

# The Threat of Marine Plastic Pollution in Australia and Australian Waters

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## Summary

The report indicates that the authors believe plastic pollution of marine waters could eventually rival climate change as a problem in the environment. It outlines the historical perspective, the problem with plastics and why they are dangerous in the marine context. We look at the effects of this in the shorter and longer term and the role of the crude oil market. TopInfo Consulting recommends that a market driven economic solution is the best way to mitigate plastic pollution and we outline some of the criteria necessary for this to be successful. Finally, we provide an example of a simple mitigation scheme and outline some of the benefits of such a solution.

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## 1 Introduction

Unless the rate of plastic pollution disposed to the environment is curtailed quickly, TopInfo Consulting believes this particular problem will soon develop in magnitude and rival the problem of man induced Climate Change.

### **1.1 Historical situation**

Plastics are a product of the petro-chemical industry when crude oil is ‘cracked’ to produce valuable petroleum and other energy sources used by modern civilisation. Essentially, plastics are bi-products, but when they were sought increasingly for packaging and containerisation of food and other manufactured products because of cost competitiveness and durability they soon became an essential commodity in their own right.

Historically, packaging and packing materials consisted of steel and aluminium, timber, cardboard, paper, tin and glass, but anybody that has frequented supermarkets or received large parcels will verify that increasingly these items are being displaced by various types of plastic and foam. This is an increasing trend and is likely to continue as plastic is an extremely versatile product.

Unfortunately, some of this plastic is disposed to the environment. On some reports this amounts to hundreds of thousands of tonnes per year. Although much of the plastic used is recovered and recycled the exceptional amount used in packaging means that huge amounts are still polluting the environment.

TopInfo Consulting considers all plastic pollution in the environment a problem and plastic pollution in the marine environment and Australian waters as a subset of this larger problem.

## **2 What is the Problem with Plastic?**

### **2.1 Types of Plastic**

There are hundreds of different types of plastic of different chemical composition, but broadly we can divide this type of product into (a) wrapping and protection type products, (b) food grade plastic packaging, (c) fishing line and nets and (d) biodegradable plastics.

Some plastics are recyclable, but many are not able to be ‘dealt with’ in this way. While some plastics are biodegradable (with increasing emphasis being placed on research in this area) they are usually manufactured from a biological source and not a traditional petroleum one. Unfortunately, biodegradable plastic type material is expensive and less versatile than the petroleum based product.

### **2.2 Plastic in the Environment**

There are a number of problems of plastic in the marine context. These include:

- Unsightly bulk pollution,
- Toxicity,
- Entanglement and strangulation,
- Malnutrition and starvation,
- Micro-plastics.

#### ***Unsightly Bulk Pollution***

Most people that have ‘been to the beach’ will verify that plastic pollution is pervasive and can be found almost anywhere. Australia is an island continent far from more populous nations and our

problem with this source of pollution is relatively mild compared to other places in the world. However, TopInfo Consulting believes Australia needs to look at these ‘other places’ and see the effects of plastic pollution, because in a decade or so Australia will be in a similar situation. I have travelled to a number of countries and some places like the beaches of Greek islands look like rubbish dumps. This is due to plastics and rubbish washed on to beaches and the inability to deal with the problem.

### *Toxicity*

As almost 100% of plastic pollution is petroleum based, we can generalise that all plastics ‘give off’ chemicals and some gas. Some plastics are more toxic than food containers (for example), but they are all petroleum based and collect other toxic chemicals to their surface as they are chemically attracted to them. Marine species that ingest this plastic also ingest the toxins that have collected on the plastic and there is some evidence that these can bio-accumulate in the food chain. Even if the plastic ingested is passed ‘out of the animal’, the toxins are likely to be adsorbed by the species.

### *Entanglement and Strangulation*

In today’s world of the internet, it is not hard to find videos of marine animals that have been entangled in nets, fishing line and other plastics. Often these videos depict people helping the marine species by cutting them free. These are every day events, but the sad situation is that for every one that is filmed there are possibly thousands that are not and the poor individuals will die. Strangulation and deformities are caused when a juvenile becomes entangled in plastic and survives, but as it grows it is deformed by its entanglement and eventually will die prematurely. I have seen photographs of birds, turtles and whales in this situation.

### *Malnutrition and Starvation*

Recent research has suggested that within twenty years up to 90% of marine birds will have consumed some form of plastic. Sometimes this plastic can puncture internal organs as it passes from the alimentary canal but at other times it will remain in the stomach and intestines. TopInfo suggests that this is ‘just the tip of the iceberg’ as literally 1000’s of marine species could consume pieces of plastic and suffer as a result.

The research indicates that migratory birds and young nestlings are at greatest risk of death as;

- Migratory birds ingest plastic they ‘feel full’ or satisfied and then attempt to migrate. However, as no nutritional value exists in plastic, the birds soon ‘run out’ of energy and drop dead in flight as they fail to get to their destination.
- Young birds fed plastic from their parents do not have sufficient nutrients and energy for growth and die prior to fledging and adulthood. This results in less recruitment to the adult population.

In time this will result in death of individuals, but more importantly could result in the extinction of sensitive species and affect the food-web and entire dependent environments.

### *Micro-plastics*

As plastics are not organic, do not rust and are extremely durable in the environment they have the potential to last 100’s or some people suggest even 1000’s of years in the environment. They are not subject to bacterial breakdown or biodegradability, but given sufficient time will degrade to bead-like substances known as micro-plastics. As far as science can tell this is the end product of plastics, that is, smaller and smaller pieces of micro-plastic.

The deposit of an 'end-product' such as micro-plastics is known as 'a sink'. The oceans are now 'a sink' for micro-plastics and will simply accumulate them. This is a problem of monumental proportions as the amount of micro-plastic accumulates. Nobody really knows what the eventual result will be, but TopInfo Consulting suggests that every lifeform in the ocean has the potential to be affected. We have documented the problems with plastic (above, 2.3.1 to 2.3.5) and it is our opinion that micro-plastic will have these effects and possibly more.

Smaller pieces of plastic have greater surface area to volume ratios which have the potential to concentrate toxins (for example) and will certainly be more accessible to more species. Species from bi-valves and corals, fish, birds, sharks and mammals all have the potential to be affected. Without trying to 'fear-monger', but extrapolating to a natural conclusion, it is possible that many fish, birds and other marine animals will become extinct or at least badly affected, the ocean environmental ecosystem could collapse and become a 'virtual desert'. As TopInfo Consulting indicated in the introduction, such a scenario would be disastrous and possibly worse than Climate Change.

### **3 Sources of Marine Plastic Pollution**

The advent of the environmental movement and the introduction of industry and household recycle bins have seen a significant reduction in rubbish (particularly recyclable rubbish) going to landfill. However, increasing product number and population dynamics as well as the proportion of product packaged in plastic materials have still seen plastic pollution increase in the environment. It is our opinion that unless a programme is introduced as a circuit-breaker plastic pollution will continue to increase at an exponential rate.

#### **2.3 Where Does the Plastic Come From?**

There are four broad types of plastic pollution to the marine environment; (a) land based disposal, (b) marine vessel or ship disposal, (c) individual people discarding smaller amounts of plastic and (d) illegal dumping of larger amounts of plastic.

In the case of land based disposal, wind has an effect, but by far the majority of pollution occurs from stormwater runoff into rivers and streams and this 'makes its way' into the marine waters. Unfortunately, many marine vessels and ships still dispose of 'rubbish and waste at sea' and plastics find their way into the marine environment. By far the most diffuse source of plastic pollution to marine waters is thoughtless individual people discarding rubbish 'a little at a time', but millions of people make this an important diffuse source. Finally, we have illegal dumping by business and individuals to avoid fees (e.g. at landfill sites).

Plastic pollution in the marine environment is avoidable and is essentially a failure of modern society. The three 'R'; Reuse, wash and reuse (e.g. glass); Recycle, return to recyclers and be remade into similar product (e.g. newspapers); Remanufactured, returned to recyclers and turned into different product (e.g. plastic containers making seating) has been a success story in numerous ways, but many types of plastic are not recyclable and carelessly discarding rubbish circumvents recycling efforts anyway.

#### **2.4 Where Does the Plastic Go?**

Australia has many small towns and villages adjacent to rivers and streams and on the coastal fringe. Most of these have some sort of rubbish collection and recycle facilities. However, only some types of plastic are recyclable and smaller and isolated municipalities do not have the financial resources to sort and store many of the plastics that can be recycled, consequently many plastics that can be recycled still go to landfill.

Reuse, Recycle and Remanufacture is not restricted to Australia as it is now a global solution to a global problem. Recyclable product is shipped around the globe repeatedly. Complex plastic products that are no longer desirable such as discarded computers and printers are shipped in bulk to third countries, broken down into component parts and transformed. Unfortunately, these third countries are usually underdeveloped, where labour costs are low and regard for health and wellbeing are a secondary issue.

We are fast finding out that we live in a global economy and the problem of plastic pollution of the marine environment is also a global problem. In some oceans discarded plastic has formed floating islands 100's of metres in diameter and most travellers will tell tales of unsightly plastic washed-up on 'what would be' pristine beaches around the world. Unless these islands of plastic are recovered and disposed of in another way, eventually they will be reduced to micro-plastic causing even greater damage to the marine ecosystem.

## **4 Impacts of Marine Plastic Pollution**

The effects of plastic pollution can be viewed and discussed in several ways. We have discussed the effects of micro-pollution on species, but the 'flow on effects to human endeavour' will now be discussed. We have chosen to discuss these on two levels; (a) the shorter term and (b) longer term.

### **1.2 The Shorter Term**

TopInfo Consulting assumes that 'practical steps' to limit marine plastic pollution will be 'put into place' eventually and such programmes will be adopted world-wide. To do otherwise would be negligent, particularly if plastic production continues into the future. However, it should be recognised that existing levels of plastic pollution may need to be cleaned up to ensure protection of the marine environment from micro-plastics entering the food chain long-term.

At the moment many communities and countries hardly recognise the extent of marine plastic pollution so there will be a lag-time until any mitigation programmes are adopted on a scale sufficient to have an impact and another lag-time, prior to having any effect on the actual quantity of plastic in the environment. TopInfo Consulting suggests that 10 to 20 years would be a realistic time-frame for 'the shorter term' and that in 20 years mitigation programmes must have sufficient 'emphasis' to show material reduction in marine plastic pollution.

Of course, if mitigation programmes are not enacted in sufficient time, or at all, the future for the marine environment and human populations are 'fairly bleak'. In the shorter term plastics will continue to accumulate in the ocean 'sink' unabated and it will start to effect marine life and fisheries in an exponential fashion; slowly at first, but at an ever increasing rate. In other words, the situation will continue at the 'status quo' with a 'tipping point' imminent in the near future.

### **1.3 The Longer Term**

Fifty to 100 years and beyond is considered to represent 'the longer term' and if mitigation programmes to clean up the oceans are not successfully implemented at this stage, it is highly likely that 100's of species will be endangered or extinct, fisheries may have collapsed and the oceans nearing a terminal decline. This is the scenario of a horror movie, as the marine environment has always been an important source of protein in the world's nutritional requirements. It is highly likely that even a small decline in the contribution of the oceans to 'feeding the world' coupled with population increase would result in famine, riots, disease and possibly human population collapse.

Before this happens, multiple ‘flow on’ effects such as business collapse and economic disruption would be precursors. TopInfo Consulting believes that if such a scenario develops there will not be an aspect of human endeavour that is not affected.

Most environmentalists believe that ‘if we destroy the environment, we are actually destroying the support mechanism for life on Earth’ and in particular Homo sapiens. Every time a species becomes less numerous or extinct, there are unexpected ‘environmental shifts’ and changes to the ecosystem that ‘echo throughout the food web’. It has now been demonstrated that a simple thing like the reintroduction of wolves into an environment (USA) that has been devoid of them for 50-100 years will change animal composition and distribution, encourage vegetation type to change toward natural species and promote better land management and water quality.

## **5 The Role of Petroleum**

As plastic pollution in the marine environment is effectively 100% petroleum based, it is worth spending a few minutes on discussion of the crude oil market.

### **1.4 Is Crude Oil a Market Driven Industry?**

Plastics are products of the crude oil industry and the manufacture of petroleum. There are a number of different qualities of crude oil and their properties and chemical composition determine their desirability and profitability. On the Oil Market crude also fluctuates in price depending on availability of alternative sources of energy such as Coal Seam Gas (CSG), Natural Gas, economic situations and price setting by cartels such as OPEC.

Although, there has been a lot of discussion about ‘peak oil’ in the last decade or so, the reality of the situation is that ‘the crude oil price’ is set by the quantity of product allowed onto the world's market by OPEC and other producers. Consequently, there is no shortage of crude oil and essentially an endless supply of the manufacturing feedstock for plastic production.

Market driven products are set in price according to the laws of supply and demand. However, in the case of crude oil, producers of oil act as cartels to maximise price and ensure a measure of stability in the market by limiting supply. Add other complications such as multi-national oil companies being subsidised by sovereign governments to encourage search, discovery and production and we can see that this commodity is not really a market driven product, but a highly controlled one. As a result, plastics (by a ‘defacto’ relationship) are also subsidised and in effect the world is actually subsidising (or paying for) the pollution of our oceans and environment by ensuring an endless supply of cheap plastics.

## **6 Measures and Resourcing for Mitigation**

A basic precept has been accepted in matters of pollution for many years and this is, ‘the Polluter should pay to fix the problem’. Once this precept is accepted a lot of the ‘heart ache’ involved in trying to determine how to solve the plastic pollution problem is also minimised.

Essentially everybody in Australia (and for that matter, the world) contributes to the plastic pollution problem as everybody uses products packaged in plastic. TopInfo Consulting would like to state that a sensible way of ‘tackling the problem’ is to apportion responsibility in a form of a hierarchy as some sections of the community contribute more to the pollution problem than others. It also follows that the sections of the community that contribute more to the pollution problem should also contribute greater amount of effort and capital toward rectifying the problem.



## **2.5 Market Driven Solutions**

Economists agree almost unanimously that market driven strategies for abatement and mitigation of problem pollution are the most efficient, cost effective and successful of all strategies. There is often a period of careful planning prior to the introduction of these strategies and occasionally an adjustment to the schemes, but once 'in place' and functioning, such schemes quickly embed themselves in the economic structure of the community and work seamlessly to mitigate the problem.

Market driven solutions move with supply and demand and (if crafted sufficiently well) will encourage good practices and discourage bad ones in both good economic times and in poorer ones.

It is for these reasons that TopInfo Consulting recommends that a market driven solution be considered by the Australian Government to reduce plastic pollution in the environment. We would also like to stress that any solution to this problem in Australia should also be viewed as a template for a global solution if it is crafted 'well enough' and is adopted in other parts of the world.

## **2.6 Characteristics of an Abatement and Mitigation Scheme**

Any solution to mitigate plastic pollution should start at the manufacturing point and incorporate the whole community as users of the product. A mixture of market based financial incentives and penalties to promote the desired outcome will be required, but it is envisaged that this scheme will need to operate under the umbrella of legislation.

A scheme that operates in the realms of a market enabling purchase of abatement and financial disincentives for those that do not recover plastic product after use would be essential. Essentially those that manufacture and distribute plastic product would be expected to develop strategies to recover it after use. This could be achieved with built-in levies, fines and taxes, but a scheme designed around financial incentives to collect and recycle plastic in the community would be an ideal starting point.

Some of these strategies by necessity will raise the cost of the initial product, but as 'we see it' this will also increase the incentive to recycle the used and discarded items.

Instead of allowing manufacturers to produce plastics without a covenant of recovery, we need to build a system where manufacturers are mindful of the;

- Type of product they produce,
- Amount that is discarded into the environment,
- Amount of damage the product does in the environment, and
- Cost to clean up the environment.

The manufacture of hundreds of different types and composition of plastics should be penalised as these compound the problem of recycling so to minimise the problem a rating scheme for different plastic type should be introduced.

Such a system would require a mixture of incentives and penalties to promote the desired outcome. Typical incentives could mean tax breaks for perceived 'good behaviour' and fines for 'bad behaviour'. The ultimate punishment would be fines and clean-up notices.

## **2.7 Example Market Driven Strategy**

- Introduce legislation to mandate the payment of levies on all manufacture and use of plastic,
- The levies can be offset (to a maximum of 50%) by facilitation of collection and clean-up of plastic pollution, but producers of plastic waste cannot and should not be able to totally offset their obligations,

- The companies producing and using plastic material can therefore off-set the cost of the levy by paying other businesses to collect and dispose of;
  - Plastic before it reaches the environment (25% offset),
  - Plastic pollution already in the environment (50% offset),
- Producers of plastics will only receive offset in levy obligation when real benefits are realised,

### **2.8 Possible Multiple Benefits**

A mitigation scheme such as the one above is designed to reduce the:

- amount of plastic pollution in the environment,
- types and variety of plastic,
- effects of plastic pollution on the marine ecosystem, and
- facilitate a method of cleaning up the environment.

It is also conceivable that such market driven mitigation schemes will have the added benefit of:

- New industry creation,
- Create significant new employment,
- Promote existing recycling and transformation industries, and
- Result in less land based plastic pollution too.