

eXXpedition

North Pacific 2018 Science Plan Overview

On each eXXpedition voyage, we collect data and samples through citizen science for partner scientists and organisations all over the world.

This serves two purposes:

- We collect much needed data and samples for scientific studies to help the global community better understand the nature of, and the challenges of, plastic and toxic pollution in our oceans
- Our multidisciplinary crew can experience plastic and toxic pollution first hand through their involvement in the citizen science, and take their experience and learnings back to their own organisations and communities.

On North Pacific 2018, we will collect the following data and samples...

1. Manta Trawl
2. Plankton Trawl
3. Sea Water
4. Air
5. Sediment
6. Observations
7. Body Burden

You can find more information on each type of sampling and the studies they are feeding into below.

1. Manta Trawl

Manta trawl sampling to collect microplastic floating on the surface of the ocean. The collection of microplastic allows us to better understand the distribution of these small fragments, but the ubiquitous nature of these pieces is accepted by the scientific community already. Scientists now need more information on the toxics the plastic is made of, the toxics they attract in the water, and how natural living organisms are interacting with the pieces. In the long-term, this will tell us more about toxics entering the food chain through seafood and the potential impacts on human health.

More details:

A manta trawl is a floating device with a net designed to sit half above and half below the surface of the ocean. On Sea Dragon, our scientific vessel, it is attached by a spinnaker pole. As the boat pulls it along at a steady speed, water travels through the net and debris floating on or very near the surface, including microplastic, is caught in the net. After a set period of time, the trawl is removed from the water and the samples are processed in different ways depending on which study they will be used for. We follow the 5 Gyres protocol for manta trawl use.

North Pacific science using the manta trawl:

- **Collection and recording of macro- and microplastics**

5 Gyres – <https://www.5gyres.org>

Crew scientists will log the macro and microplastics found in trawls using datasheets and photography. Samples will be kept for further analysis or use in outreach events.

- **Identification of species colonising microplastic**

Bonnie Brown, Professor and Interim Chair, Dept. Biology, Virginia Commonwealth University, USA – <http://bonnie-brown-vcuegl.squarespace.com>

Crew scientists will collect samples of microplastic from the trawls, which will be sent to Bonnie for analysis. She is studying microscopic organisms that live on the surface of microplastics in the ocean and will identify them using a type of DNA testing.

- **The impact of plastic pollution on sea turtle environments**

Jennifer Lynch, NOAA Associate and Program Coordinator for the NIST Pacific Islands Program – <https://www.nist.gov/people/jennifer-lynch>

The whole trawl will be collected and frozen for analysis by Jennifer and her team.

They will be particularly focusing on the toxics found on the surface and within plastic fragments.

- **Monitoring for Japanese fish species in North Pacific waters**

Nikolai Maximento, affiliate researcher at International Pacific Research Centre, University of Hawaii

– <http://iprc.soest.hawaii.edu/people/maximenko.html>

Any fish caught incidentally in the trawl will have multiple photographs taken from different angles and at different zoom levels. These photographs and location data will be passed to Nikolai, who has been exploring the movement of debris and fish stocks after the Japanese tsunami. The photographs will be used to identify fish and determine their origin. There is potential that Japanese fish could be found in the pelagic zone and different ecosystem of the gyre.

2. Plankton Trawl

Sampling of surface water microplastic using a Continuous Plankton Recorder (CPR), which is pulled on a line behind the boat in the top 1-3m under the ocean surface. This device is normally used to assess plankton distribution, but due to the mesh size, it also collects microplastic fragments. The data will be used to assess surface microplastic compared to sediment samples.

More details:

The CPR works by filtering microplastic from the water over long distances on continually moving bands of filter silk. When the voyage is complete, the cassette of silk bands is removed and split into 10 nautical mile sections, which are then analysed in a lab.

North Pacific science using the plankton trawl:

- **Measuring Microplastic in the Open Ocean**

The Sir Alister Hardy Foundation for Ocean Science (SAHFOS) and Dr Richard Thompson, University of Plymouth

– <https://www.sahfos.ac.uk/>

The CPR will be towed at between 2 and 6 knots for 1 to 5 miles from our vessel,

Sea Dragon. Samples will be preserved for further examination in an on-shore lab at University of Plymouth.

3. Sea Water

Collection of sea water to either be filtered on board or to be shipped to scientists. Similar to the manta trawl sampling above, sea water sampling allows us to collect microplastics for more detailed analysis in a shore-based lab. However, it has two additional benefits – toxics in the water around microplastics can also be analysed and very specialised analysis and identification of the smallest type of microplastic, nanoplastic, can be controlled in a lab environment.

More details:

Sea water will be collected either using a bucket or a pump, depending on the preference of the scientist involved.

North Pacific science using the collection of sea water:

- **Analysis of subsurface sea water for microplastics**
Peter Ross, Ocean Pollution Research Program Director and Senior Scientist, Vancouver Aquarium – <https://www.vanaqua.org/media/our-experts>
Sea water will be collected using a pump from below the surface of the water and then samples will be put through filters on board by the crew scientists. These filters will be sent to Peter and his team for analysis of the microplastics caught on them.
- **Analysis of sea water for PFAS**
Carrie McDonough, postdoctoral fellow at Colorado School of Mines – <http://carriemcdonough.com>
Sea water will be collected using a bucket, then stored and sent to Carrie for analysis. She is studying the levels of toxics (per/polyfluoroalkyl substances and flame retardants) found in our oceans.
- **Use of optical and scanning electron microscopy to count and characterize 'nano' plastic**
Mario Meier, Particle-Vision – <http://www.particle-vision.ch/en/>
Sea water will be pumped on board using a hand pump, then stored and sent to Mario for analysis, where he will try to use scanning electron microscopy to measure microplastic pollution. This is a method they have previously used to assess air pollution. They are particularly interested in possible microplastics that are from tyre wear.
- **Recording of ash/tephra strands found in the ocean**
Nikolai Maximento, affiliate researcher at International Pacific Research Centre, University of Hawaii – <http://iprc.soest.hawaii.edu/people/maximenko.html>
Sea water samples will be collected from areas where possible volcanic ash is seen in the ocean and the location logged. Some samples will also be dried and pressed once collected from the surface. This ash is thought to have been produced by the recent Kilauea eruption on Big Island. These samples will be analysed by the volcanologists and geophysicists at the University of Hawaii/ Hawaii Pacific University.

4. Air

Air samples are collected and tested for the presence of microplastics in the air that we breathe. Exploring and comparing the microplastics in the air of the gyre, miles from land, with air sampling in coastal regions helps scientists to understand the nature and distribution of the microplastic humans are taking into our bodies.

More details:

A bucket will be left out at head height on deck to collect air samples, then water will be used to capture any microplastic samples in the air in the bucket.

North Pacific science using the collection of air:

- **Measuring potential airborne microplastics**

Stephanie Wright, Research associate at King's College, London –

[https://kclpure.kcl.ac.uk/portal/en/persons/stephanie-wright\(06e7b1c7-2725-4437-96bf-dabc12b00e1b\).html](https://kclpure.kcl.ac.uk/portal/en/persons/stephanie-wright(06e7b1c7-2725-4437-96bf-dabc12b00e1b).html)

Samples will be collected once every 24 hours. The plastic will be counted and identified using FT-IR Raman spectroscopy. This study will provide information about airborne microplastic in areas where people are working along the coast of Canada.

5. Sediment

Collect of sediment in harbours and along the coastline in Canada to test for the presence of microplastic. It is difficult to trace microplastic to its source, because we don't know how quickly each type of plastic degrades or exactly how it travels in the oceans. By testing sediment, scientists hope to identify 'hot spots' of microplastic which can then, in the long-term, be tied to sources.

More details:

Sediment will be collected using a hand-operated grab lowered to the sea bed.

North Pacific science using the collection of sediment:

- **Analysis of sub-tidal sediments for microplastics**

Richard Thompson, professor of Biological and Marine Sciences at University of Plymouth – <https://www.plymouth.ac.uk/staff/richard-thompson>

Jars of sediment will be collected from set locations along the Canadian coastline or in harbours. This will be sent to Richard and his team for analysis for the presence, quantity and type of microplastics in each sediment sample in their lab at Plymouth University.

6. Observations

The most accessible form of citizen science, visual observations will be undertaken to access plastic pollution, wildlife and plankton. Although technology is developing quickly, there is still no truly effective large-scale alternative to human visual records of plastic debris and wildlife. Due to the nature of expeditions (expense, time and logistics) and the vastness of our oceans, there is huge value in all data of this type and it is shared real-time (if possible) and widely available for researchers all over the world.

More details:

Observations will be recorded using apps or datasheets.

North Pacific science using observations:

- **Marine Debris Tracker (MDT) for floating macro-debris and shoreline debris**

Jenna Jambeck, associate professor at the College of Engineering, University of Georgia and Co-Founder of the Marine Debris Tracker

– <http://www.marinedebris.engr.uga.edu/>

Any marine debris observed during the voyage from the boat or on beaches will be inputted into the Marine Debris Tracker app, which then adds to a global database of ocean plastic. The MDT data is then available for anyone to view and utilise.

- **Trans Pacific Marine Debris Survey for macro-plastic observations**

James Callahan, founder of Trans Pacific Marine Debris Survey

– <https://www.marinedebrissurvey.com/about.html>

Any macro-plastic marine debris observed during the voyage from the boat will be recorded on Trans Pacific Marine Debris Survey datasheets. These datasheets will then be returned to James at the end of the voyage. The data collected and the datasheets will then be available for anyone to view and utilise.

- **Macro debris identification and attachment of Universal Tracker**

Nikolai Maximento, affiliate researcher at International Pacific Research Centre, University of Hawaii

– <http://iprc.soest.hawaii.edu/people/maximenko.html>

The eXXpedition crew have been provided with a Universal Tracker for Debris Tracking, which will be attached to debris found during the voyage that is “bigger than a lunch table”, ie 80 cm x 150 cm.

This is part of a multi-institutional project, funded by NASA and including the University of Hawaii, Scripps Institution of Oceanography, Applied Physics Laboratory of the University of Washington, Smithsonian Institution and Canada Department of Fisheries and Oceans. The project is to study changes in the pelagic ecosystem induced by the growing amounts of man-made debris floating in the ocean. This debris provides a new, long-living substrate that creates a sustained “floating” ecosystem in the otherwise low-nutrients environment. The project includes tracking real debris, deployment of a set of Lagrangian instruments, and collection of biological samples. Observations will allow to improve drift models of various types of debris, from fishing nets to microplastics. Satellite trackers tagging large floating items will enable removal of these debris from the ocean and detailed sampling of biota colonizing these items.

The tracker deployed by the eXXpedition team on 4th July 2018, was the first deployment of 40 trackers, built by Pacific Gyre and owned by the Ocean Voyages Institute.

- **Recording of wildlife sightings using the BC Cetacean Sightings Network**

Jessica Torode / Soraya Abdel-Hadi

– <http://wildwhales.org>

Any wildlife sightings, particularly of whales and dolphins but also including other interesting observations, will be recorded in a BC Cetacean Sighting Network logbook. The data will then be sent back to the the Network and be added to their wider dataset on wildlife, which informs researchers on population levels and helps to identify areas in need of protection.

- **Secchi Disk to map the Oceans’ Phytoplankton**

Imogen Napper, PhD student at the University of Plymouth

– <http://www.secchidisk.org/>

A homemade device called a Secchi disk is lowered into the ocean from the side of the boat. The depth at which it disappears is the Secchi depth and this distance is recorded in the Secchi app. This information then adds to a dataset which helps scientists understand the ocean’s phytoplankton.

7. Body Burden

A lot of our sampling feeds into studies relating to the impact of toxics on our bodies, such as identification of the toxics carried on plastic. The most direct example of this is a study assessing mercury levels in our crew, which is a tangible link between the ocean as a food source and toxic transfer into our bodies.

More details:

Hair samples are taken from eXXpedition crew members to then be tested for mercury levels.

North Pacific science looking directly at body burden:

- **Oksana Lane**, Biodiversity Research Institute, Portland, ME USA
– <http://www.briloon.org/about-us/bri-staff/science-directors/oksana-lane-m-s>
Hair samples will be collected from crew members who eat fish or use skin lightening products to test each individual's exposure to mercury. Oksana will also use these results in her general analysis of trends in mercury contamination.

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