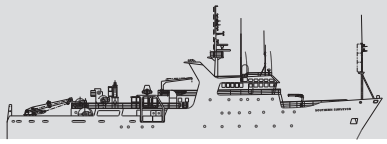

MARINE
NATIONAL FACILITY

2012 program

RV Southern Surveyor

voyageplan
ss2012_t02

Great Barrier Reef phase shift: Gardner Bank to Gardner Reef

Itinerary

Mobilise Brisbane
from 0800hrs, Wednesday 02 May, 2012

Depart Brisbane Port
1300hrs, Wednesday 02 May, 2012

Depart Brisbane Pilot Boarding Ground
1700hrs, Wednesday 02 May, 2012

ETA Gardner Bank
0300hrs, Thursday 03 May, 2012

Depart Gardner Bank
0200hrs, Friday 04 May, 2012

ETA Navula Passage Pilot Boarding Ground, Fiji
0530hrs, Thursday 10 May, 2012

Arrive Lautoka, Fiji
0800hrs, Thursday 10 May, 2012 and demobilise

Principal Investigators

Dr Robin Beaman (Chief Scientist)
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CSIRO

Scientific Objectives

On a global scale, coral reefs are experiencing a period of rapid change. The world has effectively lost 19% of the original area of coral reefs since 1950, with the loss predicted of 35% of coral reefs in the next 40 years (Wilkinson, 2008). About 46% of coral reefs are regarded as healthy except for currently unpredictable global climate threats, which includes the Great Barrier Reef (GBR). The vulnerability of coral reef habitats to climate change is high as scleractinian corals are highly sensitive to increasing sea temperature and ocean acidification (Marshall and Johnson, 2007). The increased frequency of coral bleaching due to further increases in sea surface temperature (SST) will cause a decline in coral cover, increases in algal dominance, and shifts towards species that are more thermally tolerant. Exceptions to this pattern may occur at the southern limits of the GBR where tropical carbonates transition into temperate carbonates. The observed shift of average marine climate zones south by >200 km since 1950 (Lough, 2008) could potentially result in the GBR extending south, causing an algal to coral phase shift as coral settlement follows the changing environmental gradient.

The shelf adjacent to Fraser Island is located at the transition between tropical carbonates (GBR) to the north and cool-water carbonates to the south (Schröder-Adams et al., 2008) and represents an ideal natural laboratory to investigate this phase shift. On the outer-shelf, Gardner Bank lies in depths of 20-60 m and comprises a hard substrate of red algal nodules and pebble- to cobble-sized rhodoliths (Lund et al., 2000), under the influence of the East Australian Current (Harris et al., 1996). Living platey and small massive corals grow in competition with both red algae and extensive areas of fleshy algae (Davies and Peerdeman, 1998; Marshall et al., 1998). The projected warming trend in SST would anticipate a phase shift from a red algal-dominated substrate to a coral-dominated substrate. A hypothesis is that Gardner Bank would form an antecedent surface for future coral reef development through net coral framework accretion. In effect, Gardner Bank would become Gardner Reef, therefore it is crucial that the extent, structure and morphology of this potentially important site be investigated.

Voyage Objectives

The key questions are: (1) will the GBR tropical carbonate province extend further south under projected warming trends?; and (2) can relatively shallow, hard substrate geomorphic features within the tropical/temperate transition zone (e.g. Gardner Bank) provide the necessary habitat to support such as shift? We propose to address these questions using two independent approaches: (1) Field mapping using multibeam and seismic methods; and (2) Oceanographic numerical modelling. The field mapping will provide the critical baseline maps to characterise the substrate of Gardner Bank for the potential to provide a suitable habitat for subsequent coral reef growth. The numerical modelling will be conducted by AIMS and CSIRO who are developing a 3D whole-of-GBR hydrodynamic model (http://www.rrrc.org.au/mtsrf/theme _ 2/project _ 2 _ 5i _ 1. html). The aim of the hydrodynamic model is to provide a capability to support the prediction and analysis of connectivity and exchange of material, including larvae, throughout the GBR. The model will be used to predict the trajectory and spatial distribution of coral larvae in the southern GBR under warming scenarios.

The field mapping would utilise the Simrad EM300 multibeam system and Topas seismic profiler on the RV Southern Surveyor to map the extent of Gardner Bank (Figure 1). The high-resolution sub-bottom, bathymetry and backscatter datasets will then be used to develop seabed character maps and sub-surface information that show the detailed spatial extent and geomorphology of the bank. The acoustic datasets, in conjunction with existing groundtruth samples, will be used to fine-tune sediment facies boundaries (Lund et al., 2000), which can then be used to highlight areas of potentially enhanced coral settlement and growth. Lastly, we propose that the seismic profiler and multibeam system be run continuously for the remaining transit leg to Fiji, and passes over the North

Recorder Seamount, which lies adjacent to the south-east Queensland margin in the Tasman Sea (Figure 2 and Table 1). The transit is an opportunity to acquire new data to help improve our understanding of these important seamount ecosystems. In addition, the Geological Survey of New Caledonia have requested a slight deviation of track between the Kelso and Capel banks, so as to acquire new multibeam data adjacent to the previous Noucaplac-2 survey between these two remote banks.

Voyage Track

Wednesday 02 May

The ship will depart Brisbane Port at 1300hrs to the Brisbane Pilot Boarding Ground at the northern end of Moreton Bay. At ~1700hrs, the vessel will then commence the 100 NM transit to Gardner Bank, east of Fraser Island. Multibeam swath mapping, Topas seismic profiling, and magnetometer survey to commence. Mandatory inductions and safety musters will be completed during this transit.

Thursday 03 May

The ship will arrive at Gardner Bank at ~0300hrs and will conduct a shallow CTD dip over the survey site for a sound velocity profile, then commence a systematic multibeam, seismic, and magnetometer survey over the Gardner Bank survey area for the remainder of the day (Figure 1).

Friday 04 May

After midnight, a single rock dredge will be taken over the Gardner Bank site using the multibeam swath map as a guide to the target site. The ship will depart Gardner Bank at ~0200hrs to commence the transit to Lautoka, Fiji (Figure 2 and Table 1). Multibeam swath and Topas profiling systems to be run continuously. Magnetometer to be recovered on reaching depths >500 m. Other piggyback projects to commence routines. Continuous XBT profiles. Continuous greenhouse gas measurements. Marine debris trawl surveys and dawn to dusk sighting surveys. Continuous Plankton Recorder (CPR) sampling. About 80 NM into the transit at ~1000hrs, the ship will pass over the North Recorder Seamount and provides an opportunity to obtain high-quality multibeam data over the seamount.

Saturday 05 May

Continuous multibeam and Topas profiling. Continuous XBT profiles. Continuous greenhouse gas measurements. Marine debris trawl surveys and dawn to dusk sighting surveys. CPR sampling. About 0400hrs, the ship will conduct a slight deviation of course between the Kelso and Capel banks to acquire new multibeam data adjacent to the previous Noucaplac-2 survey.

Sunday 06 May

Continuous multibeam and Topas profiling. Continuous XBT profiles. Continuous greenhouse gas measurements. Marine debris trawl surveys and dawn to dusk sighting surveys. CPR sampling.

Monday 07 May

Continuous multibeam and Topas profiling. Continuous XBT profiles. Continuous greenhouse gas measurements. Marine debris trawl surveys and dawn to dusk sighting surveys. CPR sampling.

Tuesday 08 May

Continuous multibeam and Topas profiling. Continuous XBT profiles. Continuous greenhouse gas measurements. Marine debris trawl surveys and dawn to dusk sighting surveys. CPR sampling.

Wednesday 09 May

Continuous multibeam and Topas profiling. Continuous XBT profiles. Continuous greenhouse gas measurements. Marine debris trawl surveys and dawn to dusk sighting surveys. CPR sampling.

Thursday 10 May

Complete all multibeam and Topas data acquisition, and any continuous piggyback project measurements by ~0500hrs. Arrive Navula Passage Pilot Boarding Ground, Fiji at ~0530hrs. Commence pilotage into Lautoka Port, arriving at ~0800hrs. On arrival, demobilise any equipment. Science crew may overnight onboard the ship prior to flight back to Australia on Friday 11 May.

Time Estimates

Overall, the total hours from berth to berth is 187hrs using a conservative 10kts average speed. This calculation has allowed for the loss of 2hrs for time zone changes. This time period allows for 4.5hrs of zero progress and 1.5hrs of 10kt progress for the trawl net towing.

On departure from the Brisbane Pilot Boarding Ground at Moreton Bay, the ship would transit 100 NM to the Gardner Bank survey site, taking about 8hrs. On arrival at the survey site, a single CTD will be cast in shallow-water (<50 m) to obtain a sound velocity profile. The time taken should be no more than 30 min. On completion of the CTD dip, the ship would commence surveying multibeam and Topas lines over Gardner Bank for 100% coverage. Lines are approximately 340°/160° and 10 NM long. Based on swath coverage of about 4 x average depth (50 m), we estimate just under 24 hours to survey the area. Within this ~24 hour time period, and on completion of the multibeam survey, we would deduct enough time ~1 to 2 hours to obtain one rock dredge sample of the site in depths <50 m.

On completion of the Gardner Bank survey, the ship would then commence the transit to Lautoka, passing over the North Recorder Seamount and between the Kelso and Capel banks. The transit leg from Gardner Bank is ~1400 NM to Lautoka. Continuous multibeam and Topas profiling would be conducted at the transit speed. Similarly, the continuous XBT drops and greenhouse gas measurements would be conducted at transit speed. The proposed marine debris trawls at <5kts have been factored into the overall time estimate. The Continuous Plankton Recorder will be towed at transit survey speed.

Piggy-back Projects

Title: Transect Measurements of Greenhouse Gases in the Marine Atmosphere

Principal Investigators: Clare Murphy (Paton-Walsh) (University of Wollongong), Professor Peter Rayner (UniMelbourne), Professor David Griffith (University of Wollongong)

Objectives: (1) Make continuous measurements of carbon dioxide, methane, nitrous oxide, carbon monoxide and ozone as the RV Southern Surveyor travels along the chosen transect. (2) To take flask sample measurements at a number of points to allow later isotopic analysis which will assist in identifying sources of enhanced concentrations of the trace gases. (3) Assimilate measured data into a variety of atmospheric chemical transport, inverse and statistical models to improve our knowledge and understanding of atmospheric greenhouse gases and their sources and sinks.

Methods: The main measurement technique will be a continuous flow gas analyser. The instrument incorporates a pump, a Fourier transform spectrometer and a White cell. It is a fully automated system that is capable of making simultaneous measurements of carbon dioxide, methane, nitrous oxide and water vapour. In addition a number of evacuated flasks would be carried during the voyage and open up at a series of measurement locations for later analysis of isotopic abundances.

Time estimates: Continuous gas samples will be taken enroute with no impact on transit voyage time.

Title: Predicting the sources, distribution, and fate of marine debris

Principal Investigators: Julia Reisser (CSIRO/UWA), Chris Wilcox (CSIRO), Charitha Pattiaratchi (UWA), Britta Denise Hardesty (CSIRO)

Objectives: Estimate concentration of floating marine debris using (1) neuston trawls and (2) visual surveys.

Methods: (1) Neuston trawls: Floating debris will be sampled with a net lined with 0.33mm mesh. It will be deployed by two people to sample the air-water interface. We plan to conduct one net station (three tows of 15 min) every 150 NM (Figure 2 and Table 2). (2) Visual surveys: Visual surveys will be conducted from dawn to dusk for 1 hour, four times per day. These sighting surveys do not require any change to the vessel transit speed enroute.

Time estimates: This project requires around 9 hours at 2-4knots (10 net stations of 50 min duration).

Title: XBT samples

Principal Investigators: Alan Poole (CSIRO)

Objectives: Continuous XBT samples provide improved time series and data coverage for temperature in the deep ocean.

Methods: About 100 XBTs to be deployed during the transit at every hour around the clock.

Time estimate: There is no anticipated time impact as the XBTs will be deployed at transit speed.

Title: Transect measurements of plankton distribution in surface waters

Principle Investigators: Philip Wiles (Secretariat of the Pacific Regional Environment Program) and Anthony Richardson (CSIRO)

Objectives: To pilot test a proposed regular plankton sampling program across the Pacific, ultimately performed by vessels of opportunity. Take continuous samples (every 5 nautical miles) of surface phytoplankton and zooplankton along the chosen transect using the proven Continuous Plankton Recorder.

Methods: A Continuous Plankton Recorder (CPR) will be towed behind the RV Southern Surveyor during its transit from Brisbane to Fiji. The CPR will be first deployed on completion of the Gardner Bank survey and after departure from the continental shelf in depths >500 m. The CPR is towed from an already existing fixture on the RV Southern Surveyor, and the ship's crew are familiar with its

operation from previous tows. Seawater is filtered over a silk ribbon and the sample is preserved automatically in a cassette for post-cruise analysis. The CPR will have to be deployed and recovered every 450 nautical miles during the transit to replace the silk cassette. This does not require any slowing of the vessel or change of course by the vessel. If the vessels slows down below 4 knots or stops the CPR must be brought onboard. The ship's crew are familiar with the protocol.

Time estimates: The CPR will be run during the vessel transit with no impact on transit voyage time.

Title: Magnetic survey of the Fraser continental shelf

Principal Investigators: Benjamin Cohen (UQ) and assisted by the swath team to monitor data collection, assist in deploying and recovery, and record keeping.

Objectives: To make continuous magnetic measurements before and during the survey of Gardner Bank. Data will be used to map the offshore extents of a high-frequency magnetic zone that extends over much of the Fraser region, interpreted as buried Oligocene volcanic rocks. The magnetic response of the volcanic rocks contrasts markedly with the magnetically quiet sedimentary rocks of the Maryborough Basin. This data will contribute to understanding the geological substrate of Gardner Bank and the Fraser continental shelf.

Methods: The magnetometer and winch (supplied by Geoscience Australia) will be installed aboard the vessel in Brisbane, as part of the mobilisation for SS2012 _ V02. The magnetometer will be deployed on departure from the Brisbane Pilot Boarding Ground, and towed at a distance specified by MNF staff behind the vessel. The magnetometer must be retrieved before the vessel stops (e.g. for CTD cast, dredge), then redeployed for the remaining Gardner Bank survey. The magnetometer cable may need to be shortened or the magnetometer retrieved at other times (e.g. if the ship slows during tight turns), especially over the shallowest parts of Gardner Bank. Procedures to shorten or recover the magnetometer cable to be discussed at the toolbox meeting prior to arrival at Gardner Bank. The magnetometer will be retrieved and stowed on departure from the continental shelf in depths >500m and prior to the deployment of the CPR.

Time estimates: The magnetometer will be towed at swath mapping speed, with no impact on survey time.

Southern Surveyor Equipment

Gardner Banks and transit multibeam survey:

We require the use of the Topas sub-bottom profiler and Simrad EM300 multibeam system for the Gardner Bank survey and for the remaining transit to Lautoka. We also request a single CTD dip prior to the start of the Gardner Bank survey so as to ascertain sound velocity. The XBT samples collected during the transit will provide the sound velocity profiles required for the multibeam transit survey to Fiji. We request the use of the rock dredge for one sample over the Gardner Bank survey site. Samples will be bagged and stored in a nally bin within the ship's cold room, then removed from the vessel on return to Sydney.

Predicting the sources, distribution, and fate of marine debris:

None required.

Transect Measurements of Greenhouse Gases in the Marine Atmosphere:

We need to be located in the ventilated fish laboratory to get our sample lines out of the laboratory, as well to use pressurised gas cylinders (nitrogen, ambient air, synthetic air). The inlet lines need to be installed on the mast on the forecastle deck. We require access to the meteorological data collected by the ship after the leg completes, e.g. wind direction, heading, temperature etc.

XBT samples:

Use of the XBT launcher at 1 hour intervals.

Transect measurements of plankton distribution in surface waters:

None required.

Magnetic survey of the Fraser continental shelf:

None required.

User Equipment

Gardner Banks and transit survey:

Will supply own nally bin, sample bags and alcohol preservative.

Predicting the sources, distribution, and fate of marine debris:

Will supply two neuston nets and sample jars. Samples will be preserved in alcohol.

Transect Measurements of Greenhouse Gases in the Marine Atmosphere:

See attached list UoWEquipment.doc.

XBT samples:

Will bring a standalone XBT launcher as a backup for the ship's launcher. Will supply own XBTs.

Transect measurements of plankton distribution in surface waters:

Will supply own CPR and silk cassettes.

Magnetic survey of the Fraser continental shelf:

Geoscience Australia will supply the magnetometer and winch, for fitting on the vessel prior to departure from Brisbane.

Special Requests

Gardner Banks and transit survey:

No special requests.

Predicting the sources, distribution, and fate of marine debris:

No special requests.

Transect Measurements of Greenhouse Gases in the Marine Atmosphere:

No special requests.

XBT samples:

No special requests.

Transect measurements of plankton distribution in surface waters:

No special requests.

Magnetic survey of the Fraser continental shelf:

No special requests.

Personnel List

Robin Beaman	JCU	Chief scientist
Murphy Birnberg	JCU	Scientist
Gustavo Hinestrosa	USydney	Scientist
Adrian Eddy	AHS	Scientist
Benjamin Cohen	UQ	Scientist
Clare Murphy (reserve)	UWollongong	Scientist
Dagmar Kubistin	UWollongong	Scientist
Christopher Caldow	UWollongong	Scientist
Julia Reisser	CMAR/UWA	Scientist
Don McKenzie	CMAR	MNF Voyage manager
Lindsay MacDonald	CMAR	MNF Electronics support
Hugh Barker	CMAR	MNComputing support
Tara Martin	CMAR	MNF EM300 swath technician
Sascha Frydman	CMAR	MNF EM300 swath technician
Alan Poole	CMAR	Scientist

There will be at least two MNF support staff included in this list. Refer the Application Form and liaise with the Operations Manager as required.

Any additional scientific berths over 12 up to the maximum of 15 must be occupied by System Support Technicians (SST's) as per AMSA requirements. You must identify these SST's on the personnel list as well as quoting their AMSA Certificate of Safety Training number. The Operations Manager can assist as most MNF support staff have the required qualifications.

As per AMSA requirements for additional berths on the RV Southern Surveyor, the following personnel are designated as System Support Technicians and are required to carry their original AMSA medical and AMSA Certificate of Safety Training on the voyage:

Name	AMSA Certificate of Safety Training No.
Don McKenzie	AS02764
Lindsay MacDonald	AS04157
Hugh Barker	BB05460
Tara Martin	BB05761

This voyage plan is in accordance with the directions of the Marine National Facility Steering Committee for the Research Vessel Southern Surveyor.

Robin Beaman

Chief scientist

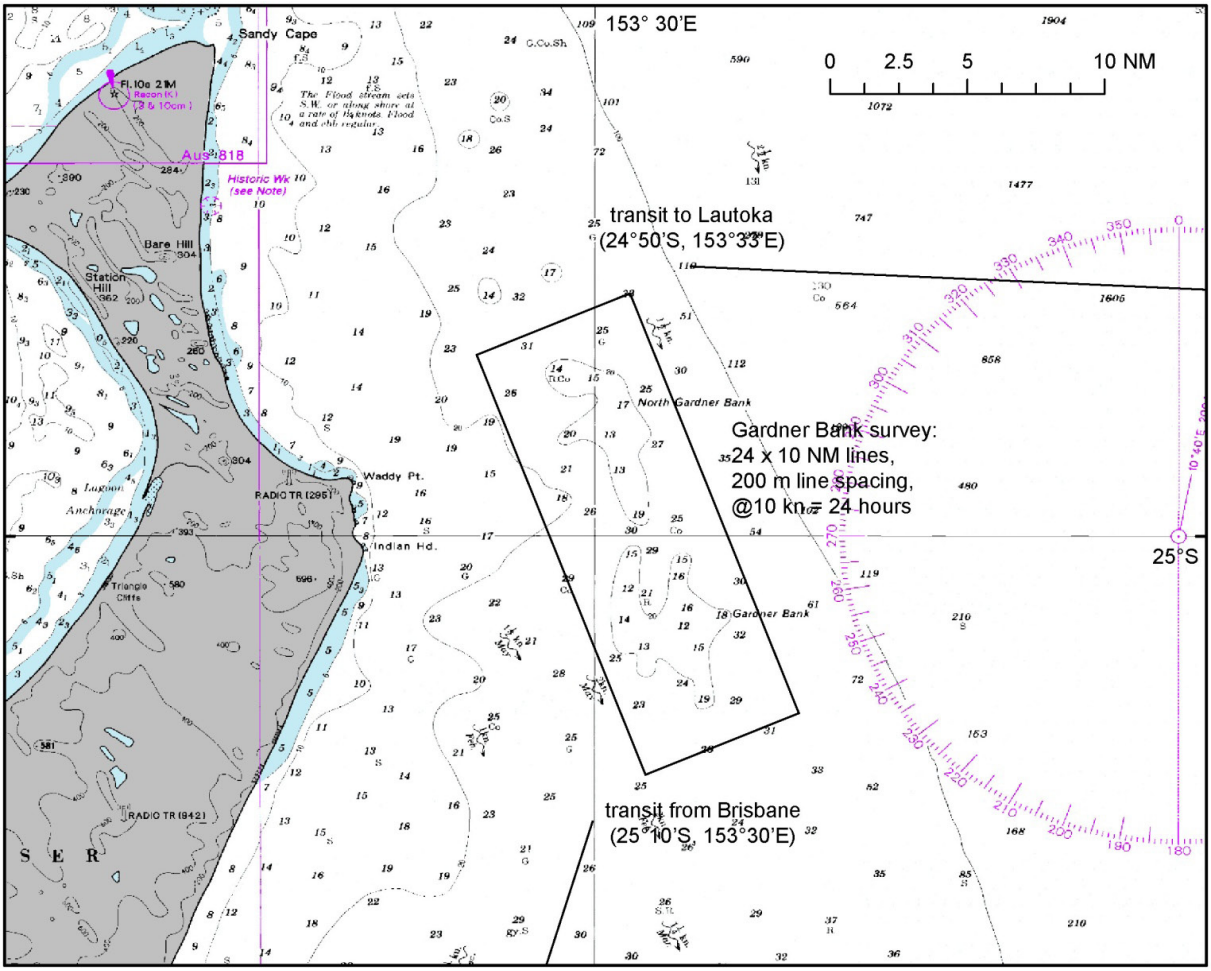

Figure 1. Close-up view of proposed survey area at Gardner Bank.

LongitudeDD	LatitudeDD	LongitudeDM	LatitudeDM	Waypoint	Name
153.178860	-26.706340	153° 10.7'E	26° 42.4'S	1	Brisbane
153.550000	-24.833333	153° 30'E	25° 10'S	2	GardnerBank
155.000000	-24.916666	155° 00'E	24° 55'S	3	NthRecorder Seamounts
158.166666	-24.500000	158° 10'E	24° 30'S	4	KelsoBank1
159.000000	-24.250000	158° 00'E	24° 15'S	5	KelsoBank2
160.000000	-24.333333	160° 00'E	24° 20'S	6	KelsoBank3
167.500000	-23.500000	167° 30'E	23° 30'S	7	NewCaledonia
177.183333	-17.936666	177° 11'E	17° 56.2'	8	Lautoka

Table 1. Proposed transit waypoint coordinates.

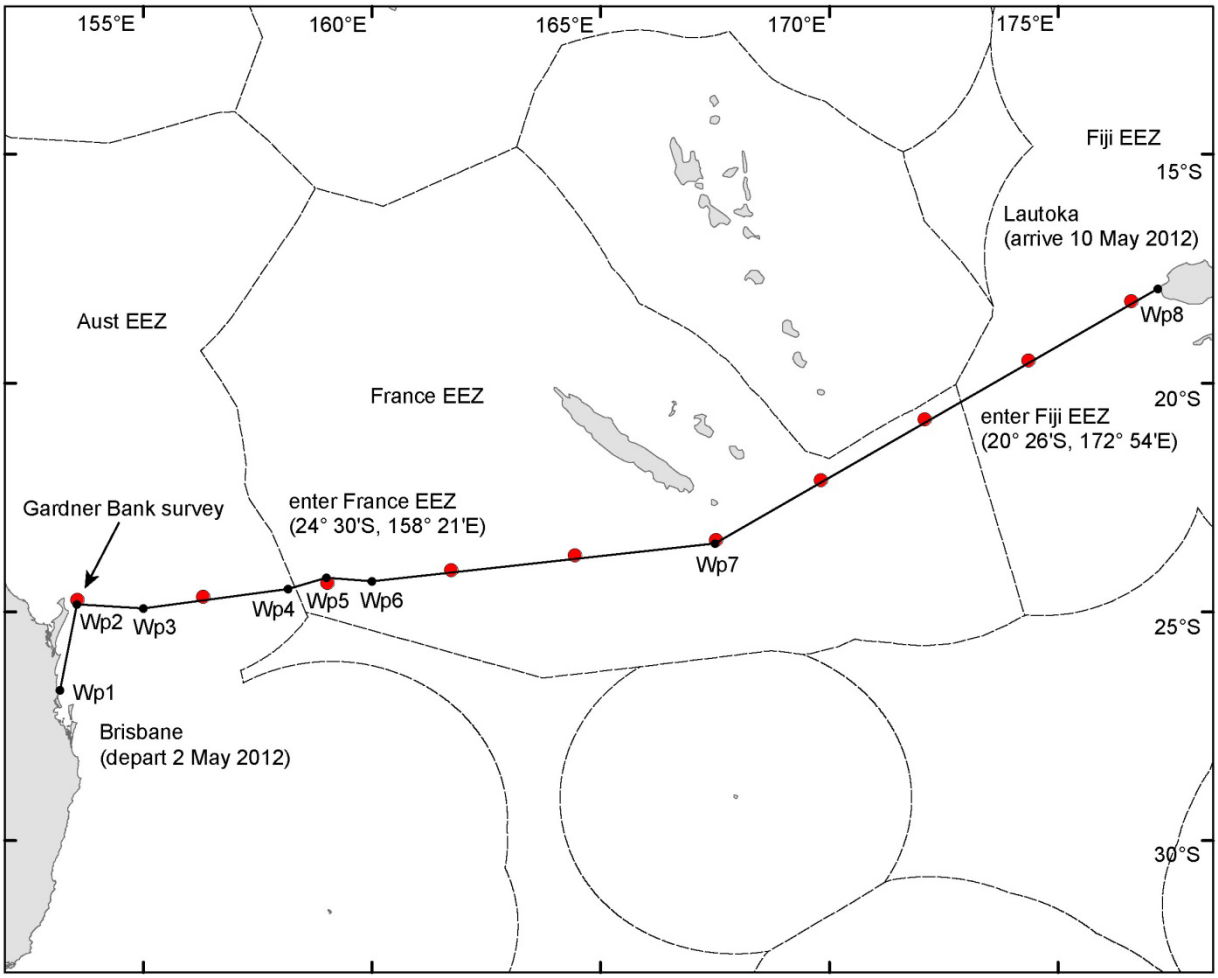

Figure 2. Transit plan from Brisbane to Lautoka with proposed waypoint positions (black dots) and proposed marine debris trawl stations (red dots). See Tables 1 and 2 for proposed transit waypoint and trawl station coordinates..

LongitudeDD	LatitudeDD	LongitudeDM	LatitudeDM	Station
153.558969	-24.733711	153° 33.54'E	24° 44.02'S	1
156.310205	-24.660578	156° 18.61'E	24° 39.63'S	2
159.026502	-24.367081	159° 01.59'E	24° 22.02'S	3
161.735393	-24.079419	161° 44.12'E	24° 04.77'S	4
164.440229	-23.760726	164° 26.41'E	23° 45.64'S	5
167.522272	-23.421242	167° 31.34'E	23° 25.27'S	6
169.821504	-22.112730	169° 49.29'E	22° 06.76'S	7
172.090130	-20.780518	172° 05.41'E	20° 46.83'S	8
174.358034	-19.502540	174° 21.48'E	19° 30.15'S	9
176.604115	-18.203533	176° 36.25'E	18° 12.21'S	10

Table 2. Proposed marine debris station coordinates.