Australian Government

Great Barrier Reef
Marine Park Authority

PRELIMINARY IMPACT ASSESSMENT REPORT:

Grounding of the *Shen Neng 1* on Douglas Shoal

Dr Paul Marshall

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Executive summary

Staff of the Great Barrier Reef Marine Park Authority and Queensland Parks and Wildlife Service conducted a preliminary assessment of damage to Douglas Shoal in the area of the *Shen Neng 1* grounding incident on 12-13 April 2010.

The initial assessment found spatially extensive and severe damage to the reef community on Douglas Shoal. While this preliminary assessment only surveyed a small proportion of the seabed within the track of the *Shen Neng 1*, approximately 19,087 m^2 of reef area was found to be damaged. The severely damaged areas were characterised by near-complete destruction of the ecological community, with the underlying reef substrate either scraped clear or covered in expanses of freshly created coral rubble. Particles of antifoulant paint were observed amongst the rubble and smeared onto the reef substrate in some of the severely damaged areas. Coral reef communities suffering this type of damage can take substantially longer to recover compared to recovery from natural disturbances. Remediation of damaged areas can facilitate natural recovery processes.

Additional, more detailed surveys will help ascertain the full extent of physical damage, the severity and distribution of contamination from antifoulant paints, and inform evaluation of remediation options.

Contents

Introduction

The cargo carrier *Shen Neng 1* ran aground on Douglas Shoal (Figure 1), around 92km north-east of Gladstone, on Saturday 3 April 2010. After transfer of some of the oil on board the *Shen Neng 1* to a bunker barge, salvage specialists assessed the ship as safe for refloating and transport. At approximately 8pm on Monday 12 April the *Shen Neng 1* was removed from its position on Douglas Shoal.

The initial focus of the grounding response was on minimising risks associated with an oil spill or sinking of the *Shen Neng 1*. In addition to these risks, there was also substantial concern about the environmental damage done to Douglas Shoal as a result of the vessel grounding and related salvage activities (hereafter referred to as the grounding incident).

A damage assessment team comprising experts from the Great Barrier Reef Marine Park Authority (GBRMPA) and the Queensland Parks and Wildlife Service (QPWS) was deployed to the site on 12-13 April 2010 to make a preliminary assessment of the nature and extent of environmental impacts and to provide information to inform further assessments and remediation options.

Figure 1. ***Shen Neng 1* over Douglas Shoal on the southern Great Barrier Reef.**

Assessment objectives

This initial assessment aimed to characterise the nature and spatial extent of ecological damage at areas of Douglas Shoal potentially affected by the grounding of the *Shen Neng 1*. The results of this initial survey were used to inform subsequent, more detailed, surveys of ecological damage to the shoal and to provide advice on further assessments and remediation options. This preliminary assessment only inspected a small proportion of the total area of seabed within the track of the *Shen Neng 1*. Consequently, it did not aim to map all damaged areas on Douglas Shoal, or to provide a detailed quantitative analysis of the ecological impacts of the grounding incident.

The primary objectives of the preliminary impact assessment were to:

1) Inspect areas of Douglas Shoal in the vicinity of the known path of the grounded vessel (Figure 2) and identify areas that had suffered recent physical damage
2) Delineate areas of recent physical damage and characterise the type and severity of damage
3) Collect indicative samples of sediments, including samples of any reef material visibly affected by antifoulant paint
4) Collect water samples (if there was any indication of oil leakage or hydrocarbon contamination of discharged ballast water)
5) Collect photos and video footage representative of damaged and undamaged areas of Douglas Shoal.

Methods

Impact assessment team

The impact assessment team was lead by Dr Paul Marshall from the Great Barrier Reef Marine Park Authority. Dr Marshall has a PhD in coral reef ecology, with a focus on recovery of corals from physical damage. He has led marine ecology surveys and impact assessments throughout Australia and overseas for over 17 years, including assessment and restoration projects following vessel grounding incidents. These have included major grounding incidents caused by the *Bunga Teratai Satu* and *Doric Chariot* in the northern Great Barrier Reef and the *Jessica* in the Galapagos Islands, as well as a range of smaller grounding incidents. Dr Marshall has published over 40 scientific papers, including five publications in international journals relating to ship grounding incident responses.

Other members of the assessment team included Dr Tyrone Ridgway (GBRMPA; coral biologist), Laise Harris (GBRMPA; GIS specialist), Jesse Low (QPWS; dive supervisor), Oliver Lanyon (QPWS; compliance expert) and Darren Larcombe (QPWS; marine operations). Vessel support was provided by the Gladstone-based *MV Eastern Voyager*.

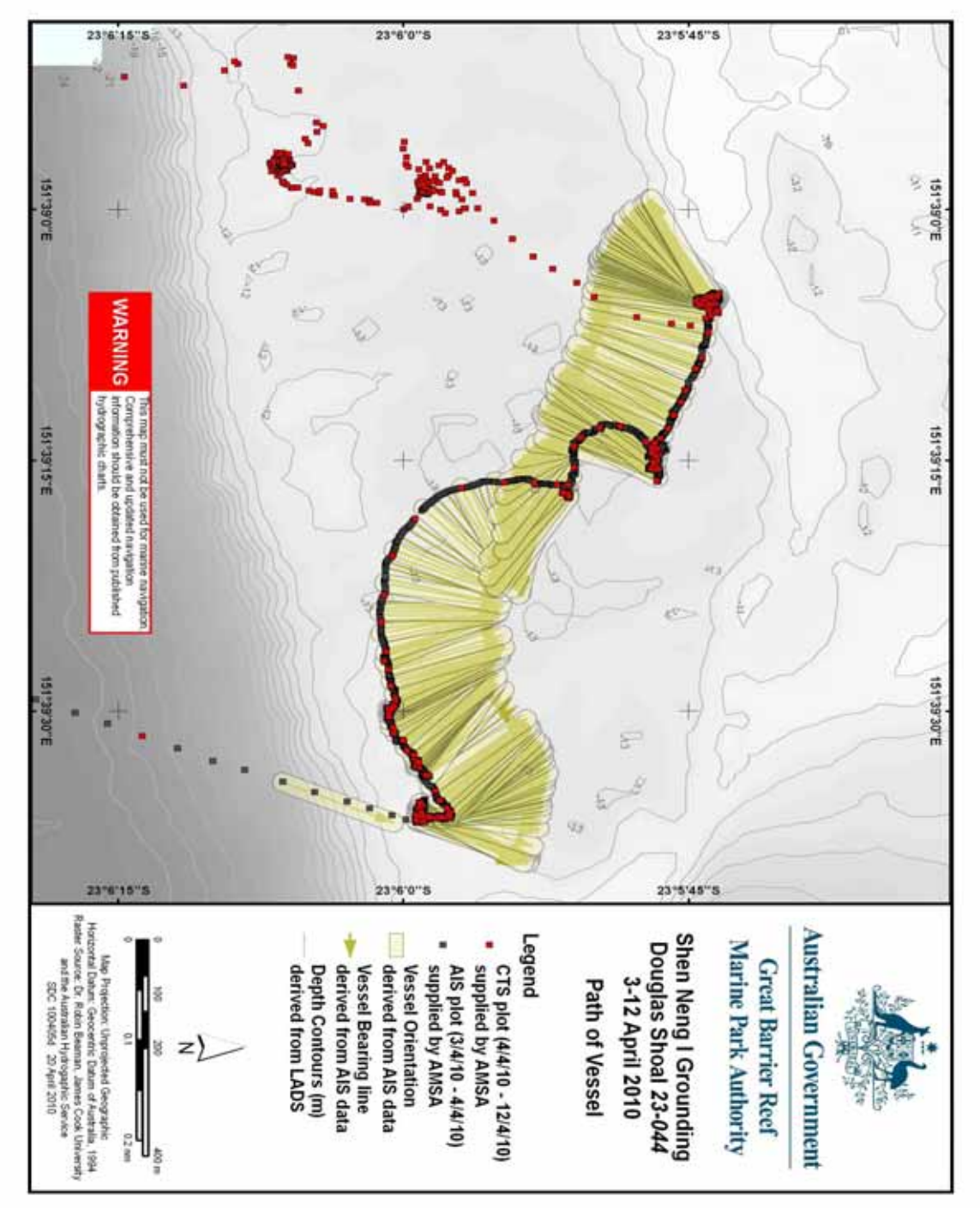
An environmental scientist, Andy Graham (Polaris Applied Sciences), advising the vessel insurer, joined the *MV Eastern Voyager* to work alongside the assessment team during the surveys. A selection of underwater photos showing the general nature and extent of the grounding impacts were shared with Mr Graham.

Chronology of preliminary assessment

The assessment team arrived on site at approximately 06:00 h on Monday 12 April 2010. On arrival the *Shen Neng 1* was observed to be still aground at the centre of a 2 nm exclusion zone. The exclusion zone was declared by the Australian Maritime Safety Authority (AMSA) to prevent vessels and aircraft that were not directly assisting the salvage operation from approaching the area.

The assessment team sought and was granted special permission to enter the exclusion zone to enable commencement of the preliminary impact assessment. The survey vessel entered the zone at approx 09:30 h on Monday 12 April, allowing the preliminary impact assessment to begin at approx 10:30 h.

Figure 2. Map provided for preliminary assessment by GBRMPA's Spatial Data Centre. The map is plot of the location of the Shen Neng 1 over Douglas Shoal, based on information provided by the Australian Maritime Safety Authority.



The Incident Controller instructed the assessment team to leave the shoal by 17:00 h to clear the exclusion zone to allow for the efforts to refloat the grounded vessel.

The successful refloat of the *Shen Neng 1* on the evening of Monday 12 April enabled the assessment team to resume work on the shoal at 07:30 h on Tuesday 13 April. The preliminary impact assessment was concluded approximately midday on 13 April.

The schedule of events of the assessment is outlined in Appendix 1.

Assessment methods

A range of standard observation methods were employed by the assessment team to meet the objectives of the assessment. Implementation of the assessment was coordinated and supervised by the assessment team leader.

Areas of Douglas Shoal where there was the greatest potential for damage from the grounding of the *Shen Neng 1* were identified from a map of the position of the vessel while over the shoal (Figure 2). This map was generated by the Great Barrier Reef Marine Park Authority's Spatial Data Centre using coordinates of the vessel's position supplied by the Australian Maritime Safety Authority (AMSA).

The initial focus of the assessment team was to visually locate signs of physical damage to the shoal in the area where the *Shen Neng 1* position data indicated the vessel had travelled over the shoal. Recent damage was discerned by clean, uncolonised surfaces on broken corals or on other calcium carbonate (reef substrate) materials.

The assessment team used snorkelling equipment to identify areas of shoal that had been recently damaged. Four areas of substantial damage were identified (Site A, B, C and D in Figure 5). Surface snorkelling and breath-hold diving were used to delineate two broad areas of physical damage (Sites A and C) and one linear strip of damage (Site B). SCUBA diving was used to delineate the largest area of damage (Site D).

SCUBA equipment was used to do more detailed inspections of the damage at two broad areas of the shoal confirmed to have suffered severe damage (Site B and D), and one area of the shoal that was undamaged (Site E). The area of undamaged shoal was inspected to provide an indication of the type of coral reef community that was likely to have characterised the shoal in areas that were severely damaged.

Still photographs and video footage were collected during snorkel and SCUBA inspections using digital compact cameras in underwater housings. A summary of the nature of the ecological damage in each area was compiled by the assessment team leader from a combination of in-situ observations and qualitative analysis of the still photos and video footage. A catalogue of images and video footage collected during the assessment is provided in Appendix 2.

Handheld global positioning system devices (GPS units) were used to obtain spatial coordinates of observations made by the assessment team. For the linear strip of damage (Site B) the location of the centreline of the damage was recorded. For broad areas of damage the perimeter was recorded. For damaged areas delineated on snorkel, GPS fixes were recorded by an assistant in the snorkelling tender vessel. This was done by navigating the tender over the point of interest indicated by the snorkel diver and taking a GPS fix directly above the point of interest. For damaged areas delineated on SCUBA, GPS fixes were recorded automatically at fixed intervals by the GPS unit that was being towed on a surface float by the dive team. The coordinates of the location of underwater photos were estimated by correlating the time at which the photo was taken with the position recorded by the GPS unit at that time. The approximate area of shoal damaged at the areas inspected (Site A, B, C and D) was estimated using GIS software from maps of the GPS fixes and additional observations made during snorkel and SCUBA inspections.

Samples of sediments and antifoulant paint and metal debris were collected during SCUBA dives at Sites B and D. Sediment samples were also collected during the SCUBA dive at Site E. A total of 14 samples of sediments were collected. Four samples of paint particles were also collected, as well as four samples of metal debris (large metal flakes; bolt; gasket) found on the sea floor in areas recently damaged. Contamination of samples was avoided through the use of gloves and specially-prepared sampling jars and spatulas. Samples were handled in accord with standard procedures for evidence collection and laboratory analysis.

Categorisation of physical damage

It was observed through initial snorkel surveys that the severity of physical damage varied among areas inspected. To assist the team to categorise and report on damage observations, three qualitative categories of damage were defined. These were chosen to broadly reflect the ecological severity of the damage using the experience of the team leader derived from previous research and ship grounding impact assessments.

The three categories of physical damage (Figure 3) defined for describing the severity of impacts to the shoal were:

- Severe damage : *all benthos*[1] *displaced, crushed or smothered and substrate scraped or covered in rubble*
- Moderate damage: *most benthos killed; patchy damage to substrate*
- Minor damage: *most benthos intact; some damaged*

[1] Benthos refers to those organisms (plants and animals) attached to, or living on, in or near, the seabed.

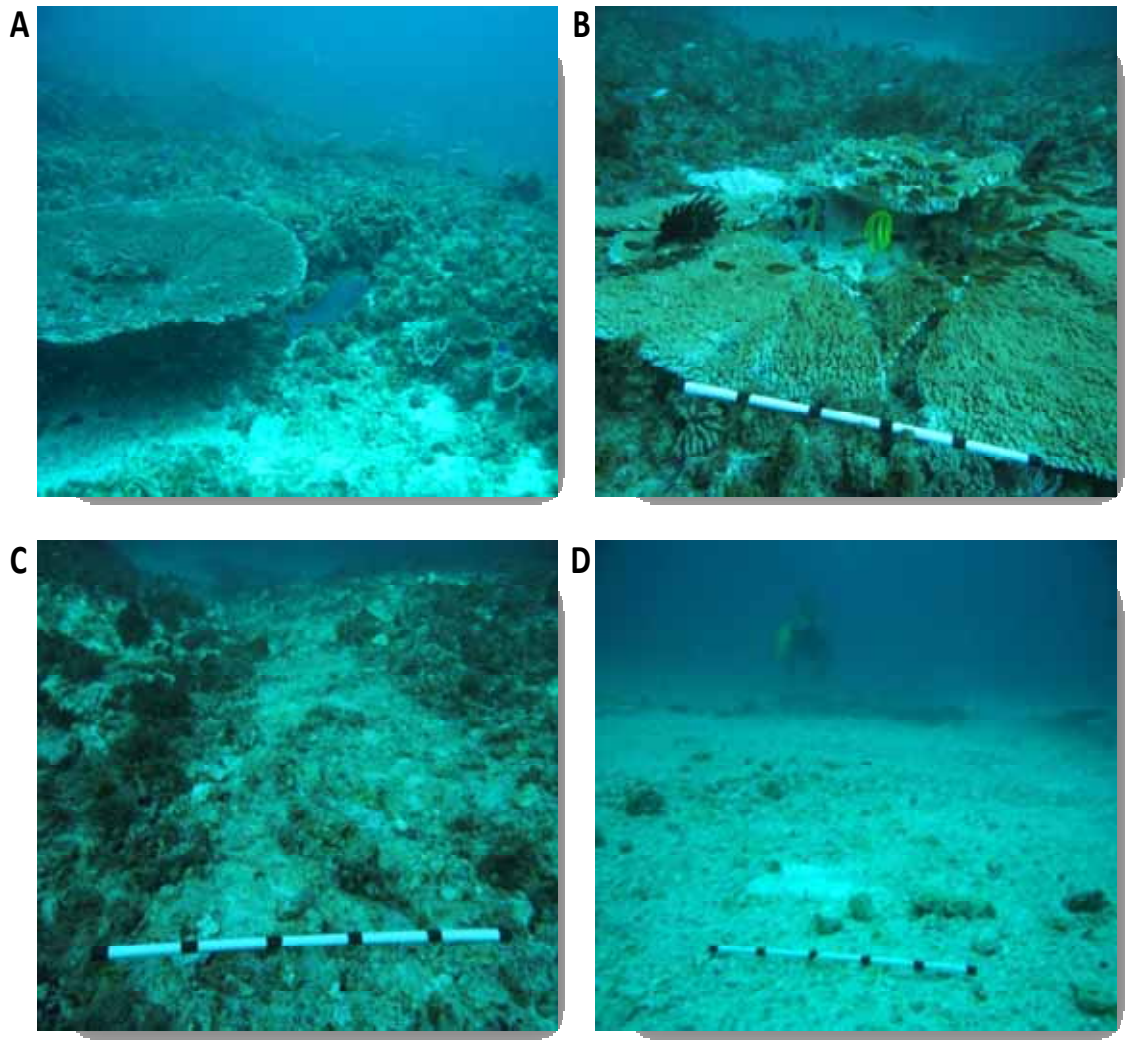
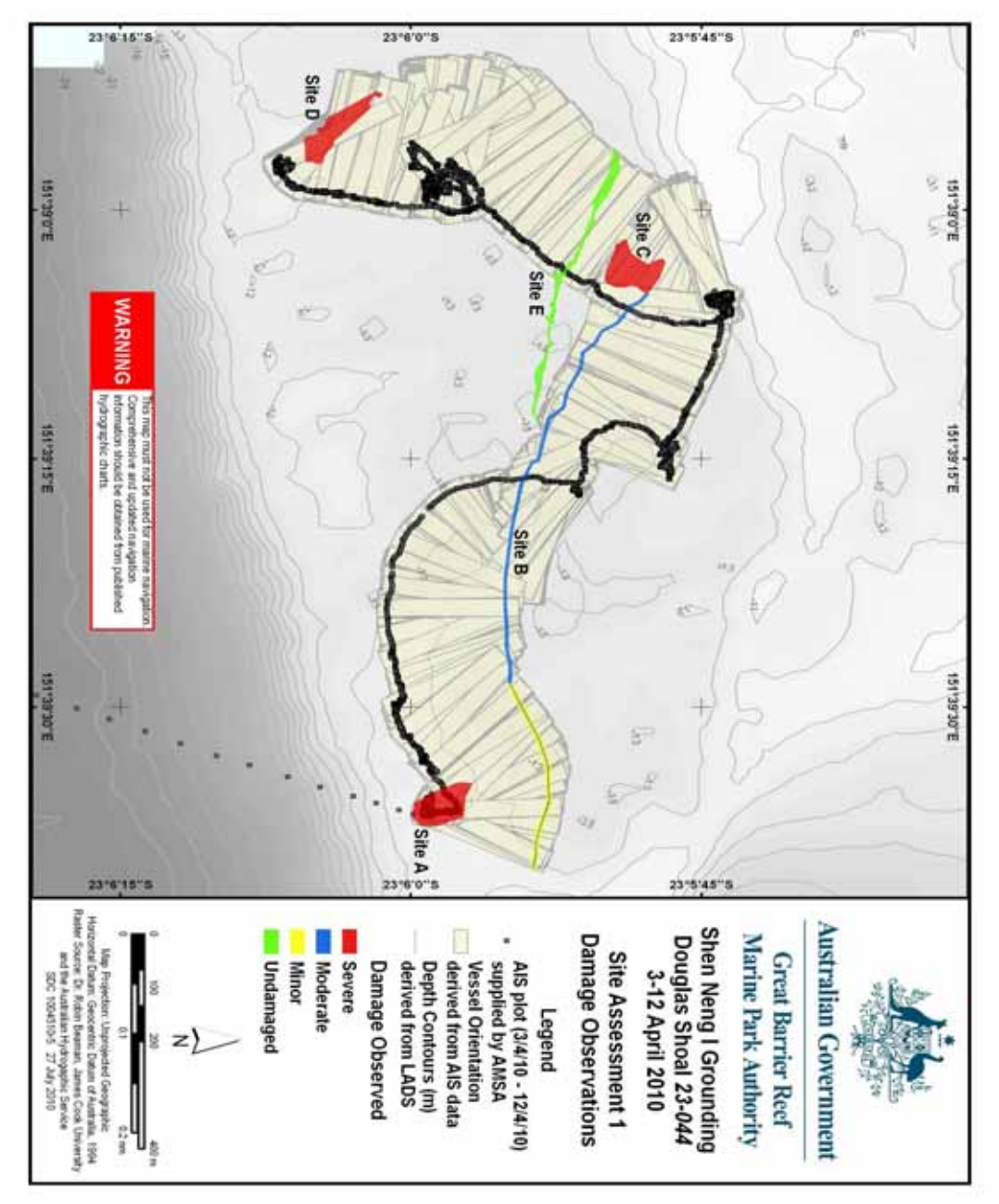


Figure 3. Images from Douglas Shoal after *Sheng Neng 1* grounding showing the different categories of damage. (A) Undamaged reef; (B) Minor damage (most benthos intact; some damaged); (C) Moderate damage (most benthos killed; patchy damage to substrate); (D) Severe damage (all benthos displaced, crushed or smothered and substrate scraped or covered in rubble). Scale bar = 50 cm.

Results

This section presents the results of the preliminary assessment. The results are based on the in-situ observations of the assessment team leader and other members of the assessment team, photographs and video footage collected during in-water inspections, and from maps of the vessel position available at the time of the assessment. Observations were obtained from snorkel and SCUBA inspections of the five sites identified as priority areas for this initial assessment. The location of the priority sites and a summary of the severity of damage is provided in Figure 5.

Figure 5. Locations of the sites inspected during the Preliminary Impact Assessment at Douglas Shoal, showing categories of damage observed against backdrop of vessel positions.



Habitats, species and community of Douglas Shoal

Douglas Shoal is a large, isolated reef rising from approx 25-30 m depth to within 9-15 m of the surface. Inspections of the shoal indicated that the top of the shoal is very flat, with little topographical relief or structural complexity. Inspections of the benthic community adjacent to damaged areas and in other areas away from the track of the vessel (Site E in Figure 5) showed the shoal top to be visually dominated by macroalgae (seaweeds). The brown algae *Sargassum* was the most abundant genus, interspersed with coralline red algae and a range of other seaweeds.

The undamaged areas were also characterised by a diverse assemblage of benthic invertebrate animals inhabiting Douglas Shoal. This assemblage included sponges (up to 20 cm), ascidians, zooanthids, anemones, soft corals (particularly *Sarcophytyon, Lobophytum,* and *Sinularia*), hard corals, echinoderms (Asteroidea and Crinoidea), and crustaceans (Palinuridae).

Hard corals represented approximately 10% of benthic cover, and included the genera, *Acropora, Stylophora*, *Pocillopora*, *Porites*, *Montipora, Goniastrea, Goniopora, Scolymia, Turbinaria* and various other faviid species. *Turbinaria* and plating *Acropora* were the most visually dominant hard corals and obtained the largest sizes (up to 100 cm for *Acropora* plate corals).

There was abundant fish life observed on undamaged areas of Douglas Shoal. Any small outcrops or patches of relief on the shoal were the focus of a diverse aggregation of fish. Species of emperor (Lethrinidae) and sweetlip (Haemulidae) were observed congregating around small outcrops amidst schools of fusiliers (Caesionidae), damselfishes (Pomacentridae) and other small fish. Coral trout (*Plectropomus sp.*) and other cods (Serranidae) were observed commonly over the shoal, as were breams (Sparidae), wrasses (Labridae), parrotfishes (Scaridae), and large schools of pelagic fish such as mackerels (Scombridae) and trevally (Carangidae). Coral- associated fish included butterfly fishes (Chaetodontidae), angel fishes (Pomacanthidae), blennies (Blennidae), and gobies (Gobidae) as well as extremely large schools of cardinalfishes (Apogonidae), which blanketed large areas of the shoal (1000s of m^2). Other vertebrate taxa observed included sea snakes, turtles and large stingrays.

Extent and severity of damage

The survey team identified areas of recent ecological damage at four locations on the shoal (marked as Sites A, B, C and D on Figure 5). Sites A, C and D were characterised by broad areas of severe damage. Site B was a long, narrow tract of moderate damage. The severity of damage can be seen in the photographs and video footage recorded during the survey and in representative photos presented in Figures 3 and 4. A more detailed description of observations at each site is provided below. Table 1 provides a summary of the estimated size of damaged areas at each site.

Inspections in Site A identified a large area of severe damage approximately 4492 m^2. One part of this had all benthos and the top layers of reef substrate removed, leaving a flat section of solid reef matrix with large smears of antifoulant paint. In the other part all benthos had been crushed or displaced and the substrate ground into gravel-sized pieces. Severe damage was observed extending further along the shoal in the direction travelled by the grounded vessel, as indicated by the mapped vessel position data, although the full extent of this damage was not surveyed during this preliminary assessment. Adjacent to the severely damaged zones the assessment team observed numerous corals (most noticeably

Acropora plate corals) that were shattered or showing signs of recent partial mortality. Pieces of antifoulant paint were recovered from this area.

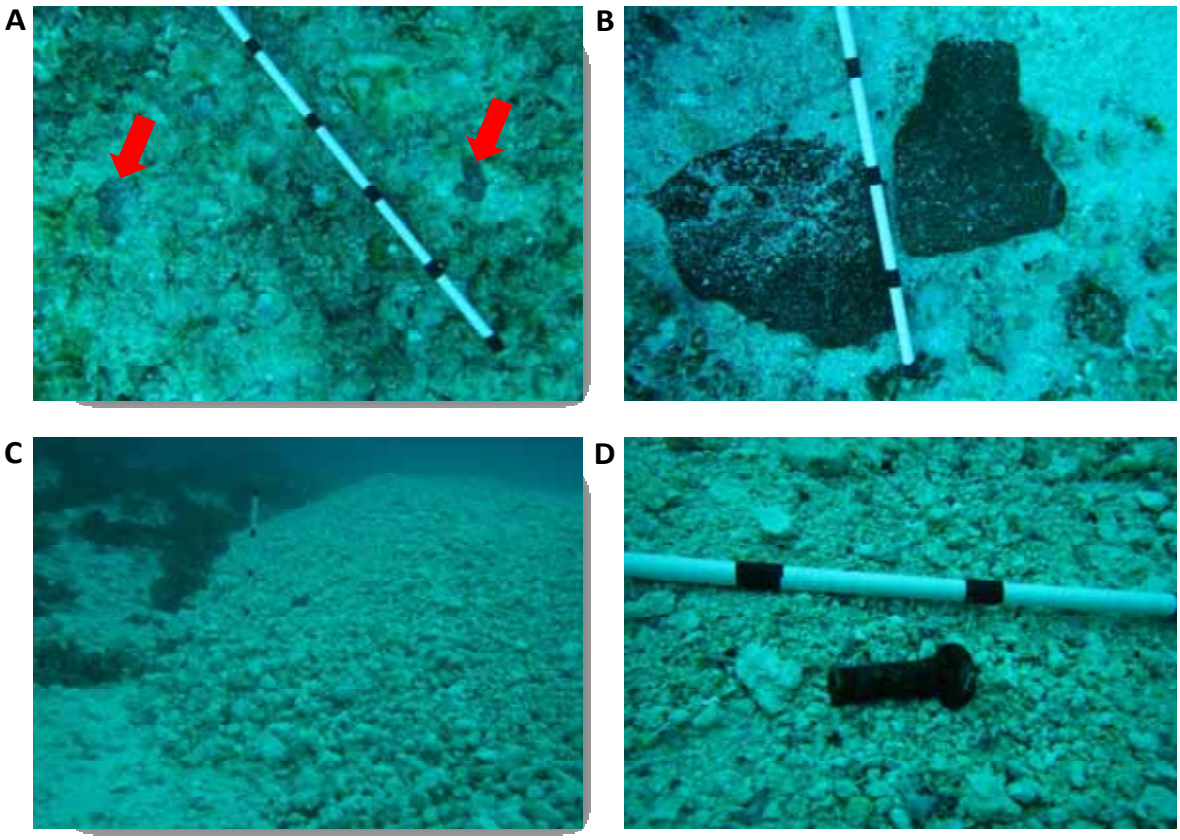


Figure 4. Photographs from damaged areas of Douglas Shoal. (A) Antifoulant paint smears (red arrows) on moderately damaged site (Site A); (B) Large metal flakes on moderately damaged reef site (Site B); (C) Recently created rubble bank on edge of severely damaged site (Site D); (D) Metal bolt on severely damaged seabed (Site D). White sections on scale bar = 8 cm.

A long, narrow tract of damage was observed in Site B, running in a general westerly direction for approximately 1.5 km. The reef was moderately damaged along the centre of this tract, with most benthos smashed or displaced, and some large (up to 3 x 3 m) chunks of reef substrate fractured and broken off the main reef. The area of moderate damage totalled approximately 4293 m^2. A more detailed inspection of the eastern end of the tract revealed a band of minor damage either side of the centre of the tract. This totalled approximately 1346 m^2 in area. A few pieces of rusted metal plating were recovered from this area.

In Site C, another large area, approximately 4642 m^2 was found to have severe damage with all benthos removed and substrate reduced to gravel.

Site D was a large area of contiguous and particularly severe damage. The survey team recorded an area of at least 4314 m^2 in which the only observed intact benthic reef organisms were in small depressions. In the remainder of the area, there were no visible remnants of benthic reef organisms and the substrate had been crushed into gravel or scraped down to solid reef matrix. Along the outer edges of this area were linear ridges of coral rubble up to 1 m high. Observations of the colour and form of the rubble clearly indicated it had been recently created or mobilised.

The animals and plants growing on the seabed up to 20 m on either side of this the severely damaged area at Site D were smothered in a layer of rubble and sand, and small seaweeds (mostly *Sargassum*) were the only reef life that appeared to have survived the smothering. Pieces of antifoulant paint and other metal components (e.g. bolts) were found in this area.

Some areas of reef in Sites A and D were clearly exposed to contamination from antifoulant paint, as evident from visible flakes of paint amongst the rubble or smears of paint on the exposed reef substrate (Figure 4).

Site E was mostly undamaged, although a small patch of moderate damage was observed near the western end of the area inspected.

Table 1. Summary of estimated size of damaged areas at inspection sites.

Damage Site	*Damage*	*Area (m2)*
Site A	Severe	4492
Site B	Moderate	4293
Site B	Minor	1346
Site C	Severe	4642
Site D	Severe	4314
Total		**19087**

Conclusions

This preliminary assessment found that the community of animals and plants growing on the seabed atop Douglas Shoal is similar to other mid-depth reefs exposed to strong currents and rough seas in the southern Great Barrier Reef that have previously been visited by members of the assessment team. It has many of the characteristics of a highly dynamic environment, with moderate diversity, heterogeneous distribution of species and few large sessile (attached) organisms. Like many coral reef habitats, the benthic community growing on Douglas Shoal is prone to damage from physical disturbances such as vessel anchoring or groundings. However, reef communities of the type observed at Douglas Shoal often have

the capacity to recover relatively quickly from natural physical disturbance due to high recruitment rates and short replacement times for much of the biota.

This preliminary assessment identified approximately 19,087 m^2 of the seabed atop Douglas Shoal to be recently damaged. Of this, approximately 13,448 m^2 was severely damaged (all benthos displaced, crushed or smothered and substrate scraped or covered in rubble). A further approximately 4,293 m^2 of seabed was moderately damaged and approximately 1,346 m^2 had minor damage. There were also signs that additional patches of the reef community had been smothered by freshly created coral gravel that appeared to have spilled out beyond the main damage area at Site D, although the size of the area was not measured.

Recovery times for areas of reef damaged by vessel groundings are likely to take much longer than recovery from natural disturbances (Negri and Marshall 2009). Large areas of stable reef substrate on Douglas Shoal were covered by coral rubble and crushed reef substrate that are prone to movement by currents and waves. Loose and mobile substrate is not suitable for colonisation by most sessile organisms and these damaged areas are likely to remain bare of reef growth as long as the substrate remains mobile (Marshall et al. 2002).

Signs of freshly deposited antifoulant paint were observed at three of the damage sites inspected. Visible flakes of paint were observed among the crushed coral substrate at Sites A, C and D, and antifoulant paint was seen smeared onto the exposed reef substrate at Site A. Antifoulant paints are designed to inhibit settlement by larvae of sessile marine organisms, including algae, ascidians, sponges, molluscs and corals. They are also known to be toxic to adult reef organisms, such as corals (Smith et al. 2003). The presence of antifoulant chemicals at a ship grounding site can prevent or slow recolonisation of damaged areas, and also has the potential to cause additional stress or mortality to corals not damaged by direct physical impacts (Haynes et al. 2002; Marshall et al. 2002).

In summary, this preliminary assessment identified extensive areas of Douglas Shoal that had been recently and severely damaged. These areas correlate with areas of the shoal traversed by the *Shen Neng 1* during the grounding incident, as indicated by plots of the vessel's location data. The presence of unstable substrate and antifoulant chemicals in damaged areas suggests that recovery of the damaged areas is likely to take substantially longer than would normally be expected for natural disturbances. More detailed ecological surveys and analyses of antifoulant contamination of sediments will be valuable for determining the full spatial extent of the damage and for informing analyses of the costs and benefits of remediation of the site.

References

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Negri, A., Marshall, P. (2009) TBT contamination of remote marine environments: Ship groundings and ice-breakers as sources of organotins in the Great Barrier Reef and Antarctica. Journal of Environmental Management, 90 (SUPPL. 1)

Smith. L., Negri, A., Philipp, E., Webster, N., Heyward, A. (2003). The effects of antifoulant-paint-contaminated sediments on coral recruits and branchlets. Marine Biology 143: 651–657.

Appendix 1: Schedule of events during the preliminary impact assessment at Douglas Shoal following grounding of the *Shen Neng 1*.

Date	Time	Activity
11 April	21:00	Board MV Eastern Voyager in Gladstone Harbour; depart for overnight travel to Douglas Shoal
12 April	05:00	Arrived Johnson Patch and awaited confirmation of permission to access Douglas Shoal within exclusion zone; low winds, good surface conditions
	10:00 – 14:00	Snorkel swims and manta tows to locate damaged areas of reef; strong currents
	14:00 – 16:45	SCUBA dive in vicinity of initial impact site to collect photos, video and sediment samples; strong currents
	17:00	MV Eastern Voyager required to relocate outside exclusion zone due to planned attempted refloat; relocate to North Reef for overnight anchorage
13 April	07:30	MV Eastern Voyager returns to Douglas Shoal (vessel refloat successful); SCUBA dive in vicinity of final resting place of grounded vessel (timed at slack tide; no current) to collect photos, video and sediment samples; winds increasing, surface conditions deteriorating
	10:00	SCUBA dive east of final resting place to collect photos, video and sediment samples in undamaged area of shoal; strong current (drift dive); winds increasing, surface conditions rough
	13:00	MV Eastern Voyager returns to North Reef due to conditions becoming unsuitable for diving
	16:00	MV Eastern Voyager departs for Gladstone; PM, TR and JL transfer to Heron Island on MV Reef Heron to await arrival of RV *Cape Ferguson*.

Appendix 2: Catalogue of images and video footage collected during the preliminary impact assessment

Shen Neng 1 **Photo Catalogue**

Photo label	Description	Original ID	Date taken	Location
Photo 001	Shen Neng 1 on Douglas Shoal with tugs	IMG_3288	12-Apr-10	Close to inital grounding location
Photo 002	Charter vessel MV Eastern Voyager	IMG_3295	12-Apr-10	Close to inital grounding location
Photo 003	Metal fragments on reef substrate	IMG_1974	12-Apr-10	Close to inital grounding location
Photo 004	Damage from ground level	IMG_1975	12-Apr-10	Close to inital grounding location
Photo 005	Diver over damage	IMG_1977	12-Apr-10	Close to inital grounding location
Photo 006	Damage from ground level	IMG_1978	12-Apr-10	Close to inital grounding location
Photo 007	Broken rubble on reef substrate	IMG_1979	12-Apr-10	Close to inital grounding location
Photo 008	Broken rubble on reef substrate	IMG_1981	12-Apr-10	Close to inital grounding location
Photo 009	Close up of damaged substrate	IMG_1982	12-Apr-10	Close to inital grounding location
Photo 010	Broken *Acropora* plate coral	IMG_1986	12-Apr-10	Close to inital grounding location
Photo 011	Overturned *Acropora* plate coral	IMG_1989	12-Apr-10	Close to inital grounding location
Photo 012	Damage and diver	IMG_1992	12-Apr-10	Close to inital grounding location
Photo 013	Damage from above	IMG_1993	12-Apr-10	Close to inital grounding location
Photo 014	Manta towing with Shen Neng 1 in background	IMG_3188	12-Apr-10	Close to inital grounding location
Photo 015	Damaged reef substrate	IMG_3210	12-Apr-10	Close to inital grounding location
Photo 016	Damaged reef substrate	IMG_3211	12-Apr-10	Close to inital grounding location
Photo 017	Diver over damaged reef substrate	IMG_3214	12-Apr-10	Close to inital grounding location
Photo 018	Diver over damaged reef substrate	IMG_3217	12-Apr-10	Close to inital grounding location
Photo 019	Metal fragment and antifouling paint on reef	IMG_3218	12-Apr-10	Close to inital grounding location
Photo 020	Antifouling paint on the reef	IMG_3219	12-Apr-10	Close to inital grounding location
Photo 021	Broken coral	IMG_3224	12-Apr-10	Close to inital grounding location
Photo 022	Broken coral and rubble	IMG_3225	12-Apr-10	Close to inital grounding location
Photo 023	Broken coral and rubble	IMG_3228	12-Apr-10	Close to inital grounding location
Photo 024	Broken encrusting coral on reef	IMG_3229	12-Apr-10	Close to inital grounding location
Photo 025	Stressed' *Acropora* plate coral	IMG_3237	12-Apr-10	Close to inital grounding location
Photo 026	Damage from above	IMG_3241	12-Apr-10	Close to inital grounding location
Photo 027	Overturned *Acropora* plate coral	IMG_3242	12-Apr-10	Close to inital grounding location
Photo 028	Stressed' *Acropora* plate coral	IMG_3270	12-Apr-10	Close to inital grounding location
Photo 029	Metal fragments on reef	IMG_3271	12-Apr-10	Close to inital grounding location
Photo 030	Damage from above	IMG_3274	12-Apr-10	Close to inital grounding location
Photo 031	Diver on damaged substrate	IMG_2003	13-Apr-10	Final resting location
Photo 032	Broken rubble on reef	IMG_2004	13-Apr-10	Final resting location
Photo 033	Diver taking sediment samples	IMG_2011	13-Apr-10	Final resting location
Photo 034	Close up of damaged substrate	IMG_2017	13-Apr-10	Final resting location
Photo 035	Antifouling paint on the reef	IMG_2019	13-Apr-10	Final resting location
Photo 036	Diver on rubble bank	IMG_2030	13-Apr-10	Final resting location
Photo 037	Bolt on damaged substrate	IMG_2035	13-Apr-10	Final resting location
Photo 038	Large broken piece of reef	IMG_2036	13-Apr-10	Final resting location
Photo 039	Overview of damaged substrate	IMG_2049	13-Apr-10	Final resting location
Photo 040	Material debris on substrate	IMG_2056	13-Apr-10	Final resting location
Photo 041	Diver taking sediment samples	IMG_2058	13-Apr-10	Final resting location
Photo 042	Rubble bank at edge of damaged substrate	IMG_2068	13-Apr-10	Final resting location
Photo 043	Sediment on *Acropora* plate coral	IMG_2076	13-Apr-10	Final resting location
Photo 044	Divers on damaged substrate	IMG_3304	13-Apr-10	Final resting location
Photo 045	Diver taking sediment samples	IMG_3313	13-Apr-10	Final resting location
Photo 046	Diver on damaged substrate	IMG_3330	13-Apr-10	Final resting location
Photo 047	Diver on damaged substrate	IMG_3335	13-Apr-10	Final resting location
Photo 048	Overview of damaged substrate	IMG_3351	13-Apr-10	Final resting location
Photo 049	Diver on damaged substrate	IMG_3359	13-Apr-10	Final resting location
Photo 050	Dead *Acropora* plate coral	IMG_3364	13-Apr-10	Final resting location
Photo 051	Close up of damaged substrate	IMG_3365	13-Apr-10	Final resting location
Photo 052	Rubble bank at edge of damaged substrate	IMG_3368	13-Apr-10	Final resting location
Photo 053	Rubble bank at edge of damaged substrate	IMG_3369	13-Apr-10	Final resting location
Photo 054	Potential dislodged massive coral scar	IMG_3406	13-Apr-10	Final resting location
Photo 055	Dive float with GPS attached	IMG_3421	13-Apr-10	Final resting location
Photo 056	Natural sand channel in undamaged reef	IMG_2084	13-Apr-10	Undamaged reef adjacent to final resting location
Photo 057	Undamaged reef substrate	IMG_2094	13-Apr-10	Undamaged reef adjacent to final resting location
Photo 058	Cardinalfish blanketing substrate	IMG_2109	13-Apr-10	Undamaged reef adjacent to final resting location
Photo 059	Diver taking sediment samples	IMG_2111	13-Apr-10	Undamaged reef adjacent to final resting location
Photo 060	Undamaged coral and algae	IMG_2124	13-Apr-10	Undamaged reef adjacent to final resting location
Photo 061	Undamaged *Stylophora* coral	IMG_2129	13-Apr-10	Undamaged reef adjacent to final resting location
Photo 062	*Tridacna* clam on undamaged reef	IMG_2135	13-Apr-10	Undamaged reef adjacent to final resting location
Photo 063	Undamaged reef substrate	IMG_2136	13-Apr-10	Undamaged reef adjacent to final resting location
Photo 064	Undamaged *Acropora* plate coral	IMG_2148	13-Apr-10	Undamaged reef adjacent to final resting location
Photo 065	Sponge on undamaged reef	IMG_2152	13-Apr-10	Undamaged reef adjacent to final resting location
Photo 066	Diver on damaged substrate	IMG_3423	13-Apr-10	Undamaged reef adjacent to final resting location
Photo 067	Cardinalfish blanketing substrate	IMG_3429	13-Apr-10	Undamaged reef adjacent to final resting location
Photo 068	Undamaged *Acropora* coral	IMG_3436	13-Apr-10	Undamaged reef adjacent to final resting location
Photo 069	Undamaged reef substrate	IMG_3459	13-Apr-10	Undamaged reef adjacent to final resting location
Photo 070	Diver over undamaged reef	IMG_3484	13-Apr-10	Undamaged reef adjacent to final resting location

Video label	Description	Original Vide	Date taken	Location
Video 001	Diver sampling antifouling paint from reef substra	MVI_3222	12-Apr-10	Close to inital grounding location
Video 002	Pan over area of moderate damage	MVI_3267	12-Apr-10	Close to inital grounding location
Video 003	Diver sampling metal fragments from reef substra	MVI_3272	12-Apr-10	Close to inital grounding location
Video 004	Pan from adjacent reef over final resting location	MVI_3349	13-Apr-10	Final resting location
Video 005	Pan over final resting location	MVI_3354	13-Apr-10	Final resting location
Video 006	Diver taking sedimet sample	MVI_3355	13-Apr-10	Final resting location
Video 007	Pan from adjacent reef over final resting location	MVI_3378	13-Apr-10	Final resting location
Video 008	Pan from severely damaged area over adjacent ur	MVI_3424	13-Apr-10	Undamaged reef adjacent to final resting location