



Nurdle Soup?

Preliminary investigation of 'nurdles' in Port Phillip Bay October 2013

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Introduction

This report was prompted in December 2012 by the discovery of nurdles by Jess Jeyasingham (MacRobertson Girls High School) in an audit of a Middle Park beach clean-up. Since then, work experience students and volunteers at Port Phillip EcoCentre have pioneered a new study of the presence of nurdles in Port Phillip Bay.

Nurdles are small plastic pellets used to make a wide range of plastic items.

While some have been found on local beaches in the past, there has been no systematic study to measure how many are entering the Bay, or from where they came. As they are very small (2-3 mm wide) and light weight, they are easily transported by wind and water and are found in oceans and streams around the world.

They are oil-based, so absorb other oil-based, toxic pollutants in waterways. Like other plastic debris they are ingested by wildlife such as fish, birds and mammals. Apart from plastic being indigestible, the toxins cause illness. Impacts on the whole food chain are not yet known.

This investigation involves two survey methods:

- Close inspection and data collection at survey sites on foreshores;
- Boat trawls to capture plastics floating in the Bay and major streams flowing into it.

Floating plastics are caught in a manta-net (as was used to measure the quantity of micro-plastics in the North Pacific Ocean, aka the North Pacific Garbage Patch). The limited number of boat trawls conducted so far found nurdles in the Yarra and Maribyrnong Rivers, but not in the Bay. However, foreshore surveys have recorded nurdles at many sites from Sorrento to Altona.



Kayes Drain, Altona, May 2013



Karen Maillard (John Monash Science School) counting nurdles found in Kayes Drain Altona.

Most nurdles in the Bay have probably escaped to the stormwater system after spills on loading bays in industrial areas. As they float in the upper water column, once in the Bay they are likely to be pushed onto foreshores by waves, depending on the prevailing winds. Like cigarette butts and many other plastic fragments, nurdles are too small to be caught by litter traps.

About 95% of litter in Port Phillip Bay comes from the stormwater drains across metropolitan Melbourne. Litter is washed from streets into stormwater drains, to creeks and rivers, and eventually to Port Phillip Bay. Approximately 4,600,000 of the items that enter Melbourne waterways are floatable.



Thousands of nurdles from Kayes Drain, Altona

Nurdle survey study methods

The nurdles discovered in December 2012 created the incentive to further investigate from where they came, and how common they are in Port Phillip Bay. Since then, nurdle data have been collected from different locations along the eastern foreshores of the Bay.

Two survey methods have been used:

- *Shoreline surveys: collecting nurdles by hand;*
- *Waterways surveys: trawling surface waters of rivers and the bay with a boat and manta-net;*



The manta-net skims plastics from upper water column

The first land-based survey locations (sampled from 27/4/13 to 29/4/13) were on the banks of the Maribyrnong River, Merri Creek, Kayes Drain and Laverton Creek. An estimated 2.5 kg of nurdles was found in a waterway in Altona. This find sparked more searches along the bay and St Kilda Pier. The survey site at St Kilda Pier was selected directly south-east of the Yarra mouth. Plastics flushed from the Yarra during thunderstorms are pushed towards St Kilda by north-westerly winds.



Nurdles in the high tideline at St Kilda West Beach



Phillip, Yoshi and Yaan-Kit pioneered nurdle hunting methods next to St Kilda Pier

Our preliminary surveys have found nurdles are not evenly spread across beaches. Although some areas searched showed high numbers of nurdles, other sections of the same beach may have none. This variability could be due to wave patterns (driven by wind strength and direction) and tidal movements.

Reaching clear conclusions on the level of plastic pollution in Port Phillip bay will require surveys over several years across all seasons. A combination of manta-net trawls in the Maribyrnong and Yarra Rivers and foreshore nurdle hand collection surveys is the most effective way to gather data and measure the extent of the problem.

On several occasions, we've found too many nurdles to possibly collect before sundown! To achieve a reasonably accurate estimate of their numbers, we recorded the number of collectors, the total time spent collecting, an estimate of the total area covered by nurdles, and the percentage of the total area that was actually collected from.



Nurdles found on St Kilda West Beach

Shoreline survey data

Date	Location	Nurdles	Search area (m ²) or Time (min)	Map
27/04/13	Merri Creek, Just upstream of Heidelberg Rd	53	3m strandline	1
28/04/13	Pt Ormond	8	2m strandline	2
29/04/13	Sandridge Beach	5	1m ² quadrat	3
5/05/13	Williamstown Rifle Range Wetlands	15	20m strandline	4
5/05/13	Jawbone Sanctuary East Shore	23	10m strandline	5
5/05/13	Kayes Drain, east of Burns Road Altona	416	0.4m ² quadrat	6
5/05/13	Altona Waterway Drain	est 104,000	14m ² quadrat	7
12/05/13	Laverton Creek mouth (Altona)	27	5m strandline	8
12/05/13	Laverton Crk Altona, 30m downstream of Queens St	6	2m strandline	
12/05/13	St Kilda Pier entry (Nth Side)	21	1m ² quadrat	9
29/05/13	St Kilda Pier (surface survey sieved)	281	1m ² quadrat	
31/05/13	St Kilda Pier (surface survey sieved)	50	1m ² quadrat	
31/05/13	St Kilda Pier (surface survey sieved)	217	1m ² quadrat	
1/06/13	Kananook Crk (Boat Ramp)	51	6m ² quadrat	10
1/06/13	Mornington Harbour Boat Ramp	283	6m ² quadrat	11
1/06/13	St Kilda Pier (surface survey sieved)	67	1m ² quadrat	
15/6/13	Sorrento beach	12	6m strandline	12
18/06/13	St Kilda Pier	488	2m ² quadrat	
13/08/13	St Kilda Pier	359	45 minutes	
15/08/13	St Kilda Pier	396	60 minutes	
20/08/13	St Kilda West Beach	610	30 minutes	
20/08/13	St Kilda Pier	276	30 minutes	
26/08/13	St Kilda West Beach	856	30 minutes	
29/08/13	Kerferd Pier (Albert Park)	57	30 minutes	
29/08/13	Lagoon Pier (Port Melbourne)	96	30 minutes	
03/09/13	St Kilda Pier	157	30 minutes	
03/09/13	St Kilda Pier (East side)	252	30 minutes	
03/09/13	St Kilda Pier	191	30 minutes	
03/09/13	St Kilda Pier (East side)	155	30 minutes	
19/09/13	St Kilda Pier	34	30 minutes	
19/09/13	St Kilda West Beach	323	30 minutes	
19/09/13	St Kilda West Beach	121	30 minutes	
19/08/13	St Kilda West Beach	153	30 minutes	
19/08/13	St Kilda Pier	98	30 minutes	
15/10/13	St Kilda West Beach	1,012	20 minutes	

Preliminary survey sites on eastern Port Phillip Bay coasts



Figure 1: Map of nurdle survey locations surveyed prior to October 2013

At this stage, there have been no searches on western Bay foreshores (including Corio Bay); and practically all sites south of St Kilda have only been surveyed once. The fact that nurdles have been found at Sorrento (12) suggests that at least some nurdles may escape to Bass Strait. Increased search effort in the south-east and west of the Bay will enable conclusions as to where nurdle hotspots may exist in the Bay, and from where they came.

Environment Protection Authority modelling: The Victorian EPA has conducted computer modelling to track the likely fate of 'virtual nurdles' entering the Bay on the front of the Yarra flood plume in early November 2010. The model incorporated catchment inflows, and the interactions of rainfall, evaporation, air pressure, wind, tides, air and sea temperature recorded between July 2009 and June 2011. The 'virtual nurdles' were allowed to circulate around the 'virtual Bay' for 8 months.

*Where nurdles have been found,
and where they are likely to be found....*

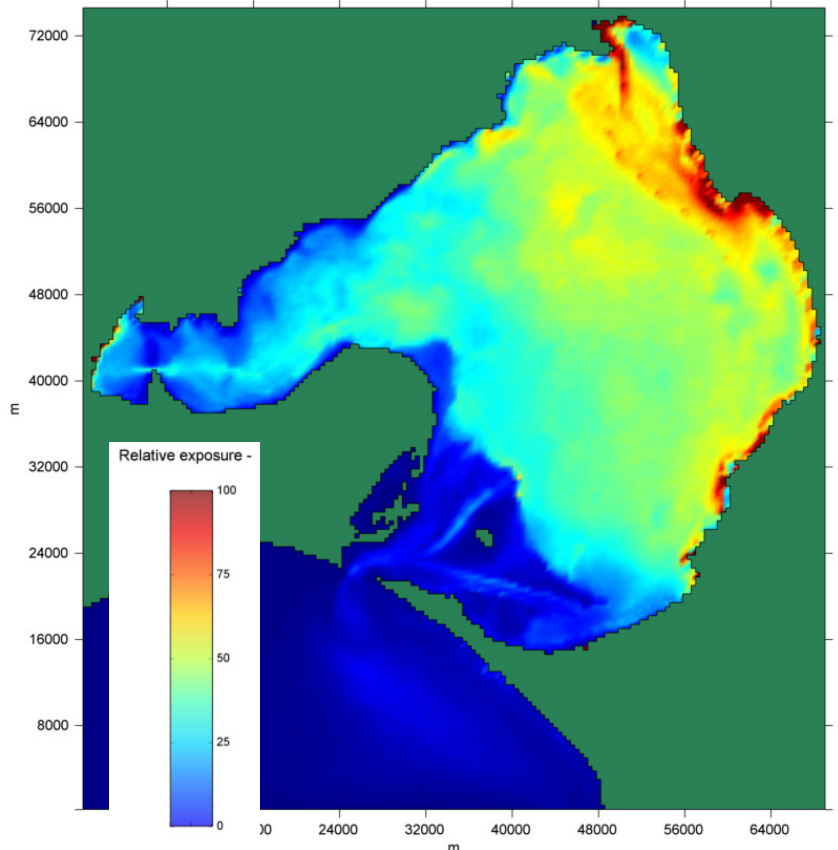


Figure 2: EPA model shows the % relative exposure of different areas of the Bay to nurdles, and highlights where they typically accumulate

At the end of the eight month period the accumulated number of visits of any released nurdles in each (400 x 400m) model cell was counted and calculated into a *percentage of relative exposure* for each cell.

In figure 2 (above) the darker red colour indicates a higher relative likelihood of nurdle visits to that area; and the darker blue indicates fewer nurdles. According to the model, most nurdles can be found along eastern foreshores of the Bay, with highest accumulations behind headlands, as is the case south of Ricketts Point, Mornington and east of Williamstown.

The computer model result is an indicator of nurdle movements for the modelled period (Nov 2010-June 2011), noting that specific wind patterns during other periods may cause different results. Assessment of winds for the period of study are also needed to confirm the potential location of nurdle accumulation to support and optimise on-ground surveys.

Measuring plastic pollution in waterways

Nurdles and other plastic objects and pieces in waterways are measured by trawling a manta-net with a 0.3 mm mesh size (as used to measure plastic pollution in the North Pacific Garbage Patch).

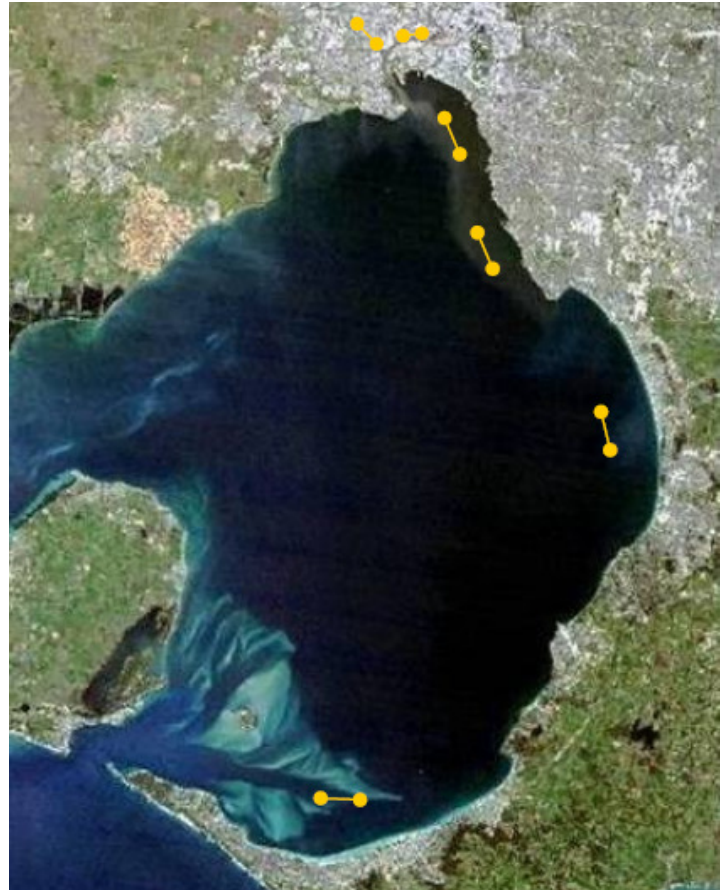
Manta net trawls were conducted in June 2013 with the 'Karingal' (motor launch) moored in Mordialloc and the 'Polperro' (dolphin swim tour boat based in Sorrento). The initial trawls recorded very few plastic items in the Bay. Trawls in the Maribyrnong River and Yarra River collected nurdles and other plastic objects. As the trawls were done when there had been no rain for a week the results can be considered to be background levels, which would likely increase after rain.

TRAWL METHOD

The net was towed outside of the boat's wake zone as turbulence within the wake prevents a representative surface sample from being collected. A spinnaker pole was used to deploy the trawl away from the side of the boat. The performance of the net was observed and the tow line adjusted where needed to sample the surface properly. Samples were poured into jars and labelled with the sample number and latitude and longitude at the start and end of the trawl.

TRAWL SPEED/DIRECTION – A steady linear course was maintained at 2-3 knots. Higher speeds would reduce the ability of the net to sieve seawater, creating a bow wake in front of the trawl.

Care was taken not to fill the net with air, as this results in the net aperture being above water, which makes volume measurements inaccurate.



Locations of preliminary manta-net trawls in 2013

TRAWL LOCATIONS AND DURATION – A total of six trawls were undertaken, one of which was in the Yarra River, one in the Maribyrnong River and four in the Bay. The duration of the trawls was approximately one hour per trawl, to avoid overfilling the cod end with debris.

TRAWL RESULTS — Counting the plastics in the samples was done out of the wind on a flat table, with tweezers and a magnifying glass. A negligible amount of plastic was found in the Bay trawls.

The river trawls yielded the following results:

Plastic type	Yarra	Maribyrnong
Nurdles	23	107
User plastic fragments	30	46
Polystyrene beads/pieces	78	6
Cigarette butts	4	8
Cellophane pieces	2	23
Straws	0	2
Total	137	191

Ongoing trawls of the Yarra and Maribyrnong Rivers will allow us to measure metropolitan Melbourne's progress in reducing plastic pollution at the source.



Neil Blake (Port Phillip Baykeeper), Ian Penrose (Yarra Riverkeeper) & Rod Ingham (Riverkeeper Projects Officer)

Discussion and Conclusion

As plastics float at the surface they travel widely and degrade habitats in creeks, rivers, bays and oceans. They transport chemical pollutants, threaten marine life, and interfere with human use of marine and coastal environments. Ingestion of plastic debris by seabirds, fish and other wild-life species has been widely documented; problems associated with the ingestion of plastic vary from development of internal injury, to starvation.

As plastic pollution persists in the environment for many years it has enormous potential to impact wildlife and people. The potential for harmful plastic-derived chemicals getting into the human food chain is great. **Monitoring plastics in and around the Bay will help to make a case to improve industrial practices and human behaviour at the source of the issue.**

Regularly using the same search methods at the same location over a few months will enable the average number of nurdles to be calculated for that area. If more survey sites around the Bay are regularly monitored the data collected will show where hotspots are. Rainfall, wind direction and tidal movements in the 24 hours prior to the survey are clues as to the source of the nurdles. Repeated searches of the same location will provide data necessary to prove this is an ongoing problem for marine organisms in Port Phillip Bay. Individual people, schools, or community groups can all help to create a solution to this problem. Enjoy a day on the beach and help improve wild-life habitat both locally and globally. Just a few hours of your time will contribute to strategies to reduce plastic pollution in our waterways.

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Websites:

- <http://www.bay-keeper.com/>
- <http://5gyres.org/>
- <http://www.pelletwatch.org/>
- <http://nurdle.org/plastic-resin-pellet-research/>
- <http://www.tangaroablue.org/amdi/campaigns/59-pellet-alert-project/205-finding-plastic-resin-pellets.html>
- <http://www.plasticizedthemovie.com/>
- <http://www.jenniferlavers.org/>
- <http://www.take3.org.au/>
- <http://www.twohandsproject.org/>

How you can help make a difference

Tracking nurdles abundance and the distribution in and around the bay requires extensive data collection. To maximise community involvement, the sampling method and equipment required have been simplified.

Individual people or groups can easily conduct surveys by going to their local foreshore and collecting nurdles by hand for 30 minutes along the latest tideline (the line of debris that has washed up on the beach with the last high tide).

For research purposes, it is important to record the date, the survey site and at what time of day the sampling has been done. Ideally the same survey site will be sampled once a month throughout the year.



Community volunteers collecting from the high tideline

Materials needed: Watch/phone/stopwatch with timer. Jar for nurdle collection. Gloves/handwash. Pen and paper.

Nurdle Collection: Determine where most of the nurdles are located. If you are not sure where the nurdles are, then the tideline is usually your best bet. Remember, finding no nurdles at all also counts as a result!

Set your timer to the amount of minutes you are going to collect nurdles. It is best to break up time over 30 minutes into smaller portions so you can get up, stretch and walk around.

Example: instead of 60 minutes, collect 2 x 30 minutes, or 3 x 20 minutes).

Collect as many nurdles as you can in a set amount of time at a particular location. Collect with as few distractions as possible, until the time is up.



If you are collecting at several different locations, make sure you use a different collection vessel for each location. Write the location on a piece of paper and put this in the jar so you know which nurdles were collected at which location.

Recording your findings: Record the following details per collection location:

- **Location name:** E.g. West Beach, St Kilda

- **Location coordinates:** To find the coordinates, go to Google Maps or Google Earth and pinpoint the location of your survey site accurately as you can. Record the coordinates (e.g. -37.858668, 144.967617). If you are in a group, try to collect in approximately the same spot.

How to get the coordinates: Go to Google Maps and put in your collection *location* (e.g. West Beach, St Kilda). Click “satellite view” in the top right corner. Zoom in as much as you need to and right click on your collection *spot*. Choose “What’s here?” An arrow will appear on your spot. Read the coordinates from the search bar.

- **Total time spent on collection:** If you have searched 2 x 30 minutes in one particular spot, count all of these nurdles as one 60 minute collection. If more than one person collected nurdles in that particular location, record the number of people who collected and how long they each searched for (e.g. 3 people, 30 minutes each, at West Beach, St Kilda)

- **Total number of nurdles:** Count all the nurdles you have found in a single search location. Nurdle counting is best done inside and out of the wind.

Report your findings: www.bay-keeper.com