T R A N S C R I P T

STANDING COMMITTEE ON THE ENVIRONMENT AND PLANNING

Inquiry into the Environment Protection Amendment (Banning Plastic Bags, Packaging and Microbeads) Bill 2016

Melbourne — 1 December 2016

Members

Mr David Davis — Chair
Ms Harriet Shing — Deputy Chair
Ms Melina Bath
Mr Richard Dalla-Riva
Ms Samantha Dunn
Mr Khalil Eideh
Mr Cesar Melhem
Mr Daniel Young

Participating Members

Mr Greg Barber
Mr Jeff Bourman
Ms Colleen Hartland
Mr James Purcell
Mr Simon Ramsay

Staff

Secretary: Mr Michael Baker

Witness

Associate Professor Mark Osborn (affirmed), Associate Dean, Biosciences and Food Technology, RMIT University.

The DEPUTY CHAIR — Thank you very much, Associate Professor Osborn. My apologies for the fact that we have gone over time with the previous witnesses. There is a lot to get through in this inquiry into the Environment Protection Amendment (Banning Plastic Bags, Packaging and Microbeads) Bill 2016, and we are grateful for your patience. Just to advise you all evidence provided at this hearing is protected by parliamentary privilege. Therefore you are protected against any action arising from whatever you say here today, but if you do go outside and repeat the same things, those comments may not be protected by the same privilege.

Without further ado, I invite you to provide an overview of your position, information and data which is relevant to this inquiry of perhaps 10 minutes, whereupon we can then head into the question and answer stage of the committee hearing. During the course of the hearing we might also ask you to take some things on notice and/or to provide further information to the committee at a later date. If that does happen, the secretariat will be in touch with you to assist you with that process. So over to you for, say, 5 or 10 minutes, and then we can get into questions

Assoc. Prof. OSBORN — Firstly, thank you very much for the opportunity to come and attend the hearing today. I really appreciate this chance to talk about plastic pollution. I am an associate professor at RMIT University. I am an environmental microbiologist and also an environmental scientist with an interest in how pollution impacts upon our environment, in particular the role of microorganisms in mitigating some of that pollution. As part of some of our research we are particularly interested in the impacts of plastic pollution within aquatic environments, both marine and freshwater. I have given you some slides today, which are a presentation of what I would briefly like to cover. They also relate to the earlier submission I made.

Very briefly, I do not know if you are familiar with the book *Silent Spring* by Rachel Carson.

The DEPUTY CHAIR — One of the first books I read as a young adult was in fact that book.

Assoc. Prof. OSBORN — Oh, marvellous. As you are aware, this has inspired and contributed towards driving very much human society's response in relation to pollutants. But I think it is significant that the Stockholm convention, which was introducing legislation to globally try and introduce bans towards a number of pollutants, was not introduced until 2004, many, many years after the original book was published. I think this is apposite in relation to plastic pollution, because we are talking about a body of evidence which is emerging, and there are clearly debates within the society about whether plastic pollution is going to be a problem for the environment. But I just highlight the fact that we need to actually consider that there are long lead-in times in relation to action being taken.

There are a number of POPs which are important. I am going to come back to some of these, in particular in relation to polybrominated diphenyl ethers, which are brominated flame retardants which are important and probably have the potential of bioaccumulation once they are absorbed onto plastics. But I also highlight on slide 3 that plastic is not actually legislated as a pollutant. Nevertheless, the United Nations environment program are identifying it as a global environmental threat. There have been moves by scientists around the world, mostly in that paper in *Nature*, to recommend the classification of plastic pollution as a hazardous substance.

I would also highlight that the International Maritime Organisation have also banned the disposal of plastic at sea, yet we of course continue to dispose of and discard our plastic on land, which ultimately of course is getting out into our marine environments. So although plastic is not yet recognised formally as a pollutant, there are moves at many, many levels to actually make those changes occur.

I am sure you have been hearing of a number of images today and seeing images of the distress which is caused to animals, so I am not going to say more in relation to that. Slide 4 obviously relates to both ingestion and also entanglement as major problems. But I do want to provide a little evidence about the amount of plastic which is just present within our oceanic surface waters, and that is in slide 5 now — 5 trillion plastic pieces, 250 000 tonnes, and more recent estimates suggesting it is as high as 15 trillion pieces of plastic globally across our surface water oceans. These are just the top few metres.

I would also highlight in this figure where you are seeing a heat map that the high abundance of red relates particularly to plastics, which are extremely small, so microplastics — those pieces of plastics which are less than 5 millimetres in size — which of course are resulting from the fragmentation of things like plastic bags and larger plastic by a physical process, partly by chemical processes. People kind of assume that plastic is gone

when it is out of sight and you can no longer see and find plastic bags, but what is happening is that these particles are getting shredded, and actually as a consequence of that they are then more bioavailable to more organisms because they are smaller.

There are estimates in relation to the year-on-year accumulation of plastics — so this is going to be on slide 6 — which are now both present within our marine systems and also accumulating year on year in our marine systems. You may have heard evidence suggesting that by 2050 we will have more pieces of plastic in the sea than we will have fish. These are just shocking figures.

As I have highlighted in slide 7, a lot of plastics that we are dealing with are microplastics. The particular bill you are looking at here is related to microbeads, which are a subset of microplastics. Microplastics can be classified as anything which is less than 5 millimetres across. I am just showing plastic production pellets which are used, and of course these production pellets here were all harvested off Sandwich Beach. You can see the size of them. Microbeads again are a bigger problem, and I will turn to those in a while.

Within the Australian context a study from Julia Reisser at the University of Western Australia and CSIRO conducted a circumnavigation of Australia identifying surface seawater concentrations of plastics, and this is slide 8. You will notice that there are high concentrations in Sydney, Brisbane and Hobart. There is no data available for Melbourne and Port Phillip, partly because the cruise did not come into the bay, so there was a data gap in relation to that. I have alluded to the fact that Port Phillip is an interesting ecosystem in that we have a very slow turnover of water with the Tasman Sea. Typically water is retained for 270 to 300 days, meaning the plastic which is coming from our land into Port Phillip will stay there for a long time.

Onto slide 9, I am showing you this just to give you some indication of the sorts of plastic that we are seeing day in, day out in the Yarra River. This is one day's litter catch in one of the plastic litter traps on the Yarra River and parts of Victoria. But more broadly we should not just think about plastic floating on the water; we should think about plastic also being deposited down into the sediments, and it will depend upon the particular plastic polymer type as to the fate of that plastic. So things like polyethylene, plastic bags, will float. Polyethylene terephthalate, the drinking water bottles that we are very familiar with, once those are no longer floating — in other words, once you have no cap on them — they are then more prone to sink as soon as you get them broken down and actually fragmented from the bottle shapes. They are then settling into our sediments and then affecting our sedimentary systems as opposed to our pelagic system.

The DEPUTY CHAIR — Do they continue to break down into ever smaller pieces along the lines of microplastic over time, or do they stay in larger pieces?

Assoc. Prof. OSBORN — To give you a flavour of this, we have been doing some work along the Yarra River. I have not shown any of this data, but we have been looking at persistence or the age of plastic bottles which are present in the Yarra River on the basis of the dates which are written on the bottles. Of course we see highest numbers of dates for plastic bottles from 2018, 2017 and 2016, but we are still finding bottles in the surface water which go back to 2008 and 2007. After a while, of course, these dates will rub off, so there are a number of things which we cannot date. So, yes, some of them are going to remain floating and they will be trapped in the vegetation, for example, along rivers and out into our coastline, but also in addition some of that plastic is going to fragment and it is going to be getting down to our sediments.

Onto the impacts of plastic, I have already shown you some pretty horrific images in relation to entanglement and also ingestion. This is work on slide 11 from one of our collaborators, Jennifer Lavers at the University of Tasmania. This is a single freshwater shearwater with over 270 pieces of plastic in their gut. Obviously this poor bird has died. Work from the CSIRO, in particular from Denise Hardesty and Chris Wilcox published in 2015, has suggested that by 2050, 99 per cent of marine bird species will have been subjected to ingestion of plastic. That does not mean 99 per cent of birds will have plastic in them, although anecdotally when we look at the shearwater population, for example, we are finding 60 per cent or 70 per cent of the population on Lord Howe Island are carrying plastic ingested within them. So this is only going to get worse over the coming years, and of course the more plastic you put out there, the more it is ingested.

An intriguing recent paper has suggested that one of the reasons that birds are mistaking plastic for food is due to the colonisation of those plastics by microorganisms, in particular algae, and the smell associated with those is then making them more likely to be predated upon by those birds. I will not talk much about microbiology today; I think there are more powerful consequences in relation to chemistry, which I will come to on slide 12.

Whilst the threat of plastic entanglement and ingestion we can more readily see, there is a more horrific and probably more dangerous threat of plastic which is associated with the accumulation of the system to organic pollutants onto the surface of the plastic. That is partly onto the surface of the plastic itself by direct binding of those chemicals onto the plastic surface, but also with the consequence of microorganisms forming sticky biofilms, which particularly in relation to metals can then cause accumulation of those heavy metals onto the microorganisms, which are attached to the plastic. They are then passed through into the gut of organisms. You can then get release of that within the gut and then transporting of those metals back out into whichever poor, unfortunate organism has actually accumulated them.

The DEPUTY CHAIR — I will just ask you a question on that if I may. What is it about the qualities of plastic that make it into a substance that attracts these substances in the way that it does?

Assoc. Prof. OSBORN — What we are looking at is interactions with hydrophobic chemicals in many, many cases. So what we are looking at is plastic itself — two types. We are looking at those types of plastic which are derived from petroleum hydrocarbons, which are based on carbon with hydrogen, sometimes also with whatever compounds are within them. But those themselves are then causing the binding of organic pollutants onto them.

In addition we have also got plastic compounds which are actually inserted into the backbone of the plastic, things like phthalates, for example, in PET drinking water bottles, which can, when those plastics are then broken down and partly oxidised by chemical reactions, then be released out into their systems. Then, as I say, we have the capacity for microorganisms to attach onto those.

We are now looking at compounds — for example, sticky sugars. If you spill a sticky sugar drink, for example, you know it is sticky. In the same way, those microorganisms which form a sticky biofilm can then provide a mechanism for pollutants to absorb into the biofilm matrix.

The DEPUTY CHAIR — Just another follow-on question — I am sorry, but this is really apposite to the issues we are dealing with — the nature of plastics and the way that they behave to attract certain things, whether these chemicals here in slide 12 or that sticky biofilm that you referred to, does that occur with any other organic or inorganic substance in our marine environments?

Assoc. Prof. OSBORN — Certainly, yes, we will get binding of pollutants onto, for example, sediment particles. So sediment particles, for example, will bind metals. They will also bind organic compounds. But the problem is that the sediment particles, unless you have a filter feeder within the sediments, are not readily being ingested by other organisms.

The DEPUTY CHAIR — So it is the size of the plastic particles — —

Ms DUNN — Or where it sits.

Assoc. Prof. OSBORN — It is a combination of both.

The DEPUTY CHAIR — Sorry, I interrupted you, but thank you; that was very useful.

Assoc. Prof. OSBORN — The other issue in relation to bioplastics is that bioplastics are very often posited as a safe alternative because they are perceived to degrade. Those bioplastics are perceived to degrade or will degrade in the systems in which they have been designed to degrade. So if you are looking at bioplastics which are then making their way into a controlled composting system for which they have been designed to degrade, yes, they are going to disappear.

We have been running some experiments in the Yarra River, where we have been putting out plastic coffee lids made from bioplastics. We have also been putting out polypropylene discs into the Yarra River.

The DEPUTY CHAIR — I am just going to put my hand over here.

Assoc. Prof. OSBORN — I am looking at it, I am afraid. I cannot — —

The DEPUTY CHAIR — It is all right, you can acknowledge it. Everybody else has.

Mr DALLA-RIVA — I have hidden mine.

The DEPUTY CHAIR — If anybody wants me, I will be downstairs flogging myself with a whip for 4 hours after today's hearing has finished.

Assoc. Prof. OSBORN — But in the experiments which we have been running when there are both the bioplastics and also more conventional polypropylene takeaway containers are going out into the Yarra River, we are seeing that those compounds are as strong nine months after we put them in as on the day on which we put them in. There is no evidence of degradation at all. And if you think about it from a perspective — —

Mr DALLA-RIVA interjected.

Assoc. Prof. OSBORN — Hopefully they are being recycled, but I encourage you — —

The DEPUTY CHAIR — They are being recycled. Even then, based on nine months, that is significant.

Ms DUNN — One can only hope they stay in the waste stream and not get out of the waste stream.

The DEPUTY CHAIR — So what happens in an industrial composting situation? If you were to apply that nine-month time frame to the coffee cup lid here under those circumstances, but then process — —

Assoc. Prof. OSBORN — Is that a bioplastic lid or not?

The DEPUTY CHAIR — Yes.

Assoc. Prof. OSBORN — It is. Okay. What you are looking at in relation to those — these are plant matter, and if they are going into a system which is basically a composting heap which contains microorganisms which are able to degrade plant matter and you have those conditions where there is aeration and there is a high concentration of nutrients within them, the microorganisms think this is their normal food. They see this as normal plant matter and have the enzymes available to degrade those. But if you are looking at that plant matter going out into a freshwater system or indeed into a marine system where the microorganisms which are present in those systems think, 'Actually, why would we try and degrade this very difficult to degrade plant material when we can use the more readily available organic carbon, which we are used to degrading?'.

It comes down to that issue from the microbial perspective. And it is not that they are thinking about it; it is just that they have evolved the capacity to degrade the things which they are used to dealing with. That plant matter is difficult to degrade, so inevitably it is going to take far longer to degrade.

The DEPUTY CHAIR — So how does biofilm form on the surface of something like this in the water if biofilm is in and of itself attractive to microorganisms?

Assoc. Prof. OSBORN — So how biofilms are formed — what we are looking at is individual microorganisms. So these are micron-scale organisms attaching onto pieces of plastic which are 1000, 10 000 or 100 000 times their size. Those organisms are themselves very often sticky, so they have the capacity — they have polysaccharide coatings around them, which enable those organisms just to attach onto surfaces.

So if you look at drinking water pipelines, for example, which is one of the other areas of research which we are interested in, the internal coverage of those pipelines is lined with microbial biofilms, because these organisms are able to exist in the presence of low concentrations of carbon, and from a microbial perspective it is just a safe place to live. Alternatively, if you are a photosynthetic microorganism it is a convenient place to sunbathe, so if you are on the surface of the water — —

The DEPUTY CHAIR — It is close to the surface.

Assoc. Prof. OSBORN — Exactly. In turn, in those microbial communities you get an initial attachment of some organisms, so if you get the attachment of an algae onto a piece of plastic, those algae are then leaking out the polysaccharides which they are producing onto whichever bacteria are then accumulating. So you get the building up of really quite complex communities. The work we have been doing is showing maybe as many as 1000 individual species on a piece of microplastic a few millimetres across.

The DEPUTY CHAIR — What does that do in the aggregate? If you have got a large volume of that sort of plastic, particulate or pieces, floating around in the ocean, what is the impact of that from a bacterial or biochemical perspective?

Assoc. Prof. OSBORN — From the bacterial perspective it is a convenient place to live, because there are many other particles which exist within marine systems. There is particulate organic matter onto which many microorganisms have adapted to live on surfaces. So that is their preferred mode of lifestyle; plastic is just another piece or just another substrate. So if we do experiments with glass, for example, we will find attachment onto glass, although obviously the glass is inert as far as the microorganisms are concerned. But it can also lead to changes, for example, in the buoyant density of plastics. I have been talking about plastic in the surface levels, but there is also the capacity as you get biofiling, sequential absorption of complex food web onto that, that that can change the relationship of where plastic actually stays and drive possible transport down through to deeper components within the system.

The DEPUTY CHAIR — Right, thank you. Sorry, I interrupted you. You were just about to head off to slide 13. My apologies for that.

Assoc. Prof. OSBORN — Obviously the draft legislation which has been presented relates in particular to plastic bags and also microbeads. I am not really talking about plastic bags because I understand they have been covered at length in relation to the numbers of them. But I did want to provide some evidence in relation to the potential for microbeads in particular to serve as another mechanism of transport for persistent organic pollutants, which I was talking about right at the start, directly into animal tissue. The problem with microbeads is that they are a factor of 10 or 100 even smaller than those microplastics I was showing in relation to the size of a $1 coin.

What we are looking at here is that the microbeads which are present in many cosmetics, and they are present at sort of gram levels within a 50-gram or 100-gram container of cosmetics, when those microbeads then go through our sewerage system, are not trapped by many of our sewerage systems and are going out into the system. They, because of their larger surface area to volume ratios — they have got a huge surface area to a very small volume — again provide a potential surface for absorption of pollutants onto those plastics.

I just want to highlight some work from one of our colleagues at RMIT, from Brad Clarke's group, which has demonstrated the capacity for these microbeads in particular, extracted directly from 'beauty products', and I use that in inverted commas, to directly facilitate the transfer of a persistent organic pollutant directly into the body tissue of fish. It is a study which came out earlier this year, and it has provided direct evidence that when you get direct contact of persistent organic pollutants onto the surface of cosmetic microbeads, if the fish are in that environment, those pollutants that can be transferred into the tissue of the fish, in this case.

The DEPUTY CHAIR — How does that work? If fish, particularly fish living in brackish or salty water, do not have salt in the tissue and yet plastic can make it into the tissue — —

Assoc. Prof. OSBORN — It is not the plastic that is making it into the tissue.

The DEPUTY CHAIR — Sorry. If the persistent organic pollutants are making it into the tissue of the fish, what is the distinction in terms of the size of the POPs, for example, in comparison to salt?

Assoc. Prof. OSBORN — If you think about a cell, an individual cell is lined by a myriad of different transporter proteins. So what you have got is the capacity, for example, for many different organic pollutants to be mistakenly transported into cells or, indeed, into those tissues. What you are looking at in relation to these persistent organic pollutants, as I alluded to earlier, there are many persistent organic pollutants which can get into even our tissue, and PPDs are one of these. We can get accumulation, for example, of PPDs into breastmilk.

What we are looking at is effectively in an aquatic environment the microbeads, in this case, are serving as a sponge. We are getting attachment of persistent organic pollutants in this case in which, from Brad Clarke's creeks work, we are looking at the absorption of the polybrominated diphenyl ethers, the flame retardants, onto the surface. That piece of plastic now containing this persistent organic pollutant is then eaten by the fish. Within the gut you are then getting release of the persistent organic pollutant from the microbead surface and then that can be absorbed through the gut lining.

The DEPUTY CHAIR — What is it that precipitates the release of that PBDE from the POP?

Assoc. Prof. OSBORN — I cannot answer specifically. My guess would be you will be looking at changes in the chemical environment within the gut will be so different from that which occurs within the immune system that you can get de-absorption from them.

The DEPUTY CHAIR — A catalyst for desorption?

Assoc. Prof. OSBORN — Exactly.

The DEPUTY CHAIR — Thank you. Sorry, I strayed into a different subject.

Assoc. Prof. OSBORN — What this data is really showing is that you can get the capacity for those pollutants to be transported into our gut tissue. But also I would highlight the issue of bio-accumulation, whereby if you are looking at small fauna ingesting one or two pieces of plastic and then receiving whatever pollutant load is on those individual pieces of plastic into their tissue, you are then looking at the capacity for fish to of course then feed on many, many individuals, which means you get bio-accumulation occurring within them. So ultimately we are at the top of many million food chains.

The DEPUTY CHAIR — Like mercury.

Assoc. Prof. OSBORN — Exactly, yes. I do not know if you are familiar with the horrific tale in relation to Minamata Bay from the 1960s and 70s, where mercury was accumulating within fish tissue and then caused many, many deaths within Japan. The same principles apply.

A lot of the research which we are doing, as you may gather from the fact that I am here today, is not just about doing research. It is about communicating the research, working with stakeholders and working to try and provide an evidence base for you as policy-makers to try and move forward in relation to introducing a policy which is going to have a beneficial impact in relation to reducing the amount of plastic which we are having.

I think it is important that much of what you are covering today specifically in relation to the issues of plastic bags and also microbeads and also gratuitous plastic has been covered in far greater detail in the Australian Senate inquiry. If you have not had a chance to read that, I would encourage you to have a look. As I am sure you are aware, it reported on 20 April 2016. I thought it would be useful to highlight on slides 15 and 16 just a few of the key recommendations, because on many of the things which you are discussing today there have been recommendations directly relating to this at federal level. I would highlight recommendation 21, which specifically is recommending bans on single-use plastic bags, and 22, which is also banning microbeads.

I would also highlight recommendations 23 and 25, which relate to issues which are beyond the direct scope of this particular inquiry but relate to plastic production pellets, those plastic production pellets which I was showing, for example, in relation to the size of a $1 coin. These are again getting out into our aquatic systems. They are larger than the microbeads which we are specifically interested in within this particular inquiry, but again these are small pieces of plastic, and there is no reason why they should be going out there. A future legislation which may look to try and mitigate their impact will be of value, as indeed would legislation which hopefully will relate to the introduction of a container deposit scheme, to limit the amount of plastic bottles which are again going out into our marine systems.

The DEPUTY CHAIR — The last sentence in recommendation 21 is:

> In doing so, the Australian government should ensure that alternatives do not result in other pollutants entering the environment.

Depending on what your definition of pollutant is — and I put this to the Sea Shepherd witnesses who were here earlier — might it not also be the case that something like a cornstarch, rice bran or other abrasive material product might in fact present pollutant-related challenges to the environment if introduced as an alternative?

Assoc. Prof. OSBORN — We have been talking about absorption of pollutants onto surfaces, and we have been talking about absorption or the attachment of microorganisms onto surfaces. Whatever we have which is going out into aquatic systems has the capacity to be absorbing pollutants. So I was talking about the bio-plastics, for example. They are probably as bad as conventional plastics. The other thing is we need evaluation in relation to this and we need more careful handling of our litter streams. This is not simply that this

legislation will provide a solution there. It will provide a start towards trying to change people's behaviours, and I think that sends a very important message, because it is not just about inconveniencing members of the general public; it is about beginning that process of educating people about waste, trying to move towards a more circular economy, where we are trying to use the resources which we have more effectively and to limit our impacts upon our environment, for all the reasons which Rachel Carson first identified back in 1962.

The DEPUTY CHAIR — Recommendation 22 is:

> The committee recommends that the Australian government move to immediately ban the importation and production of personal care products containing microbeads.

We had evidence earlier from the Boomerang Alliance which I believe referred to a distinction between cleaners and cleaning products having 1000 times the number of microbeads in them, as opposed to the personal care products. What is your view in relation to the fact that recommendation 22 only deals with personal care products containing microbeads and does not go to consumer, commercial or industrial cleaners?

Assoc. Prof. OSBORN — I would love to see it broadened.

The DEPUTY CHAIR — So you would propose that the recommendation be broader to cover any product containing microbeads?

Assoc. Prof. OSBORN — Yes, I think that is fair.

The DEPUTY CHAIR — I do not want to verbal you here. I just want to make sure that that is in fact your view. Okay. Thank you very much. My apologies again — I keep interrupting because there is a lot to cover.

Assoc. Prof. OSBORN — I really just want to finish off where I started to say it is our responsibility as a society to try and limit the impacts of pollution going into our systems. Whilst at the moment plastic is not officially classified as a pollutant, there is a huge body of evidence, and I have just hinted at some of that body of evidence today, in relation to plastic pollution and its potential impacts — physical, chemical and indeed biological impacts upon aquatic organisms in particular. I just want to highlight some of the examples of plastic pollution, which we can see on an everyday basis in our immediate environment, just to plant in your minds that I am advocating that the state of Victoria bring in legislation that begins to try and address and reduce this flow of plastic waste into our systems. I would really just like to thank you very much for your attention.

The DEPUTY CHAIR — Thank you very much, Associate Professor. I have in fact used up my question quota throughout the course of your presentation. I apologise for breaking your flow, but can I just thank you for the really comprehensive submission you have provided as well as the overview. It is integral to this parliamentary inquiry that we are in a position to take an evidence-based approach to this issue and to broker our way to an outcome that deals in the best possible way with all of the issues associated with marine and general pollutants arising through plastic production and use. So with thanks, I will pass on now to Ms Dunn, who may have other questions.

Ms DUNN — Thank you, Associate Professor, for your submission today. We heard earlier some references to toxicity and, I guess, prevalence in the environment of spans of hundreds of years. I am just interested in your views. You have certainly talked about toxicity in relation to POPs. Do you have any commentary to make in terms of how long those pollutants may persist in the environment — like the timescales?

Assoc. Prof. OSBORN — Are we talking about the plastics or the POPs?

Ms DUNN — I think both.

Assoc. Prof. OSBORN — The plastics — we are doing an experiment effectively.

Ms DUNN — That is right. It is pretty live!

Assoc. Prof. OSBORN — We are putting plastic out into our environments. I got into this line of research following a paper I first read back in 2004, which is from Richard Thompson's group at the University of Plymouth and is called 'Lost at Sea: Where Is All the Plastic?'. At that stage, the question was: we know we are

producing a lot of plastic, we know a lot of it is getting out into the marine environment — why do we not see seas of floating bottles and bags?

Ms DUNN — Yes, where is it?

Assoc. Prof. OSBORN — The problem is that it has been fragmented, so when we do go looking for those microplastics, we do find them. That first paper published in *Science* back in 2004 — there had been early reports, going back to the 1970s, showing small pieces of plastic, but that was the first time, back in 2004, when we really appreciated actually that the bigger pieces of plastic are going to smaller pieces of plastic. As you can see in relation to the loads of plastic that we are now seeing and the fact that we are, year on year, having increases in that plastic, it is not going away anytime soon, because when we are going out and sampling plastic, we are finding more and more and more of it, so if we continue to produce more and more and more of it, it is not going away.

Can I put a timescale on it as to whether the plastic is going to last for 10 years, 100 years or 1000 years? No, I cannot. Ultimately these are organic carbon compounds. Ultimately, yes, there is the potential for them to be nibbled away slowly, but the reality is that they are going to be fragmenting and they are going to be surviving. The challenge is that I do not think it is a case of us waiting to see how the experiment turns out in terms of how long the plastic lasts, because we now know we have got a problem in relation to its immediate impacts and the fact that year on year we produce more.

The DEPUTY CHAIR — Whether it is a plastic bag, a lid or a cap — —

Assoc. Prof. OSBORN — Exactly.

Ms DUNN — Yes, whatever it looks like.

Assoc. Prof. OSBORN — Just to pick up on something that occurred to me in relation to one of your earlier questions about pollutants absorbing onto the surface of other compounds, such as plant matter: in relation to those, the very nature of our plastics makes them more durable and resistant to degradation and breakdown of those bigger things into smaller organic compounds, whereas plant matter, by its very nature, is more likely to deteriorate.

The DEPUTY CHAIR — Yes. Thank you. That is an important point.

Ms DUNN — This bill — you talked about how it is the start of a behaviour change and education on waste. It would seem that there are significant concerns in relation to not only the impacts on ecosystems but also the impacts on people who interact with and eat fish from that ecosystem and are part of that ecosystem. So we have got a bill; setting that aside, in terms of mitigating the impacts that are already manifesting in the ecosystem and will already be impacting on humans, do you have any views on what steps to take?

Assoc. Prof. OSBORN — Are you talking about mechanisms to actually try to capture, for example, the plastic that is out there? You have seen figures today of the litter traps. Those litter traps are doing a great job of capturing some of the much larger mass of large plastic that is out there. The challenge in relation to mechanisms such as those is that the litter traps are okay for bigger stuff, but when you are looking at microplastics, they go straight through. You can put booms in, but there are challenges in relation to putting booms in, because of course if, for example, you get high tides or you get extreme rainwater events, that plastic is again getting washed out. So mechanisms to capture plastic — yes, I think where possible and where it makes sense to employ them, by all means. Should that be our primary focus and we just continue to put plastic out into the system? No, we should not. We need to take responsibility at the level of the individual and put mechanisms in place to support changes in behaviour, because those are the things which are going to be important.

There are some specific measures which will be important in relation to industry and, for example, plastic production pellets, which have no right to be going out. They are those nurdles, which are used and then moulded up into the bigger plastics. But in reality if they are made in one plant, transported to another and then built into something else, they should at no stage be having access to the environment. So there is a need certainly in relation to industry having responsibility and also being regulated more strongly by the EPAs to try to deal with those sorts of issues. I think in many ways the genie is out of the bag.

Ms DUNN — Yes, exactly.

Assoc. Prof. OSBORN — We have got to now just try to reduce the stem and level off those grafts of plastic which are going out. It is obviously a global problem, but I see Victoria — and Australia more broadly — as being a state that should be leading by example.

Ms DUNN — Yes, it is about — and we have had other submitters say similar — stopping the source now getting out, so changing the way we handle production and plastic use generally.

Assoc. Prof. OSBORN — Exactly.

Mr DALLA-RIVA — I am conscious of the time. I have been fascinated by your evidence. The question I have, which I was just talking to the Deputy Chair about, is that the bill actually relates to plastic bags. I know you have covered a range of areas, like the coffee lids, and there is a whole range of other significant amounts of plastic in the community, in our waterways and in — —

The DEPUTY CHAIR — It covers packaging and microbeads as well.

Ms DUNN — Yes, microbeads, packaging and bags.

Mr DALLA-RIVA — Yes, packaging, but I am talking about general toys and broader plastic components which are outside of the bill. My single question is: in relation to the plastic bag component, how big an issue are single-use plastic bags in your research in terms of the impact on the amount of concern that you have got and that you have raised? Is it 5 per cent, 10 per cent or just unknown?

Assoc. Prof. OSBORN — My answer will be 'unknown'. I cannot put a figure in relation to what proportion of the waste which is going out into our aquatic systems is plastic bags. But if we think about it logically in relation to the idea of producing something which is used once and for a matter of minutes, the capacity of that plastic bag to then be released into the environment is madness, especially when you are looking at the downstream impacts of that plastic being shredded, broken down into smaller pieces and potentially accumulating up the food chain or passaging other pollutants back into our marine system.

I see plastic bags, I see drinking water bottles and I see coffee lids as mechanisms by which we can change behaviours within society. I think that is probably the real value of introducing a ban in relation to plastic bags, because it is changing people's way of dealing with them. It is also preventing the waste of a huge amount of resource. We must not forget that the plastic bags themselves are made from petroleum hydrocarbons. We are looking at oil-based plastics which are being generated. They of course have their wider impacts in relation to the production of global greenhouse gases, and it is not sustainable.

I am just about old enough to remember going to the supermarket every week and coming home with our shopping in cardboard boxes. Those cardboard boxes had been used for the packaging of the food on the shelves. Then sometime during the 1970s and particularly through the 1980s we moved to a society where plastic bags were the norm. Why are we doing that? It is done for the convenience. It is very easy to just pull a plastic bag off at the supermarket and to carry it. But we need to challenge that, because we know it is a pollutant. It is not written in script that it is a pollutant, but we know that plastic is out there as a pollutant. We know it has adverse effects.

Mr DALLA-RIVA — Do you think that is the issue — that people do not associate plastic with being a pollutant? It is a plastic bag, and it is safe for us to put our food in.

Assoc. Prof. OSBORN — Absolutely, yes.

Mr DALLA-RIVA — There are water bottles. I notice you have got an aluminium, dented water bottle.

Assoc. Prof. OSBORN — It gets dropped a lot.

The DEPUTY CHAIR — It is well loved.

Assoc. Prof. OSBORN — It is, yes.

Mr DALLA-RIVA — A well-loved, dented water bottle. There has been a huge growth in water bottles in the last — —

Assoc. Prof. OSBORN — Personally I was not involved in the development of the draft legislation here. I would have loved to have seen drinking water bottles included — beverage bottles, I think. Also there was interest in relation to the fact that — I cannot help myself, looking at your coffee cup — in the UK, Costa, one of the main coffee shop chains, are now introducing a recycling scheme for their coffee cups and lids. It is not just about the lids, because the cups themselves are plastic coated. If you think about the use of the resources on the planet, anything we can do to actually reduce the amount of waste we are producing — and where we are producing waste, to actually recycle — that has got to be a good thing.

Mr DALLA-RIVA — My issue in the whole discussion today is your revelation that plastic is now becoming a pollutant. A previous witnesses spoke about mercury. Everyone is aware of the growth in mercury levels in fish, and now you are telling me that I am going to walk away from this hearing scared of eating fish because of what you are saying is the build-up of toxins in it. That scares me. That is all. It is confronting to hear that in evidence that I have not heard before.

Assoc. Prof. OSBORN — The key thing is that it all comes back to concentrations. The more pollutant we put out, the more likely we are to be accumulating pollutants within our food chain. If we can take steps and Victoria can take steps to actually reduce at least some of that pollution which is going out — in particular if we are looking at an environment like, for example, Port Phillip Bay, which is almost a trap for litter because of those very slow turnover times between the bay and the wider marine waters — any attempt we can make to mitigate and reduce those pollution loads we should be doing and taking seriously. In the same way we do not want to increase the amount of nitrogenous fertilisers which are going out into the system and causing algal blooms, for example.

Victoria has been very strong in making very important changes to the general health of, for example, Port Phillip Bay and the wider catchment, and I am very much aware of the draft environment management plan for Port Phillip Bay, which has been released for consultation by the DELWP. That, interestingly, raises many of the issues which we have been talking about today in relation to pollution, but it specifically includes litter as one of the things that we need to be addressing. And clearly government agencies in particular are looking at this. They have highlighted litter, along with nutrients and also other pollutants, including microbial pathogens, which may be coming through. But we need to take a holistic view as to how we are trying to improve the quality of our environment, because you have talked about pollution coming up through the food chain, but of course we use these waters for recreational purposes as well.

Mr DALLA-RIVA — Final question: how do you test the amount of pollutants in the environment? How do you test that?

The DEPUTY CHAIR — The marine environment?

Mr DALLA-RIVA — Yes, the marine bird environment. Are you doing that now?

Assoc. Prof. OSBORN — For organic pollutants or indeed for inorganic pollutants, such as heavy metals, there are some very, very good and well-established mechanisms — using mass spectrometry, for example, or gas chromatography — which enable you to quantify pollutant loads within particular systems. It is slightly more difficult to actually quantify those on the surface of plastics because of the fact that they are absorbed onto them, but we can do those.

The DEPUTY CHAIR — But they are still spot testing, are they not?

Assoc. Prof. OSBORN — Yes.

The DEPUTY CHAIR — You cannot necessarily get more than a very defined cross-section of an area by testing a particular piece or section or grid of a — —

Ms DUNN — Yes, the sampling.

The DEPUTY CHAIR — Yes.

Assoc. Prof. OSBORN — And you are also looking at sort of qualitative versus quantitative descriptions, so you can actually give a catalogue of which pollutants are found on a particular substrate. Quantifying those back down to surface area, for example, is far more difficult, but it can be done. For the microbial pollutants, which again are another alternative mechanism, we use DNA-sequencing-based approaches to identify those organisms, and that is the approach we have been using for a number of years.

The DEPUTY CHAIR — One final final question: in relation to the Australian standards that define biodegradability and the extent to which they seek to shed light on when something is or is not biodegradable, if you had an opportunity to make those standards clearer and to better equip the public to make informed decisions about what they buy and how, what would you do, if anything, to change those standards?

Assoc. Prof. OSBORN — For me the problem is that the language that is used to actually classify those alternatives to petroleum hydrocarbons is opaque at best. The challenge is that very often when we are talking about bioplastics, we may actually be talking about products which are truly biodegradable — under composting conditions, I would add as a caveat — but also there is a continuum of products that also contain, for example, plant-based plastics, which are then actually on the same piece of organic plastic which is from petroleum hydrocarbon. We need to clear blue light between those different classes of plastic, and we need to have much clearer information in relation to saying, 'Yes, these things are truly biodegradable', although I question whether they would be as soon as they get out into the aquatic environment.

The DEPUTY CHAIR — Yes, and that is difficult in a buying situation. Green credentials are a big thing in purchasing power these days, so do you have any sort of proposal or suggestion for how to have the notion of biodegradability through the standards better reflect, I suppose, the factual situation around the way in which certain substances will behave versus what people think when they buy something that is only biodegradable under certain conditions? They may think they are doing a great thing when in fact they are not.

Assoc. Prof. OSBORN — I think clearer labelling as much as anything — something that actually says, 'This has been shown to degrade' — —

The DEPUTY CHAIR — So simple language.

Assoc. Prof. OSBORN — Exactly, yes — rather than different classifications that mean different things for different people.

The DEPUTY CHAIR — Like 'sugar free'.

Assoc. Prof. OSBORN — Exactly.

Ms DUNN — I do not have a question per se, but I am just wondering: if we have any further questions in relation to your research, are you happy to field those questions from the committee?

Assoc. Prof. OSBORN — I am, yes. My only caveat is that I will be in Europe from about 19 December through to 17 January.

Ms DUNN — Good luck to you.

The DEPUTY CHAIR — Enjoy the white winter, hopefully!

Assoc. Prof. OSBORN — Yes!

The DEPUTY CHAIR — Thank you very much, Associate Professor. We will be in touch through the secretary. You will be provided with a copy of the transcript, and in the event that we do have any further questions, for example, through January, we might actually seek your indulgence through a teleconference for some further conversation.

Assoc. Prof. OSBORN — Thank you very much.

Committee adjourned.