Survey 8 (July 2013)	Monitoring Survey 9 (October 2013)
				
				
				

Plate 3 Continued: Deck Port Stern

Deck, Port, Stern

Monitoring Survey 10
(March 2014)



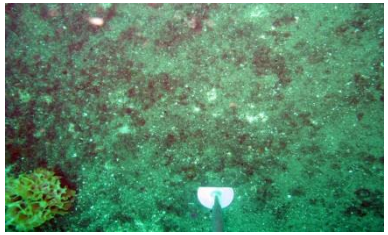


Plate 3 Continued: Deck Port Stern

Deck, Starbord, Bow

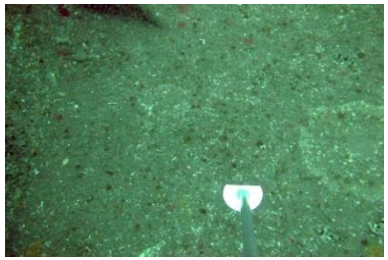
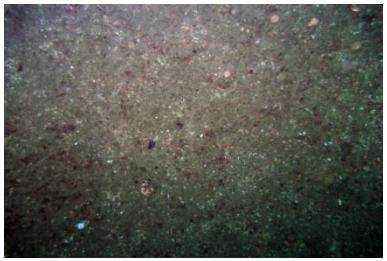
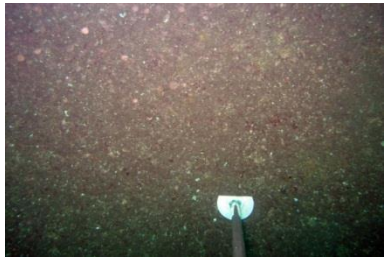
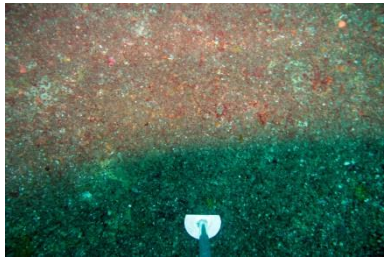
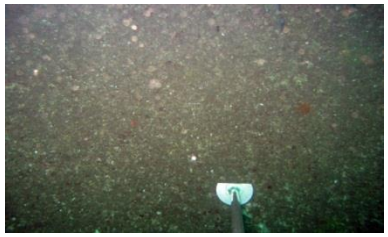
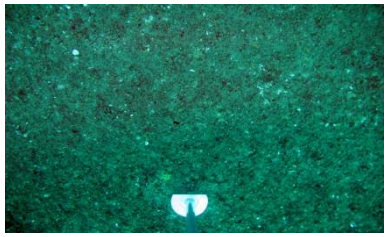
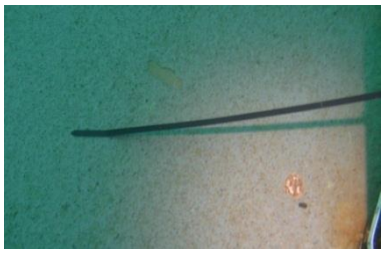
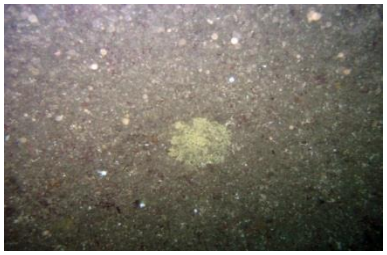
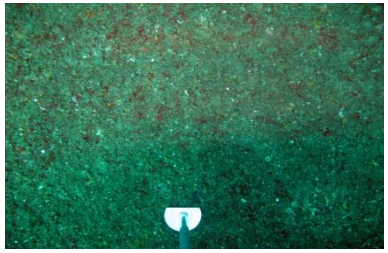
Baseline Survey (April/May 2011)	Monitoring Survey 1 (October 2011)	Monitoring Survey 2 (February 2012)	Monitoring Survey 3 (May 2012)	Monitoring Survey 4 (August 2012)
				
				
				

Plate 4: Deck Starbord Bow

Deck, Starbord, Bow

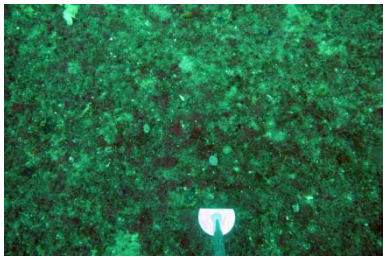
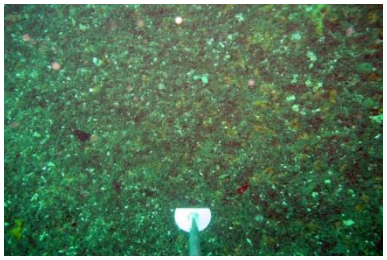
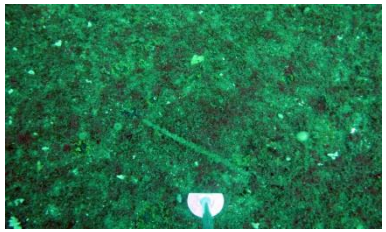
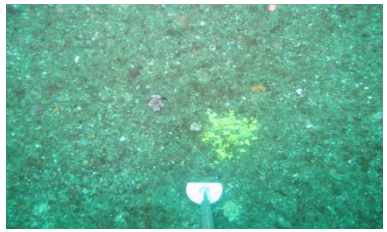
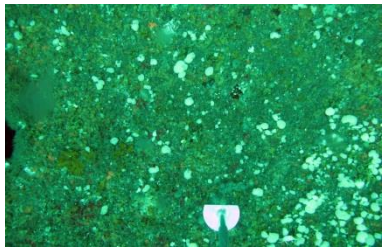
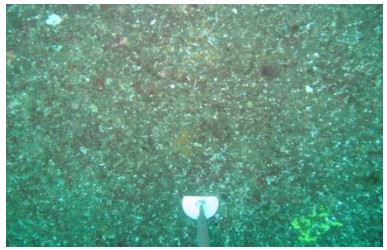
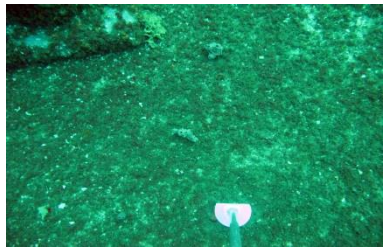
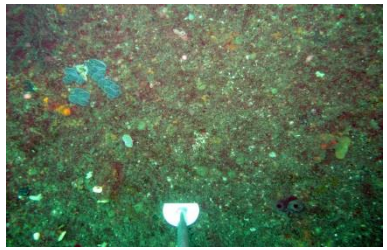
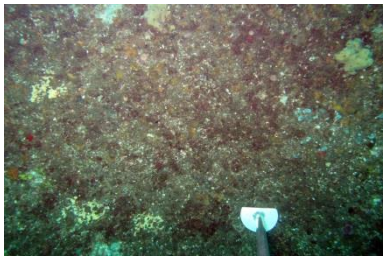
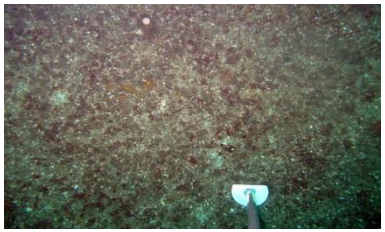
Monitoring Survey 5 (October/November 2012)	Monitoring Survey 6 (January 2013)	Monitoring Survey 7 (April 2013)	Monitoring Survey 8 (July 2013)	Monitoring Survey 9 (October 2013)
				
				
				

Plate 4 Continued: Deck Starbord Bow

Deck, Starbord, Bow

Monitoring Survey 10
(March 2014)





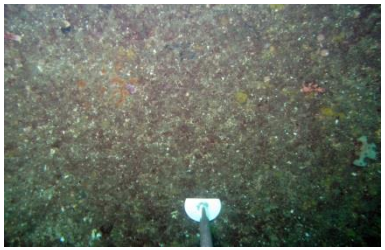


Plate 4 Continued: Deck Starbord Bow

Deck, Starbord, Mid

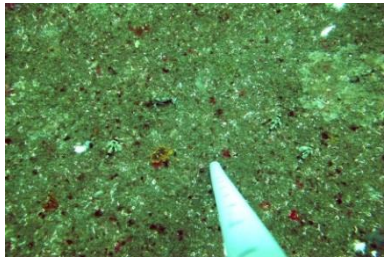
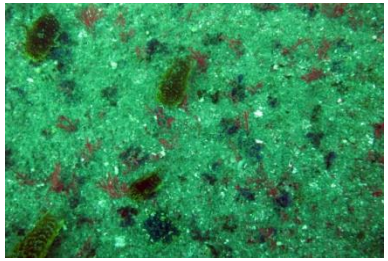
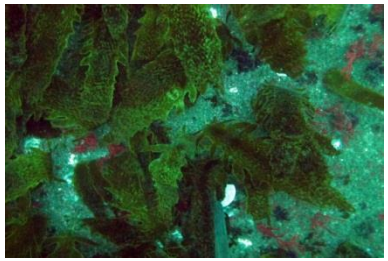
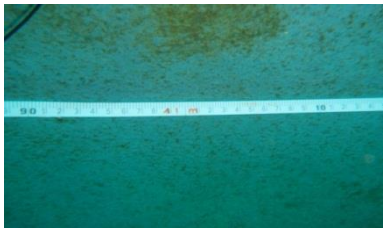
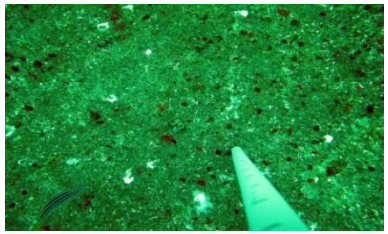
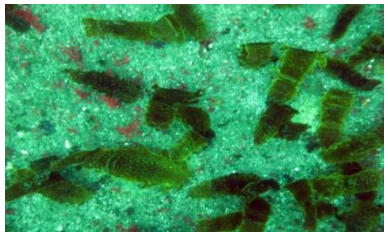
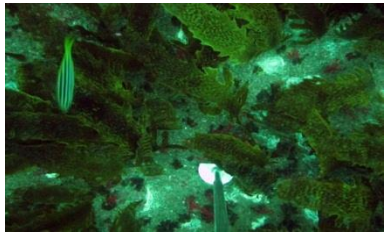
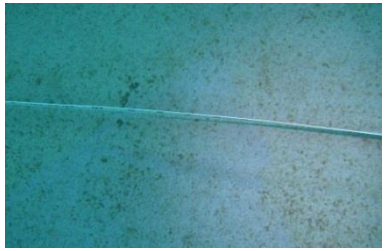
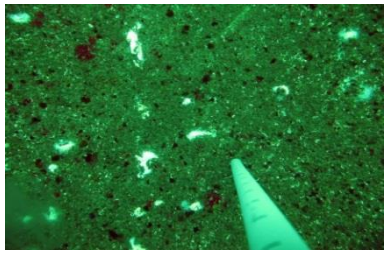
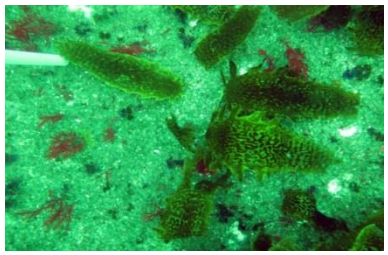
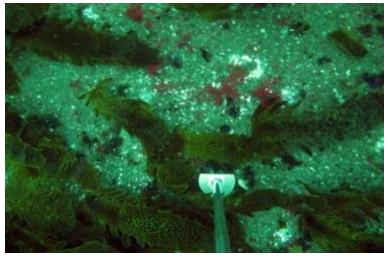
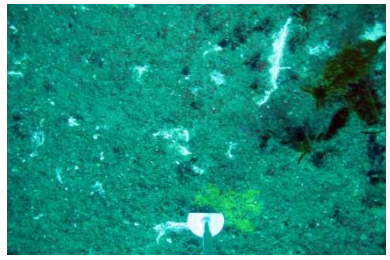
Baseline Survey (April/May 2011)	Monitoring Survey 1 (October 2011)	Monitoring Survey 2 (February 2012)	Monitoring Survey 3 (May 2012)	Monitoring Survey 4 (August 2012)
				
				
				

Plate 5: Deck Starbord Mid

Deck, Starbord, Mid

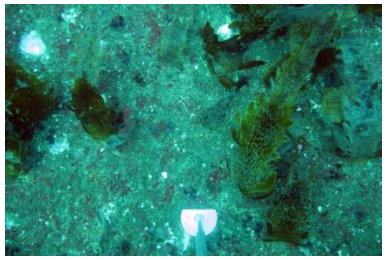
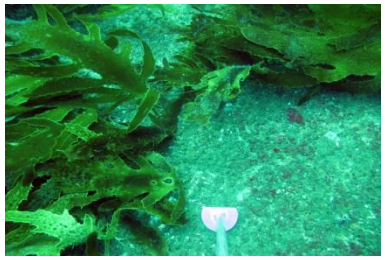
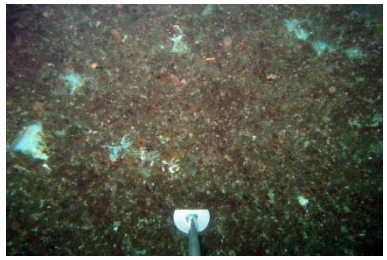
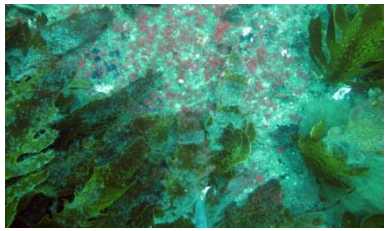
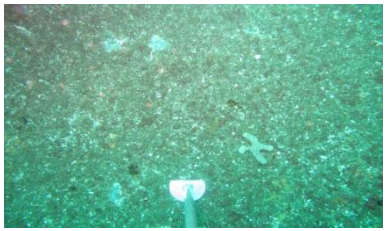
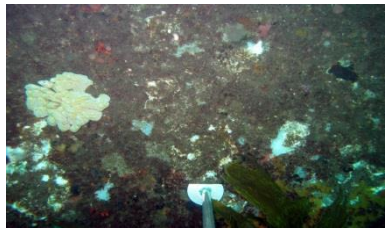
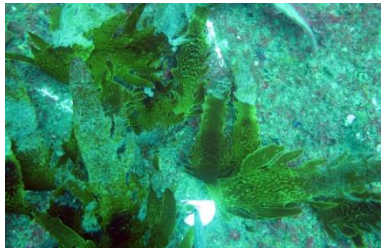
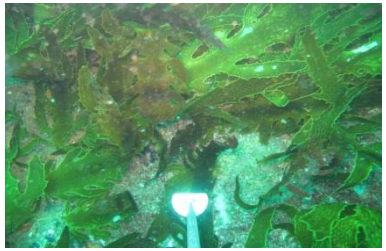
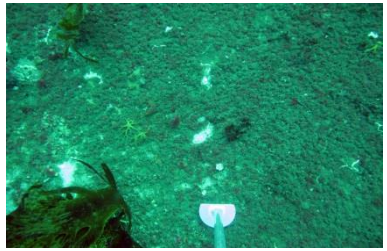
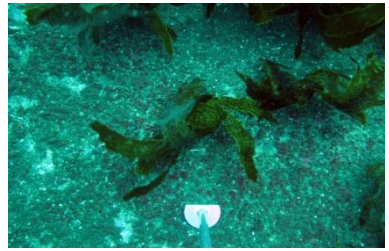
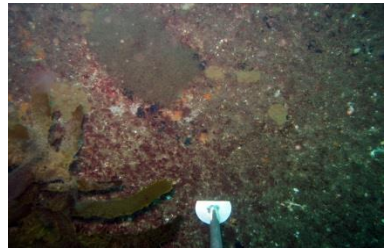
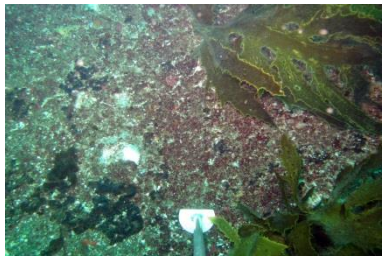
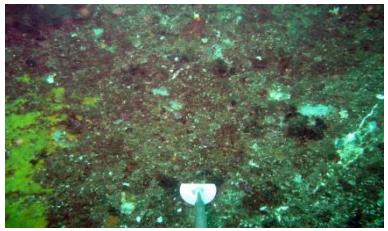
Monitoring Survey 5 (October/November 2012)	Monitoring Survey 6 (January 2013)	Monitoring Survey 7 (April 2013)	Monitoring Survey 8 (July 2013)	Monitoring Survey 9 (October 2013)
				
				
				

Plate 5 Continued: Deck Starbord Mid

Deck, Starbord, Mid

Monitoring Survey 10
(March 2014)





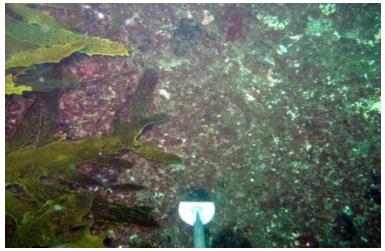


Plate 5 Continued: Deck Starbord Mid

Deck, Starbord, Stern

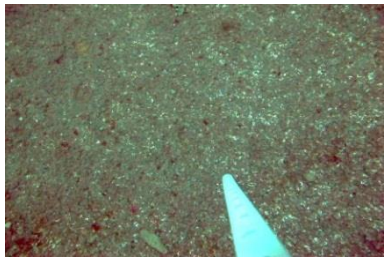
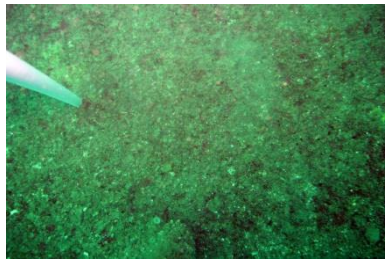
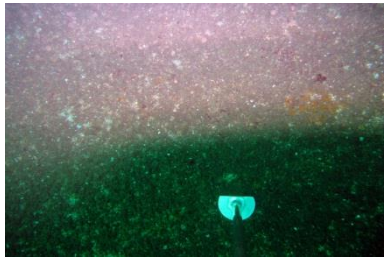
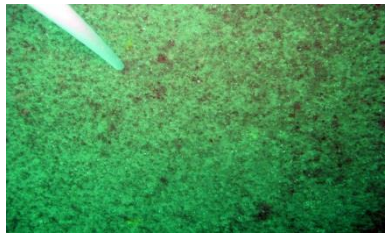
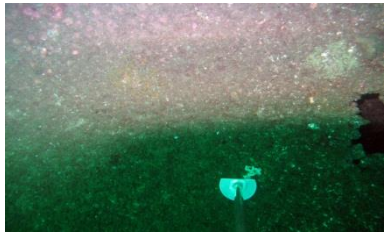
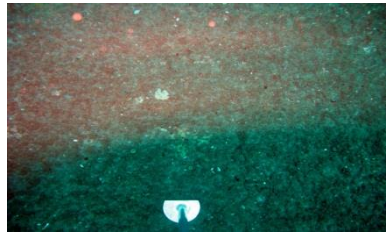
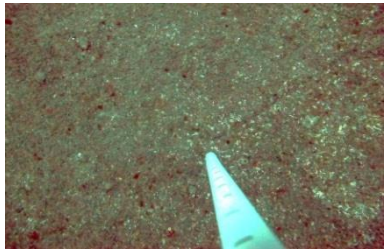
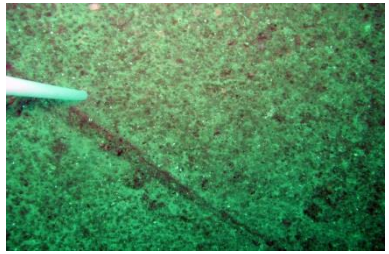
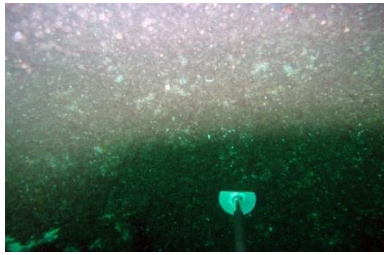
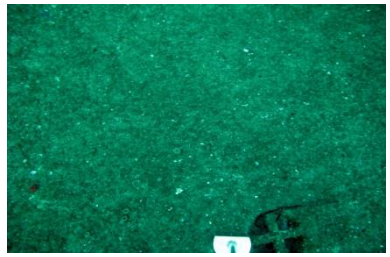
Baseline Survey (April/May 2011)	Monitoring Survey 1 (October 2011)	Monitoring Survey 2 (February 2012)	Monitoring Survey 3 (May 2012)	Monitoring Survey 4 (August 2012)
				
				
				

Plate 6: Deck Starbord Stern

Deck, Starbord, Stern

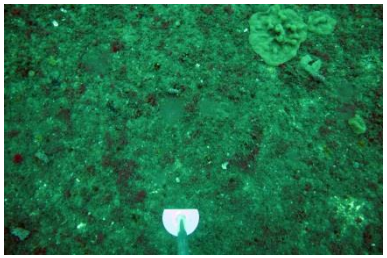
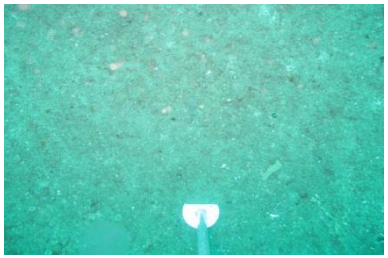
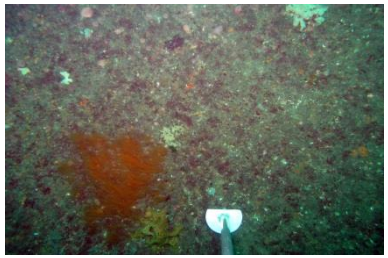
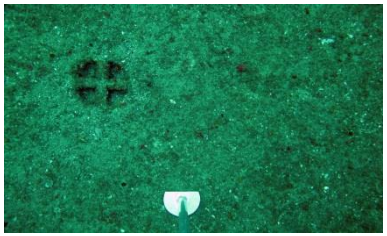
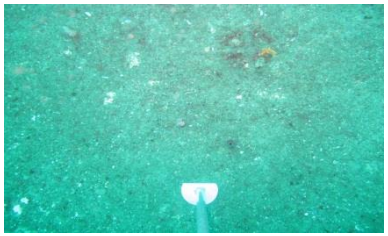
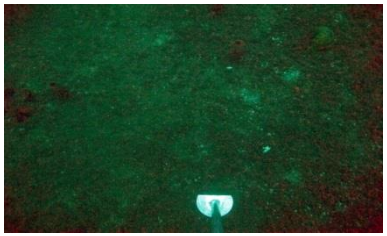
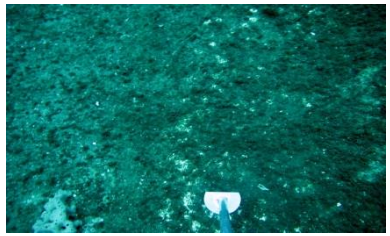
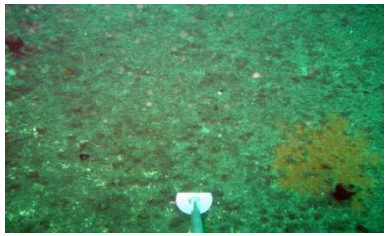
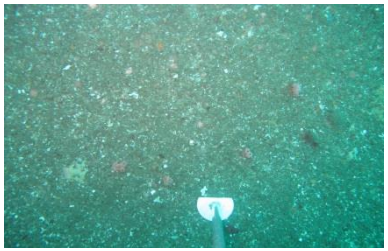
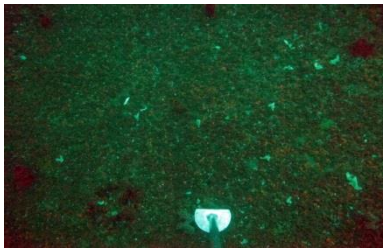
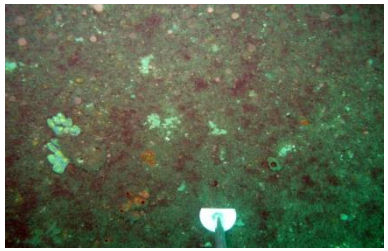
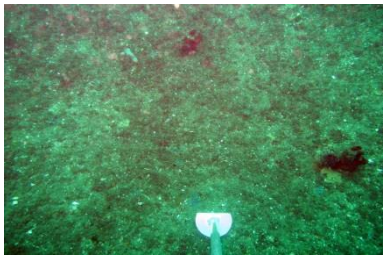
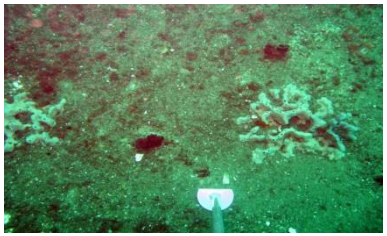
Monitoring Survey 5 (October/November 2012)	Monitoring Survey 6 (January 2013)	Monitoring Survey 7 (April 2013)	Monitoring Survey 8 (July 2013)	Monitoring Survey 9 (October 2013)
				
				
				

Plate 6 Continued: Deck Starbord Stern

Deck, Starbord, Stern

Monitoring Survey 10
(March 2014)





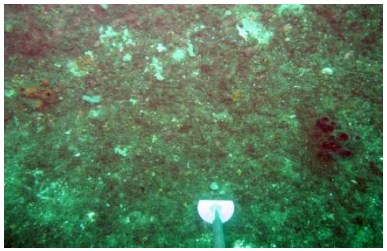


Plate 6 Continued: Deck Starbord Stern

Horizontal Hull Port

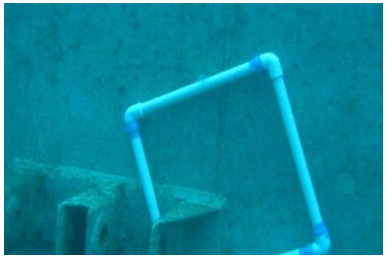
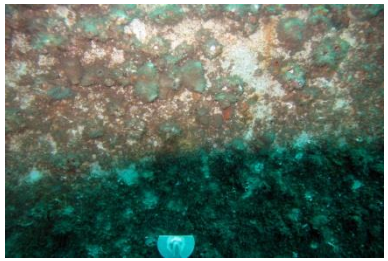
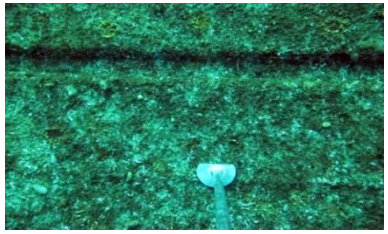
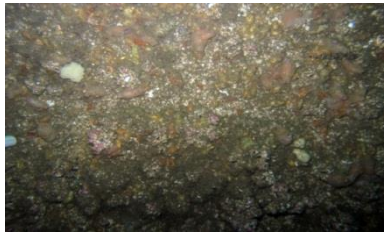
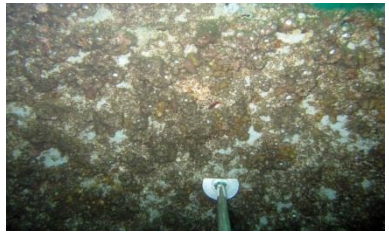
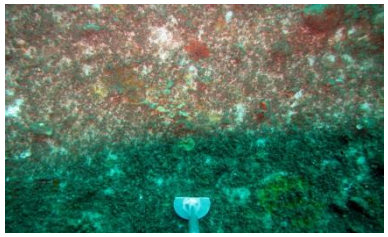
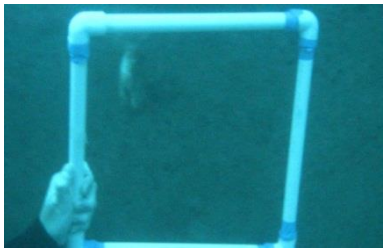
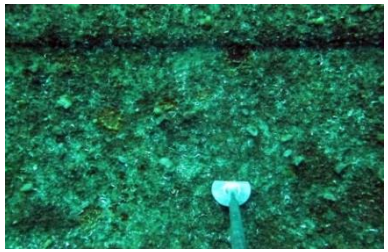
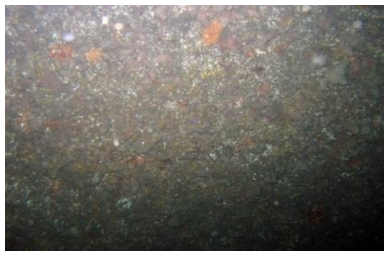
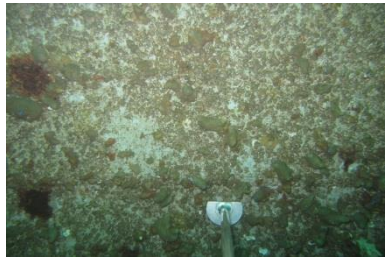
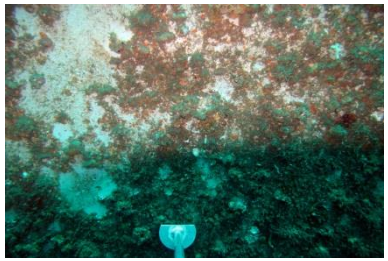
Baseline Survey (April/May 2011)	Monitoring Survey 1 (October 2011)	Monitoring Survey 2 (February 2012)	Monitoring Survey 3 (May 2012)	Monitoring Survey 4 (August 2012)
				
				
				

Plate 7: Horizontal Hull Port

Horizontal Hull Port

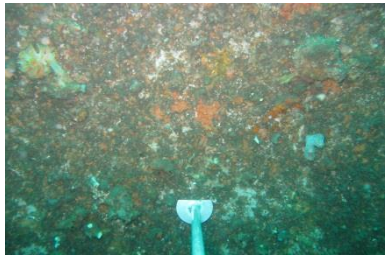
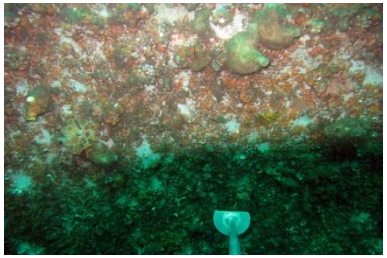
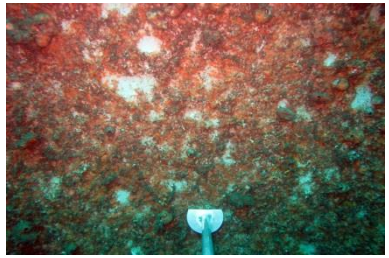
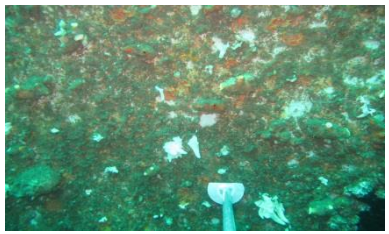
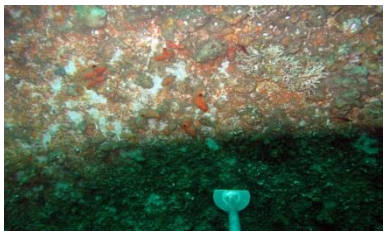
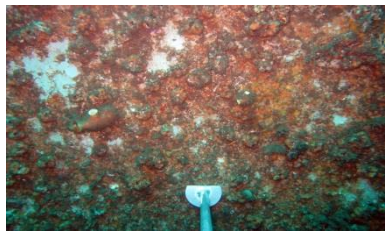
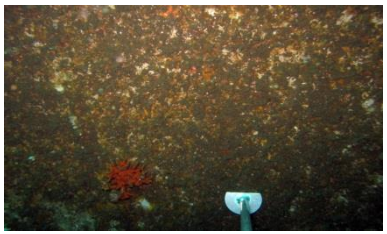
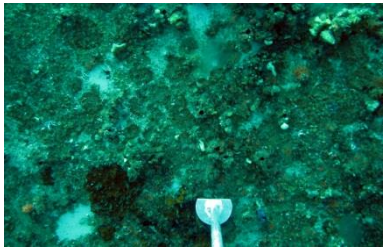
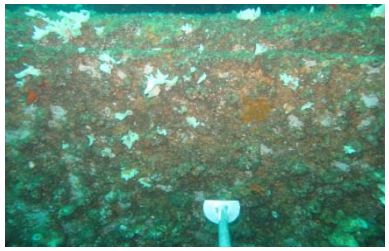
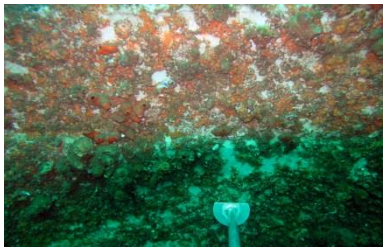
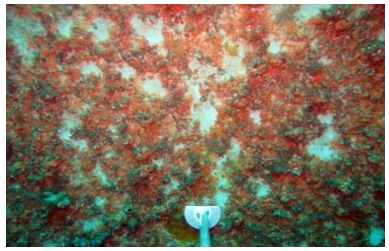
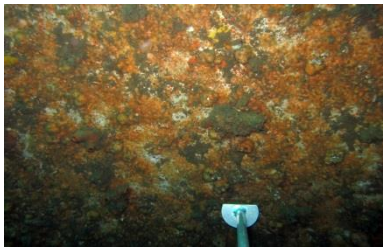
Monitoring Survey 5 (October/November 2012)	Monitoring Survey 6 (January 2013)	Monitoring Survey 7 (April 2013)	Monitoring Survey 8 (July 2013)	Monitoring Survey 9 (October 2013)
				
				
				

Plate 7 Continued: Horizontal Hull Port

Horizontal Hull Port

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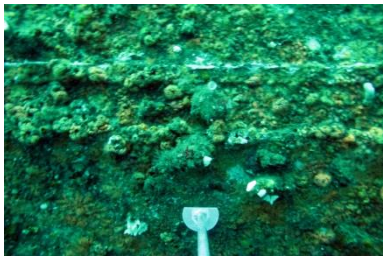


Plate 7 Continued: Horizontal Hull Port

Horizontal Hull Starbord

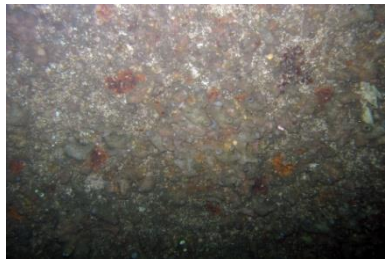
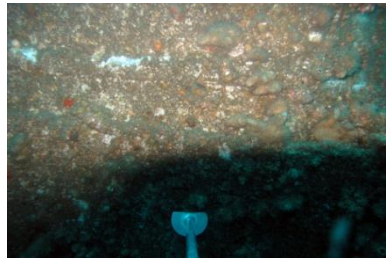
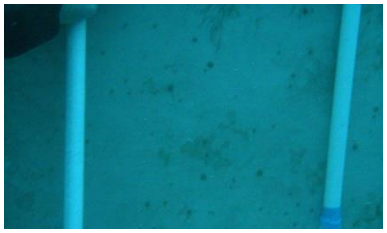
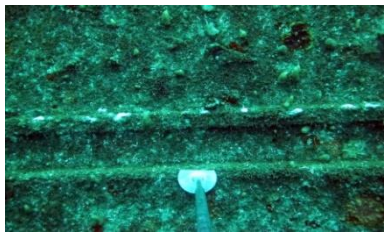
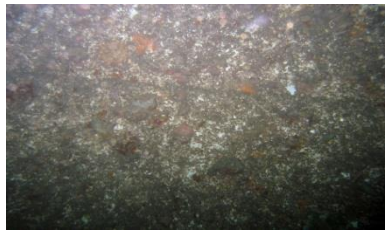
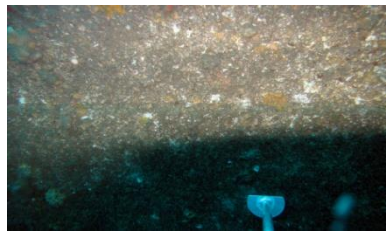
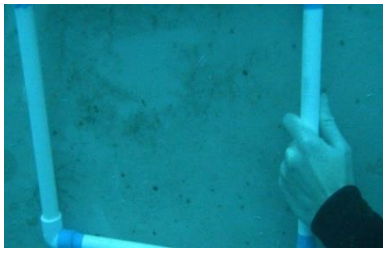
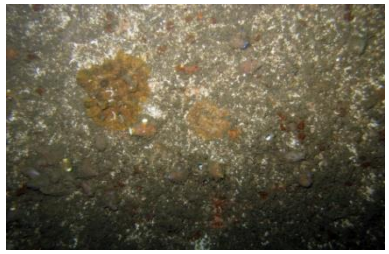
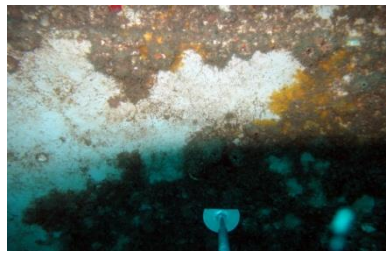
Baseline Survey (April/May 2011)	Monitoring Survey 1 (October 2011)	Monitoring Survey 2 (February 2012)	Monitoring Survey 3 (May 2012)	Monitoring Survey 4 (August 2012)
				
				
				

Plate 8: Horizontal Hull Starbord

Horizontal Hull Starbord

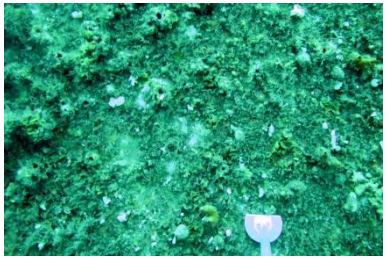
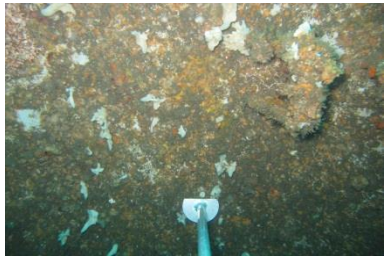
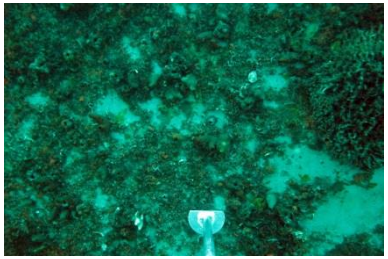
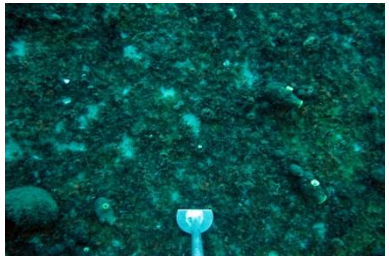
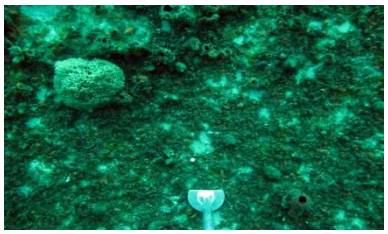
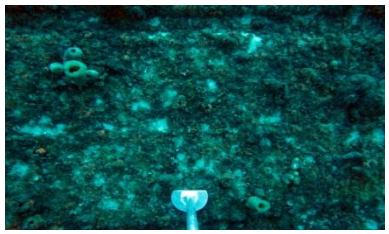
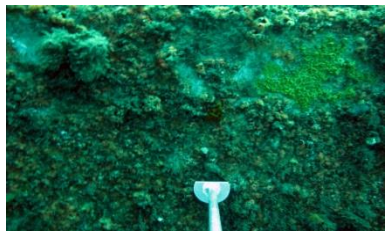
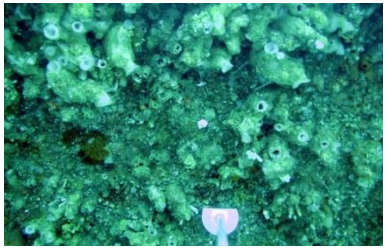
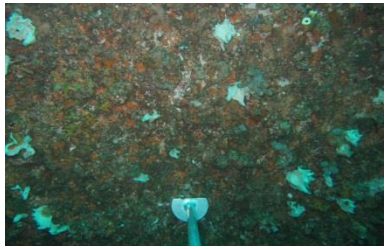
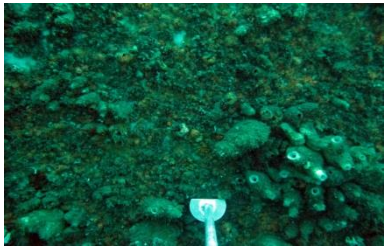
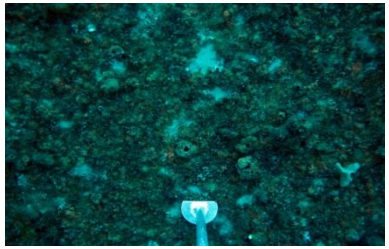
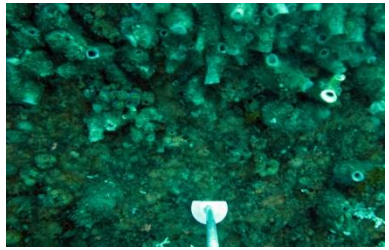
Monitoring Survey 5 (October/November 2012)	Monitoring Survey 6 (January 2013)	Monitoring Survey 7 (April 2013)	Monitoring Survey 8 (July 2013)	Monitoring Survey 9 (October 2013)
				
				
				

Plate 8 Continued: Horizontal Hull Starbord

Horizontal Hull Starbord

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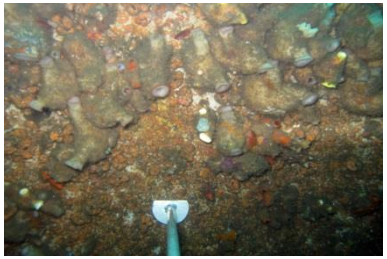


Plate 8 Continued: Horizontal Hull Starbord

Vertical Hull Port Bow

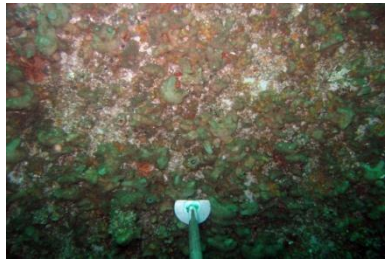
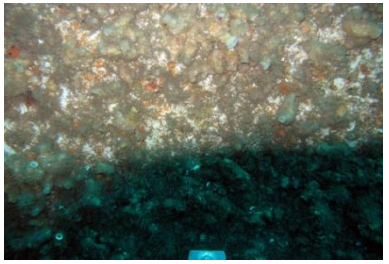
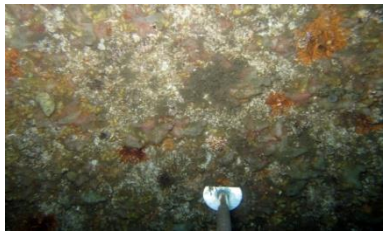
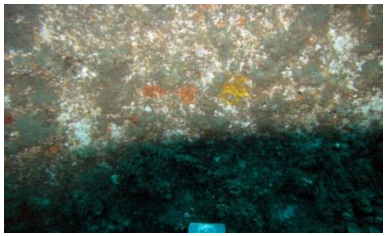
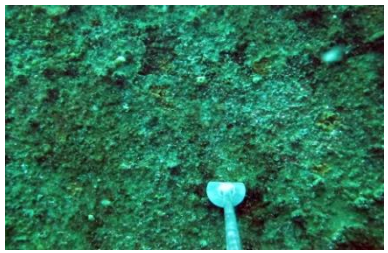
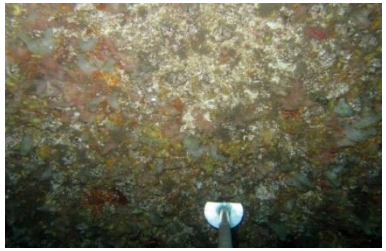
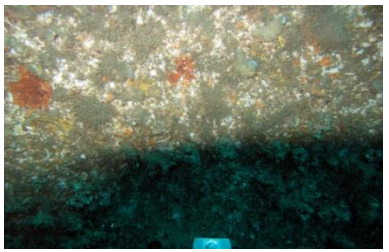
Baseline Survey (April/May 2011)	Monitoring Survey 1 (October 2011)	Monitoring Survey 2 (February 2012)	Monitoring Survey 3 (May 2012)	Monitoring Survey 4 (August 2012)
				
				
				

Plate 9: Vertical Hull Port Bow

Vertical Hull Port Bow

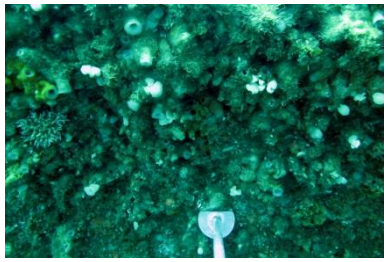
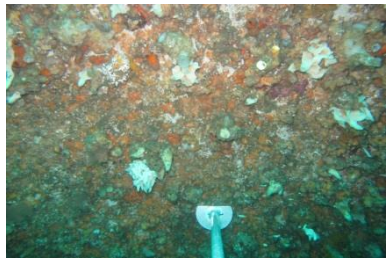
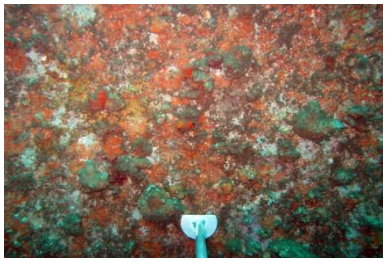
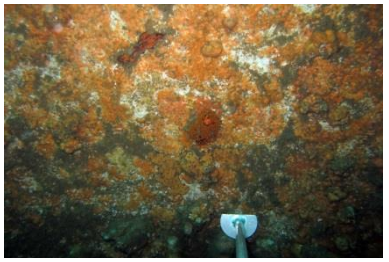
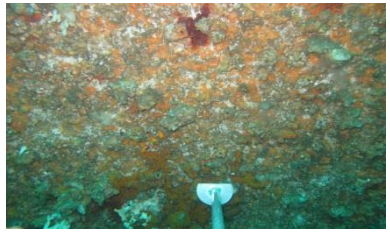
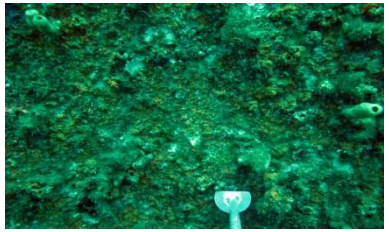
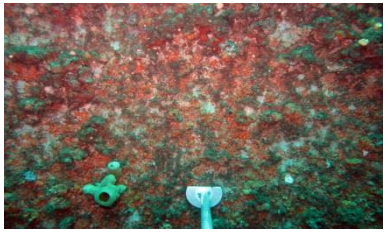
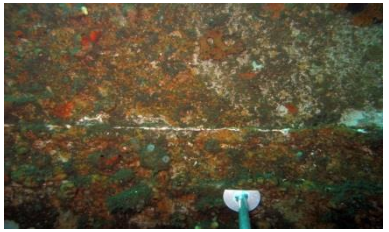
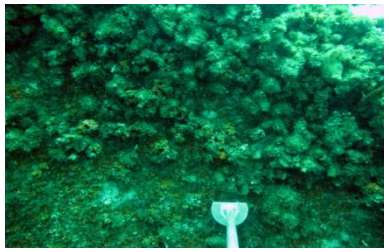
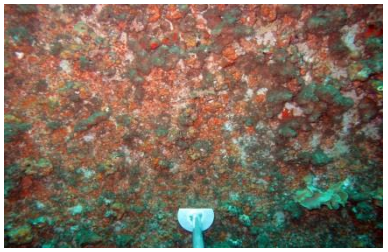
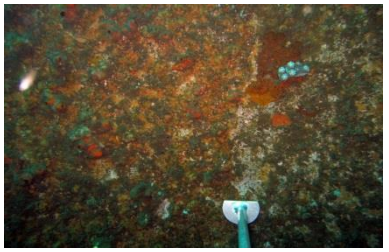
Monitoring Survey 5 (October/November 2012)	Monitoring Survey 6 (January 2013)	Monitoring Survey 7 (April 2013)	Monitoring Survey 8 (July 2013)	Monitoring Survey 9 (October 2013)
				
				
				

Plate 9 Continued: Vertical Hull Port Bow

Vertical Hull Port Bow

Monitoring Survey 10
(March 2014)

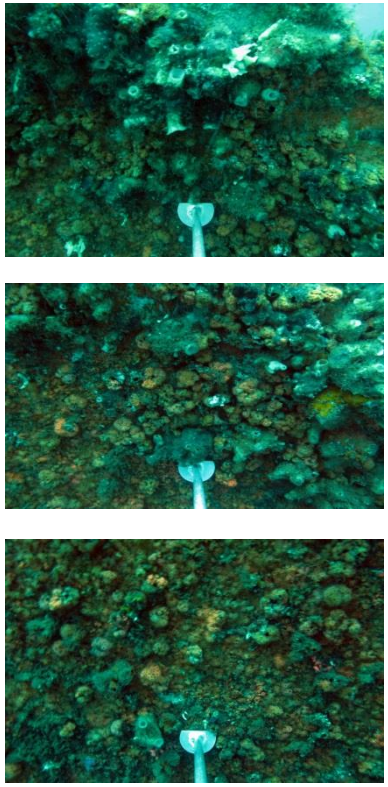


Plate 9 Continued: Vertical Hull Port Bow

Vertical Hull Port Stern

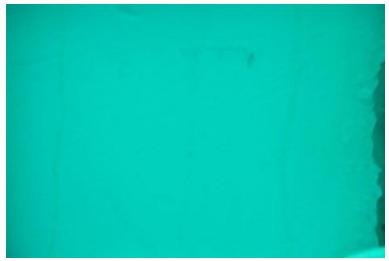
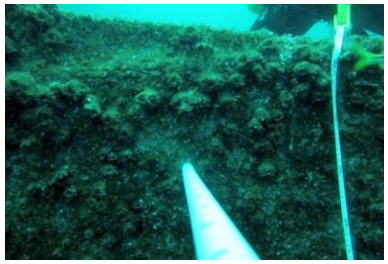
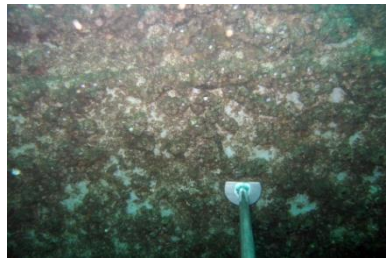
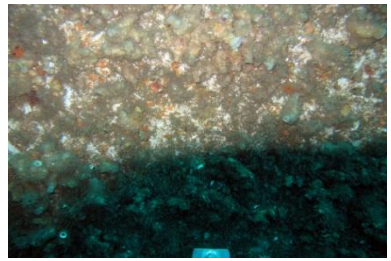
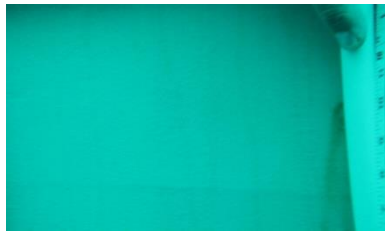
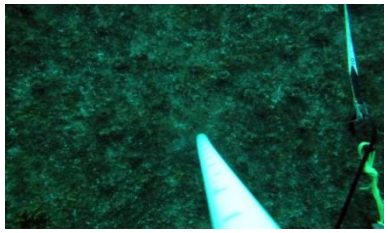
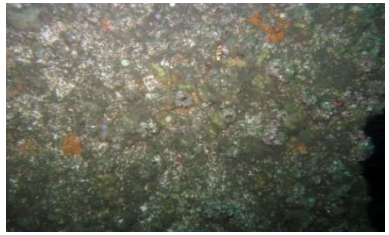
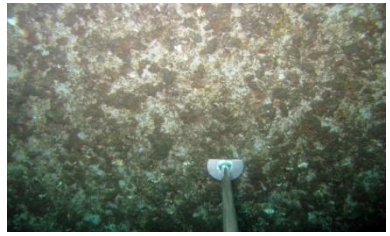
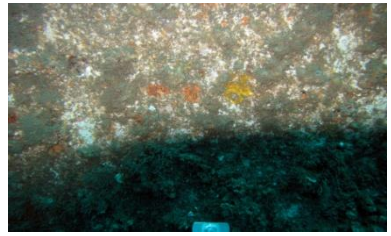
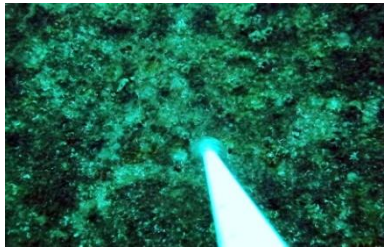
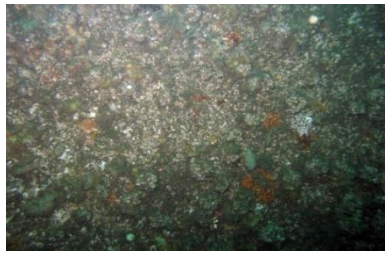
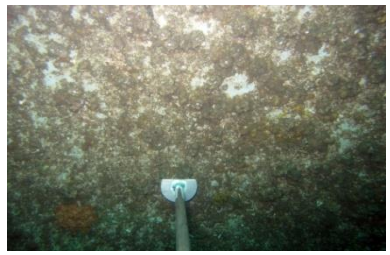
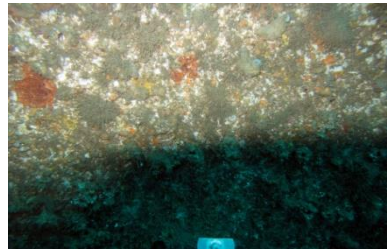
Baseline Survey (April/May 2011)	Monitoring Survey 1 (October 2011)	Monitoring Survey 2 (February 2012)	Monitoring Survey 3 (May 2012)	Monitoring Survey 4 (August 2012)
				
				
				

Plate 10: Vertical Hull Port Stern

Vertical Hull Port Stern

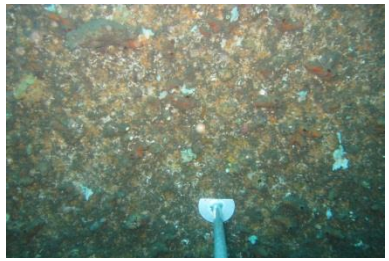
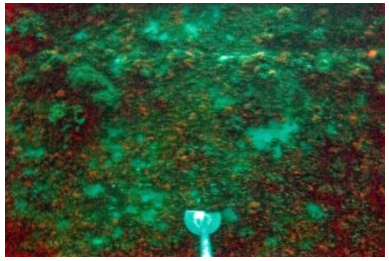
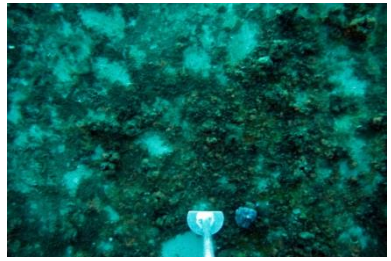
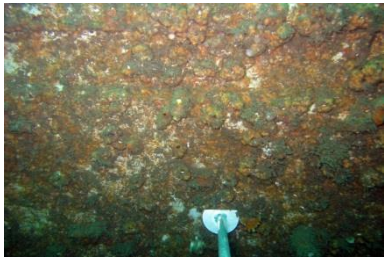
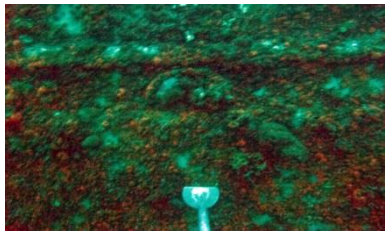
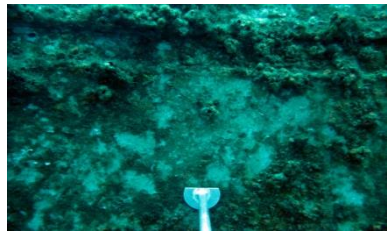
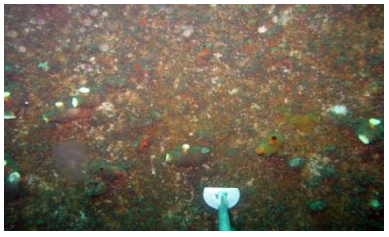
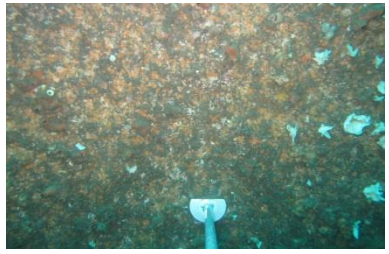
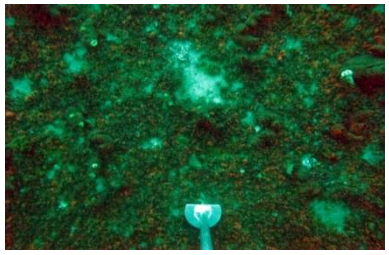
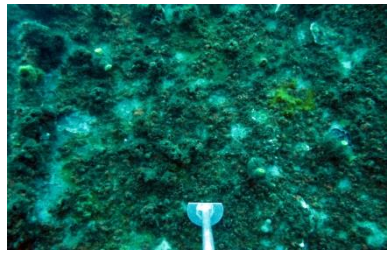
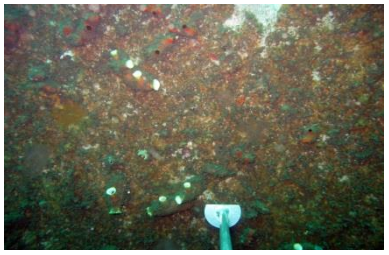
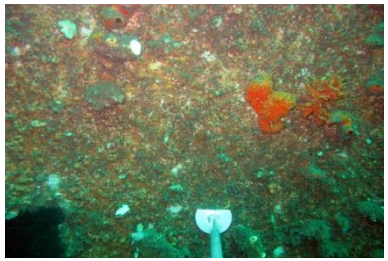
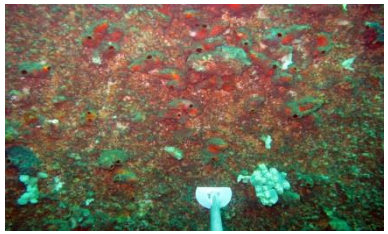
Monitoring Survey 5 (October/November 2012)	Monitoring Survey 6 (January 2013)	Monitoring Survey 7 (April 2013)	Monitoring Survey 8 (July 2013)	Monitoring Survey 9 (October 2013)
				
				
				

Plate 10 Continued: Vertical Hull Port Stern

Vertical Hull Port Stern

Monitoring Survey 10
(March 2014)





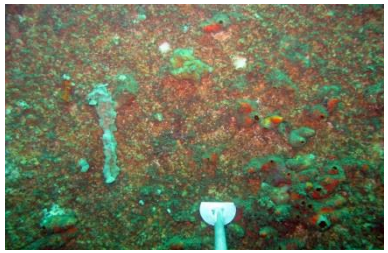


Plate 10 Continued: Vertical Hull Port Stern

Vertical Hull Starbord Bow

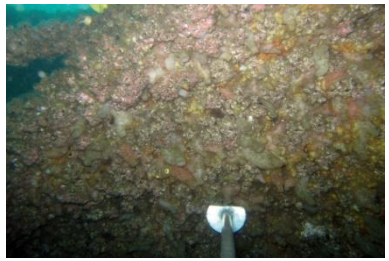
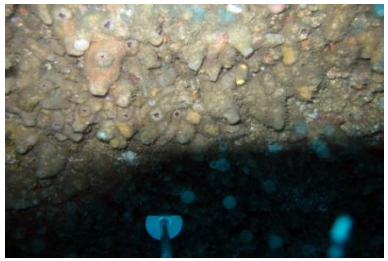
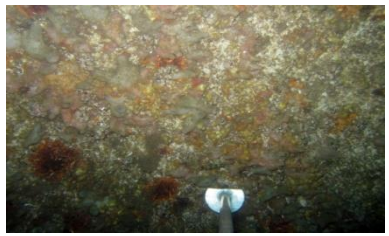
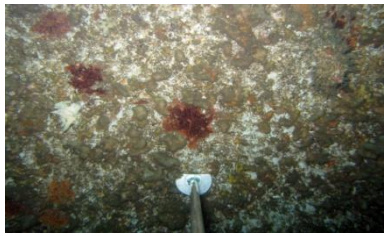
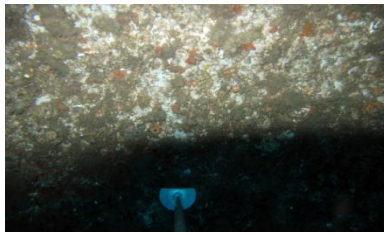
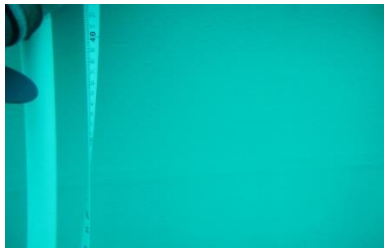
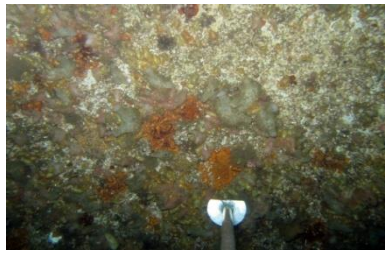
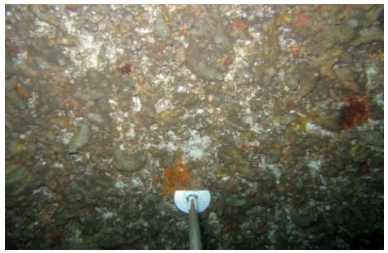
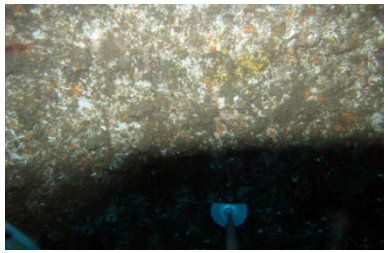
Baseline Survey (April/May 2011)	Monitoring Survey 1 (October 2011)	Monitoring Survey 2 (February 2012)	Monitoring Survey 3 (May 2012)	Monitoring Survey 4 (August 2012)
				
				
				

Plate 11: Vertical Hull Starbord Bow

Vertical Hull Starbord Bow

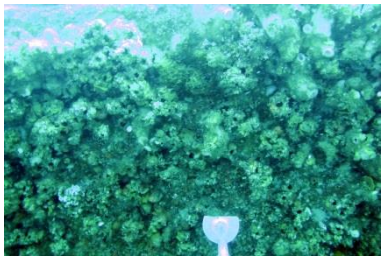
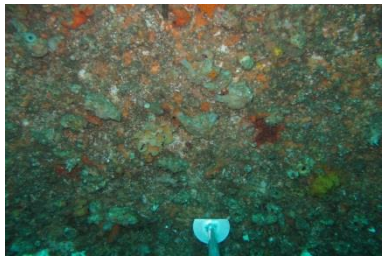
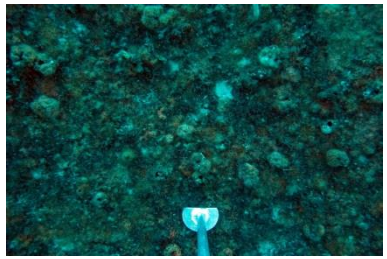
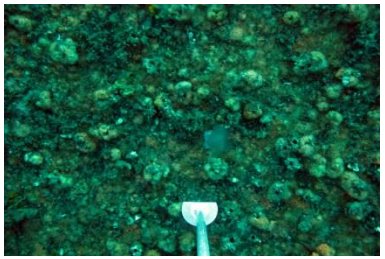
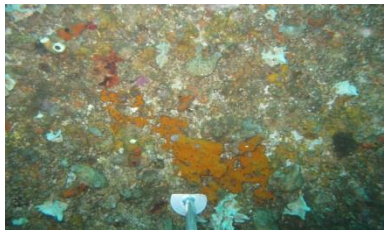
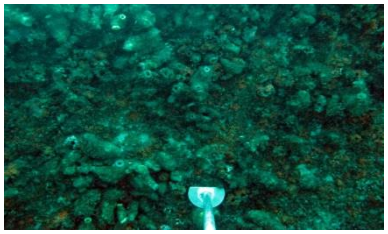
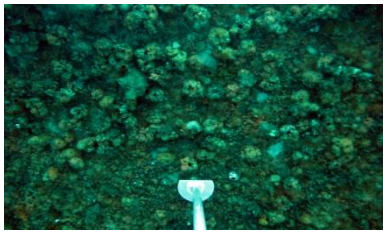
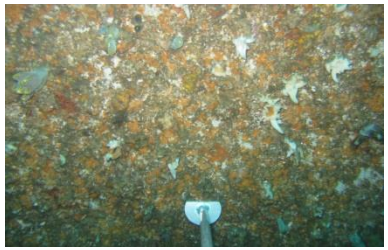
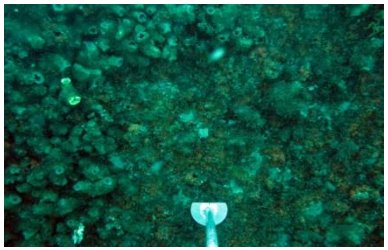
Monitoring Survey 5 (October/November 2012)	Monitoring Survey 6 (January 2013)	Monitoring Survey 7 (April 2013)	Monitoring Survey 8 (July 2013)	Monitoring Survey 9 (October 2013)
				
				
				

Plate 11 Continued: Vertical Hull Starbord Bow

Vertical Hull Starbord Bow

Monitoring Survey 10
(March 2014)

Plate 11 Continued: Vertical Hull Starbord Bow

Vertical Hull Starbord Stern

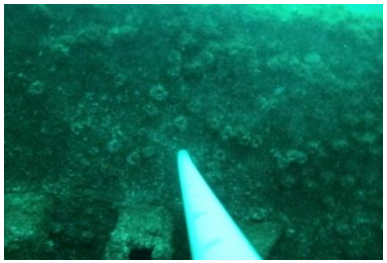
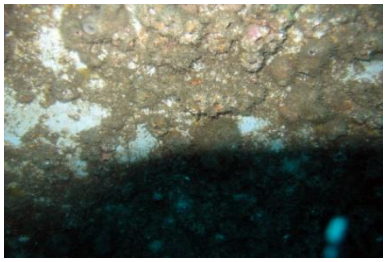
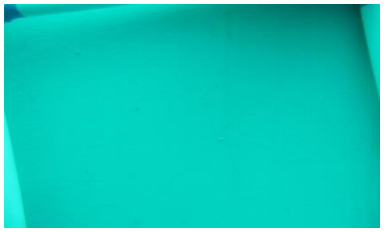
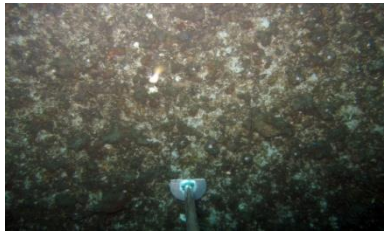
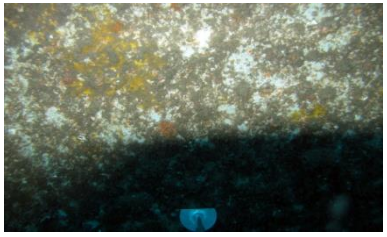
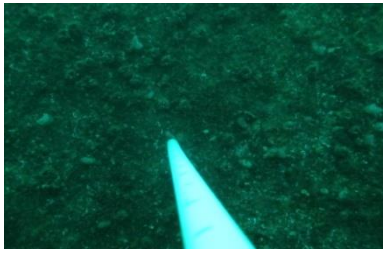
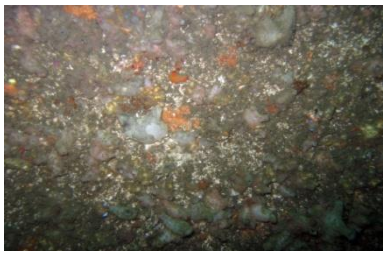
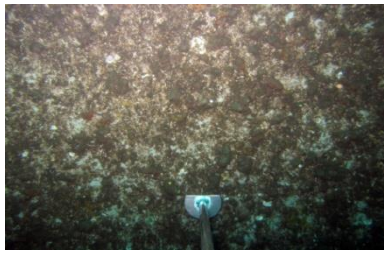
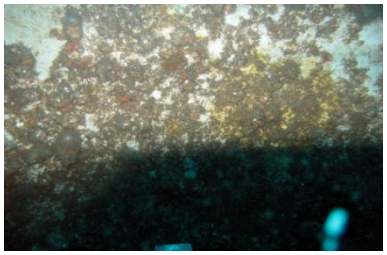
Baseline Survey (April/May 2011)	Monitoring Survey 1 (October 2011)	Monitoring Survey 2 (February 2012)	Monitoring Survey 3 (May 2012)	Monitoring Survey 4 (August 2012)
				
				
				

Plate 12: Vertical Hull Starbord Stern

Vertical Hull Starbord Stern

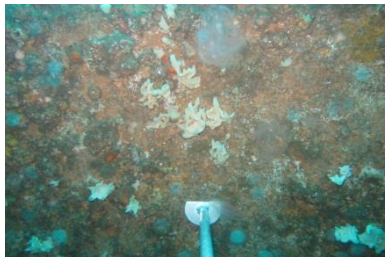
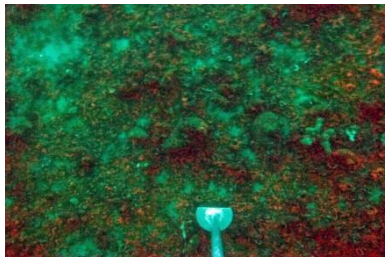
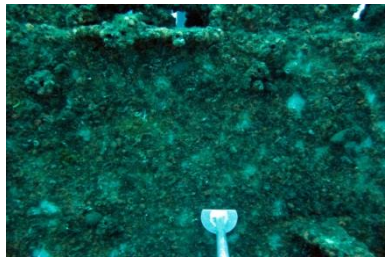
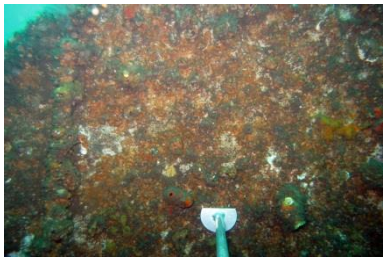
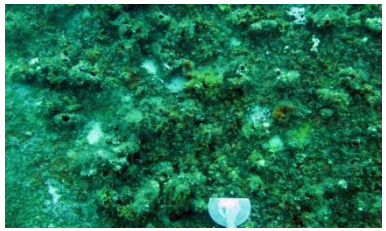
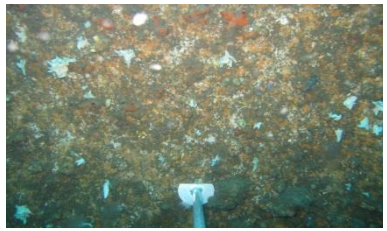
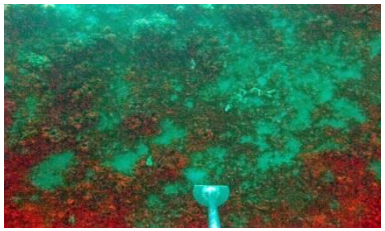
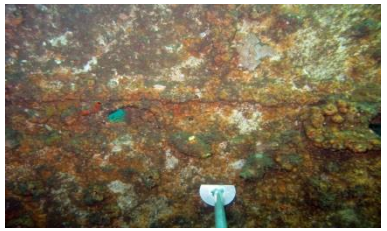
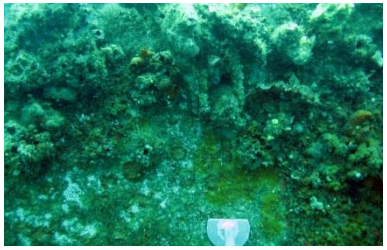
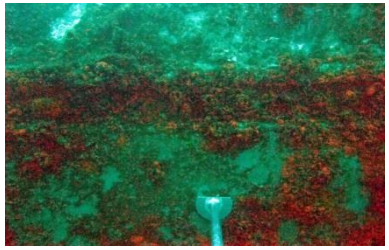
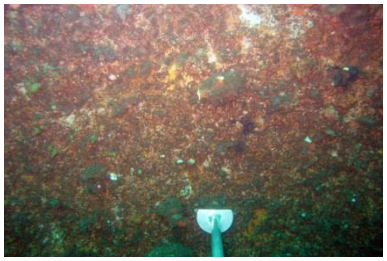
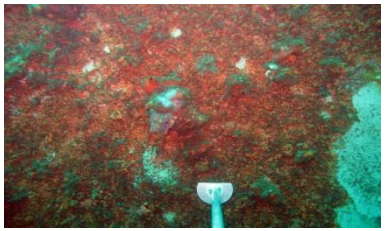
Monitoring Survey 5 (October/November 2012)	Monitoring Survey 6 (January 2013)	Monitoring Survey 7 (April 2013)	Monitoring Survey 8 (July 2013)	Monitoring Survey 9 (October 2013)
				
				
				

Plate 12 Continued: Vertical Hull Starbord Stern

Vertical Hull Starbord Stern

Monitoring Survey 10
(March 2014)





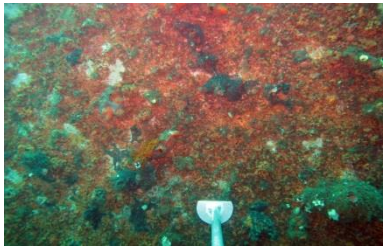


Plate 12 Continued: Vertical Hull Starbord Stern

Vertical Superstructure Port Bow

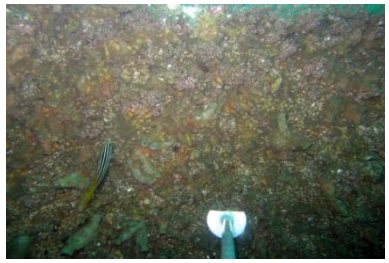
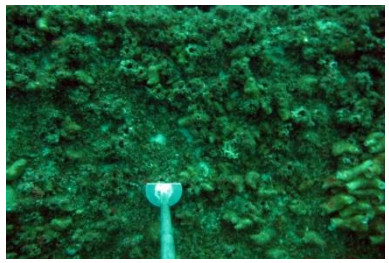
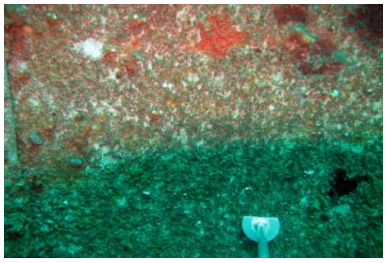
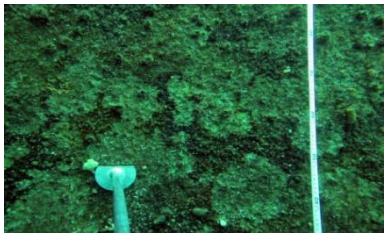
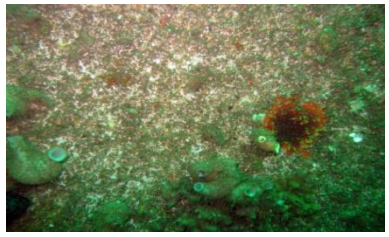
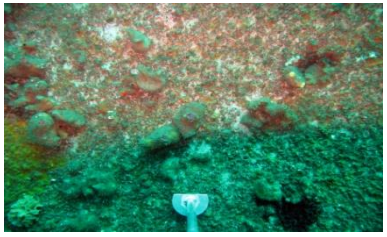
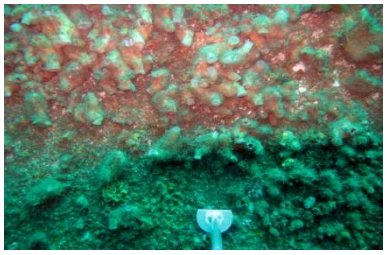
Baseline Survey (April/May 2011)	Monitoring Survey 1 (October 2011)	Monitoring Survey 2 (February 2012)	Monitoring Survey 3 (May 2012)	Monitoring Survey 4 (August 2012)
Not Sampled				
Not Sampled				
Not Sampled				

Plate 13: Vertical Superstructure Port Bow

Vertical Superstructure Port Bow

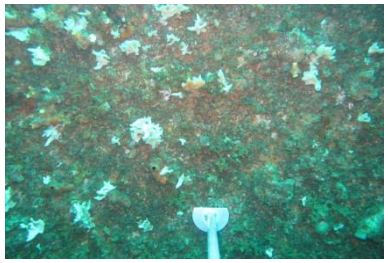
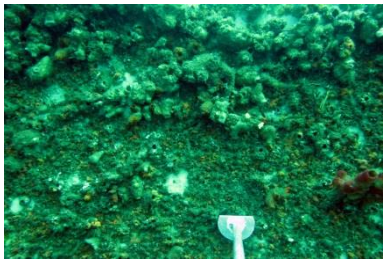
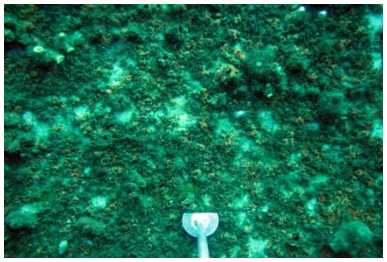
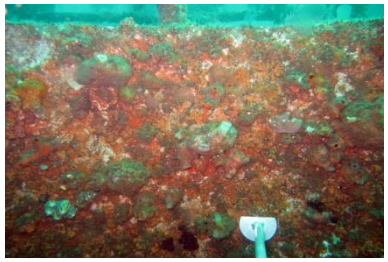
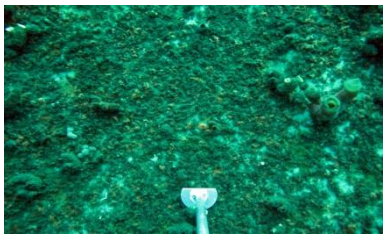
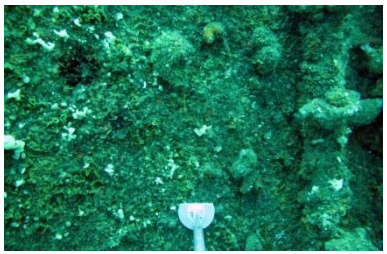
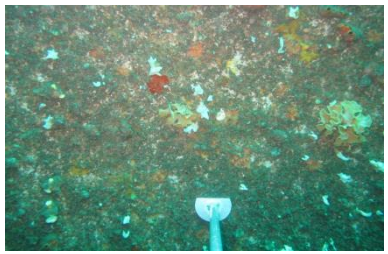
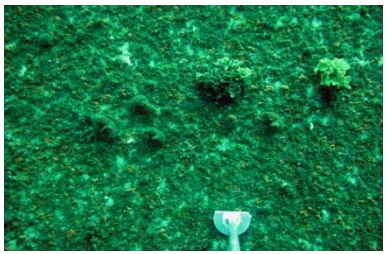
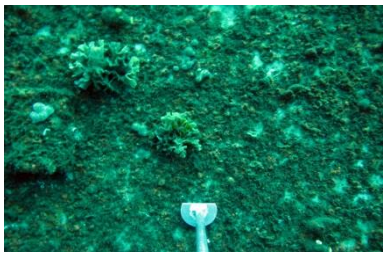
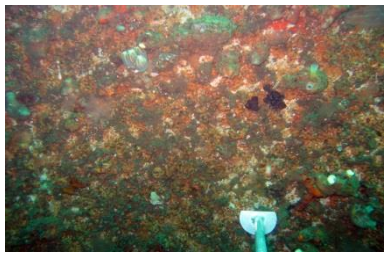
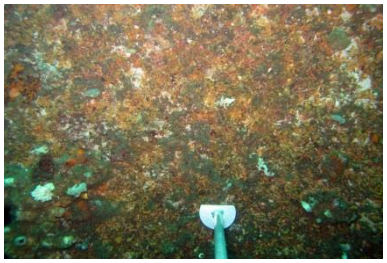
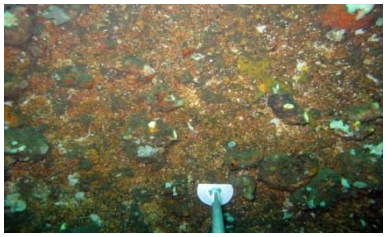
Monitoring Survey 5 (October/November 2012)	Monitoring Survey 6 (January 2013)	Monitoring Survey 7 (April 2013)	Monitoring Survey 8 (July 2013)	Monitoring Survey 9 (October 2013)
				
				
				

Plate 13 Continued: Vertical Superstructure Port Bow

Vertical Superstructure Port Bow

Monitoring Survey 10
(March 2014)





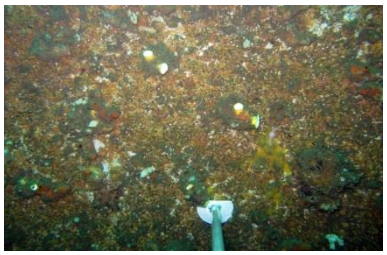


Plate 13 Continued: Vertical Superstructure Port Bow

Vertical Superstructure Port Stern

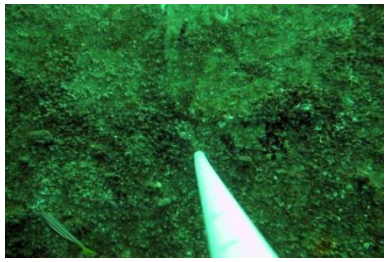
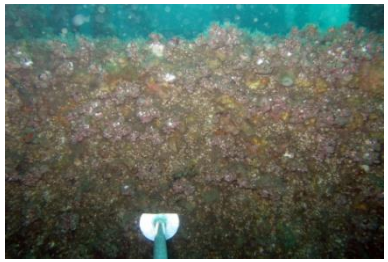
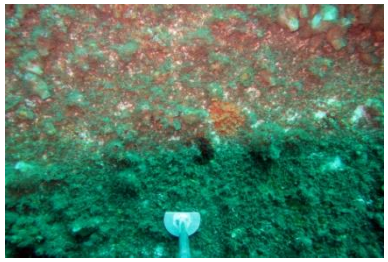
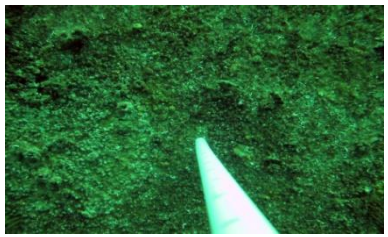
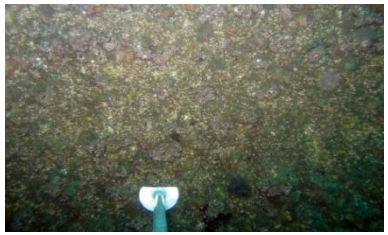
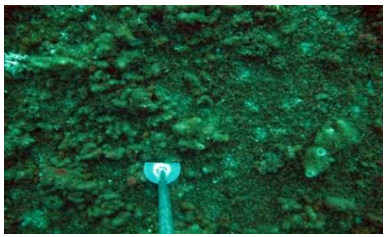
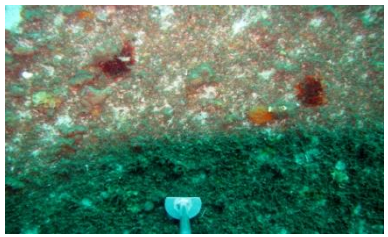
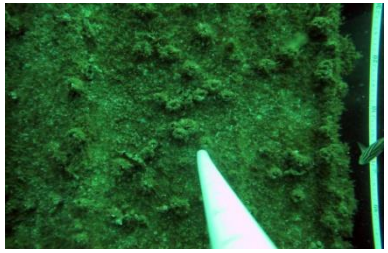
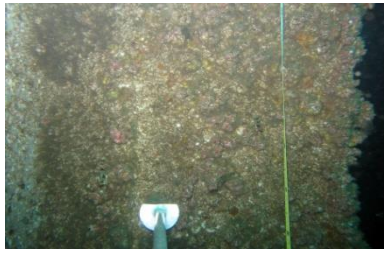
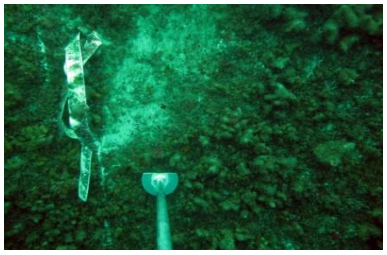
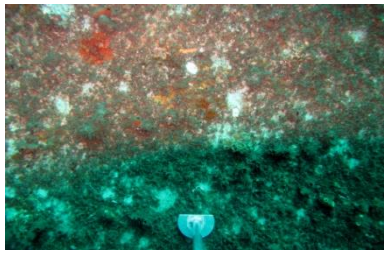
Baseline Survey (April/May 2011)	Monitoring Survey 1 (October 2011)	Monitoring Survey 2 (February 2012)	Monitoring Survey 3 (May 2012)	Monitoring Survey 4 (August 2012)
Not Sampled				
Not Sampled				
Not Sampled				

Plate 14: Vertical Superstructure Port Stern

Vertical Superstructure Port Stern

Monitoring Survey 5 (October/November 2012)	Monitoring Survey 6 (January 2013)	Monitoring Survey 7 (April 2013)	Monitoring Survey 8 (July 2013)	Monitoring Survey 9 (October 2013)

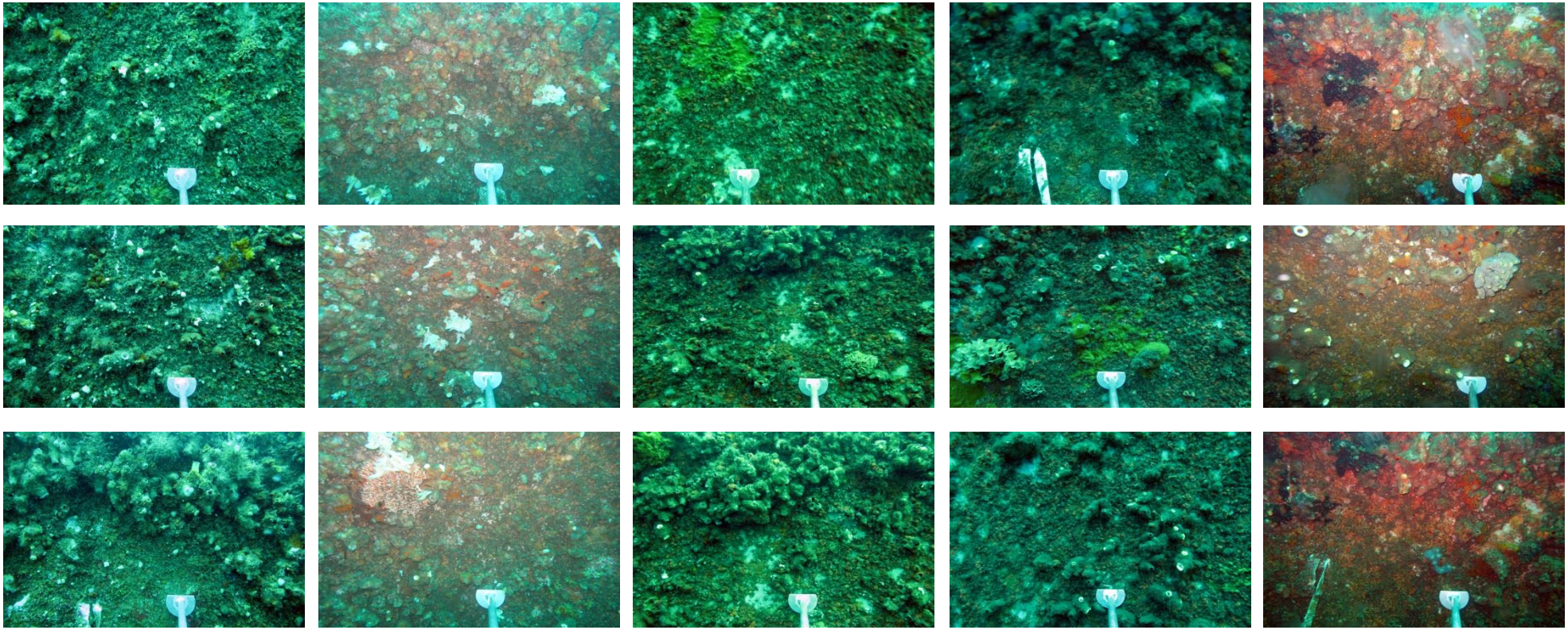
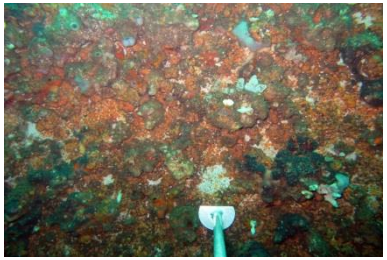


Plate 14 Continued: Vertical Superstructure Port Stern

Vertical Superstructure Port Stern

Monitoring Survey 10
(March 2014)



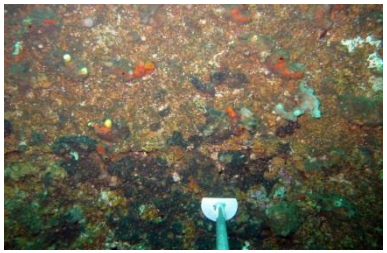


Plate 14 Continued: Vertical Superstructure Port Stern

Vertical Superstructure Starboard Bow

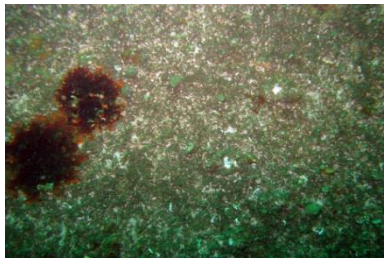
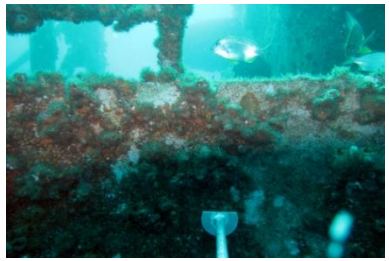
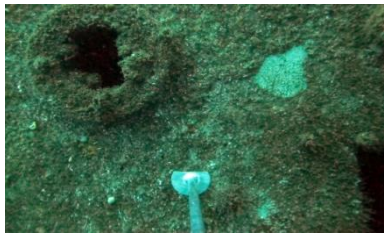
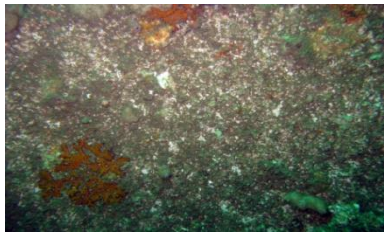
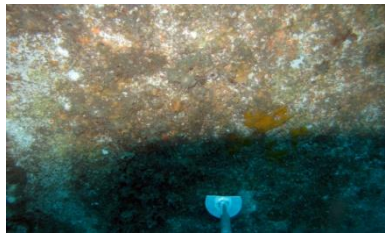
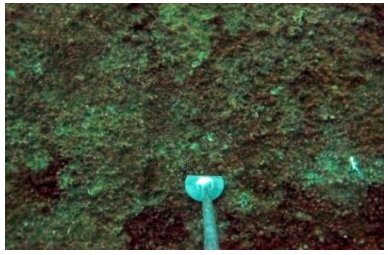
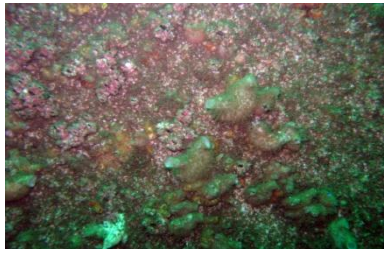
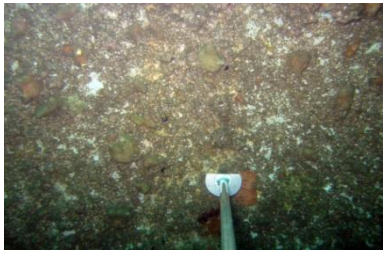
Baseline Survey (April/May 2011)	Monitoring Survey 1 (October 2011)	Monitoring Survey 2 (February 2012)	Monitoring Survey 3 (May 2012)	Monitoring Survey 4 (August 2012)
Not Sampled				
Not Sampled				
Not Sampled				

Plate 15: Vertical Superstructure Starbord Bow

Vertical Superstructure Starboard Bow

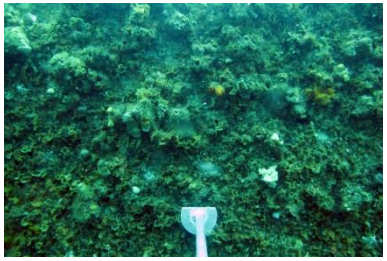
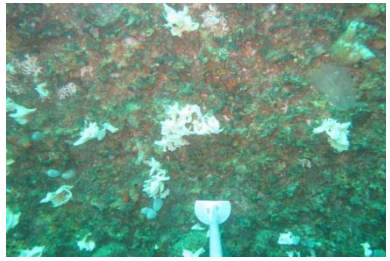
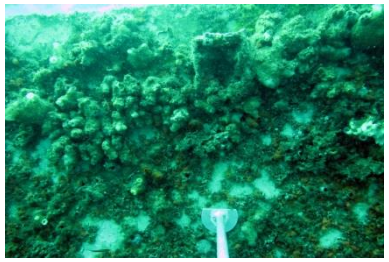
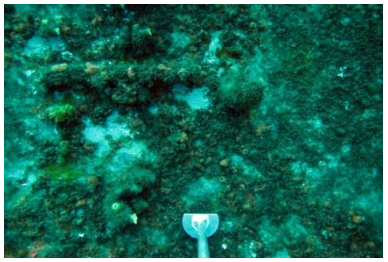
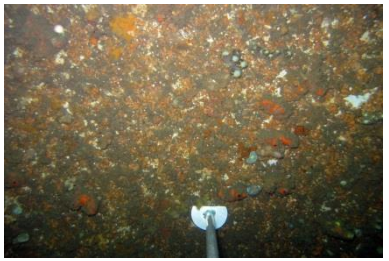
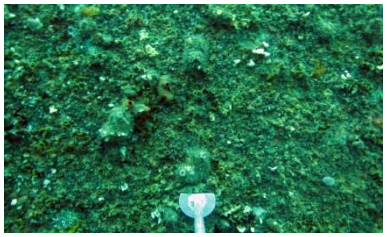
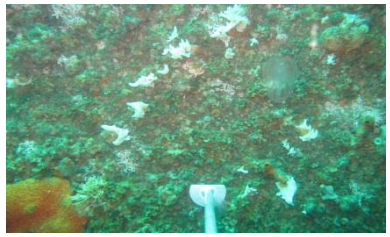
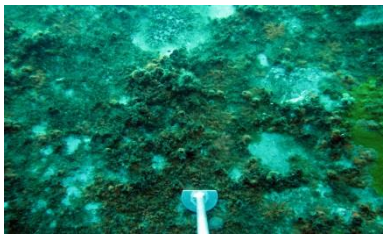
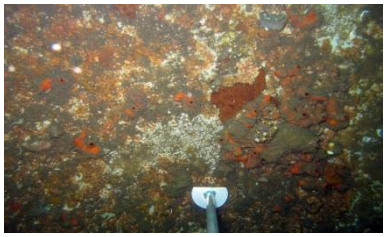
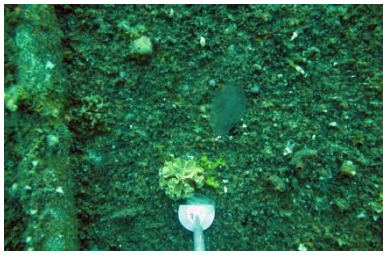
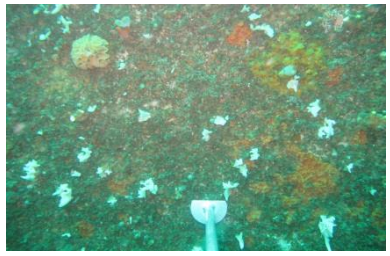
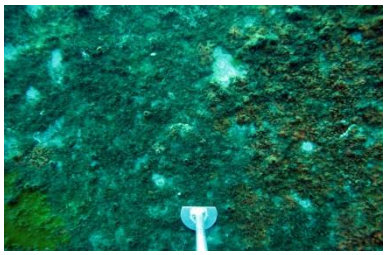
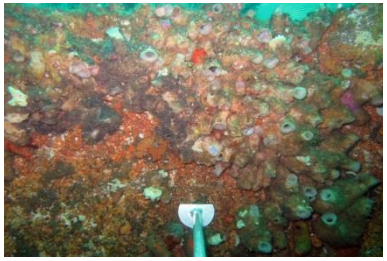
Monitoring Survey 5 (October/November 2012)	Monitoring Survey 6 (January 2013)	Monitoring Survey 7 (April 2013)	Monitoring Survey 8 (July 2013)	Monitoring Survey 9 (October 2013)
				
				
				

Plate 15 Continued: Vertical Superstructure Starbord Bow

Vertical Superstructure Starbord Bow

Monitoring Survey 10
(March 2014)



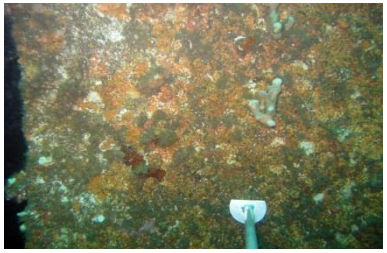


Plate 15 Continued: Vertical Superstructure Starbord Bow

Vertical Superstructure Starboard Stern

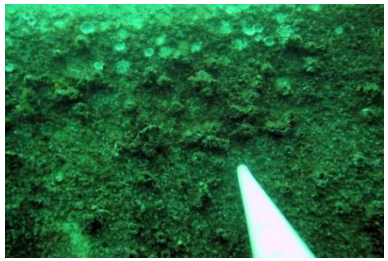
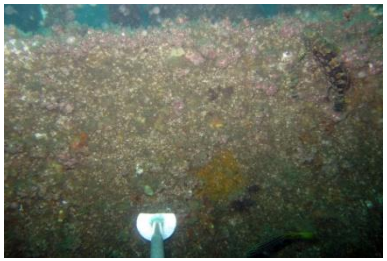
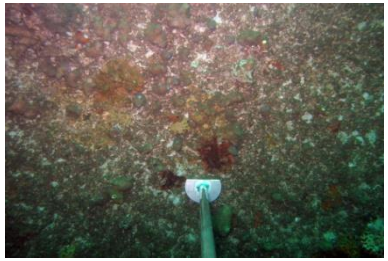
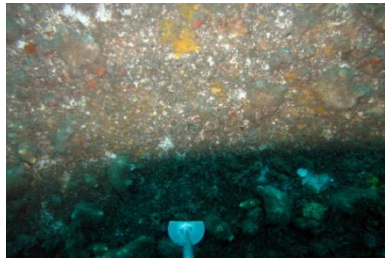
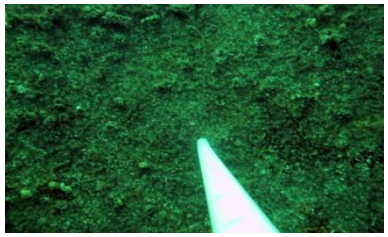
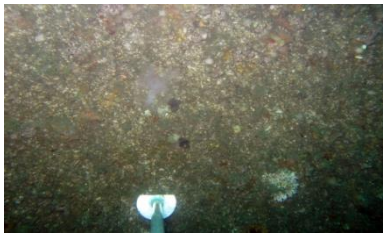
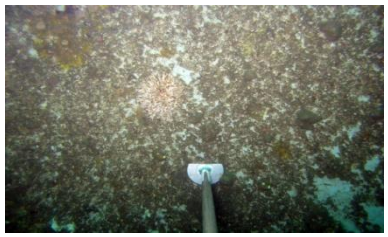
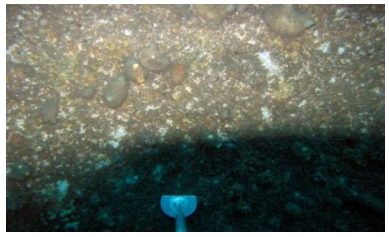
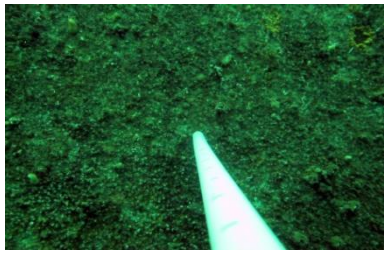
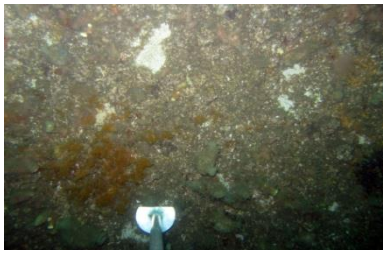
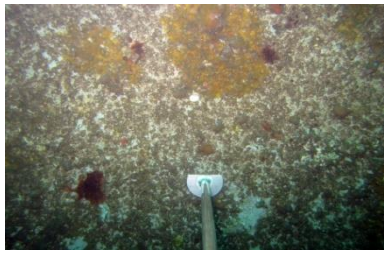
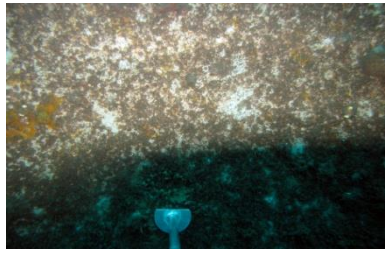
Baseline Survey (April/May 2011)	Monitoring Survey 1 (October 2011)	Monitoring Survey 2 (February 2012)	Monitoring Survey 3 (May 2012)	Monitoring Survey 4 (August 2012)
Not Sampled				
Not Sampled				
Not Sampled				

Plate 16: Vertical Superstructure Starboard Stern

Vertical Superstructure Starboard Stern

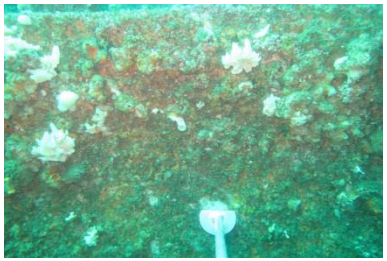
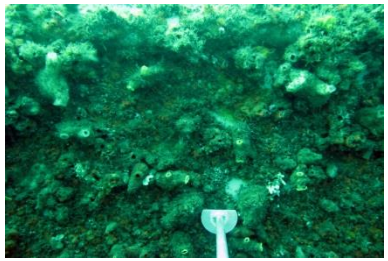
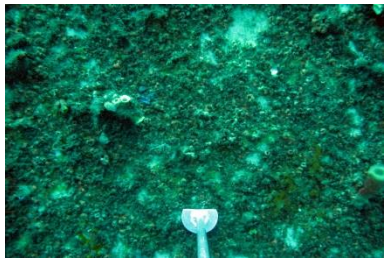
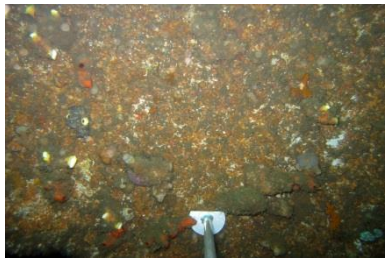
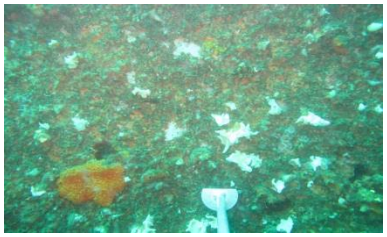
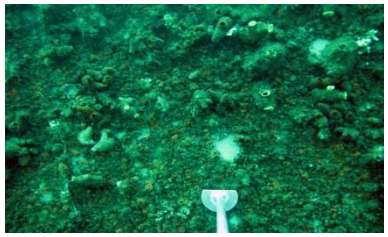
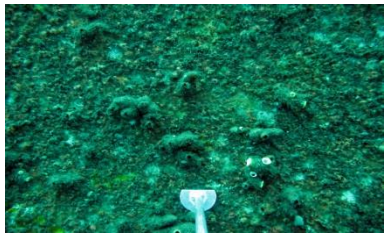
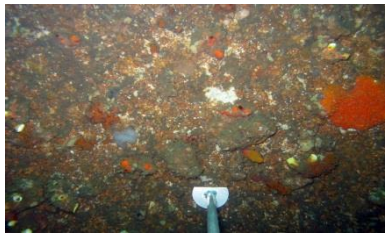
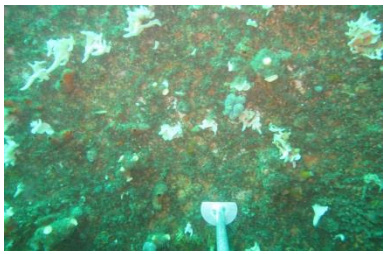
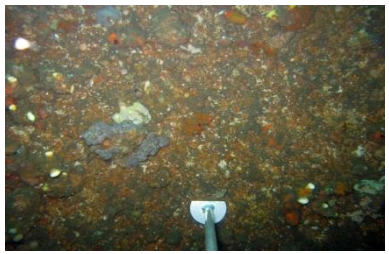
Monitoring Survey 5 (October/November 2012)	Monitoring Survey 6 (January 2013)	Monitoring Survey 7 (April 2013)	Monitoring Survey 8 (July 2013)	Monitoring Survey 9 (October 2013)
				
				
				

Plate 16 Continued: Vertical Superstructure Starboard Stern

Vertical Superstructure Starbord Stern

Monitoring Survey 10
(March 2014)

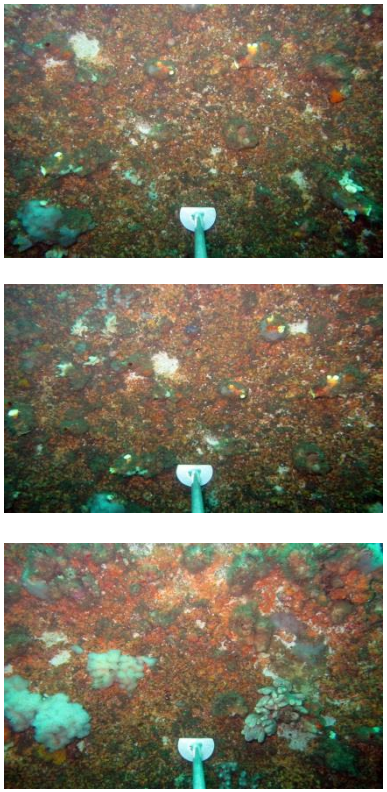


Plate 16 Continued: Vertical Superstructure Starbord Stern

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

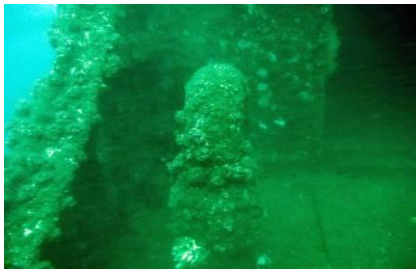
Fixed Photo: 1

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

Survey 4

Survey 5

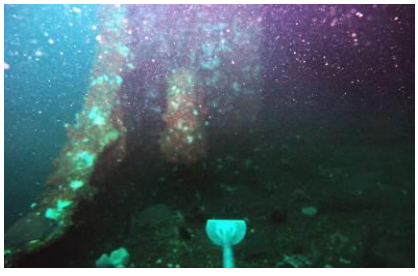
Survey 6

Survey 7

Survey 8

Survey 9

Survey 10



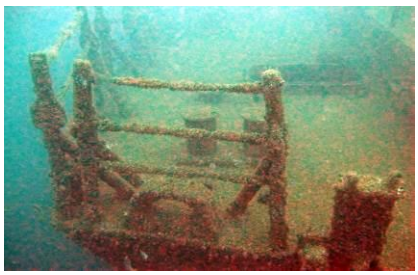
Appendix A: (Continued).

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

No Data

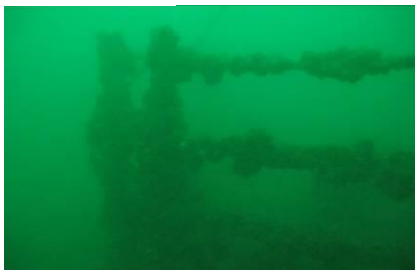
Survey 4

Survey 5

No Data

Survey 6

Survey 7



Survey 8

Survey 9

Survey 10

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

Survey 4

Survey 5

Survey 6

Survey 7

Survey 8

Survey 9

Survey 10

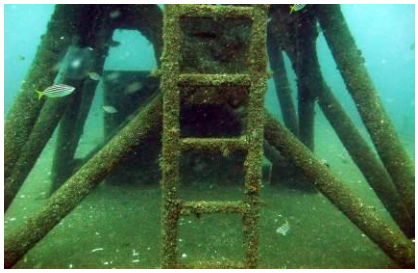
Appendix A: (Continued).

Fixed Photo: 4

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

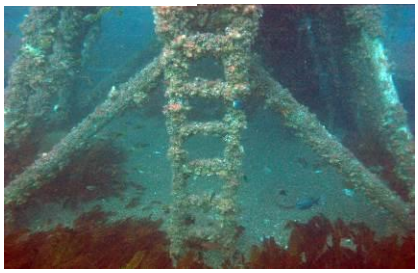
Depth: Approximately 23 m

Survey 1



Survey 2

Survey 3



Survey 4

Survey 5

Survey 6

Survey 7 (Structure missing; found over port side of ship)

No Data

No Data

Survey 10

No Data

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

Survey 4

Survey 5

Survey 6

Survey 7

Survey 8

Survey 9

Survey 10

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

Survey 4

Survey 5

Survey 6

Survey 7

Survey 8

Survey 9

Survey 10

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

Survey 4

Survey 5

Survey 6

Survey 7

Survey 8

Survey 9

Survey 10

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

Survey 4

Survey 5

Survey 6

Survey 7

Survey 8

Survey 9

Survey 10

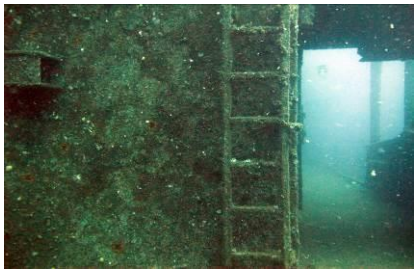
Appendix A: (Continued).

Fixed Photo: 9

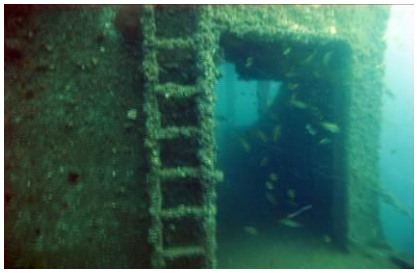
Location: Wall below the bridge on the starboard side. Photo taken standing on front deck 2 m in front of the ladder.

Depth: Approximately 26 m.

Survey 1



Survey 2



Survey 3

Survey 4

Survey 5

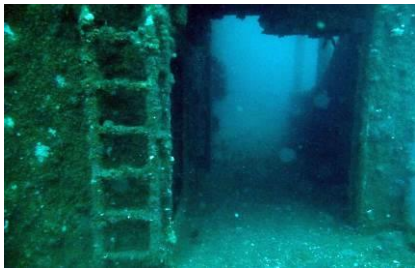
Survey 6

Survey 7

Survey 8

Survey 9

Survey 10



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

Survey 4

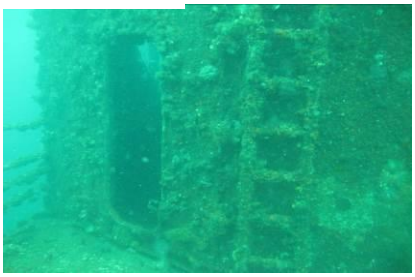
Survey 5

Survey 6

Survey 7

Survey 8

Survey 9



Survey 10

Appendix B: Mean percentage cover (± standard error) of reef communities for each transect analysed during Survey 10 (March 2013).

	Deck Port Bow		Deck Port Mid		Deck Port Stern	
Categories	Mean	S.E.	Mean	S.E.	Mean	S.E.
PHAEOPHYTA						
Brown Filamentous Algae	0.00	0.00	0.00	0.00	0.00	0.00
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
Orange Filamentous Algae	0.20	0.20	0.42	0.42	0.42	0.42
Turfing Brown Algae	0.00	0.00	0.00	0.00	0.00	0.00
RHODOPHYTA						
Encrusting Coralline	0.20	0.20	0.00	0.00	0.00	0.00
Encrusting Red Algae	0.00	0.00	8.64	1.70	8.64	1.70
Red Filamentous	0.00	0.00	0.41	0.41	0.41	0.41
Thin Branching Red Algae	1.41	0.51	0.00	0.00	0.00	0.00
BRYOZOA						
Encrusting Orange Bryozoan	0.20	0.20	0.00	0.00	0.00	0.00
Triphyllozoan sp.	0.00	0.00	0.82	0.82	0.82	0.82
SPONGE						
Orange Encrusting Sponge	0.00	0.00	1.85	0.82	1.85	0.82
Purple Sponge	0.00	0.00	0.00	0.00	0.00	0.00
White Encrusting Sponge	0.20	0.20	0.41	0.41	0.41	0.41
White Globular Sponge	0.00	0.00	0.41	0.25	0.41	0.25
White Papillate Sponge	0.00	0.00	0.00	0.00	0.00	0.00
Yellow Encrusting Sponge	0.00	0.00	0.00	0.00	0.00	0.00
Pink Spikey Sponge	0.00	0.00	0.00	0.00	0.00	0.00
Red Solitary Sponge	0.00	0.00	0.21	0.21	0.21	0.21
ASCIDIAN						
Botryloides magnicoecum	0.00	0.00	0.00	0.00	0.00	0.00
Herdmania momus	0.00	0.00	0.00	0.00	0.00	0.00
Orange Colonial Ascidian	0.00	0.00	0.00	0.00	0.00	0.00
Orange Bubbly Ascidain	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
POLYCHAETE						
Serpulid Polychaete	0.00	0.00	0.00	0.00	0.00	0.00
CNIDARIAN						
Blue Fuzzy Hydroid	0.00	0.00	0.00	0.00	0.00	0.00
Tiny Orange Anemone	0.00	0.00	0.00	0.00	0.00	0.00
Translucent Anemone	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
Early Colonising Matrix	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	97.78	0.49	86.83	1.87	86.83	1.87
FISH MOBILE						
Fish Mobile	0.00	0.00	0.00	0.00	0.00	0.00
INDETERMINATE						
Poor Quality	0.00	0.00	0.00	0.00	0.00	0.00
TAPE, WAND, SHADOW						
Shadow	0.40	0.24	0.80	0.37	0.80	0.37
Wand	0.40	0.24	2.20	0.20	2.20	0.20

Appendix B: (Continued).

	Deck Starbord Bow		Deck Starbord Mid		Deck Starbord Stern	
	Mean	S.E.	Mean	S.E.	Mean	S.E.
PHAEOPHYTA						
Brown Filamentous Algae	0.00	0.00	0.00	0.00	0.00	0.00
Ecklonia radiata	0.00	0.00	12.00	7.41	0.00	0.00
Lobed Brown Algae	0.00	0.00	2.80	1.07	0.00	0.00
Orange Filamentous Algae	0.00	0.00	0.00	0.00	0.00	0.00
Turfing Brown Algae	0.00	0.00	0.20	0.20	0.00	0.00
RHODOPHYTA						
Encrusting Coralline	0.00	0.00	0.00	0.00	0.00	0.00
Encrusting Red Algae	2.26	1.00	10.23	3.32	2.86	2.17
Red Filamentous	1.24	0.76	2.60	1.43	0.00	0.00
Thin Branching Red Algae	0.00	0.00	0.00	0.00	0.00	0.00
BRYOZOA						
Encrusting Orange Bryozoan	0.00	0.00	0.00	0.00	0.20	0.20
Triphyllozoan sp.	0.00	0.00	0.00	0.00	0.00	0.00
SPONGE						
Orange Encrusting Sponge	0.41	0.25	0.40	0.40	0.41	0.25
Purple Sponge	0.20	0.20	0.00	0.00	0.00	0.00
White Encrusting Sponge	0.21	0.21	0.00	0.00	2.04	1.80
White Globular Sponge	0.00	0.00	0.20	0.20	0.00	0.00
White Papillate Sponge	0.00	0.00	0.00	0.00	0.00	0.00
Yellow Encrusting Sponge	0.00	0.00	1.82	1.82	0.41	0.41
Pink Spikey Sponge	0.00	0.00	0.20	0.20	0.00	0.00
Red Solitary Sponge	0.21	0.21	0.00	0.00	0.61	0.25
ASCIDIAN						
Botryloides magnicoecum	0.41	0.41	0.00	0.00	0.00	0.00
Herdmania momus	0.00	0.00	0.00	0.00	0.61	0.41
Orange Colonial Ascidian	0.00	0.00	0.20	0.20	0.00	0.00
Orange Bubbly Ascidain	0.00	0.00	0.60	0.60	0.00	0.00
ABIOTIC						
Bare Ships Surface	0.00	0.00	2.21	1.12	0.20	0.20
POLYCHAETE						
Serpulid Polychaete	0.00	0.00	0.00	0.00	0.00	0.00
CNIDARIAN						
Blue Fuzzy Hydroid	0.00	0.00	0.00	0.00	0.00	0.00
Tiny Orange Anemone	0.00	0.00	0.00	0.00	0.00	0.00
Translucent Anemone	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
Early Colonising Matrix	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	95.06	1.97	66.53	7.62	92.65	2.80
FISH MOBILE						
Fish Mobile	0.00	0.00	0.00	0.00	0.00	0.00
INDETERMINATE						
Poor Quality	0.00	0.00	0.00	0.00	0.00	0.00
TAPE, WAND, SHADOW						
Shadow	1.60	0.24	0.20	0.20	0.00	0.00
Wand	0.80	0.37	0.00	0.00	2.00	0.00

Appendix B: (Continued).

	Horizontal Hull Port		Horizontal Hull Starbord		Vertical Hull Port Bow	
	Mean	S.E.	Mean	S.E.	Mean	S.E.
PHAEOPHYTA						
Brown Filamentous Algae	0.00	0.00	0.00	0.00	1.48	0.51
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
Orange Filamentous Algae	0.00	0.00	0.00	0.00	0.00	0.00
Turfing Brown Algae	0.00	0.00	0.00	0.00	0.00	0.00
RHODOPHYTA						
Encrusting Coralline	0.00	0.00	0.00	0.00	0.00	0.00
Encrusting Red Algae	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						
Encrusting Orange Bryozoan	0.00	0.00	0.34	0.34	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	0.34	0.34	0.00	0.00
Purple Sponge	0.00	0.00	0.17	0.17	0.00	0.00
White Encrusting Sponge	0.34	0.21	0.51	0.23	0.22	0.22
White Globular Sponge	0.00	0.00	0.00	0.00	0.00	0.00
White Papillate Sponge	0.17	0.17	0.00	0.00	0.00	0.00
Yellow Encrusting Sponge	0.17	0.17	0.34	0.22	0.00	0.00
Pink Spikey Sponge	0.00	0.00	0.00	0.00	0.00	0.00
Red Solitary Sponge	0.00	0.00	0.00	0.00	0.00	0.00
ASCIDIAN						
Botryloides magnicoecum	0.00	0.00	0.34	0.34	0.00	0.00
Herdmania momus	4.58	1.58	12.23	7.30	15.86	7.41
Orange Colonial Ascidian	0.00	0.00	0.17	0.17	0.21	0.21
Orange Bubbly Ascidain	0.00	0.00	0.00	0.00	0.00	0.00
ABIOTIC						
Bare Ships Surface	0.34	0.22	1.37	0.78	0.20	0.20
POLYCHAETE						
Serpulid Polychaete	0.00	0.00	0.00	0.00	0.00	0.00
CNIDARIAN						
Blue Fuzzy Hydroid	0.00	0.00	0.00	0.00	0.00	0.00
Tiny Orange Anemone	12.50	2.91	3.74	1.36	2.63	1.15
Translucent Anemone	0.00	0.00	0.00	0.00	0.22	0.22
MATRIX						
Barnacle,Sediment,Brown Fil	0.00	0.00	2.89	2.89	0.00	0.00
Early Colonising Matrix	0.00	0.00	8.87	2.33	0.00	0.00
Large Barnacle,Sediment,Brown Fil	7.46	3.16	7.27	3.77	40.66	4.64
Serpulid Barnacle and Encrusting Algae Matrix	74.44	3.41	61.24	10.14	38.51	7.52
FISH MOBILE						
Fish Mobile	0.00	0.00	0.00	0.00	0.00	0.00
INDETERMINATE						
Poor Quality	0.00	0.00	0.17	0.17	0.00	0.00
TAPE, WAND, SHADOW						
Shadow	0.83	0.31	0.50	0.22	7.80	2.37
Wand	0.67	0.33	1.50	0.34	0.00	0.00

Appendix B: (Continued).

	Vertical Hull Port Stern		Vertical Hull Starbord Bow		Vertical Hull Starbord Stern	
	Mean	S.E.	Mean	S.E.	Mean	S.E.
PHAEOPHYTA						
Brown Filamentous Algae	1.05	0.58	0.00	0.00	4.53	1.16
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
Orange Filamentous Algae	0.20	0.20	0.00	0.00	0.00	0.00
Turfing Brown Algae	0.00	0.00	0.00	0.00	0.00	0.00
RHODOPHYTA						
Encrusting Coralline	0.00	0.00	0.00	0.00	0.00	0.00
Encrusting Red Algae	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						
Encrusting Orange Bryozoan	0.21	0.21	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	0.21	0.21	0.00	0.00	0.00	0.00
Purple Sponge	0.00	0.00	0.21	0.21	0.00	0.00
White Encrusting Sponge	0.00	0.00	0.21	0.21	0.82	0.38
White Globular Sponge	0.20	0.20	0.00	0.00	0.00	0.00
White Papillate Sponge	0.21	0.21	0.00	0.00	0.00	0.00
Yellow Encrusting Sponge	0.00	0.00	0.00	0.00	0.00	0.00
Pink Spikey Sponge	0.00	0.00	0.00	0.00	0.00	0.00
Red Solitary Sponge	0.00	0.00	0.00	0.00	0.00	0.00
ASCIDIAN						
Botryloides magnicoecum	0.20	0.20	0.21	0.21	0.20	0.20
Herdmania momus	16.71	3.67	36.83	10.70	5.35	1.36
Orange Colonial Ascidian	0.00	0.00	0.42	0.42	0.00	0.00
Orange Bubbly Ascidain	0.21	0.21	0.00	0.00	0.00	0.00
ABIOTIC						
Bare Ships Surface	0.21	0.21	0.00	0.00	2.06	1.56
POLYCHAETE						
Serpulid Polychaete	0.00	0.00	0.00	0.00	0.00	0.00
CNIDARIAN						
Blue Fuzzy Hydroid	0.00	0.00	0.00	0.00	0.00	0.00
Tiny Orange Anemone	5.15	0.85	5.15	1.61	11.53	2.97
Translucent Anemone	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
Early Colonising Matrix	1.65	1.19	3.05	2.09	8.66	2.60
Large Barnacle,Sediment,Brown Fil	0.21	0.21	10.49	3.87	0.82	0.39
Serpulid Barnacle and Encrusting Algae Matrix	73.56	3.02	43.44	5.71	66.02	7.48
FISH MOBILE						
Fish Mobile	0.00	0.00	0.00	0.00	0.00	0.00
INDETERMINATE						
Poor Quality	0.00	0.00	0.00	0.00	0.00	0.00
TAPE, WAND, SHADOW						
Shadow	1.20	0.80	2.00	0.63	0.80	0.20
Wand	2.00	0.00	1.60	0.24	2.00	0.00

Appendix B: (Continued).

	Vertical Super Port Bow		Vertical Super Port Stern		Vertical Super Starbord Bow	
	Mean	S.E.	Mean	S.E.	Mean	S.E.
PHAEOPHYTA						
Brown Filamentous Algae	6.16	1.15	2.87	1.10	1.31	0.64
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
Orange Filamentous Algae	0.00	0.00	0.00	0.00	0.00	0.00
Turfing Brown Algae	0.00	0.00	0.00	0.00	0.00	0.00
RHODOPHYTA						
Encrusting Coralline	0.00	0.00	0.00	0.00	0.00	0.00
Encrusting Red Algae	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						
Encrusting Orange 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	0.00	0.00	0.21	0.21	0.00	0.00
Purple Sponge	0.00	0.00	0.00	0.00	0.00	0.00
White Encrusting Sponge	1.85	0.94	1.42	0.61	1.46	0.62
White Globular 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	0.42	0.42	0.00	0.00	0.00	0.00
Pink Spikey Sponge	0.00	0.00	0.00	0.00	0.00	0.00
Red Solitary Sponge	0.20	0.20	0.00	0.00	0.00	0.00
ASCIDIAN						
Botryloides magnicoecum	0.61	0.41	0.41	0.25	1.21	0.81
Herdmania momus	9.51	2.12	31.85	14.21	21.10	9.43
Orange Colonial Ascidian	0.41	0.25	0.41	0.41	0.20	0.20
Orange Bubbly Ascidain	0.00	0.00	0.00	0.00	0.00	0.00
ABIOTIC						
Bare Ships Surface	0.20	0.20	0.61	0.25	0.22	0.22
POLYCHAETE						
Serpulid Polychaete	0.00	0.00	0.00	0.00	0.94	0.94
CNIDARIAN						
Blue Fuzzy Hydroid	0.00	0.00	0.00	0.00	0.00	0.00
Tiny Orange Anemone	5.14	1.33	4.30	1.53	6.69	1.20
Translucent Anemone	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
Early Colonising Matrix	9.88	2.35	3.26	1.00	11.30	4.81
Large Barnacle,Sediment,Brown Fil	0.00	0.00	9.01	5.46	1.30	0.61
Serpulid Barnacle and Encrusting Algae Matrix	65.61	4.94	45.65	12.12	53.65	7.02
FISH MOBILE						
Fish Mobile	0.00	0.00	0.00	0.00	0.20	0.20
INDETERMINATE						
Poor Quality	0.00	0.00	0.00	0.00	0.40	0.40
TAPE, WAND, SHADOW						
Shadow	1.40	0.51	0.60	0.40	5.40	2.86
Wand	1.40	0.40	1.60	0.40	0.40	0.40

Appendix B: (Continued).

	Vertical Super Starbord Stern	
	Mean	S.E.
PHAEOPHYTA		
Brown Filamentous Algae	1.01	0.45
Ecklonia radiata	0.00	0.00
Lobed Brown Algae	0.00	0.00
Orange Filamentous Algae	0.00	0.00
Turfing Brown Algae	0.00	0.00
RHODOPHYTA		
Encrusting Coralline	0.00	0.00
Encrusting Red Algae	0.00	0.00
Red Filamentous	0.00	0.00
Thin Branching Red Algae	0.00	0.00
BRYOZOA		
Encrusting Orange Bryozoan	0.00	0.00
Triphyllozoan sp.	0.00	0.00
SPONGE		
Orange Encrusting Sponge	0.00	0.00
Purple Sponge	0.00	0.00
White Encrusting Sponge	0.61	0.40
White Globular Sponge	1.21	1.21
White Papillate Sponge	0.00	0.00
Yellow Encrusting Sponge	0.00	0.00
Pink Spikey Sponge	0.00	0.00
Red Solitary Sponge	0.00	0.00
ASCIDIAN		
Botryloides magnicoecum	0.61	0.61
Herdmania momus	8.27	1.26
Orange Colonial Ascidian	0.20	0.20
Orange Bubbly Ascidain	0.20	0.20
ABIOTIC		
Bare Ships Surface	1.01	0.45
POLYCHAETE		
Serpulid Polychaete	0.00	0.00
CNIDARIAN		
Blue Fuzzy Hydroid	0.20	0.20
Tiny Orange Anemone	8.27	3.09
Translucent Anemone	0.00	0.00
MATRIX		
Barnacle,Sediment,Brown Fil	0.00	0.00
Early Colonising Matrix	4.84	0.75
Large Barnacle,Sediment,Brown Fil	2.42	1.22
Serpulid Barnacle and Encrusting Algae Matrix	71.15	6.81
FISH MOBILE		
Fish Mobile	0.00	0.00
INDETERMINATE		
Poor Quality	0.00	0.00
TAPE, WAND, SHADOW		
Shadow	0.80	0.20
Wand	0.00	0.00

Appendix C: Permutational Analysis of Variance of Percent Cover of Reef Assemblages Sampled in Reef Monitoring Surveys 9 and 10. *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. Time (All Surveys)

Source	DF	SS	MS	F	P	Unique perms
Time	9	64614	7179.4	7.7309	**0.0001**	9878
Residual	150	1.393E5	928.66			
Total	159	2.0391E5				

2. Time, Orientation, Aspect

Source	DF	SS	MS	F	P	Unique perms
Time	1	1382.6	1382.6	2.6048	**0.0468**	9938 RED
Orientation	1	11447	11447	21.566	**0.0001**	9942
Aspect	1	512.99	512.99	0.96646	0.3963	9938
Time x Orientation	1	430.43	430.43	0.81092	0.4881	9946
Time x Aspect	1	1639.4	1639.4	3.0885	**0.0255**	9946
Orientation x Aspect	1	698.66	698.66	1.3163	0.2547	9951
Time x Orientation x Aspect	1	813.24	813.24	1.5321	0.1814	9941
Residual	75	39809	530.79			
Total	82	56299				

3. Time, Depth, Aspect, Transect

Source	DF	SS	MS	F	P	Unique perms
Ti	1	4045.3	4045.3	8.7386	**0.0001**	9951 **RED**
De	1	2850.6	2850.6	6.158	**0.0004**	9955 **RED**
As	1	1647.9	1647.9	3.5597	**0.0108**	9954 **RED**
Tr	1	1549.5	1549.5	3.3473	**0.013**	9942 **RED**
TixDe	1	681.33	681.33	1.4718	0.2067	9955
TixAs	1	1515.1	1515.1	3.2728	**0.0167**	9958 **RED**
TixTr	1	1186.8	1186.8	2.5638	**0.041**	9955 **RED**
DexAs	1	749.56	749.56	1.6192	0.1723	9957
DexTr	1	5590.9	5590.9	12.077	**0.0001**	9944 **RED**
AsxTr	1	1511.8	1511.8	3.2659	**0.0163**	9952 **RED**
TixDexAs	1	1871.1	1871.1	4.0418	**0.0048**	9948 **RED**
TixDexTr	1	2375.2	2375.2	5.1308	**0.0012**	9943 **RED**
TixAsxTr	1	2167	2167	4.6811	**0.0011**	9952 **RED**
DexAsxTr	1	1472.4	1472.4	3.1808	**0.0164**	9947 **RED**
TixDexAsxTr	1	1392.2	1392.2	3.0074	**0.0195**	9947
Res	63	29164	462.92			
Total	78	59962				

4. Time, Deck Position, Aspect

Source	DF	SS	MS	F	P	Unique perms
Ti	1	1428.2	1428.2	4.4331	**0.0169**	9954 **RED**
Po	2	9442.3	4721.2	14.655	**0.0001**	9948 **RED**
As	1	520.52	520.52	1.6157	0.1903	9944
TixPo	2	1988.4	994.22	3.0861	**0.024**	9943 **RED**
TixAs	1	534.68	534.68	1.6596	0.1807	9942
PoxAs	2	1072.3	536.14	1.6642	0.164	9952

TixPoxAs	2	1697.3	848.66	2.6343	**0.0427**	9946
Res	48	15464	322.16			
Total	59	32148				

Appendix D: Pairwise tests of reef assemblages for significant terms. Only significant pairwise results for the relevant terms are presented. Significant results in bold.

1. Times (All Surveys)

Term 'Ti'

Groups	t	P(perm)	Unique perms
1, 2	1.902	**0.0256**	9946
1, 3	2.2409	**0.0079**	9950
1, 4	4.3128	**0.0001**	9946
1, 5	3.8913	**0.0001**	9949
1, 6	4.0002	**0.0001**	9941
1, 7	4.0715	**0.0002**	9947
1, 8	4.2386	**0.0001**	9944
1, 9	3.9414	**0.0001**	9921
1, 10	3.9944	**0.0001**	9937
2, 3	1.0401	0.3465	9948
2, 4	3.2352	**0.0002**	9949
2, 5	2.7874	**0.0001**	9959
2, 6	2.9683	**0.0001**	9955
2, 7	3.1645	**0.0001**	9955
2, 8	3.4435	**0.0001**	9956
2, 9	3.023	**0.0001**	9958
2, 10	2.8985	**0.0001**	9947
3, 4	2.3061	**0.0005**	9953
3, 5	1.998	**0.0018**	9943
3, 6	2.1216	**0.0007**	9946
3, 7	2.1354	**0.0005**	9947
3, 8	2.3774	**0.0002**	9960
3, 9	2.1324	**0.0002**	9937
3, 10	2.0363	**0.0017**	9944
4, 5	1.7909	**0.0091**	9944
4, 6	1.5849	**0.036**	9938
4, 7	1.3004	0.1447	9945
4, 8	1.2995	0.1397	9942
4, 9	2.0158	**0.003**	9946
4, 10	1.8018	**0.0368**	9940
5, 6	1.1947	**0.2048**	9940
5, 7	1.6529	**0.022**	9944
5, 8	1.8101	**0.0086**	9928
5, 9	1.6509	**0.0158**	9920
5, 10	1.6265	**0.0355**	9940
6, 7	1.7059	**0.0233**	9941
6, 8	1.62	**0.0383**	9944
6, 9	1.759	**0.0108**	9931
6, 10	1.7066	**0.0282**	9946
7, 8	0.88275	0.5005	9960
7, 9	1.7415	**0.0149**	9942
7, 10	1.7011	**0.043**	9943
8, 9	1.6928	**0.0169**	9941
8, 10	1.7087	**0.033**	9944
9, 10	0.91456	0.4936	9952

2. Time, Orientation, Aspect

Term 'Or'

Groups	t	P(perm)	Unique perms
Deck, Hull	4.6439	**0.0001**	9945

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

Within level 'Port' of factor 'Aspect'

Groups	t	P(perm)	Unique perms
9, 10	2.1283	**0.008**	9936

Within level '10' of factor 'Time'

Groups	t	P(perm)	Unique perms
Port, Starbord	1.8617	**0.0132**	9940

Appendix D: Continued.

3. Time, Depth, Aspect, Transect

Within level '9' of factor 'Time'
Within level 'Port' of factor 'Aspect'
Within level 'Stern' of factor 'Transect'

Groups	t	P(perm)	Unique perms
Deep, Shallow	1.3905	**0.1238**	126

Within level '9' of factor 'Time'
Within level 'Starboard' of factor 'Aspect'
Within level 'Bow' of factor 'Transect'

Groups	t	P(perm)	Unique perms
Deep, Shallow	2.5664	**0.0159**	126

Within level '9' of factor 'Time'
Within level 'Starboard' of factor 'Aspect'
Within level 'Stern' of factor 'Transect'

Groups	t	P(perm)	Unique perms
Deep, Shallow	3.4964	**0.0087**	126

Within level '10' of factor 'Time'
Within level 'Port' of factor 'Aspect'
Within level 'Bow' of factor 'Transect'

Groups	t	P(perm)	Unique perms
Deep, Shallow	3.9437	**0.0085**	126

4. Time, Deck Position, Aspect

Within level '9' of factor 'Time'
Within level 'Port' of factor 'Aspect'

Groups	t	P(perm)	Unique perms
Bow, Mid	2.761	**0.0087**	126
Bow, Stern	1.6257	0.0635	121
Mid, Stern	2.3044	**0.0373**	126

Within level '9' of factor 'Time'
Within level 'Starboard' of factor 'Aspect'

Groups	t	P(perm)	Unique perms
Bow, Mid	2.2659	**0.0155**	126
Bow, Stern	1.2077	0.21	126
Mid, Stern	2.0524	**0.0243**	126

Within level '10' of factor 'Time'
Within level 'Port' of factor 'Aspect'

Groups	t	P(perm)	Unique perms
Bow, Mid	3.9794	**0.0071**	126
Bow, Stern	3.9794	**0.0083**	126
Mid, Stern	6.6648E-9	1	26

Within level '10' of factor 'Time'
Within level 'Starboard' of factor 'Aspect'

Groups	t	P(perm)	Unique perms
Bow, Mid	2.3114	**0.0086**	126
Bow, Stern	0.74284	0.7342	126
Mid, Stern	2.2422	**0.0181**	126

Appendix E: Results of SIMPER analyses of reef assemblages sampled in The Ex-HMAS Adelaide Artificial Reef Community Surveys 9 and 10. Cut off for percentage contribution is 90%. Note that only relevant SIMPER results have been included in this Appendix.

1. Time, Orientation and Aspect

Groups Deck & Hull
Average dissimilarity = 37.81

Species	Group Deck Av.Abund	Group Hull Av.Abund	Av.Diss	Diss/SD	Contrib%	Cum.%
Serpulid, barnacle and encrusting algae matrix	81.60	65.92	12.62	1.44	33.37	33.37
Large barnacle,sediment,brown fil	0.00	9.55	4.78	0.82	12.63	46.00
Solitary ascidian (Herdmania momus/)	0.34	9.49	4.65	0.75	12.31	58.31
Tiny orange anemone	0.17	6.97	3.43	1.08	9.08	67.39
Red encrusting algae	6.69	0.00	3.35	0.70	8.85	76.24
Early colonising matrix	0.42	3.78	1.94	0.80	5.13	81.37
Ecklonia radiata	3.84	0.00	1.92	0.37	5.08	86.45
Brown filamentous algae/hydroid	0.51	1.42	0.88	0.55	2.33	88.78
Orange encrusting sponge	1.17	0.54	0.71	0.61	1.87	90.65

2. Time, Depth, Aspect, Transect

Groups 9DeepStarboardBow & 9ShallowStarboardBow
Average dissimilarity = 45.42

Species	Group 9DeepStarboardBow Av.Abund	Group 9ShallowStarboardBow Av.Abund	Av.Diss	Diss/SD	Contrib%	Cum.%
Large barnacle,sediment,brown fil	34.74	1.54	16.60	1.90	36.56	36.56
Early colonising matrix	0.00	20.22	10.11	2.19	22.26	58.81
Serpulid, barnacle and encrusting algae matrix	58.09	59.30	9.97	1.40	21.95	80.76
Solitary ascidian (Herdmania momus/)	2.63	5.14	2.76	1.12	6.08	86.84
Tiny orange anemone	3.02	6.14	1.70	1.54	3.74	90.59

Groups 9DeepStarboardStern & 9ShallowStarboardStern
Average dissimilarity = 43.18

Species	Group 9DeepStarboardStern Av.Abund	Group 9ShallowStarboardStern Av.Abund	Av.Diss	Diss/SD	Contrib%	Cum.%
Early colonising matrix	38.94	5.15	16.90	1.96	39.14	39.14
Serpulid, barnacle and encrusting algae matrix	44.62	71.35	14.08	1.86	32.60	71.73
Solitary ascidian (Herdmania momus/)	1.42	10.71	4.64	2.04	10.75	82.49
Large barnacle,sediment,brown fil	5.09	0.00	2.54	1.34	5.89	88.38
Tiny orange anemone	6.68	8.44	1.96	1.41	4.53	92.91

Groups 10DeepPortBow & 10ShallowPortBow
Average dissimilarity = 51.16

Species	Group 10DeepPortBow Av.Abund	Group 10ShallowPortBow Av.Abund	Av.Diss	Diss/SD	Contrib%	Cum.%
Large barnacle,sediment,brown fil	40.66	0.00	20.33	4.29	39.74	39.74
Serpulid, barnacle and encrusting algae matrix	38.51	65.60	13.63	1.50	26.64	66.38
Solitary ascidian (Herdmania momus/)	15.86	9.51	6.18	1.08	12.08	78.46
Early colonising matrix	0.00	9.88	4.94	2.06	9.66	88.12
Brown filamentous algae/hydroid	1.48	6.16	2.34	1.82	4.58	92.70

3. Time, Deck Position, Aspect

Groups 9BowPort & 9MidPort
Average dissimilarity = 56.90

Species	Group 9BowPort Av.Abund	Group 9MidPort Av.Abund	Av.Diss	Diss/SD	Contrib%	Cum.%
Serpulid, barnacle and encrusting algae matrix	91.31	42.24	24.69	1.50	43.39	43.39
Red encrusting algae	0.00	26.94	13.47	1.40	23.67	67.06
Ecklonia radiata	0.00	17.14	8.57	0.90	15.06	82.13
Unknown white material	0.00	3.88	1.94	1.19	3.41	85.53
Orange encrusting sponge	3.44	0.20	1.66	0.67	2.92	88.45
Lobed brown algae (Lobophora sp.)	0.00	2.86	1.43	0.73	2.51	90.96

Appendix E: Continued.

Groups 9MidPort & 9SternPort
Average dissimilarity = 52.84

Species	Group 9MidPort Av.Abund	Group 9SternPort Av.Abund	Av.Diss	Diss/SD	Contrib%	Cum.%
Serpulid, barnacle and encrusting algae matrix	42.24	84.65	22.55	1.47	42.69	42.69
Red encrusting algae	26.94	5.25	11.89	1.41	22.51	65.20
Ecklonia radiata	17.14	0.00	8.57	0.90	16.22	81.42
Early colonising matrix	0.61	4.04	2.00	0.85	3.79	85.21
Unknown white material	3.88	1.01	1.71	1.11	3.24	88.45
Lobed brown algae (Lobophora sp.)	2.86	0.00	1.43	0.73	2.70	91.15

Groups 9BowStarboard & 9MidStarboard
Average dissimilarity = 37.99

Species	Group 9BowStarboard Av.Abund	Group 9MidStarboard Av.Abund	Av.Diss	Diss/SD	Contrib%	Cum.%
Serpulid, barnacle and encrusting algae matrix	89.25	58.80	15.43	1.40	40.62	40.62
Ecklonia radiata	2.45	14.49	6.88	0.90	18.10	58.72
Red encrusting algae	1.82	7.96	3.63	1.17	9.57	68.29
Red filamentous/branching algae	0.00	6.31	3.16	2.62	8.31	76.60
Orange encrusting sponge	0.20	3.06	1.51	0.79	3.98	80.57
Bare ships surface	0.00	2.24	1.12	0.87	2.95	83.52
Brown filamentous algae/hydroid	0.00	1.63	0.82	0.49	2.15	85.67
Solitary ascidian (Herdmania momus/)	1.62	0.20	0.79	1.00	2.09	87.76
Tiny orange anemone	1.41	0.00	0.71	0.92	1.86	89.62

Groups 9MidStarboard & 9SternStarboard
Average dissimilarity = 36.78

Species	Group 9MidStarboard Av.Abund	Group 9SternStarboard Av.Abund	Av.Diss	Diss/SD	Contrib%	Cum.%
Serpulid, barnacle and encrusting algae matrix	58.80	87.26	14.87	1.38	40.44	40.44
Ecklonia radiata	14.49	0.00	7.24	0.91	19.70	60.13
Red encrusting algae	7.96	5.45	3.47	1.50	9.43	69.56
Red filamentous/branching algae	6.31	0.40	2.95	2.32	8.03	77.59
Orange encrusting sponge	3.06	1.63	1.69	0.99	4.60	82.20
Brown filamentous algae/hydroid	1.63	1.62	1.30	0.67	3.54	85.73
Bare ships surface	2.24	0.20	1.06	0.83	2.88	88.62
Lobed brown algae (Lobophora sp.)	1.22	0.00	0.61	0.80	1.66	90.28

Groups 10BowPort & 10MidPort
Average dissimilarity = 12.65

Species	Group 10BowPort Av.Abund	Group 10MidPort Av.Abund	Av.Diss	Diss/SD	Contrib%	Cum.%
Serpulid, barnacle and encrusting algae matrix	97.78	86.83	5.48	2.77	43.31	43.31
Red encrusting algae	0.20	8.64	4.22	2.42	33.38	76.70
Orange encrusting sponge	0.00	1.85	0.92	1.10	7.30	83.99
Red filamentous/branching algae	1.41	0.41	0.67	1.34	5.28	89.27
Tryphyllozoan sp.	0.00	0.82	0.41	0.49	3.26	92.53

Groups 9BowPort & 10SternPort
Average dissimilarity = 12.98

Species	Group 9BowPort Av.Abund	Group 10SternPort Av.Abund	Av.Diss	Diss/SD	Contrib%	Cum.%
Red encrusting algae	0.00	8.64	4.32	2.50	33.29	33.29

Appendix E: Continued.

Serpulid, barnacle and encrusting algae matrix	91.31	86.83	3.11	1.52	23.96	57.25
Orange encrusting sponge	3.44	1.85	1.79	0.87	13.76	71.01
Serpulid matrix	1.62	0.00	0.81	0.49	6.22	77.23
Tryphyllozoan sp.	0.00	0.82	0.41	0.49	3.17	80.41
Brown filamentous algae/hydroid	0.40	0.42	0.33	0.91	2.54	82.94
White encrusting sponge	0.41	0.41	0.33	0.91	2.53	85.47
Bare ships surface	0.61	0.00	0.30	0.73	2.33	87.80
Hydroid	0.61	0.00	0.30	0.73	2.33	90.14

Groups 10BowStarboard & 10MidStarboard
Average dissimilarity = 30.57

Species	Group 10BowStarboard Av.Abund	Group 10MidStarboard Av.Abund	Av.Diss	Diss/SD	Contrib%	Cum.%
Serpulid, barnacle and encrusting algae matrix	95.06	66.53	14.27	1.78	46.67	46.67
Ecklonia radiata	0.00	12.00	6.00	0.79	19.63	66.30
Red encrusting algae	2.26	10.23	4.12	1.22	13.48	79.78
Lobed brown algae (Lobophora sp.)	0.00	2.80	1.40	1.29	4.58	84.36
Red filamentous/branching algae	1.23	2.60	1.23	0.95	4.02	88.38
Bare ships surface	0.00	2.21	1.11	0.96	3.62	92.00

Groups 10MidStarboard & 10SternStarboard
Average dissimilarity = 31.08

Species	Group 10MidStarboard Av.Abund	Group 10SternStarboard Av.Abund	Av.Diss	Diss/SD	Contrib%	Cum.%
Serpulid, barnacle and encrusting algae matrix	66.53	92.65	13.07	1.58	42.05	42.05
Ecklonia radiata	12.00	0.00	6.00	0.79	19.30	61.36
Red encrusting algae	10.23	2.86	4.44	1.40	14.27	75.63
Lobed brown algae (Lobophora sp.)	2.80	0.00	1.40	1.29	4.51	80.14
Red filamentous/branching algae	2.60	0.00	1.30	0.89	4.19	84.32
Bare ships surface	2.21	0.20	1.09	1.00	3.49	87.81
Yellow encrusting sponge	1.82	0.41	1.03	0.59	3.32	91.13

Appendix F: Distance based test for homogeneity of multivariate dispersion. Significant values in bold.

1. Time

DEVIATIONS FROM CENTROID
F: 16.087 df1: 9 df2: 150
P(perm): **0.0001**

MEANS AND STANDARD ERRORS

Group	Size	Average	SE
1	16	45.333	3.2061
2	16	40.21	3.2215
3	16	35.56	4.4483
4	16	14.735	1.2719
5	16	21.295	2.3195
6	16	21.741	2.4997
7	16	17.895	1.3336
8	16	17.865	1.8215
9	16	21.694	2.1837
10	16	21.891	2.3657

2. Time, Orientation, Aspect (Time x Orientation)

DEVIATIONS FROM CENTROID
F: 1.9217 df1: 1 df2: 81
P(perm): 0.3441

MEANS AND STANDARD ERRORS

Group	Size	Average	SE
Deck	60	17.28	2.0051
Hull	23	22.053	1.8525

3. Time, Depth, Aspect, Transect (Time x Depth x Aspect x Transect)

Group factor: Time Depth Aspect Transect
Number of permutations: 9999

Number of groups: 16
Number of samples: 79

DEVIATIONS FROM CENTROID
F: 2.1326 df1: 15 df2: 63
P(perm): 0.1982

MEANS AND STANDARD ERRORS

Group	Size	Average	SE
9DeepPortBow	5	14.64	2.0457
9DeepPortStern	5	17.28	2.4868
9DeepStarboardBow	5	19.162	4.4692
9DeepStarboardStern	5	17.957	5.33
9ShallowPortBow	5	17.448	3.9126
9ShallowPortStern	5	17.641	3.5585
9ShallowStarboardBow	4	16.82	0.4096
9ShallowStarboardStern	5	7.6141	0.95513
10DeepPortBow	5	19.453	2.7512
10DeepPortStern	5	8.4726	2.2953
10DeepStarboardBow	5	21.357	4.3316
10DeepStarboardStern	5	15.395	2.7717
10ShallowPortBow	5	12.037	1.4175
10ShallowPortStern	5	29.621	7.9888
10ShallowStarboardBow	5	23.099	2.8826
10ShallowStarboardStern	5	13.072	3.7271

4. Time, Deck Position, Aspect (Position)

Group factor: TimePositionAspect
Number of permutations: 9999

Number of groups: 12
Number of samples: 60

DEVIATIONS FROM CENTROID
F: 30.212 df1: 11 df2: 48
P(perm): **0.0001**

MEANS AND STANDARD ERRORS

Group	Size	Average	SE
9BowPort	5	6.6909	1.1509
9MidPort	5	36.941	3.2731
9SternPort	5	11.516	1.3047
9BowStarboard	5	6.6814	1.1777
9MidStarboard	5	25.892	4.6383
9SternStarboard	5	8.2959	1.4554
10BowPort	5	1.2133	0.4078
10MidPort	5	5.1792	1.1367
10SternPort	5	5.1792	1.1367
10BowStarboard	5	3.8929	0.99942
10MidStarboard	5	21.596	1.6113
10SternStarboard	5	6.7493	1.0349