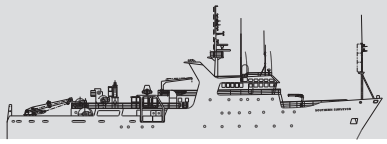

MARINE
NATIONAL FACILITY

2012 program

RV Southern Surveyor

voyageplan
ss2012_t03

Predicting the sources, distribution and fate of floating marine debris

Itinerary

Mobilise Lautoka 0800hrs,
Thursday 07 June, 2012

Depart Lautoka 1000hrs,
Thursday 07 June, 2012

Arrive Hobart 0800hrs,
Sunday17 June, 2012 and demobilise

Principal Investigators

Ms Julia Reisser
CSIRO Marine and Atmospheric Research
and University of Western Australia
Phone: 0423072500 Email: Julia.Reisser@csiro.au

Dr Chris Wilcox
CSIRO Marine and Atmospheric Research

Dr Charitha Pattiaratchi
University of Western Australia (UWA)

Dr Britta Denise Hardesty
CSIRO Ecosystem Sciences

CSIRO

Scientific Objectives

Marine debris has become a major hazard to marine life through ingestion and entanglement and is also leading to aesthetic degradation, economic losses and human health hazards. The increase in amounts of marine debris can be attributed to at least three factors: (1) plastics replaced natural fibers in the manufacture of many everyday items; (2) plastics are often less expensive than the materials they replace, thereby decreasing incentives to reuse or recycle items; (3) there are simply more ships and coastal residents that can lose or discard materials. Monitoring studies are needed to assess the effectiveness of governments' actions in reducing the overall amount of marine debris as well as certain types of debris of particular concern, such as fishing gear and microplastics.

Microplastics are formed as a consequence of the breakdown of larger plastic material or it can be produced for direct use (i.e. resin pellets and synthetic textile fibers). Marine plastics contain toxins such as phthalates, and also concentrate and transport additional toxic chemicals such as persistent organic pollutants through adsorption. Bacteria-like cells living in microplastics have been reported but it remains uncertain whether these microorganisms are digesting the plastic or just breaking it down to smaller pieces.

Marine debris can immediately sink to the seafloor or it can float for extended periods before it is cast ashore or is pushed offshore and kept in regions of convergences. Only limited data exist to quantify and explain the geographical range and content of floating marine debris (FMD) in our oceans. While shore-based studies may provide some first approximation to its composition and abundance in adjacent seas, they nevertheless represent only the fraction of marine debris that has been cast ashore. An understanding of the dynamics of FMD can only be obtained by surveys at sea. Computer models (particle tracking codes and statistical models using tracks of oceanographic buoys) have been used to predict marine debris spatial distribution but the outputs have yet to be validated.

For the first time, FMD will be systematically sampled in oceanic waters close to east coast of Australia. This voyage will provide us the opportunity to collect samples over a broad range of latitudes. These data will be useful to test a hypothesis recently proposed by marine researchers: FMD concentrations tend to be higher at subtropical latitudes. The general aim of this project is to estimate FMD composition and concentration (pieces/km^2) at different locations around Australia (Figure 1).

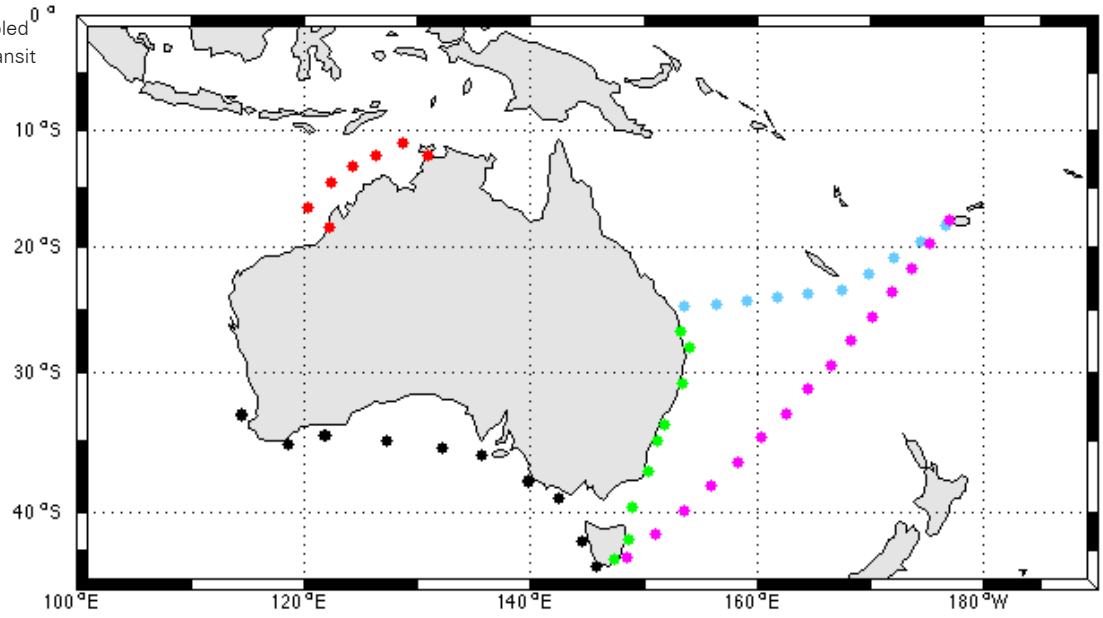

Figure 1: Areas to be sampled during Southern Surveyor Transit Voyages ss2011_t03 (black) ss2012_t01 (green) ss2012_t02 (blue) ss2012_t03 (magenta) ss2012_t06 (red)

The data might provide information with which to identify the sectors and regions that contribute most significantly to the increase in marine debris in Australia, facilitating the government's ability to address this threat via national regulations and international negotiations. Additionally, marine plastic fragments will be characterised by scanning electron microscopy (SEM), which has the ability to resolve the fine structure of the organisms present on the surface of the plastics, and by attenuated total reflectance-Fourier transform infra red spectroscopy (ATR-FTIR), which will allow sample spectra to be obtained to identify plastic types.

Voyage Objectives

1. Identify the types and estimate concentration (pieces/km2) of floating marine debris (FMD) along the ss2012 _ t03 voyage area using trawling and visual surveys.

Trawling surveys: Small FMD will be sampled with a neuston and/or manta net lined with 0.33mm mesh. It will be deployed by 2 people to sample the air-water interface. These tows will be conducted for 15 minutes while the ship is moving at a speed of 2-4knots. Ideally, 3 tows of 15 minutes will be conducted every 100-150 nautical miles. Debris found in each tow (i.e. wood, pieces of plastic) will be counted, measured and classified as to color, material, size and, if possible wear. Encrusting biota also will be noted and recorded. After all these procedures, the material will be stored in 2.5% glutaraldehyde buffered in filtered water for laboratory analysis (SEM and ATR-FTIR). Debris concentration will be computed as the total number of pieces collected divided by the tow area (tow length * net width), and reported in units of pieces/km^2.

Visual surveys: Sighting surveys of 1 hour duration will be conducted from dawn to dusk, four times per day. These surveys don't require any change at the vessel speed or route. During navigation, Reisser and Wilcox will continuously focus on the port or starboard side of the vessel recording position (using a laser rangefinder binocular), type, and size of each item found. We will use general linear models to investigate effects of location, current, proximity to urban areas and shipping lanes, and other potentially influential factors on the density of debris.

2. Estimate mixture layer depth at each net station (Figure 2) from digital conductivity–temperature–depth (CTD) profiles.

CTD profiles: Shallow (300m) CTD down/up cycles will be conducted before each net station (3 15 minutes tows).

Voyage Track

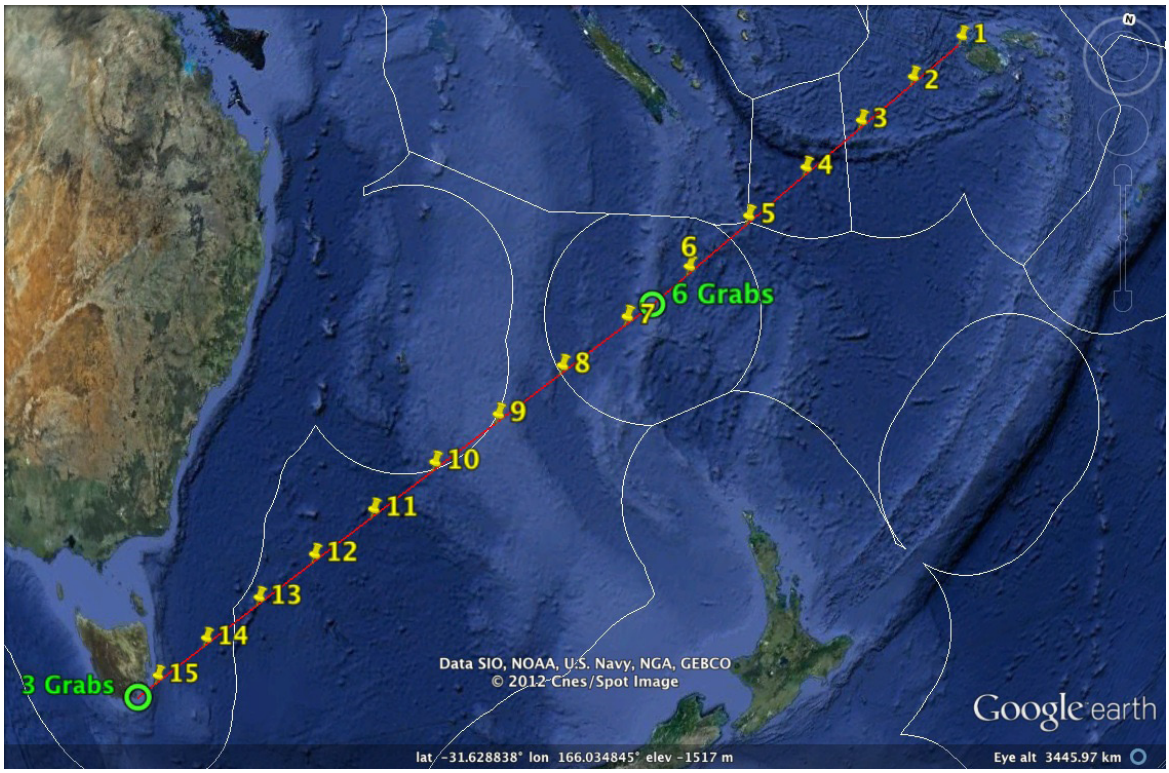

Figure 2: Intended ss2012_t03 voyage track (red line) and location (yellow dots) of the 15 proposed net stations (3 tows of 15min plus 300m CTD profile). The exact latitude and longitude will be determined onboard by Chief Scientist and Master. Green circles are suggested locations for the collection of sediment samples using a Smith-McIntyre grab (PI: Luana Lins).

Time Estimates

Navigation Time: This transit voyage requires around 10 days (~2143 nautical miles at 9 knots) to navigate from Laukota to Hobart if following the track plotted in Figure 2.

SS Marine Debris Time: It requires around 12.5 hours at 2-4knots (15 net stations of 50 min duration) plus ~7.5 hours to conduct 15 300m CTD stations (prior to net trawls).

Benthic Isopods Time: It requires around 4.5 hours to conduct 9 Smith-McIntyre grabs at 500m depth (see details bellow).

Extra Time: Any remaining time available at the end of the voyage will be used for extra net stations.

Piggy-back Projects

Phylogeny and gut flora of benthic isopods

Principal Investigator: Luana Lins (University of Sydney and Australian Museum)

Objectives: Understand the evolution and distribution of deep-sea isopods through morphological and molecular phylogeny.

Methods: 9 sediment samples will be collected using a Smith-McIntyre grab deployed at 500m depth locations. The samples will be washed with seawater and then fixed in ethanol.

Luana's project has impact on transit voyage time. It requires the ship to stop at 3 locations (<500m depth), to deploy the Smith-McIntyre grab 3 times. If performed at 500m, each grab will take approx. 30 min.

Transect Measurements of Greenhouse Gases in the Marine Atmosphere

Principal Investigator: Clare Murphy (University of Wollongong)

Objectives: Clare's project is looking at transect measurements of greenhouse gases in the marine atmosphere.

Methods: The main measurement technique will be a continuous flow gas analyser.

Clare's project has no impact on transit voyage time.

Transect measurements of plankton distribution in surface waters

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

Objectives: Take continuous samples of surface phytoplankton and zooplankton along the chosen transect using CPR.

Methods: A CPR will be towed behind the Southern Surveyor during its transit from Fiji to Hobart. The ship's crew is familiar with the protocol.

This project has no impact on transit voyage time.

Southern Surveyor Equipment

Marine debris study

Winches and hydrographic frame for deployment of nets;
Fish Lab to process samples;
Bridge area with access to vantage points for starboard and port observations;
Safe place to keep alcohol drums and samples (~30 jars);
CTD rosette;
Underway clean water supply;
Underway thermosalinograph.

Benthic isopods study

2 Smith-McIntyre grabs;
Winches and hydrographic frame for deployment of grabs;
Fish lab to process samples;
Seawater and fresh water supply.

Greenhouse gases study

They need to be located in the ventilated fish laboratory to get 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. They require access to the meteorological data collected by the ship after the leg completes, e.g. wind direction, heading, temperature etc.

CPR study

Trawl winch

User Equipment

Marine debris study:

2 15L alcohol drum;
100ml 2.5% glutaraldehyde buffered in filtered seawater;
1 Neuston net (1.2 x 0.6 meters);
1 Manta net (2.2 x 0.47 x 0.73 meters - http://swfsc.noaa.gov/textblock.aspx?Division=FRD&id=1352)
Net cod ends, squirt bottles, stainless steel 300μm sieve, forceps (small and large), latex gloves, glass and plastic jars, datasheets (on waterproof paper), waterproof labels in jars (pre-labelled and inserted into jars prior to trawls), pencils, permanent markers, White trays, 12" square (or equivalent) for sorting debris

Benthic isopods study

1 15L alcohol drum;
200 ml glycerine;
Stainless steel 300μm sieve, forceps, latex gloves, plastic jars and drums (suitable to store dangerous goods).

Greenhouse gases study

Equipment list provided.

CPR study:

CPR and silk cassettes

Special Requests

Marine debris study:

Net deployment preferably outside the ships wake to avoid disrupting the spatial distribution of microplastics.

Benthic isopods study

None

Greenhouse gases study

- gas measurements of the atmosphere: two inlet sample lines (1/4" or 3/8") well above the ocean
- a space of 110 cm (height) x 100 cm x 50 cm
- a bench of about 150 cm x 80 cm for monitor, computers and for working space. an opening to get sampling inlet lines out.
- 'clean' usv power for instruments.
- sea-ocean flux measurements: bench to allow for instrument of dimensions of 200 cm (height) x 50 cm x 50 cm
- ability to pump ocean water in without contact with ambient air.

CPR study:

None

Personnel List – Science

Julia Reisser	CMAR/UWA Facility	Marine debris study
Chris Wilcox	CMAR	Marine debris study
Dagmar Kubistin	UoW	Greenhouse gases study
Luana Lins	USYD	Benthic Isopods Study
Stephen McCullum	CMAR	MNF Voyage Manager
Pamela Brodie	CMAR	MNF Computing support
Brett Muir	CMAR	MNF Electronics Support

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:Personnel List – Ship

Name	AMSA Certificate of Safety Training No.
Stephen McCullum	BB03845
Pamela Brodie	AS02763
Brett Muir	BB07279

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

Julia Reisser

Chief Scientist