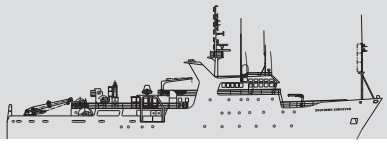

MARINE
NATIONAL FACILITY

2012 program

RV Southern Surveyor

voyageplan
ss2012_t07

1. Epibenthic communities of northern Australia

and

2. An examination of the microbial oceanography of north-eastern Australia

Itinerary

Load Darwin 0800hrs, Monday 15 October, 2012
Depart Darwin 1600hrs, Monday 15 October, 2012

Arrive Cairns 0800hrs, Wednesday 24 October, 2012,
Unload Cairns 1700hrs, Wednesday 24 October, 2012

CSIRO

Principal Investigators 1. Epibenthic communities of northern Australia

Belinda Alvarez de Glasby
Museum and Art Gallery of the Northern Territory (MAGNT)

Rachel Przeslawski
Geoscience Australia (GA)

Neil Smit
Marine Biodiversity unit,
Department of Natural Resources, Environment, Sport and the Arts (NRETAS-Marine Biodiversity)

Libby Evans-Illidge
Australian Institute of Marine Sciences Bioresources Library (AIMS-Bioresources Library)

Principal Investigators 2. An examination of the microbial oceanography of north-eastern Australia

Dr. Martina Doblin (Chief Scientist)
University of Technology, Sydney
Plant Functional Biology and Climate Change Cluster
PO Box 123 Broadway, NSW 2007
Phone: 02 9514 8307 **Mobile:** 0439 339 230
Fax: 02 9514 4079
e-mail: martina.doblin@uts.edu.au

Dr. Justin Seymour
University of Technology, Sydney
Plant Functional Biology and Climate Change Cluster
PO Box 123 Broadway, NSW 2007
Phone: 02 9514 4092 **Mobile:** 0412 193 915
Fax: 02 9514 4079
e-mail: justin.seymour@uts.edu.au

Dr Mark Brown
School of Biotechnology and Biomolecular Sciences
The University of New South Wales
Kensington, NSW 2052
Phone: 02 9382 1255 **Mobile:** 0422 589 571
Fax: 02 9385 1483
email: markbrown@unsw.edu.au

Scientific Objectives

1. Epibenthic communities

1. To use a remotely operated underwater video camera (ROV) to explore two areas along the transit voyage track of RV Southern Surveyor from Darwin to Cairns (15-24 October 2012) for discovery of habitat-forming and bioactive epibenthic fauna.
2. To collect epibenthic fauna using a sled thereby ground-truthing the video data.
3. To sort, photograph, document and prepare taxonomic vouchers of the samples captured with the benthic sled.
4. To deposit taxonomic vouchers of all samples at MAGNT for curation, registration and distribution to the appropriate taxonomic experts for taxonomic identification.
5. To prepare and freeze suitable samples for screening of bioactive compounds and accession them at the AIMS Bioresources library for future export to the US National Cancer Institute (NCI) laboratories or for research on marine natural products.
6. To correlate biodiversity measure obtained from the survey with available physical datasets from GA (e.g. geomorphology, sediment grain-size).

2. Microbial oceanography

The major biotic players in controlling the function of the global ocean are microorganisms. These microbes represent 50-90% of total ocean biomass, form the foundation of the marine food-web, and constitute the engine-room of the ocean's major chemical cycles (C, N, P, S). The composition and biogeochemical functionality of these microbial assemblages underpins the ecology of marine ecosystems and mediates the ocean-atmosphere exchange of climatically important gases. To fully understand the basic biological and chemical dynamics of ocean ecosystems, the identity and role of the microbial assemblages inhabiting seawater must be accurately defined.

Although the physical oceanography of many of Australia's key ocean provinces has been well characterised, the microbial oceanography is relatively undeveloped. We know particularly little about the composition, functionality and dynamics of the microbial assemblages inhabiting Australia's northern waters, a relatively pristine environment, which plays a significant role in regional oceanographic and climatic processes. The proposed research will provide an important new platform for understanding the ecology and biogeochemistry of this region.

The specific objectives of the proposed research are to:

1. Provide a first characterisation of the taxonomy, diversity and biogeography of prokaryotic and eukaryotic microorganisms inhabiting Australia's NE ocean waters;
2. Assess the physiological and biogeochemical potential of the microbial communities inhabiting this region;

3. Characterise the light climate to define optical niches for growth of marine primary producers and undertake manipulative experiments to examine optical regulation of carbon fixation;

4. Characterise the eco-physiology and fine-scale community structure of abundant microbial primary producers, including Prochlorococcus, Synechococcus and photosynthetic pico-eukaryotes;

5. Establish and test new microbial oceanography experimentation protocols, while also providing valuable training to students and early career researchers in oceanographic research practices.

Voyage Objectives

1.1 Visit two sites and characterise their benthic communities

2.1 Deploy CTD-rosette to obtain vertical profiles of water column structure (temperature, salinity, dissolved oxygen, Photosynthetically Active Radiation, chlorophyll-a fluorescence, CDOM fluorescence), as well as photosynthetic rates and collect water samples for microbial assessment.

2.2 Undertake deckboard biogeochemical process studies, focusing on the nutrient poor water in the Gulf of Carpentaria and outer lagoon waters of the Great Barrier Reef to understand the links between macro-nutrient availability, microbial diversity (bacteria and phytoplankton) and biogeochemical transformations by lower trophic levels.

2.3 Undertake manipulative experiments to alter the quantity and quality of light available for photosynthesis and carbon fixation.

2.4 Trial experimental methods to assess rates of biogeochemical transformations, including N-fixation and organic phosphorus uptake.

2.5 Conduct deployments of 'in situ chemotaxis assay' at process stations.

Voyage significance

There is an urgent need to more comprehensively examine the dynamics of the microorganisms that underpin the function of important Australian marine environments. The proposed work will represent the most detailed assessment of marine microbial ecology performed in Australia's northern waters to date. This region includes the pristine but environmentally sensitive Torres Strait and Great Barrier Reef Marine Park, as well as Coral Sea waters associated with the source of the East Australian Current. Our research will provide important new data on the drivers of ecosystem productivity and biogeochemistry in this region, which will have immediate relevance for predictions of chemical fluxes and system productivity within Australian waters.

The format of the proposed research is well suited to a Transit Voyage, because sampling procedures are relatively rapid and followed by substantial on-board processing and manipulation, which can take place while the vessel is steaming, allowing for short interruptions to the transit schedule. Our proposed research also has general significance to Australian oceanographic research, as it will incorporate a substantial training element, which will include providing scientific, logistical and leadership experience to students and Early Career Researchers (ECR).

Voyage Track

The proposed voyage track for the first part of this project is presented in Fig. 1. Dates and approximate times for arrival and departure are based on an average speed of 19 Km/hour (10 knots) (Table 1). Start times are flexible and can be adjusted.

In voyage planning discussions, the MNF noted their preference to complete Part I of the science objectives before starting Part II. The scheduling would therefore have the microbial activities starting in the Gulf of Carpentaria, leaving the area north of Darwin completely unsampled for microbes. We'd therefore prefer to stop for a pre-dawn CTD cast on day 1 of the voyage (05:00, 16 October, 2012) before reaching Area I, so that the microbial ecologists can 'shake down' any procedures related to their sampling and assays. They would then resume their activities after Part I of the science was completed at Area II.

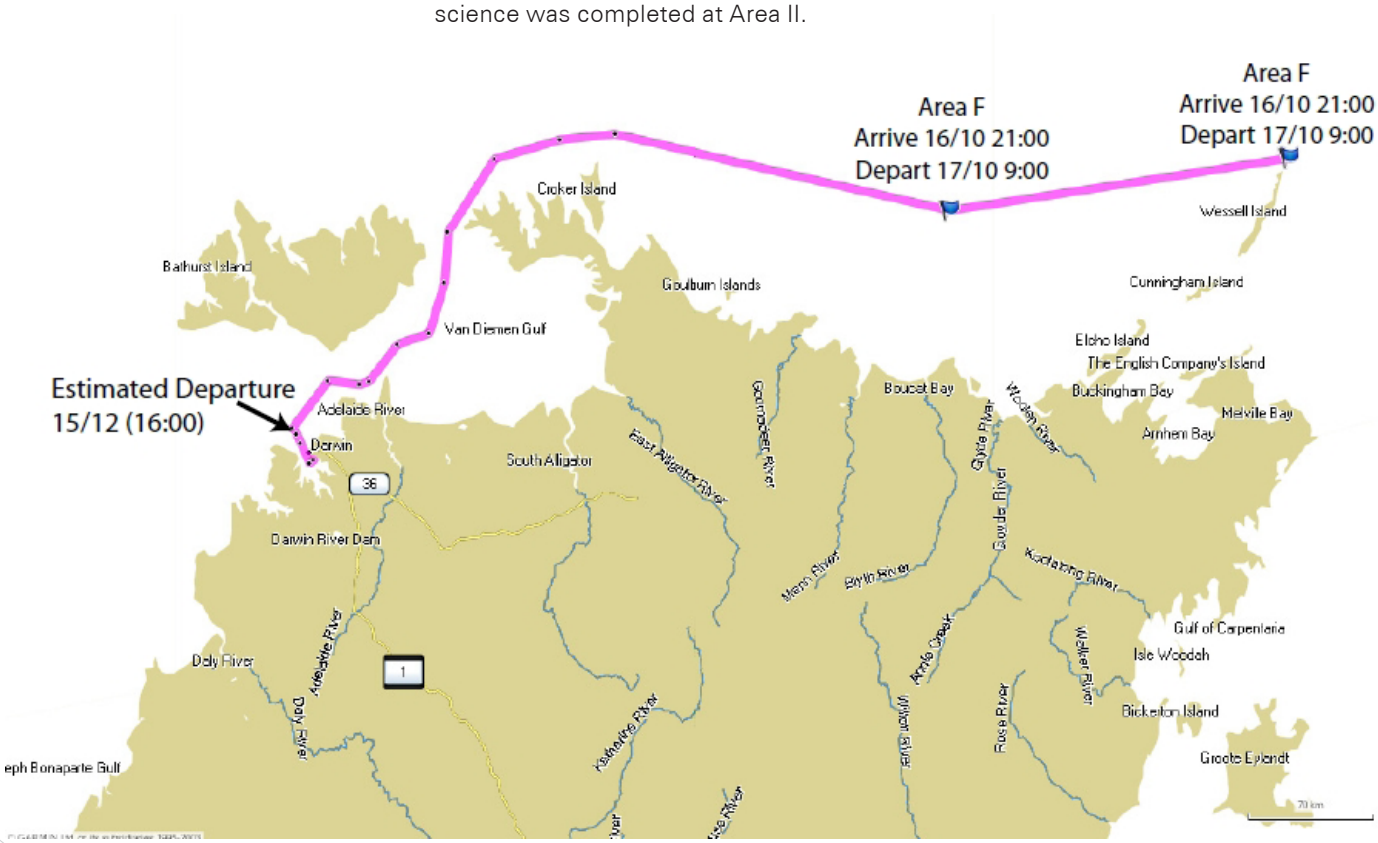

Table 1. Dates and approximate times of arrival and departure to the sampling areas.

Location	Date	Time
Departure from Darwin	15/10/2012	16:00
Arrival Area I (approximately 560 Km from Darwin) and commence of sampling program at Area I:	16/10/2012	21:00
End of sampling at Area I and departure to Area II	17/10/2012	14:30
Arrival at Area II (approximately 230 Km) and commence of sampling program at Area E	18/10/2012	2:30
End of sampling at Area E	18/10/2012	9:00

PART I

Fig. 2 and Table 2 show the location and depth of sample sites and depths. Table 3 shows timing for deployments.

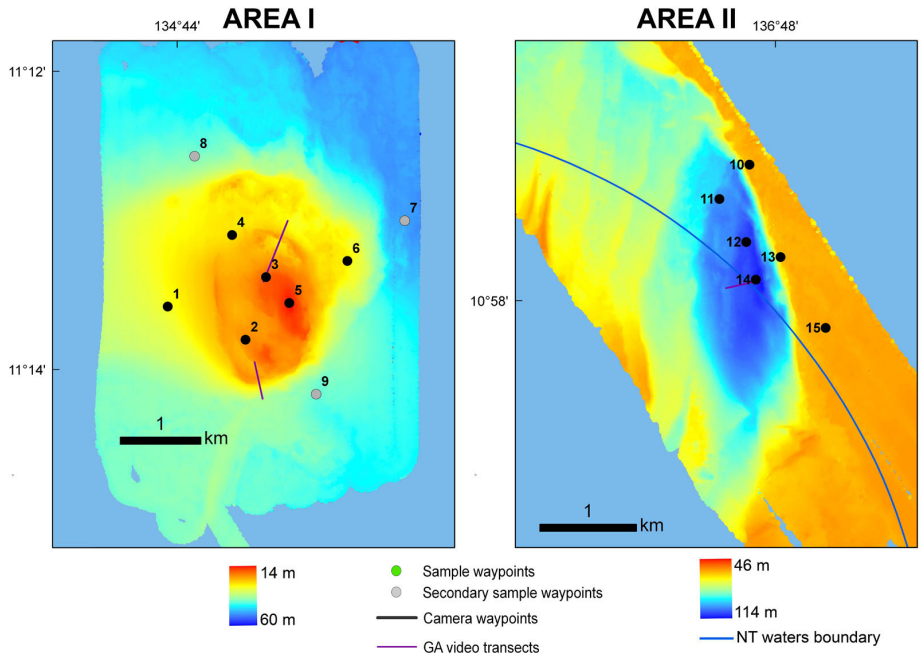

Table 2. Location and depth of the proposed sampling sites. (*) Secondary waypoints if time is permissible.

Waypoint	Area	Longitude	Latitude	Depth
1	Area I	134.7323	-11.2263	30
2	Area I	134.741	-11.23	21
3	Area I	134.7433	-11.223	18
4	Area I	134.7395	-11.2183	27
5	Area I	134.7459	-11.2259	15
6	Area I	134.7524	-11.2212	28
7*	Area I	134.7588	-11.2167	50
8*	Area I	134.7353	-11.2095	41
9*	Area I	134.7489	-11.2361	42
10	Area II	136.7976	-10.954	53
11	Area II	136.7948	-10.9572	100
12	Area II	136.7973	-10.9612	109
13	Area II	136.8005	-10.9626	61
14	Area II	136.7982	-10.9647	110
15	Area II	136.8047	-10.9692	59

Table 3. A proposed scheduled for sampling in the stations indicated in Fig 2. Times and dates are approximated. Steaming time from Area I to Area II is not included.

Area	Station	Gear	Date	Deployment time	Retrieval time	Time for clearing deck, moving between waypoints, sorting	Cumulative time
I	1CAM1	Camera	16/10/2012	21:00:00	22:00:00	1:00:00	1:00:00
I	1BS1	Sled	16/10/2012	22:00:00	22:30:00	0:30:00	1:30:00
I	2CAM2	Camera	16/10/2012	22:30:00	23:20:00	0:50:00	2:20:00
I	2BS2	Sled	17/10/2012	23:20:00	23:50:00	0:30:00	2:50:00
I	3CAM3	Camera	17/10/2012	23:50:00	0:30:00	0:40:00	3:30:00
I	3BS3	Sled	17/10/2012	0:30:00	1:00:00	0:30:00	4:00:00
I	4CAM4	Camera	17/10/2012	1:00:00	1:40:00	0:40:00	4:40:00
I	4BS4	Sled	17/10/2012	1:40:00	2:10:00	0:30:00	5:10:00
I	5CAM5	Camera	17/10/2012	2:10:00	2:50:00	0:40:00	5:50:00
I	5BS5	Sled	17/10/2012	2:50:00	3:20:00	0:30:00	6:20:00
I	6CAM6	Camera	17/10/2012	3:20:00	4:00:00	0:40:00	7:00:00
I	6BS6	Sled	17/10/2012	4:00:00	4:30:00	0:30:00	7:30:00
I	7CAM7*	Camera	17/10/2012	4:30:00	5:30:00	1:00:00	8:30:00
I	7BS7*	Sled	17/10/2012	5:30:00	6:00:00	0:30:00	9:00:00
I	8CAM8*	Camera	17/10/2012	6:00:00	7:00:00	1:00:00	10:00:00
I	8BS8*	Sled	17/10/2012	7:00:00	8:00:00	1:00:00	11:00:00
I	9CAM9*	Camera	17/10/2012	8:00:00	9:00:00	1:00:00	12:00:00
I	9BS9*	Sled	17/10/2012	9:00:00	9:30:00	0:30:00	12:30:00
II	10CAM10	Camera	17/10/2012	20:00:00	21:00:00	1:00:00	13:30:00
II	10BS10	Sled	17/10/2012	21:00:00	22:00:00	1:00:00	14:30:00
II	11CAM11	Camera	17/10/2012	22:00:00	23:00:00	1:00:00	15:30:00
II	11BS11	Sled	17/10/2012	23:00:00	0:00:00	1:00:00	16:30:00
II	12CAM12	Camera	17/10/2012	0:00:00	1:00:00	1:00:00	17:30:00
II	12BS12	Sled	17/10/2012	1:00:00	2:00:00	1:00:00	18:30:00
II	13CAM13	Camera	17/10/2012	2:00:00	3:00:00	1:00:00	19:30:00
II	13BS13	Sled	17/10/2012	3:00:00	4:00:00	1:00:00	20:30:00
II	14CAM14	Camera	17/10/2012	4:00:00	5:00:00	0:30:00	21:00:00
II	14BS14	Sled	17/10/2012	5:00:00	6:00:00	1:00:00	22:00:00
II	15CAM15	Camera	18/10/2012	6:00:00	7:00:00	1:00:00	23:00:00
II	15BS15	Sled	18/10/2012	7:00:00	8:00:00	1:00:00	0:00:00

* Secondary sample waypoints

Sampling is proposed in two areas located within the route from Darwin to Cairns from which high-resolution bathymetry reveals an isolated reef (Area I) and a deep hole and terrace feature (Area II) (Fig 2, Table 2). A sampling schedule for each area is presented in Table 3. At each area an underwater remotely operated video camera (ROV) will be deployed at the proposed waypoints (Table 2) to assess the substratum and epifaunal cover. The camera will be deployed at each waypoint from the side of the deck along a transect distance determined by the maximum tether length ,depth, and currents.

Based on the video assessment, a benthic sled will be deployed at the sampling waypoints and towed for approximately 100 m at an average speed of 2 knots.

Material captured with the sled will be dumped on deck (or on deck sorting table), roughly sorted in groups, photographed, weighed, labelled with station number and taken to the fish laboratory for further processing. While the sorting is progressing, the vessel will move to the next waypoint, and the camera and sled will be prepared for the next deployment.

At the fish lab samples will be sorted by morpho-species. Each sample will be assigned a field number, photographed with the field number, weigh and documented in the field register. A voucher of each sample will be prepared using the appropriate methods for each group of organisms. Vouchers will be preserved in Ethanol (95%) or in Formalin (10%), and stored in plastic drums in the flammable store and in the corrosive cupboard respectively. Samples with weights greater than 300 g will be prepared for bioprospecting screening in plastic bags and stored at -20 degrees. If processing at the fish lab is not completed before the next capture, the samples will be provisional stored at the walking freezer (in plastic bags or nally beens clearly labelled with the station numbers) and the processing will resume as soon as possible.

Sorting and processing in the fish lab will be finished during transit once the sampling program is completed. Samples and gear will be prepared for freight, data and photographs will be backed-up, and laboratory will be cleaned up.

PART II

This part of the science program will involve stopping at regular intervals along the transit to undertake CTD and optical casts. The goal is to characterise the microbial communities in different water types and examine their activity. Because physiology of marine photosynthetic organisms is affected by the time of day, we want to undertake operations at the same time each day if at all possible.

It's envisaged that the microbial part (II) of the voyage would resume in Area II, directly after the benthic objectives are completed – i.e. before leaving station, we want to do a CTD and optical cast.

The complete sequence of tasks and voyage schedule for Part II of the science objectives is shown below. Station locations and timing are indicative, and would be relocated depending on weather or time constraints. Stations are spaced ~70 nm apart in the Gulf so that we could reach the north-east (NE) tip of Australia by 20 October, and ~50 nm apart along the Great Barrier Reef.

The station locations in the Great Barrier Reef World Heritage Area have been designed to run along the 500 m contour.

Date	Time	Station number	Location	Latitude (°S)	Longitude (°E)	Cumulative time
15/10/2012 Monday	no operations					
16/10/2012 Tuesday	0600	1		10°56'38.95"	131°55'29.40"	1.0
17/10/2012 Wednesday	benthic activities					
18/10/2012	1400	2	Area II	10°57'14.40"	136°47'51.36"	2.5
Thursday	2300	3	Gulf E-W transect start	10°52'7.04"	137°55'42.76"	3.5
19/10/2012	0500	4	Gulf	10°49'4.00"	139° 4'24.76"	4.5
Friday	1300	5	Gulf	10°46'27.99"	140°16'33.02"	6.0
	2300	6	Gulf transect end	10°44'35.60"	141°29'52.53"	7.0
20/10/2012	0500	7	NE transect start	10°41'42.25"	142°40'59.12"	8.0
Saturday	1300	8	NE transect	10°39'35.46"	143°18'33.17"	9.5
	2300	9	NE transect end	10°41'3.98"	144° 0'51.68"	10.5
21/10/2012	0500	10	N-S transect start	11°21'11.36"	144° 7'45.81"	11.5
Sunday	1300	11	GBR	12°10'15.17"	144°21'19.98"	13.0
	2300	12	GBR	12°58'29.99"	144°25'36.27"	14.0
22/10/2012	0500	13	GBR	13°43'41.07"	144°34'49.14"	15.0
Monday	1300	14	GBR	13°38'15.27"	145°18'18.25"	16.5
	2300	15	GBR	13°31'55.61"	146°15'19.23"	17.0
23/10/2012	0500	16	GBR	14°15'2.71"	145°46'52.94"	18.0
Tuesday	1300	17	GBR	15° 9'42.16"	145°51'32.29"	19.5
	2300	18	N-S transect end	16°14'9.43"	145°59'53.23"	20.5
24/10/2012 Wednesday	voyage ends					

A summary of operations is shown below.

6 Biogeochemical N-fix and C-fix stations
6 Optical casts
6 Other CTD rosette samplings|
Total = 18 operations

15/10/2012
1600 depart Darwin

16/10/2012
0500 Tool box
0600 CTD+Rosette for microbial sampling/ setup N2 fixation incubation, 14C and 3H

17/10/2012 Area I

18/10/2012 Area II

1400	CTD+Rosette for microbial sampling ***Note: Would prefer 1300 to time with satellite
1430	*Optical cast to coincide with satellite overpass*
1700-1800	Dinner
2300	CTD+Rosette for microbial sampling

19/10/2012

0500	CTD+Rosette for microbial sampling/ setup N2 fixation incubation, 14C and 3H Leucine incubations
0700-0745	Breakfast
1130-1230	Lunch
1300	CTD+Rosette
1330	*Optical cast to coincide with satellite overpass*
1700-1800	Dinner
2300	CTD+Rosette for microbial sampling

20/10/2012

0500	CTD+Rosette for microbial sampling/ setup N2 fixation incubation, 14C and 3H Leucine incubations
0700-0745	Breakfast
1130-1230	Lunch
1300	CTD+Rosette
1330	*Optical cast to coincide with satellite overpass*
1700-1800	Dinner
2300	CTD+Rosette for microbial sampling

21/10/2012

0500	CTD+Rosette for microbial sampling/ setup N2 fixation incubation, 14C and 3H Leucine incubations
0700-0745	Breakfast
1130-1230	Lunch
1300	CTD+Rosette
1330	*Optical cast to coincide with satellite overpass*
1700-1800	Dinner
2300	CTD+Rosette for microbial sampling

22/10/2012

0500	CTD+Rosette for microbial sampling/ setup N2 fixation incubation, 14C and 3H Leucine incubations
0700-0745	Breakfast
1130-1230	Lunch
1300	CTD+Rosette
1330	*Optical cast to coincide with satellite overpass*
1700-1800	Dinner
2300	CTD+Rosette for microbial sampling

23/10/2012

0500	CTD+Rosette for microbial sampling/ setup N2 fixation incubation, 14C and 3H Leucine incubations
0700-0745	Breakfast
1130-1230	Lunch
1300	CTD+Rosette

1330 *Optical cast to coincide with satellite overpass*
1700-1800 Dinner
2300 CTD+Rosette for microbial sampling

24/10/2010

0700-0745 Breakfast
0800Arrival Cairns

Unloading

Figure 3. Stations for microbial sampling.

Experimental design and sample collection

Samples will be acquired from ~18 stations along the transit route, weather and time depending. At each station, CTD deployments will be used to obtain samples from 3 depths (surface, chlorophyll maximum and below chlorophyll maximum). Following each CTD cast, sample filtration and preparation for incubation experiments can occur while the ship is steaming. An additional optical cast will be done after the 1330 CTD casts to capture vertical profiles of optical parameters during 'high noon'.

The voyage track proposed does not deviate substantially from the shortest route and we are flexible to accommodate changes to our proposed route. Our priority is a high resolution of sample frequency in these northern waters (i.e. high number of stations), rather than a specific or convoluted voyage track.

Sample processing and analysis

Objective 1: Water samples will be collected from 3 depths and 2 - 4 L will be filtered onto 0.2 um membrane filters. Post-voyage, microbial DNA will be extracted from filters and ribosomal tag pyrosequencing (or barcoding) used to assess the taxonomic community composition and diversity of Bacteria, Archaea and micro-Eukaryota. In support of this objective, community structure will be determined by flow cytometry (stained and 'live') post-voyage. Samples from up to 6 depths (15 ml) will be preserved in 0.1% PFA and stored at -20˚C.

Objective 2: Water samples collected in the early morning (0500 CTD cast) will be spiked with 14C-bicarbonate and 3H-leucine and incubated at in situ light and temperature conditions for 1-24 hrs. Rates of 14C and 3H incorporation will be calculated after liquid scintillation counting, allowing for estimates of phytoplankton primary production and bacteria production. Rates of nitrogen fixation will be assessed from on-deck incubation experiments (24 hr) by addition of $^{15}N2$ tracer enriched water. The preparation of $^{15}N2$ –enriched water will entail degassing of 0.2um filtered artificial seawater by application of a vacuum (<= 200 mbar absolute pressure) to continuously stirred seawater for 30 min. The degassed water will be transferred to a septum-capped glass bottle and 1ml $^{15}N2$ (98%) injected per 100 ml seawater. 200 ml of this enriched water will be added to triplicate incubation bottles containing 1.8L natural seawater. A total volume of 48 ml $^{15}N2$ gas will be used. Samples will be filtered, stored frozen and the 15N2 content will be measured using mass spectrometry post-voyage.

Objective 3: Profiling instruments will characterise the underwater hyperspectral light availability, surface water reflectance and rates of photosynthesis using a Ramses hyperspectral radiometer (TRIoS), and Fastrackka II Fast Repetition Rate fluorometer (Chelsea Technologies), respectively. Water samples will be collected from multiple depths and filtered through 0.7 um glass fibre and 0.2 um membrane filters for later analyses of particulate absorption and absorption due to dissolved organic matter. Water samples will also be incubated under manipulated light conditions, with or without nutrient enrichment, to examine optical regulation of carbon fixation.

Objective 4: We will characterise the fine-scale biogeography and population 'pan-genomes' of abundant primary producers. Fine scale biogeography will be conducted on the DNA extracted from samples taken for Objective 1. For population genomics water samples (2 - 120 L) will be collected from CTD casts, concentrated by filtration and preserved in LN2. Distinct populations will be sorted post-voyage for genomics analyses.

Scientific outcomes and relevance to Great Barrier Reef Marine Park management

The proposed research will provide a new understanding of the ecology and biogeochemistry of Australia's northern waters and will answer the following important questions:

- Who are the dominant microbes inhabiting the photic-zone in NE Australian waters?
- What are the key chemical cycling processes that these organisms mediate and how do phylogenetic and physiological shifts influence these processes?
- How do NE Australian marine microbial communities and their biogeochemical function vary in space and time?
- How does light quality and quantity, both of which are affected by human activities, regulate carbon fixation?
- Establish the group-specific contribution to C and P cycling of abundant phytoplankton groups

International Collaboration

The proposed research will involve collaboration with leading international scientists, who will add capacity to oceanographic research in Australia. Dr Claire Mahaffey (University of Liverpool, UK), will provide expertise in the nitrogen fixation techniques, and optical expert Dr Zbigniew Kolber will provide bio-optics expertise and instrumentation that will be employed during the voyage.

Student / ECR training

A major feature of the proposed research involves the excellent opportunities for involvement by students and early career researchers (ECRs). This research will provide a platform for training the next generation of biological oceanographers at several levels. 3 PhD students will participate in this voyage, which will provide them with an opportunity to gain ship-board research experience and collect data for their research projects. Several early career researchers, including 2 post-doctoral researchers and 4 research fellows will also participate in the voyage. The post-doctoral scientists will obtain new experience in running ship-board experiments. While ECR's Brown, Ostrowski and Seymour have substantial experience in ship-board research, they have not yet played leading roles in research voyages. During this transit voyage, these ECR's will gain guidance from the Chief Scientist (Doblin) in voyage planning and leadership roles. This will provide a timely boost to Australia's future oceanographic capacity, with the imminent commissioning of a new major research vessel.

Southern Surveyor Equipment

1. Walk in freezer and minus 80 °C blast freezer
2. Refrigerators
3. Simrad EK500 sounder for biological research (12, 38 and 120 kHz)
4. Simrad EA500 sounder for bottom detection (12 kHz)
5. ADCP set for shallow water profiling (to 700 m) with bins set at 0-20 m, 20-40, 40-60, 60-80, 80-100 etc until 680-700 m.
6. Thermosalinograph and underway fluorometer, pCO2, Masthead PAR measurements
7. Controlled temperature lab/cool room – ambient water temperature at time of voyage
8. Hydrochemistry laboratory
9. Wet lab/CTD room
10. Fish lab – bench closest to back deck to set up for filtration
11. Fish sorting room
12. Flammables cabinet and hazardous materials fume cupboard
13. CTD/Hydro winch (8 mm single core conducting cable)
14. Scintillation counter
15. Radio-isotope lab
16. General purpose depth sensor (Sonardyne)
17. CTD (Seabird SBE 911 plus)
    Rosette (24 bottles up to 10 litres)
    10 L Niskin bottles
    Transmissometer
    Profiling fluorometer
    Light (PAR)
    Dissolved oxygen
    Eco triplet sensor on CTD
18. Underway fluorometer
19. Milli-Q water supply
20. Laboratory freshwater
21. Data processing IT
22. Data processing lab computers, printers, scanners, photocopiers etc.
23. Sea-surface fed on-deck incubator
24. DALEC sensor (IMOS) for measuring above surface reflectance
25. Satellite images sent every 1-2 days so space needed for data transfer

User Equipment

1. Downwelling irradiance sensor on the masthead (CSIRO Land and Water)
2. Bio-optics cage (fully autonomous with power and data logging)
   ac-S: hyperspectral absorption(a) and light attenuation(c) sensor (UTS owned)
3. Hydroscat-6: backscattering instrument – to be confirmed with CSIRO Land and Water
4. Fast-tracker fluorometer (to be attached to the CTD using Niskin bottle connector)
5. Photosynthetron (UTS)
6. Vacuum pumps, peristaltic pumps, filters for chlorophyll, stable isotopes, molecular analyses
7. HPLC filtration unit (UTS)
8. Molecular filtration units (UTS/UNSW/MacU)
9. 47mm filtration units for TSS/POC (UTS)
10. 47mm glass filtration units for DOC (UTS)
11. Liquid Nitrogen dewars, filled
12. Formalin, alcohol, Lugols solution, glutaraldehyde, Paraformaldehyde, Sodium Azide, Phosphoric acid
13. deckboard incubator
14. Heated Magnetic stir plate
15. Dishwasher for filtration kit (plus into tap)
16. Temperature and light loggers for deckboard incubators
17. Water-PAM fluorometer
18. Gear from Bronte Tilbrook to sample DIC and alkalinity

Special Requests

We aim to conduct incubation experiments during the transit. With no weather contingency, we may still require access to deck incubators and labs on arrival into Cairns on the final day of the voyage (Wednesday 24 October).

We have one instrument that needs to be mounted onto the CTD for deployment:

- Fast Repetition Rate Fluorometer that would ideally sit in a Niskin bottle position for easy attachment and detachment. This instrument is self-powered and self-logging.

During the voyage, personnel will need access to the top deck to check on instruments measuring atmospheric properties.

We'd like pCO2 measurements made while underway and would like to request ammonia measurements.

Personnel List

Personnel all have experience at sea (with the possible exception of the postgrad student).

Scientific Staff	Affiliation	Duties (cabin)
1. Dr. Belinda Glasby	MAGNT	Co-Chief Scientist
2. Rachel Przeslawski	GA	
3. Neil Smit	NRETAS-Marine Biodiversity	
4. Elizabeth Dethmers	CDU	
5. Dr. Martina Doblin	UTS	Co-Chief Scientist
6. Dr Justin Seymour	UTS	Supporting Chief Scientist Shift leader A
7. Dr. Mark Brown	UNSW	Supporting Chief Scientist Shift leader B
8. Dr Martin Ostrowski	MacU	Supporting Scientist
9. Ms Charlotte Robinson	UTS	PhD Student
10. Ms Lauren Messer	UTS	PhD Student
11. Lisa Woodward	CMAR	MNF Voyage Manager
12. Peter Hughes	CMAR	MNF Hydrochemistry Support
13. Brett Muir	CMAR	MNF Electronics Support
14. Lindsay Pender	CMAR	MNF Computing Support
15. Rick Smith	CMAR	MNF Swath Support

UTS – University of Technology Sydney; **UNSW** – University of NSW;
MacU – Macquarie University; **MAGNT** – Northern Territory Museum and Art Gallery;
GA – Geosciences Australia; **CDU** – Charles Darwin University;
MNF – Marine National Facility; **CMAR – CSIRO** Marine and Atmospheric Research;

As per AMSA requirements for additional berths on 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.
Lisa Woodward	CBP29388
Lindsay Pender	CBP24212
Brett Muir	CBP24633
Peter Hughes	ACM41312

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

Nutrient sample calculations:

Dissolved NOx, NH4, PO4, Si as well as Total N and Total P

CTD stations (18 x 6 depths) = 108

Incubations (7 x 12 bottles) = 84