OCEANWATCH AUSTRALIA

Reducing plastics in the Australian seafood industry: Phase 1 desktop feasibility study

May 2007

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Australian Government
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SEAFOOD SERVICES AUSTRALIA

Natural Heritage Trust
Helping Communities Helping Australia

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SEANET
SMARTER FISHING FOR INDUSTRY
TIDE TO TABLE
RESTORING AQUATIC HABITAT

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This Report has been prepared for Seafood Services Australia and the Natural Heritage Trust by OceanWatch Australia. The report has been funded through the Fisheries Research and Development Corporation, Seafood Industry Development Fund and the Australian Government Natural Heritage Trust.

The Fisheries Research and Development Corporation (FRDC) plans, invests in and manages fisheries research and development throughout Australia. It is a statutory authority within the portfolio of the federal Minister for Agriculture, Fisheries and Forestry, jointly funded by the Australian Government and the fishing industry.

The Natural Heritage Trust (NHT) was set up by the Australian Government in 1997 to help restore and conserve Australia's environment and natural resources. Since then, thousands of community groups and organisations have received funding for environmental and natural resource management projects.

OceanWatch Australia Ltd is a national, not-for-profit company that works to achieve sustainability in the Australian seafood industry through protecting and enhancing fish habitats, improving water quality and advancing sustainable fisheries through action based partnerships with the Australian seafood industry, government, natural resource managers, private enterprise and the community.

Acknowledgements

The majority of information contained in this report has been obtained through desktop research and the sharing of knowledge and experience from members of the retail trade, the plastics industry and the Australian seafood industry. OceanWatch Australia would like to thank all those who provided assistance and information.

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OBJECTIVES:

To undertake a desktop study to review where plastics are used across the harvest and post harvest sectors of the Australian seafood industry and whether potential alternatives/substitutes are available. The scope of the project originally related to examining only the post harvest sector. The scope has been expanded with additional funding obtained from the Australian Government Natural Heritage Trust.

Recommendations from the desktop study findings have been suggested where there is application to the seafood industry with respect to policy and practice.

NON TECHNICAL SUMMARY

The level of plastics used by the wild catch sector of the Australian seafood industry is unknown, however considered to be substantial. A desktop feasibility study was undertaken to quantify if possible, the size of the problem, review alternative, more sustainable materials and packaging and handling options available and suggest recommendations to move the Australian seafood industry forward with respect to improving the life cycle (cradle to grave impacts) and closing the loop on waste management within the industry.

It is important that the Australian seafood industry is aware of the options available for reducing plastics and makes all attempts to operate as a responsible industry, moving towards sustainability. Until now, there has been limited forward strategic planning in the Australian seafood industry to address the need to reduce plastics usage. Given the environmental damage that can be caused by plastics and the contribution to this issue from the Australian seafood industry it is essential that some background work be done to assess the current position and to create some viable alternatives.

OUTCOMES ACHIEVED

The desktop feasibility study findings indicate that a great deal of research and development (R&D) in Australia and internationally has been/is being undertaken to develop sustainable alternatives to virgin plastic products. The Australian seafood industry can be one of the greatest beneficiaries of this R&D with the introduction of numerous cost efficient, environmentally acceptable packaging products now available. Any reduction in the use of plastics, or the acceptance of alternatives by the Australian seafood industry will however, require commitment from all within the industry. The answers to how to reduce the use of plastics and non-recyclable waste in the Australian seafood industry are available here and now, but for these products to become commonplace they need to be:

- affordable;

- acceptable and beneficial to the consumer and the producer;

- able to withstand harsh storage and transport conditions; and

- meet Australian health and food safety standards.

Key recommendations

This desktop feasibility study has identified that there is great opportunity for the Australian seafood industry to undertake actions to reduce plastics usage across the supply chain. This project should be advanced to the next phase to adopt the recommendations made in Section 6 of this report, as summarised below:

- Conduct a comprehensive plastic usage survey specific to the Australian Seafood Industry and develop a strategic approach for the industry to adopt cost effective sustainable solutions to plastics usage.

- Undertake a 3-6 month pilot study at Sydney Fish Market to investigate the volumes of plastic currently used, waste separation and waste recycling opportunities and subsidise trials of alternative products across the entire supply chain.

- Subject to the findings from a Sydney Fish Market pilot study, explore opportunities to roll out suitable alternatives and lessons learned across the post harvest sector nationally. Develop an education program and undertake training to post harvest seafood industry members with an emphasis on environmental impacts and recycling.

- Undertake a feasibility study and pilot study with key plastics and nylon recycling companies for recycling of waste fishing net and line. Further investigation for reducing the impacts and volume of polystyrene boxes should be undertaken.

- Undertake a pilot study at the port of Mooloolaba to investigate the feasibility of recycling monofilament line and tuna bags with longline fisheries.

- Assist, through the provision of resources and expertise those sections of the harvest and post harvest sectors currently investigating alternatives to plastics or to reduce marine debris.

- The Master Fish Merchants Association to become a member of the Retail Traders Association, representing the seafood industry.

KEYWORDS: Plastic, packaging, alternatives, recycling, reuse, life cycle assessment, seafood industries.

Executive Summary

The level of plastics used by the wild catch sector (harvest and post harvest) of the Australian seafood industry is unknown, however considered to be substantial. A desktop feasibility study was undertaken to quantify if possible, the size of the problem, review alternative, more sustainable materials and packaging and handling options available and suggest recommendations to move the Australian seafood industry forward with respect to improving the life cycle (cradle to grave impacts) and closing the loop on waste management within the industry.

Given the current trend by Planet Ark, local councils, and other industries within Australia, and the European Union and other organisations internationally to reduce plastics and other non-recyclable materials such as polystyrene, it is important that the Australian seafood industry is aware of the options available for reducing plastics and makes all attempts to operate as a responsible industry, moving towards sustainability. Until now, there has been limited forward strategic planning in the Australian seafood industry to address the need to reduce plastics usage. Given the environmental damage that can be caused by plastics and the contribution to this issue from the Australian seafood industry it is essential that some background work be done to assess the current position and to create some viable alternatives.

In some instances the use of plastic bags and other plastics products with seafood is driven by food safety requirements, price, and customer satisfaction, or may simply be a historical trend. The nature of seafood lends itself to a need for leak proof packaging. The use of plastics to address this need, particularly relating to retail purchases by consumers and when freighting product (domestically and internationally) is industry wide and across the full supply chain.

Whether it is through environmental awareness, economic circumstances or technological advances, this desktop feasibility study has identified that generally, the use of plastics across the harvest sector (that is, commercial fisheries) is, at present high with respect to the use of equipment to harvest seafood such as nets, lines and floats. Project findings indicate that a high number of fishers and fishing co-operatives have already introduced plastic and waste minimisation initiatives with the most difficult hurdle being post point of sale waste disposal. Quite simply, wastage and overuse is a luxury that no fishing industry can afford within the current economic climate. There are however, some aspects of fishing, particularly with respect to fish preparation for market that utilise plastic and where options for alternatives can be considered to reduce potential marine debris threats.

Packaging waste from the post harvest sector, that is, seafood wholesale and retail outlets continues however, to contribute to marine debris and landfill. A majority of cooked and fresh seafood outlets are using recyclable takeaway food containers, with some going as far as using biodegradable containers and carry bags. However the good, environmentally conscious intent of using recyclable/biodegradable containers is quickly lost when packaging is discarded with non-sorted general waste or is left or illegally dumped by members of the community who are apathetic or are

unaware of the detrimental effect of plastics in our environment. In Australia there is great diversity in attitudes and awareness of waste disposal and its impacts on the environment.

With the economic squeeze occurring across all sectors of the Australian seafood industry there is a trend emerging to reduce costs wherever possible. A number of retail outlets as a result, are opting for the cheapest option when it comes to packaging, namely polystyrene. The key driver for these retailers is to reduce costs, rather than reduce their environmental impact. In the current climate it is difficult to demonstrate why an alternative could or should be used when it cannot always be justified on economic grounds.

The Australian community's attitude to waste disposal and environmental awareness is by no means mature. An echoed concern from those within industry who provided assistance with this desktop feasibility study was the emergence of a general community attitude and acceptance that recyclable/biodegradable technology will be the saviour of our environment. Our environment will of course derive great benefit from this new, ever-improving technology, but many express concerns for such complacency. We need to complement this new technology with increased community waste disposal awareness and education. Many, including the European Union for Coastal Conservation (1999) share this sentiment and have suggested the reintroduction of anti litter programs similar to the highly successful Australian Government "Do The Right Thing" campaign.

The desktop feasibility study findings indicate that a great deal of research and development (R&D) has been/is being undertaken to develop sustainable alternatives to virgin plastic products. The Australian seafood industry can be one of the greatest beneficiaries of this R&D with the introduction of numerous cost efficient, environmentally acceptable packaging products now available. Any reduction in the use of plastics, or the acceptance of alternatives by the Australian seafood industry will however, require commitment from all within the industry. The answers to how to reduce the use of plastics and non-recyclable waste in the Australian seafood industry are available here and now, but for these products to become commonplace they need to be:

- *affordable;*
- *acceptable and beneficial to the consumer and the producer;*
- *able to withstand harsh storage and transport conditions; and*
- *meet Australian health and food safety standards.*

Key recommendations

This desktop feasibility study has identified that there is great opportunity for the Australian seafood industry to undertake actions to reduce plastics usage across the supply chain. This project should be advanced to the next phase to adopt the recommendations made in Section 6 of this report, as summarised below:

- *Conduct a comprehensive plastic usage survey specific to the Australian seafood industry and develop a strategic approach for the industry to adopt cost effective sustainable solutions to plastics usage.*
- *Undertake a 3-6 month pilot study at Sydney Fish Market to investigate the volumes of plastic currently used, waste separation and waste recycling opportunities and subsidise trials of alternative products across the entire supply chain.*
- *Subject to the findings from a Sydney Fish Market pilot study, explore opportunities to roll out suitable alternatives and lessons learned across the post harvest sector nationally. Develop an education program and undertake training to post harvest seafood industry members with an emphasis on environmental impacts and recycling.*
- *Undertake a feasibility study and pilot study with key plastics and nylon recycling companies for recycling of waste fishing net and line. Further investigation for reducing the impacts and volume of polystyrene boxes should be undertaken.*
- *Undertake a pilot study at the port of Mooloolaba to investigate the feasibility of recycling monofilament line and tuna bags with longline fisheries.*
- *Assist, through the provision of resources and expertise those sections of the harvest and post harvest sectors currently investigating alternatives to plastics or to reduce marine debris.*
- *The Master Fish Merchants Association should become a member of the Retail Traders Association, representing the seafood industry.*

1. Introduction

1.1 Background

OceanWatch Australia received Australian Government grant funding through the Seafood Industry Development Fund and the Natural Heritage Trust, to undertake a desktop feasibility study to review where plastics are used within the Australian seafood industry and to assess the feasibility of reducing usage or substituting plastics with more sustainable alternatives. The project aimed to review current plastic use across the harvest and post harvest sectors, alternatives or substitute products available or emerging both nationally and internationally, and opportunities for reduction, recycling or reuse strategies.

1.2 The history of plastics use

In 1907 Belgian born chemist, Leo Hendrik Baekeland earned naming rights by developing the first all-synthetic Plastic (bakelite). Baekeland coined the term "plastic" from a Greek root meaning "to form".

The use of plastic notably increased during World War II due to a critical shortage in metal. Manufactures turned to the use of plastics to provide a wide variety of parts for all forms of military equipment.

By the end of the 1960's plastic was being used in many industries including the manufacture of motor vehicles, trains and planes. It quickly found its way into homes, appearing in many forms from moulded furniture to wrinkle free, stain resistant clothes.

It was not until the 1960s that plastics really made an entry into the world of packaging. In the supermarkets most products were sold loose or sealed in tin or glass. Loose produce was packed in paper bags, and then transported home in larger paper carry bags. Australians are now using 13 million plastic bags a day (Clean Up Australia, 2005).

There are now many variations of plastic available for packaging and non-packaging applications. A plastics coding system was developed by the Plastics and Chemical Industry Association (PACIA) in 1990 (PACIA 2005) that identifies the most common types of plastic material used in the manufacture of a product or packaging. It is a voluntary scheme to assist collectors when sorting the collected plastics by material type. The symbols do not necessarily indicate that a product can be recycled or is made from recycled content. Table 1 provides a summary of the types of plastics used today and options for recycling.

Table 1 Plastic Coding System (Source: PACIA 2005)

Plastic Identification Code	Name of plastic	Description	Some uses for virgin plastic	Some uses for plastic made from recycled waste plastic
	polyethylene terephthalate (PET)	Clear tough plastic, may be used as a fibre.	Soft drink and mineral water bottles, filling for sleeping bags and pillows, textile fibres.	Soft drink bottles, (multi-layer) detergent bottles, clear film for packaging, carpet fibres, fleecy jackets.
	high density polyethylene (HDPE)	Very common plastic, usually white or coloured.	Crinkly shopping bags, freezer bags, milk and cream bottles, bottles for shampoo and cleaners, milk crates.	Compost bins, detergent bottles, crates, mobile rubbish bins, agricultural pipes, pallets, kerbside recycling crates.
	unplasticised polyvinyl chloride (UPVC)	Hard rigid plastic, may be clear.	Clear cordial and juice bottles, blister packs, plumbing pipes and fittings.	Detergent bottles, tiles, plumbing pipe fittings.
	plasticised polyvinyl chloride (PPVC)	Flexible, clear, elastic plastic.	Garden hose, shoe soles, blood bags and tubing.	Hose inner core, industrial flooring.
	low density polyethylene (LDPE)	Soft, flexible plastic.	Lids of icecream containers, garbage bags, garbage bins, black plastic sheet.	Film for builders, industry, packaging and plant nurseries, bags.
	polypropylene (PP)	Hard, but flexible plastic - many uses.	Icecream containers, potato crisp bags, drinking	Compost bins, kerbside recycling crates, worm factories.

Plastic Identification Code	Name of plastic	Description	Some uses for virgin plastic	Some uses for plastic made from recycled waste plastic
			straws, hinged lunch boxes.	
	polystyrene (PS) expanded polystyrene (EPS)	Rigid, brittle plastic. May be clear, glassy. Foamed, lightweight, energy absorbing, thermal insulation.	Yoghurt containers, plastic cutlery, imitation crystal "glassware". Hot drink cups, takeaway food containers, meat trays, packaging.	Clothes pegs, coat hangers, office accessories, spools, rulers, video/CD boxes.
	Includes all other plastics, including acrylic and nylon.			

Total plastics consumption in Australia in 2004 was 1,510 839 tonnes (1,521,394 tonnes in 2003) (PACIA 2005). Figure 1 shows the consumption of plastics for single-use or short-term packaging applications and the more durable non-packaging applications. HDPE, LDPE, PS, EPS and nylon that make up the majority of packaging, are key plastics consumed by the Australian seafood industry. All have the potential to enter the waste stream very quickly.

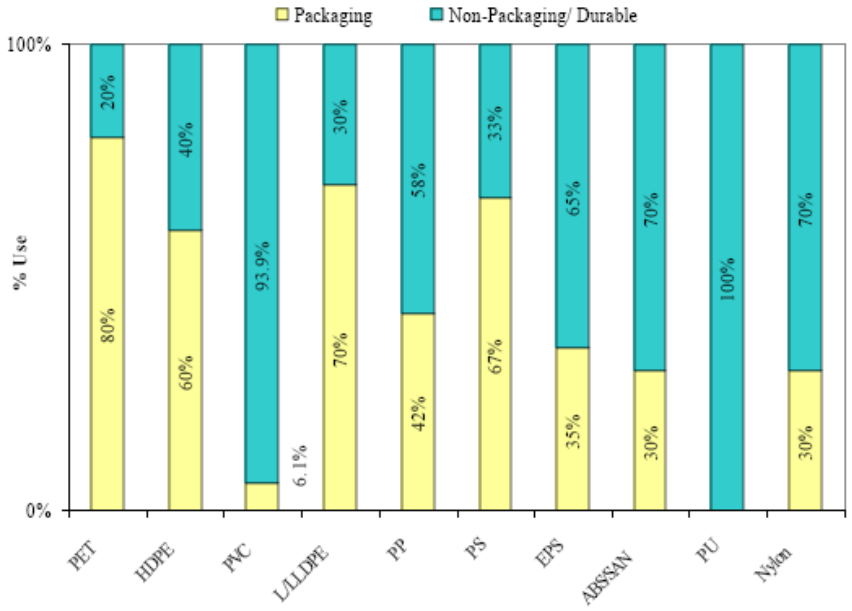

Figure 1 Packaging and non-packaging/durable use of plastics (Source PACIA 2005)

1.2.1 The introduction of plastic into the Australian seafood industry

Plastics were introduced into the seafood industry in the 1960s. There can be no denying the benefits of plastic, with the seafood industry standing out as one of its biggest beneficiaries. Plastics, along with other modern technologies, have played a major role in changing the way seafood is harvested, transported, marketed and stored. On fishing boats for example, anchor lines and rigging changed from sisal to synthetics, floats changed from cork or glass to plastic or foam, nets moved from natural fibres to synthetics and timber boxes and cane baskets were replaced with plastic tubs, crates and pallets. In the post harvest sector, produce found its way into homes wrapped in not one, but two plastic bags to ensure product freshness, reduce spoilage and keep it well separated from other groceries.

Table 2, taken from the Nolan ITU (2005) report provides estimates of HDPE carry bag consumption on a retail sector basis. There is currently no direct measurement of plastic bag consumption across all sectors on a sector-by sector basis and hence it is difficult to extrapolate what this means for seafood industry plastic bag usage.

Table 2 Estimated 2002 & 2005 HDPE carry bag consumption by sector (Source: Nolen ITU 2005).

Retail Sector	2002 Bag Consumption (billions)	Est. 2005 Bag Consumption (billions)	Change (%)
Supermarkets	3.64	2.44	-33.0%
Other food and liquor	0.92	0.71	-23.05
General merchandise and apparel	0.58	0.49	-16.0%
Fast food, convenience and service stations	0.35	0.30	-15.0%
Other retail	0.46	0.37	-20.0%
Total	5.95	4.30	-27.7%

1.3 The Australian packaging industry

As a nation we cannot deny the economic benefits of plastics and the packaging industry. The value of packaging produced in Australia is estimated to be $AUD7-7.5 billion. By international standards the Australian market is extremely small. The value of world packaging is estimated to be $US300 billion (PCA 2005).

The Australian plastics industry accounts for slightly in excess of 1% of GDP. About 30,000 people are directly employed in the production of packaging in Australia. The two major packaging manufacturers in Australia are almost entirely Australian owned, as are a substantial proportion of small and medium enterprises (SME). Paper/board packaging is the largest single material constituting about 36% of the total Australian packaging market. Plastics have gained significant market share to be the second largest sector (30%), with flexibles increasing at the expense of rigid plastics. In the early 1960s plastics had less than 10% of the share of the packaging market. Metal packaging has lost market share in food applications, but still accounts for 20%, with glass at 10%. Other types of packaging make up the remainder (PCA 2005).

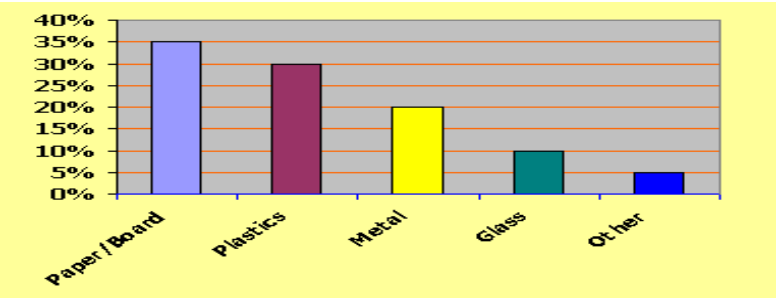

Figure 2 Market share of packaging alternatives within Australia (Source: PCA 2005)

Within the pre-consumer and post-consumer sectors, recycled plastic is sourced from a variety of market sectors. Figure 3 presents the market sector sources of recycled plastics in detail. The Australian seafood industry is included in Commercial and industrial (C&I).

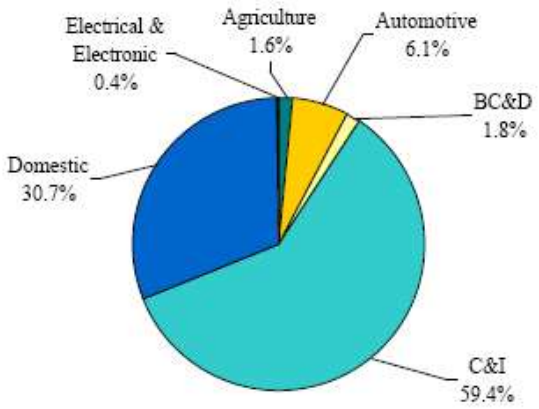

Figure 3 Market sector sources of recycled plastics (Source PACIA 2005)

1.4 The costs and benefits of plastics

Although plastics usage is having detrimental impacts via marine debris within waterways and to our marine life the environmental/economic benefits of plastics, particularly during manufacture need to be acknowledged. Some of these benefits, as identified by Plastics New Zealand (2003) include:

- the reduction in reduced food spoilage and total loss to as little as 2% through modern food packaging techniques;
- total air pollution emissions through all stages of plastic production, use and disposal range between 63% and 73% less than the alternatives;
- substantial reductions in transport costs for plastics, for example, previously approximately seven trucks would have been required to deliver the alternative more bulky product equivalent to one truck load of plastic bags;
- a reduction in fuel costs of $18,000 per year through the use of plastic drink bottles on aircraft for New Zealand; and
- total waterborne wastes from the manufacture of plastics are approximately 90% less than those created during the manufacture of alternatives.

The development and use of plastic has come a long way in a reasonably short period of time and consumers have welcomed that advancement with open arms. For example, in 2002 Australians used almost 1,200,000 kilotonnes of plastic (that is 60kg per person) (Zero Waste 2002) with only 12.6% of this being recycled in 2004 (PACIA 2005). It is to be noted however, that this recycling rate was the highest on record to date. A levy on plastic carry bags of 26 cents per bag introduced in 2002 in Ireland resulted in a rapid drop in consumer use of plastic bags by 90%, which clearly demonstrates that consumers can use alternatives and can learn to better manage their use of plastics when forced to.

With benefits come costs and with plastic, one of the greatest losers is the environment, in particular the marine environment. Every year, ships throughout the world jettison 5.5 million items of waste, of which many are plastics, in the sea (that is three times the amount of fish caught annually) (Australian Marine Conservation Society, 2004).

1.4.1 The marine environment

Waste enters our oceans and waterways at a continuing alarming rate. The National Academy of Sciences estimates that 6.4 million tonnes of rubbish enters the world's oceans each year (UNEP nd). This included rubbish from merchant ships, fishing fleets, passenger cruise liners, military ships, oilrigs and recreational boats. Other sources suggest that as many as 8 million pieces of rubbish enters the oceans and seas each day (UNEP nd). Plastics are the most common type of marine debris worldwide. Globally the proportion of plastic among marine debris ranges from 60-80% (Derraik 2002).

Apart from deliberate dumping and littering, stormwater outlets and the wind are the main carriers of rubbish into our marine environment, creating a form of marine debris. Approximately 70% of marine debris sinks to the bottom, 15% floats on the surface and the remaining 15% is washed up onto our coastline (NSW EPA 2004). Plastics comprise up to 90% of all floating marine debris (UNEP nd). The life of plastic in our environment is unknown, however a plastic 6-pack ring could last up to 450 years (NSW EPA 2004).

Many studies (Faris and Hart, 1995; Willoughby, et al., 1997; Gregory, 1998; Alderman, et al., 1999; Donohue, et al., 2000; Barnes, 2002; Derraik, 2002; Mayell, 2002 as referred to in Kiessling (2003) have shown that marine debris not only causes injury and fatality to marine wildlife through entanglement and ingestion, but it can also:

- smother coastal and benthic habitats and directly threaten coral and temperate reef ecosystems through the abrading and scouring of coral/temperate substrates as derelict fishing gear snags on coral outcrops;
- cause deterioration in water quality in estuaries and along beaches; and
- facilitate the spread and regional introduction of marine pests and weed species.

The statistics on the amounts of waste entering our oceans and the destructive impacts of marine debris are mind-boggling. For example, approximately 100,000 metric tons of monofilament line and fishing gear are dumped/lost into the ocean each year around the world. A worldwide estimate of lost trawl netting amounts to anywhere between 19,964 to 217,350 kilometres annually (Pacific Whale Foundation, 2005).

Protected species such as turtles, whales, dugong, and sawfish and some birds have been recorded entangled in fishing debris along areas of the coastline. Of all debris types responsible for the death and injury of marine wildlife, fishing nets have been responsible for entangling the majority of marine wildlife in Australia. The primary concern is with solid debris that can be sourced to, or associated with, marine-based activities such as fishing and shipping.

As stated by Kiessling (2003), marine debris is a complex issue that requires development of integrated, collaborative solutions among different sectors and across institutional and jurisdictional boundaries. There is a critical need for detailed information on where marine debris comes from, who is responsible for it, why it occurs, what materials are being lost and dumped and how best to alter the practice of those who are contributing to the problem.

Many of the species that are impacted by debris are listed as endangered or threatened under national and international conservation conventions (Laist, 1997; Laist and Liffman, 2000 as referred to in Kiessling 2003). Waterborne litter masquerading as a food source can, when ingested, starve animals by preventing further ingestion, but it can also reduce absorption of nutrients, result in ulceration, and cause animals to become more buoyant thereby inhibiting diving (Beck and Barros, 1991; Bjorndal, et al., 1994; Sloan, et al., 1998; EPA/QPWS, 2000 as referred to in Kiessling 2003). Tiny fragments of degraded plastic may be consumed by and effectively 'strangle' filter feeders by inhibiting their ability to feed (Faris and Hart, 1995; Moore, et al., 2001 as referred to in Kiessling 2003). Research has also demonstrated that there is a strong potential for biological uptake of heavy metals and/or other toxic substances through ingestion of suspended 'microplastics' (Balazs, 1985; Ananthaswamy, 2001; Mato, et al., 2001 as referred to in Kiessling 2003).

Kiessling (2003) identified that the composition and sources of marine debris in the Arafura Sea, a hot spot for marine debris, is important in identifying where efforts at finding solutions should be directed. Both the composition and source of marine debris varies considerably depending on where it is found. Close to population centres for example, debris will often comprise around 75-80% urban litter, and typically consist of food packaging, plastic shopping bags and six pack rings that have reached beaches via streams and drains. In contrast, litter accumulating on coastlines distant from urban centres is more likely to originate from marine sources such as fishing vessels and cargo ships.

In 2003, *Injury and fatality to vertebrate marine life caused by ingestion of, or entanglement in, harmful marine debris* was listed as a key threatening process under the *Environment Protection and Biodiversity Conservation Act 1999* by the Australian Government.

1.4.2 The terrestrial environment

Rubbish is transported to, and ends up on the terrestrial landscape in much the same way as the marine environment, that is, by littering, dumping, carried by the wind or via stormwater. While the majority of waste is disposed to landfill, ocean borne rubbish can be carried onshore by currents, winds and waves. Some of the harmful effects of terrestrial rubbish include:

- ingestion by livestock;
- smothering of vegetation;
- clogging of waterways;
- encouraging the spread of vermin; and
- visually unsightly.

1.5 The focus and success of plastic reduction campaigns

The invasion of plastic and the recognition of its impacts on our natural environment have been a growing concern for all tiers of government, non-government organisations (NGO's) and the community for a number of years. Over ten years ago concerns for the environment and economic costs of waste brought about massive increases in recycling and waste disposal awareness in Australia and around the world. In particular, plastic carry bags are continually the number one on the "Most Wanted" list. It is important to remember however, that although the media attention is on plastic bags, there are many other types of packaging etc that go unmentioned, yet should not be ignored when it comes to finding alternatives.

The need to reduce waste in Australia resulted in the establishment of a number of not for profit NGO's, namely organisations such as Keep Australia Beautiful, Clean-Up Australia and Planet Ark. These organisations set about raising awareness through numerous recycling, waste reduction and clean-up campaigns. These campaigns saw the establishment of successful working partnerships between all tiers government, community groups and industries. Since its establishment in 1991 Planet Ark for example, in partnership with governments, industries and community groups have delivered a number of successful environmental campaigns including *National Recycling Week*, the *Plastic Bag Free Towns* campaign and the *Plastic Bags Reduction* campaign.

Waste collection survey results for Clean-Up Australia Day, 2005 found that plastics made up 32% of all rubbish collected, which was a decrease of 5% on the 2004 survey.

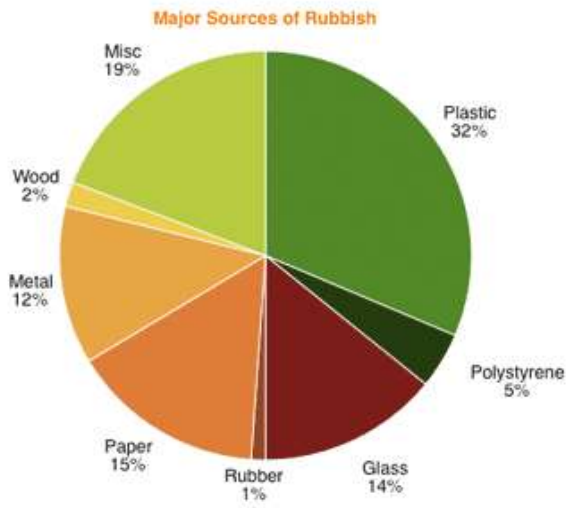

Figure 4 The types of rubbish collected during Clean Up Australia Day 2005 (Clean Up Australia 2005).

In 1992 the Australian and New Zealand Environment and Conservation Council (ANZECC) adopted a national target of 50% waste reduction by the year 2000. Concurrently, all States and Territories set ambitious waste minimisation goals to meet or exceed national targets. Available information indicates that although waste reduction has occurred, mostly through recycling, the original targets have not been met by States and Territories (Australian State of the Environment Committee 2001).

In 2003 the Australian Government established a range of targets relating to the reduction and recycling of retail carry bags. These targets included a 25% reduction in the number of HDPE bags issued by the end of 2004 against the base of December 2002 and a 50% reduction by the end of 2005. HDPE plastic carry bag consumption decreased by 20.4% from 2002 to 2004 and was projected to reach 25.4% for 2005 thereby reaching the Australian Government target. From the 2002 baseline consumption, this equates to a saving in the use of HDPE retail carry bags of 3.58 billion bags over the 3 years (Nolan ITU 2005).

In March 2003 about 95% of Australian households recycled waste, 83% re-used waste, while only 2% did not recycle or re-use at all. Households in Victoria, the Australian Capital Territory and South Australia had the highest rates (99%) of recycling and/or re-using waste. The percentage of households not recycling was highest in the Northern Territory (7% of households) (Australian Bureau of Statistics 2005)

Waste disposal is one of the greatest dilemmas facing the world today. The diminishing options for waste disposal worldwide create the urgent need to develop and use alternatives to plastics in all industries. The ever-disappearing waste disposal options dictate differing approaches to the way plastics are used and disposed of.

The convenience of today's packaging continues to support the image of a throw away society, ironically a leading brand name of takeaway food and drink containers is *Castaway.* The easy access and availability of plastic products, particularly shopping bags and food containers makes if all too easy to produce and consume excessive volumes of plastic without giving the detrimental long-term effects a second thought. However, the long list of successful plastic reduction, recycling and alternative use campaigns clearly indicates that we can quite easily reduce the amount of plastic we use and in some instances we can completely remove it from our day to day lives.

The National Plastics Recycling Survey for 2005 (PACIA 2005) revealed that in 2004 a total of 140,584 tonnes of plastic recycled was packaging material. The total consumption of plastic used for packaging applications in 2004 was 634,380 tonnes, giving an overall plastic packaging recycling rate of 22.2%. The total quantities of recycled plastics by polymer from all sectors, including packaging and non-packaging (durable materials) is presented in Table 3.

Table 3 Total recycling (in tonnes) and recycling rates of polymers in 2004 (Source PACIA 2005)

Polymer	Consumption	Domestic Reprocessing	Export for processing	Total Recycling	Recycling Rate
PET	131,708	17,190	18,862	36,052	27.4%
HDPE	280,368	34,839	20,194	55,033	19.6%
PVC	235,871	9,926	1,904	11,830	5.0%
L/LLDPE	275,203	28,945	10,849	39,794	14.5%
PP	231,675	20,681	6,600	27,280	11.8%
PS	45,821	2,187	2,593	4,780	10.4%
EPS	35,496	1,600	907	2,506	7.1%
ABS/SAN	23,826	1,655	0	1,655	6.9%
Polyurethane	46,056	6,178	0	6,178	13.4%
Nylon	18,441	507	0	507	2.8%
Other	186,373	5,364	0	5,364	2.9%
Total	1,510,839	129,072	61,908	190,979	12.6%

Note: In the table above minor discrepancies may occur between the stated totals and the sums of the component items. Totals are calculated using component item values prior to rounding, and therefore a minor discrepancy may occur from those that could be calculated from the rounded figures given above.

2. Project scope and methodology

The project *Reducing Plastics in the Australian seafood industry* consists of three phases:

Phase 1: a desktop, global best practice, benchmark study to review plastic/non recyclable products used by domestic and international wild catch seafood industries or similar industries across the seafood supply chain and alternatives and reuse/recycle strategies available.

Phase 2: a three to six month pilot program to identify and trial packaging alternatives. This will involve working with a selection of seafood companies, as well as plastic manufacturers and freight companies/airlines etc willing to participate. Ideally, pilot participants would be identified at each stage of the seafood supply chain to ensure options can be thoroughly trialled and will satisfy all regulations, standards etc relating to health and seafood. Close interaction would also be made with the food safety and health regulators to ensure these criteria continue to be satisfied.

Phase 3: the role out of the pilot program to other industry stakeholders across Australia over two years. This phase will involve an internal marketing and education campaign by existing seafood associations and organisations, and negotiation with packaging companies to supply alternatives at competitive prices. Input will also be given into standard setting for the seafood industry relating to packaging and the supply chain.

2.1 Project scope and approach

This report addresses the Phase 1 of this project. From a review of relevant Australian and international literature and other materials, and interviews and discussions with key industry (including seafood, food and packaging) and government stakeholders, the following aspects were reviewed:

- the volume and the types of plastics used in the Australian seafood industry for harvest, wholesale, retail/consumption;
- a comparison with the situation internationally to identify case studies for innovative use of environmentally friendly plastics and other innovative measures adopted to reduce plastics use;
- the existing technology that is available to produce environmentally friendly plastics for use in the seafood industry in Australia and overseas;
- the use of plastics and measures taken to reduce plastic consumption in other relevant industries;

- the costs associated with production of new plastics verses the costs of more environmentally friendly plastics such as recycled plastics or alternatives;
- existing legislation, standards and policies for plastics use/reuse/minimisation across the industry (nationally and internationally – legally binding and voluntary initiatives); and
- companies identified as interested in piloting new programs relating to the use of packaging innovations within the seafood industry. This will include seafood businesses, packaging businesses, transport companies, recycling companies and environmental groups leading the charge on plastics reduction.

Recommendations from the desktop feasibility study are provided in Section 6.

Phase 1 commenced in September 2005 and was completed in May 2006 with the submission of the final report.

2.2 Project stakeholders

Key stakeholders who could benefit from the findings of this project include:

- line, trawl, trap and diving based commercial fisheries (wild catch harvest sector);
- commercial fishing co-operatives and fish processing centres;
- exporters;
- distributors and transporters - local and international;
- Sydney Fish Market and other auction houses for seafood;
- seafood retailers - fresh and cooked;
- bait suppliers and retailers;
- packaging manufacturers;
- environmental organisations;
- industry peak bodies and other service providers such as Seafood Services Australia, Master Fish Merchants Association and OceanWatch Australia etc;
- various local, state and commonwealth government departments; and
- consumers and the general public.

3. Plastic usage in the Australian seafood industry

3.1 Types of plastic used

A number of plastic products directly associated with the seafood industry have been identified as part of this desktop feasibility study as having the greatest detrimental impact on the marine and terrestrial environment. These items have been identified from information gained through consultation with industry stakeholders and local government waste officers, site observations, desktop research and existing statistics from various environmental programs and anti-litter campaigns by Planet Ark and Clean Up Australia

These items include:

- carry bags and plastic sheets;
- polystyrene boxes and takeaway food containers/cups;
- bait bags and strapping for bait boxes;
- produce bags, that is, bulk tear-off bags;
- plastic plates and cutlery
- tuna bags and wrap sheets;
- fishing nets;
- monofilament fishing line (recreational and commercial); and
- light sticks.

In the seafood industry plastic products are found in many forms. In the harvest sector a variety of products are used across different locations, but for the same purpose i.e. in South Australia some fisherman are using polystyrene floats while in other parts of the country hard plastic floats are being used. These differences may be due to the size of the operation justifying extra cost, or due to the expected lifespan of floats relating to different sea conditions.

Early fishing gear was made from natural fibres such as cotton, hemp or flax (Jones, 1994 as referred to in Kiessling 2003). However, with the introduction of plastics after World War II, the fishing industry replaced organic net materials with synthetics (Faris and Hart, 1995; Minton, 2000 as referred to in Kiessling 2003). The preferred materials for nets now tend to be polyethylenes and polypropylenes which float, and nylon

monofilament line which sinks. Modern fishing gear constructed of these synthetic fibres is cheaper, more durable, lighter, stronger, and more efficient than most traditional gear, and fisheries operations now comprise the most significant input of debris to the world's oceans from marine sources (Faris and Hart, 1995; Minton, 2000 as referred to in Kiessling 2003).

Table 4 summarises the different plastic products identified as being in use across the supply chain (from harvest to retail) and indicates which items can be recycled, composted, sold for scrap or replaced with an environmentally friendly alternative. Information in this table was compiled from surveys conducted with the seafood industry (Refer Appendix B), interviews and workplace observations as part of this feasibility study.

Table 4 Typical plastic items used in the seafood industry

Plastic Item	Recyclable	Possible scrap value	Alternative	Possible alternatives available
Polyethylene and polypropylene nets	●	●		Recycling options only
Monofilament lines	●	●		Recycling options only
Ropes	●	●		Recycling options only
Buckets (consumable containers)	●	●		Recycling options only
Floats (Foam)	●	●		Recycling options only
Floats (Plastic)	●	●		Recycling options only
Fish boxes (hard plastic)	●	●		Recycling options only
Tuna bags	●	●		Recycling or reuse options
Tuna mats	●			Recycling or reuse options
EPS boxes	●	●	●	CoolSeal type boxes (under trial)[1]
Produce bags including bait bags	●		●	Starch based biodegradable bags
Sheeting	●		●	Starch based biodegradable bags
Carry bags	●	●	●	Starch based biodegradable bags. Degradable bags. Calico bags. Paper bags. Non Woven

[1] As at April 2006, alternatives for some of the items identified in Table 1 were at an advanced stage of R&D. i.e. end seal flute board (CoolSeal by Corex) transport boxes are currently undergoing floor trials and starch based biodegradable bags are being further developed to suit the seafood industry.

Plastic Item	Recyclable	Possible scrap value	Alternative	Possible alternatives available
				Polypropylene (green bag)
Serving plates, trays, bowls and cups	•		•	Cardboard. Cornstarch coated paper. Sugarcane fibre (all compostable)
Foam takeaway boxes	•		•	Same as above plus biodegradable/degradable
Cutlery	•		•	Biodegradable polymer
Export boxes	•			Recycling or reuse options
Transport insulated tubs	•			
Pallets	•	•		
Light sticks				Recycling options

From Table 4, all of the plastic items most commonly used in the seafood industry can be recycled and some have a scrap value. The items listed without an alternative are products directly associated with commercial harvest, transport and sale of seafood and at this stage there is no real alternative for these items, except a return to natural fibres and timber. Recycling or reuse options for these items however, do exist.

It is noted that when an item is labelled recyclable, it should not be assumed that the item would be recycled back to a similar item. For example, the "recycling" of some grades of plastics (plastic bags included) may involve a process of converting waste plastics into small pellets. These pellets are then used as "shot" in abrasive blasting, a process that may be perceived as far removed from the assumed environmentally friendly outcomes of recycling.

The intrinsic scrap value of some waste plastic resources may vary greatly depending on a number of factors i.e. transport, grade, quantity and contamination. The tuna fleet, for example operating out of Mooloolaba, Queensland, are currently being supplied with around 50,000 plastic tuna bags per month. These bags are used to protect fish from ice burns and skin abrasions whilst kept on ice at sea. Once the vessel returns to port the bags are removed and discarded. At present these bags are disposed of to landfill, however if they were sorted, cleaned and delivered to Brisbane they may have a cash value of up to $250 per tonne. If this option was found to be viable, the beneficial impacts on an annual waste disposal bill to landfill of $45 000 are obvious.

A recent physical site inspection undertaken as part of this desktop feasibility study at Sydney Fish Market again highlighted the opportunity for alternatives or recycling. This survey was not intended to single out the Sydney Fish Market, but rather reflects a national approach with seafood retail outlets for disposal of waste. Twenty takeaway food containers and serving trays from a variety of food outlets were examined. These

items were made from a variety of material including polyurethane, polyethylene, cardboard and aluminium. The items were of different shapes and sizes, from an opened 150mm x 100mm rectangle cardboard dish valued at less than five cents each, to a large dinner plate sized plastic tray with imitation embossed mother of pearl valued at over $1.70 each (imported from Japan).

Out of the twenty containers examined, twelve were embossed with the numbered Plastic Coding System (PACIA 2001). When meals are finished the current practice is to deposit all waste into general bins with no options of separation. Given the quantity of packaging waste at this site it is assumed that most, if not all of the discarded food containers including: cutlery, paper napkins, poly cups, bottles, and drink cans could potentially be recycled or composted.

Figure 4 Recycling opportunities with unsorted waste to be taken to landfill

3.2 Volume of plastics used in the Australian seafood industry

Little, comprehensive baseline data has been identified on the volumes of plastic used, volumes of waste generated or volumes of plastics recycled or reused for the Australian seafood industry. The lack of tangible information indicates the need to further research national and international seafood industry trends in plastic consumption. Exact figures on plastic consumption in the seafood industry are hard to extract due to the individual purchasing patterns of harvesters, wholesalers and retails. It is assumed that retail sales of fresh and cooked seafood see the highest volume of plastic usage in the seafood industry, post harvest and that nets, nylon, tuna bags and EPS boxes would make up the majority of plastics used in the harvest sector.

3.2.1 Harvest sector

ABARE (2004) provides information on the number of vessels/permits/licence holders across all fisheries in Australia. It is difficult to determine from this information however, how this can be used to measure the number of nets, ropes, line, EPS boxes and other plastic items consumed by seafood harvesters. The Yellow Pages identifies 59 commercial net makers and line suppliers across Australia. There are at least 24 EPS manufacturers and suppliers across Australia (who are members of PACIA).

An examination of some surveys of marine debris can provide some insight into the composition of discarded plastics residing in our coastal waters and onshore. Kiessling (2003), in a review of derelict fishing gear and other marine debris issues in Northern Australia, found that prawn and gill nets of Australian use contributed to 12% of all nets identified. Nets manufactured in Taiwan accounted for 26 – 39% of all nets identified, while nets manufactured in Indonesia and Japan accounted for 17% and 11% respectively. Approximately 9% of nets found could not be reliably identified. Although Australia's contribution to this one area of Australia of derelict fishing nets is small, the impact of this form of marine debris on endangered wildlife has been extensively documented (Kiessling 2003).

Kiessling (2003) reported that land-based surveys of the north-west coast of the Gulf of Carpentaria indicate that derelict fishing nets comprise a relatively small proportion by number, but a very high proportion by weight of debris items washing ashore. Many of the nets recorded in surveys at north-east Arnhem Land are so large that they are not able to be weighed. Fishing net fragments ranged from small pieces of less than 1m² to entire nets (including drift nets several kilometres long) to enormous bundles made up of many different types of nets that have amassed and tangled at sea. For example, a large floating bundle of different types of net was sighted and recovered from NT waters in July 1995. The recovered net bundle weighed nine tonnes and required three trucks to remove it once it was ashore. Queensland Boating and Fisheries Patrol officers retrieved an abandoned 1km long drift net (containing entangled fish) from waters near Kerr Islet in the Torres Strait.

Smaller fishing operations/co-operatives indicated that they spent less than $4,000 per annum on plastic items which included fish box replacements/repairs, larger transport box replacement/repairs, tuna bags and wrap sheets. Larger operations, such as the Mooloolaba Tuna Fleet for example, are currently being supplied with 50,000 tuna bags per month at a cost of 80 cents each. That equates to 600,000 bags per annum, or $480,000 per annum. Excluded from these figures are individual plastic wrap sheets, which at times exceeds 50,000 per month.

Figure 5 Discarded fishing net

3.2.2 Post harvest sector

Across Australia, from a review of listings of seafood retailers in the Yellow Pages there are approximately 50 seafood wholesalers and 1, 179 retailers as follows:

- NSW 389
- WA 156
- ACT 7
- QLD 302
- SA 71
- NT 7
- VIC 288
- TAS 19

Sydney Fish Market performed a waste assessment in 2005 which identified (via in-situ visual observations) polystyrene (24.1%), cardboard (21.5%) and plastic (13.7%), respectively as contributing the greatest volumes to waste composition. All are currently going to landfill. From an analysis of total estimated mixed waste generation going to landfill (1835 tonnes p.a), it can be estimated that this equates to approximately 440 tonnes, 394 tonnes and 250 tonnes of polystyrene, cardboard and plastic respectively going to landfill per annum (SFM 2005),

The preliminary plastics usage survey undertaken as part of this desktop feasibility study indicated that individual retail outlets are spending $10,000, on average, per annum on plastic items (Refer Appendix 2 for survey results). These items included plastic carry bags, plastic tear-off bags, plastic serving trays, cutlery and foam takeaway containers. This equates to 530,000 - 545,000 items per annum per outlet (per discussions with packaging suppliers) and therefore extrapolated is in the order of at least 625 - 643 million items per annum for retailers.

Some examples of volumes of plastic packing used per annum (carry bags, produce bags and serving trays) from seafood retail outlets extracted from the survey are as follows:

- Single shop: Fresh and cooked seafood retail store located in a busy NSW coastal town uses 530,000 - 545,000 items per annum.
- A group of four shops: Fresh and cooked seafood outlets located adjacent to seafood co-operative uses 960,000 – 975,000 items per annum collectively.
- 8 busy retail shops: Fresh and cooked seafood outlets located in a busy seafood market place selling a greater variety of produce including shellfish and Asian cuisine uses 11,175,000 – 11,250,000 items per year collectively.

Due to the nature of the industry and the health and consumer requirements associated with seafood no recycled plastic products were identified during the survey as being used in the produce chain. No packaging items derived from recycled plastic were being used by those retailers surveyed. In addition, due to health and safety regulations, plastic items cannot be washed and reused. The only items produced from recycled plastics products were found in seafood transport in the form of pallets, transport tubs, floats and fish boxes.

4. What is being done to reduce plastics in Australian and international seafood industries?

Identifying national and international plastic reduction campaigns in seafood industries has proven difficult. Generally, the little information available indicates that although there is an international campaign to reduce plastic bags, there is little going on within seafood industries both within Australia and internationally to reduce plastics. Information is however, readily available promoting the research and development (R&D) of new innovations in packaging and handling, aimed at reducing plastic consumption/waste in industries such as the seafood industry. This section provides a summary of the information that was readily available regarding plastics use and reduction and R&D across a range of countries and domestically both relating to seafood industries and other similar food based industries.

4.1 Regulations and standards

Australian seafood is required to comply with a number of minimum standards with respect to food safety and quality. In most cases these standards are tougher than international requirements with respect to food. To this end, for businesses to compete in domestic and international markets while meeting these standards, cost effective solutions are required. The following section provides a summary of the key regulations and minimum standards that the seafood industry must comply with. These regulations and standards have played a major role in determining the direction the seafood industry has taken with respect to cost effective packaging, namely through the use of plastics. It is interesting to note however, that although these regulations and standards do not dictate the use of plastics to meet the requirements, and in some cases provide a range of approved packaging materials, cost has dictated the adoption of plastics as the primary product used for packaging within the Australia seafood industry.

4.1.1 *The Food Act 1984* and Food Safety Practices and General Requirements (AS 3.2.2)

The *Food Act 1984* requires all Australian business operators and food handlers to comply with the Food Safety Standards. *Standard 3.2.2 Food Safety Practices and General Requirements* sets clear requirements for food businesses to make sure that food does not become unsafe or unsuitable. This Standard sets the requirements for all food handling activities such as the receipt of food, storage, processing, display, packaging, transporting, disposal and recall of food. The Food Safety Standards are

enforceable under the *Food Act 1984* and all food premises and food handlers must comply with these Standards. These Standards require food to be stored, handled, packaged in a manner that is safe and suitable. Although not specified, a suitable and safe means to meet the standard is through the use of plastics.

4.1.2 The Primary Production and Processing Standard for Seafood (AS 4.2.1)

This Australian Standard sets out food safety and suitability requirements for seafood generally from pre-harvesting production of the seafood up to, but not including manufacturing operations. The Standard provides industry with a single standard for the safety and suitability of seafood produced or traded commercially in Australia. The Standard aims to increase consumer confidence in Australian seafood, whilst providing the flexibility for seafood businesses to implement cost-effective, relevant and innovative management systems that meet food safety requirements. The Standard reflects the Australian seafood industry's commitment to providing seafood that is produced in accordance with internationally recognised standards.

Under the Standard, seafood is required to be stored, handled and transported in a way that will not adversely affect the safety or suitability of the seafood. In terms of packaging, the standard requires the following:

- only use packaging material that is fit for its intended use; and
- only use packaging material that is not likely to cause contamination of the seafood; and
- take all reasonable measures to ensure that the seafood does not become contaminated.

Although specific mention of the use of plastics is not provided within the Standard, the general interpretation and most likely cost effective means to satisfy the requirements in the Standard is through the use of plastics.

4.1.3 Seafood Air Transport Regulations (2006)

The Seafood Air Transport Regulations define packaging performance requirements, packing methods and a package approval system. It is a requirement of the airlines that all packaging used to transport seafood by air is tested against the minimum standards defined in the Seafood Air Transport Regulations. Packaging that meets the requirements of the Regulations is granted an Approval Number and may be used to transport seafood on any of the carriers participating in the approval programme. Over 200 such containers have been approved to date, offering the seafood industry a wide range of packaging options. The Packing Methods for containers approved in these Regulations are designed to minimise problems caused by packaging failure. Some of

the reasons for such failures include poor quality of containers (eg poorly cured expanded polystyrene - EPS), overweight packages, inappropriate or inadequate absorbent, no inner liner bag and/or improper taping. Previously used fibreboard or polystyrene containers will not be accepted for air transport. Metal, moulded plastic or fibreglass containers are acceptable for multiple use but must be clean and in good condition.

4.1.4 The National Packaging Covenant

In July 1999, ANZECC, now the Environmental Protection and Heritage Council agreed to the National Packaging Covenant (the NPC). The NPC is a voluntary agreement between key stakeholders in the packaging supply chain and all levels of government.

The aim of the NPC is to minimise the environmental impacts arising from the disposal of used packaging, conserve resources through better design and production processes and to facilitate the re-use and recycling of used packaging materials. The NPC has been revised to carry through to the year 2010 after expiring in July 2005.

The NPC encompasses the entire packaging chain including governments, producers, wholesalers, distributors, retailers, fillers and brand owners who make the key decisions on design and characteristics of the packaging used for their products.

Many Australian organisations and industries have signed the NPC as part of their commitment to reducing packaging waste along with their impact on the environment. Only 2 seafood companies have signed on to the Covenant, namely Austrimi Seafoods Pty Ltd and Dover Fisheries Pty Ltd. Companies that sign up to the Covenant are, inter alia, expected to:

- produce "Action Plans" for evaluating and improving environmental outcomes with respect to their packaging;
- adopt "product stewardship" policies and contribute to the effective environmental management of packaging throughout its life cycle;
- adopt the Environmental Code of Practice for Packaging;
- apply the principles of the Covenant in their own operations;
- contribute to the industry funding mechanism; and
- encourage greater recognition that packaging is a resource to be reused where practical and feasible, or to be disposed of with the least detrimental impact on the environment.

4.2 General seafood industry initiatives

4.2.1 Australian seafood industry

Within the Australian seafood industry, there are many examples of voluntary measures where groups within the harvest sector have identified, as part of developing an Environmental Management System the need for waste management and plastics reduction as a risk management measure. The Australian Seafood Industry Council has developed a voluntary *Code of Conduct for a Responsible Seafood Industry* for all aspects of the seafood industry based on the FAO Code of Conduct for Responsible Fisheries. Specific principles of the Code that relate to debris include:

- 1.5 Strive to minimise discards and all waste associated with fishing activities;
- 1.12 Record and report the loss and recovery of fishing gear;
- 1.13 Retain material such as derelict fishing gear and other garbage recovered during routine operations for disposal on shore;
- 1.14 Minimise the taking aboard of potential garbage through proper provisioning practices; and
- 1.15 Ensure crews of fishing vessels are trained to be aware of and understand proper shipboard procedure in order to minimise garbage discharge.

In addition, some harvest sector fisheries/groups have developed Codes of Practice and/or Codes of Conduct that also outline measures that collectively a group of fishermen will undertake to minimise waste.

Within the post harvest sector, some organisations, particularly the larger ones such as Sydney Fish Market, have undertaken waste audits and have plans in place or are developing plans to reduce waste, in particular plastics usage. More recently, a number of fishers have been participating in community clean up days and undertaking beach clean ups to remove discarded fishing debris, in particular nets, ropes and floats. Within the harvest sector a number of projects are underway to reduce plastics entering the marine environment. For example, OceanWatch Australia via its SeaNet Environment Extension Program recently assisted the South Australian Rock Lobster industry to eliminate a major threat to the marine environment and sea life, in particular fur seals, by removing plastic strapping from bait boxes.

Within the post harvest sector, some groups have and are attempting to reduce plastic usage. For example, the Coffs Harbour Fishermen's Cooperative is undertaking a trial of 100% recyclable/reusable, 10-kilogram fish boxes for transport to auction. These two case studies are discussed below.

Case Study 1: Minimisation of fishing related seal entanglement in plastic packaging straps in South Australia (2005)

The project *Minimisation of fishing related seal entanglements in plastic packaging in South Australia* was designed to reduce the probability of seal entanglement in South Australian waters by removing a source of entangling material, plastic packaging straps. The project had four objectives:

- to generate public and fishing awareness of marine mammal entanglement and mortality in plastic waste and other marine debris;
- to promote correct disposal procedures for all waste, but particularly of plastics on all rock lobster fishing vessels in South Australia;
- to encourage bait suppliers and processors to use bait boxes without plastic packaging straps; and
- to run a media campaign promoting the efforts of the commercial fishing industry to solve these ongoing environmental issues.

The project proposed the following outcomes:

- changing the behaviour of the industry;
- educating the industry about the interconnectedness of their actions and the potential for causing harm; and
- achieving environmental and conservation outcomes without more legislation and regulation and showcasing these achievements/outcomes to the community, politicians, conservation organisations and the industry themselves.

In addition to the project objectives, the industry proposed a number of industry specific targets related to the project, namely:

- achievement of environmental best practice;
- minimisation of impacts on rare, vulnerable or endangered species; and
- maintenance of ecology and integrity of marine ecosystems.

The awareness of an annual entanglement of 146 sea lions and the resulting death of 64 saw more than half of the 250 licensed Rock Lobster fishermen pledge an initial and continuing commitment to the project. A full copy of the report can be viewed at; www.oceanwatch.org.au

Case Study 2: Alternative to polystyrene boxes

Polystyrene boxes pose one of the major waste disposal challenges to the Australian seafood industry. Coffs Harbour Fisherman's Co-operative (the Co-op) in NSW has been trialling a replacement product aimed at reducing the volume of polystyrene fish transport boxes. The Co-op is working in partnership with the Sydney based company Corex in developing a 10 kilogram capacity, 100% recyclable/reusable insulated transport box. Corex have developed end-sealed fluteboard boxes (CoolSeal) from dimensions and requirements specified by the Co-op. The first batch of trial boxes are are currently being road tested.

Designed specially for the cold chain delivery of chilled fish, Coolseal boxes are rapidly penetrating the traditional expanded polystyrene packaging market. The flat-packed 100% recyclable polypropylene boxes are stacked or baled for collection or disposal after delivery of the fish. Patented technology is used to seal the edges of the fibre free fluted material resulting in a strong, yet extremely lightweight and hygienic pack.

Figure 6 Typical polystyrene box and alternate fluteboard "Coolseal" box

Apart from a small number of post harvest industry specific plastic reduction projects, the desktop feasibility study did not find a unified Australian seafood industry attempt to reduce, reuse or replace plastics. Generally, individual industry members or group efforts identified took many forms including:

- participating and supporting plastic free town initiatives;
- taking part in the *Say No To Plastic Bags* campaign;
- supplying alternative packaging, that is, biodegradable carry bags and compostable takeaway containers; and
- taking part in local plastic reduction campaigns, in partnership with other general retail outlets and local government.

4.2.2 International seafood industries

Extensive efforts were made to gather information on recent innovations in reducing plastics from overseas seafood industries i.e. Norway, Sweden, U.S.A., Canada, South Africa, Ireland and the European Union. Unfortunately information was not forthcoming, indicating that there are either no plastic reduction innovations in these industries or due to various reasons information deadlines were unable to be met.

One example of a specific plastic reduction initiative comes from the United Kingdom. Fishgate (UK) is a state-of-the-art fish market in Kingston-upon-Hull. Waste problems were created due to the large amount on fish delivered in EPS boxes. The management team at Fishgate was determined to find a positive environmental solution to the waste issue. Grant funding from the Department for Environment, Food and Rural Affairs secured the purchase of suitable compaction machine, enabling Fishgate to compact used EPS fish boxes, ready for reuse/recycling. Fish processors are charged a small amount for each box. The cost is set at a rate that is cost effective for them and encourages them to recycle rather than landfill their used fish boxes. Once the boxes have been compacted they are stored until large enough amounts can be sold, for a fixed sum per tonne, and collected by EPS recyclers. Management at Fishgate does not expect to make a profit but they do hope to make the scheme economically viable, ensuring its long-term sustainability (UK EPS 2005).

The need to reduce the volumes of polystyrene in the seafood industry has resulted in the trials of 100% recyclable/reusable flat pack fish transport boxes (Refer Section 3.2). The same boxes being trialled in Australia are already in use in European and South African seafood industries. This new product range, when and if fully adopted by the seafood industry will potentially reduce the volumes of polystyrene boxes.

Comparative insulation data and fact sheets are readily available on these and other similar packaging products, however, information and data on resource requirements and emission output during manufacture and disposal are harder to find when evaluating the true economic and environment benefits of a particular alternative product.

4.3 Related industries initiatives

Related food industries have set standards and developed Codes of Practise for the management of plastics, in particular plastic bags. As an Industry peek body the Australian Retailers Association (ARA) have developed a *Code Of Practice for the Management Of Plastic Bags*. Their volume reduction targets and recycling goals are examples of commitments for all related industries including the seafood industry. Again, these standards and Codes of practice are non-binding voluntary measures. The 2005 National Plastics Recycling Survey reported the level of plastics being recycled by commercial and industrial industries at 56.4% (PACIA 2005).

The Australian National Food Industry Strategy (NFIS) is working with key stakeholders towards ensuring long-term resource availability and responsible management of environment, energy and waste to support industry growth. This includes the implementation of market-based approaches to environmental management through initiatives in areas such as waste management, recycling, water conservation and energy conservation.

The seafood industry can only benefit from an integrated approach to plastic reduction and should work with other industries through groups such as ARA and the NFIS to reduce/reuse/recycle plastics and improve the sustainability of production of seafood.

4.4 Voluntary State and Territory programs

The governance frameworks with respect to reducing plastics usage within which the seafood industry operates across Australia are voluntary schemes. At this stage there is no indication that any level of government will introduce a levy on plastics to encourage consumer behavioural changes as is occurring in some countries. Education is the primary means of seeking consumer behavioural change in Australia. In addition, the government approach has been to focus on post consumer behaviour by investing in collection and recycling facilities.

The Australian Government and state governments provide a number of grant and incentive programs for industries to encourage investment in recycling technologies and to promote behavioural change. The Sustainable Industries Navigator provided by the Department of Agriculture, Fisheries and Forestry (DAFF) provides information on a range of government and industry programs and initiatives concerning eco-efficiency and sustainability in the food and agricultural industries. The navigator provides information on government grants, research initiatives, programs to encourage sustainability in the food industry and practices companies have implemented.

National umbrella campaigns such as those managed by Planet Ark and Clean Up Australia provide ongoing programs and resources aimed at:

- waste avoidance;
- recycling;
- reuse;
- resource recovery;
- valuing waste;
- waste to energy; and
- cleaner production.

All states and territories have waste reduction and recycling campaigns in place that provide opportunities for the Australian seafood industry to participate. Whether it is a government or non-government campaign their goals and waste reduction examples are well proven methods of reducing and recycling waste, in particular plastics. Waste reduction techniques and awareness campaigns aimed at a community-based audience are just as effective in the commercial sector. Their basic principals in waste reduction and recycling are ideal learning recourses for all members of the seafood industry.

Australian Capital Territory (ACT)

The *ACT NOWaste* campaign is implementing the ACT Government's Waste Management Strategy by:

- providing innovative strategic planning and policy advice on waste management issues;
- commissioning and managing contracts for the delivery of recycling and waste services;
- planning, developing and managing assets to optimise their effective and efficient use;
- implementing development control measures to minimise construction and demolition waste and to ensure onsite storage of waste and recyclables;
- is facilitating maximum recovery of resources within the community;
- is engaging, consulting and involving our community;
- ensuring that our operations are environmentally sustainable; and
- undertaking research to identify and develop innovative solutions to maximise resource recovery. www.nowaste.act.gov.au

South Australia

The objective of *Towards Zero Waste SA* is to promote waste management practices that, as far as possible, eliminate waste or its consignment to landfill, advance the development of resource recovery and recycling and are based on an integrated strategy for the State. *Zero Waste SA* is also providing assistance to local councils with arrangements for regional waste management, contributing to the development of waste management infrastructure and measures to improve waste management in South Australia. www.zerowaste.sa.gov.au

Western Australia

The mission of *Zero Waste Western Australia* is to assist in establishing and maintaining environmental, social and economic sustainability for present and future generations by eliminating the creation of waste, using resources sustainably and better managing the materials that cannot be diverted from the waste stream for productive use. http://zerowastewa.com.au

Victoria

Ecorecycle Victoria delivers environmentally sustainable outcomes for energy, materials and water, across all sectors of the Victorian economy and community. www.sustainability.vic.gov.au. The Environment Protection Authority recently launched REWaRDS, a $3 million, 3 year scheme in partnership with the Plastics and Chemical Industry Association (PACIA) that provides new opportunities to support waste reduction and resource efficiency initiatives.

New South Wales

The NSW Waste Avoidance and Recourse Recovery Strategy 2003 has a number of proposed actions and targets which are endorsed by the NSW Government. The Strategy provides a framework for reducing waste and making better use of our resources. Support for the Strategy has come from industry, community groups, environmental groups, individuals and local and state governments. www.resource.nsw.gov.au

Tasmania

Don't Waste Tasmania is a new state-wide television campaign which forms the centrepiece of a litter reduction by the Tasmanian Litter Reduction Taskforce. A re-branding of the *Do The Right Thing* campaign, the new campaign sets objectives to increase recycling and reduce litter in Tasmania.
www.southernwaste.com.au/littering/DontWasteTasmania

Queensland

Waste Management Strategy for Queensland's primary objective is to provide a framework within which waste can be managed effectively to minimise or avoid adverse impacts on the environment. The strategy covers; cradle to grave waste management, waste prevention, recycling, industrial waste, domestic waste and polluter and user pays' principals. www.epa.qld.gov.au/environmental_management

4.5 International approaches for reducing plastics

Again, the majority of readily available information relating to plastics reduction internationally targets plastic bags. Although the focus tends to be on plastic bags, it is assumed that any strategies for recycling and reuse would have application to other plastic products used by industries such as seafood. It is apparent that there are two distinct methods of reducing the impact of plastic bags on the environment internationally. One is to reduce the amount of plastic bags used in the first place, with initiatives aimed at consumers. The Irish plastic bag levy is an example of this. The second method is aimed at the post-consumer stage, using initiatives to improve plastic bag collection and recycling facilities.

This section provides a summary of some of the international initiatives on packaging and then an overview of initiatives being undertaken in some countries to reduce plastic bags. This is by no means a comprehensive listing.

4.5.1 Packaging

The information below relating to packaging initiatives has been taken from the *Environmental, Health and Safety Online* (2006) web site; www.ehso.com/SustainableDevelopmentlaws.htm

New Zealand

New Zealand has a packaging Accord which was signed in 2004 with over 200 signatories. This is a voluntary Accord. There are nine packaging sectors in the accord with the plastic sector having a 2008 recovery target of 23%.

EU Packaging Directive

The European Packaging Directive currently requires EU member countries to recycle or incinerate for energy recovery 50% of packaging waste (commenced June 2001). Under the Directive, countries must also achieve a minimum total recycling rate of 25% and recycle at least 15% of each type of packaging material covered by the Directive.

Japan

Most plastic packaging discarded by households in Japan is incinerated. In 2000, a new recycling law forced six times more recycling and reuse of plastic packaging waste (up from 20,000 tons to 120,000 tons/year). Local governments must collect the discarded packaging and business is responsible for recycling and reusing the materials into saleable products. According to Japanese officials, PET recycling has grown rapidly in Japan since 1997 when PET bottles and cans became subject to mandatory recycling.

France

The national recycling program for packaging, Eco-Emballages, which currently charges manufacturers a flat fee "per package" to help fund collection and recycling of packaging, will move to a sliding-scale fee based on volume, weight, packaging material and recyclability. The new fees structure is intended to reward packagers that reduce packaging volume and use easily recyclable materials. Under this approach, the charges for some types of plastic packaging go up, other packaging materials, such as paper, will pay relatively less.

Canada

Most Canadian provinces have container deposit systems, many of them covering more types of containers than deposit systems in the U.S. Alberta and Saskatchewan have voluntary stewardship programs through which the dairy industry helps cover the costs of recycling discarded plastic milk containers. British Columbia, which already has take-back programs for many household hazardous wastes, may consider a 10% recycled content requirement for non-food plastic containers. Ontario is forming a new "Waste Diversion Organisation" that will convene stakeholders to develop voluntary stewardship and take-back approaches for packaging and products. Quebec has a legislative proposal on the table that would require producers to pay for disposal of packaging and potentially other products. However, there has not been action yet on this proposal.

Korea

Korea has an Extended Producer Responsibility System (EPRS), which applies to most packaging and selected manufactures. Paper, metal, glass and plastic packaging are subject to the EPRS. In March 2002 a voluntary agreement was established with fast food restaurants. In an effort to reduce waste, a deposit is charged on disposable food containers. All government bodies will be required to purchase “environmentally friendly” products when the proposed Environmentally Friendly Product Purchase Promotion Act is introduced.

China

China has a Solid Waste Law which prohibits the importation of potential waste which cannot be reused or recycled. The law also introduces *cleaner production* regulations for packaging. China has also introduced bans on single use foam food containers.

Taiwan

Taiwan has a *Resource and Reuse Act* which introduces recycling and reuse measures. The Act requires the Environmental Protection Authority to limit or ban the use of packaging that does not comply with the Act. New regulations on excessive packaging are proposed for implementation in 2006 (Williams 2005).

United States of America

California has recycled content laws for glass, plastic trash bags and rigid plastic containers. In particular, California requires industry to maintain an overall 25% aggregate recycling rate for rigid plastic containers or individual brand owners will face a variety of alternative requirements, including a mandate for 25% post-consumer recycled content.

A bipartisan proposal has been made to strengthen Wisconsin's recycled content mandate for rigid plastic containers. Wisconsin currently requires that rigid plastic containers achieve an aggregate recycling level of 10% in the state or face recycled content requirements (use of pre-consumer industrial regrind counts toward meeting the target). The bipartisan proposal calls for raising the recycling target to 25% for rigid plastic containers and allowing only use of post-consumer plastic to count toward achieving the goal.

Los Angeles, New York City and Madison, Wisconsin - have issued or are considering resolutions pointing out potential problems associated with the recycling of newly test-marketed plastic beer bottles and the need for more use of secondary plastic in these containers. Other cities including San Francisco are participating in a grass roots campaign to encourage more use of secondary content in plastic beverage containers.

Austin, Texas has circulated a draft policy statement on extended producer responsibility that, among other things, calls on manufacturers to report on whether their products and packaging can be handled by the city's recycling program, how much recycled content they use and any take-back initiatives they are implementing. Certain distributors and retailers are required to provide information on the recyclability of some of their products.

4.5.2 Plastics reduction

The Nolan-ITU (Smith 2004) report for the Department of the Environment and Heritage reviewed approaches to dealing with plastic bags from around the world. Although not specifically targeting the seafood industry, in most cases the measures being taken by governments, impact on the seafood industries and their consumers in those countries.

A summary of the key findings for some countries from the Nolan ITU Report are provided.

Bangladesh

Serious flooding resulting in major loss of life has been linked to plastic bags blocking drains. In March 2002 Bangladesh banned the manufacture and distribution of plastic bags. Prior to the ban, the country consumed 9 million plastic bags a day, of which 85%

were littered into the waste stream. The first stage of the ban applied to the capital only, to be extended nationally.

Canada

Plastic bags are included in kerbside collection services in many areas of Canada. The report described the program as very successful, but gave no recycling rates.

Denmark

In January 1994 the Danish Government introduced a range of 'green' taxes – including a packaging tax. Originally a tax on plastic carrier bags was introduced, but it now includes paper bags as well. The tax reduced consumption of plastic and paper by 66%. The tax is included in the wholesale price of the bags to the retailers, and is therefore not obvious to consumers.

Hong Kong

Hong Kong prohibits retailers over a specified size from providing bags to customers free of charge. There are also recovery facilities for plastic bags provided within supermarkets.

India

There is very little waste and recycling infrastructure in many areas, and the low value of lightweight plastic shopping bags means that bags are not recovered through scavenging activity. In August 2000, the manufacture and use of plastic shopping bags was banned in Bombay, in an effort to reduce the number of plastic bags clogging stormwater drains and causing flooding. Large fines and the suspension of trading for one month apply if retailers are caught using plastic bags.

Ireland

In Ireland plastic shopping bags were a cause for widespread concern as they were a very visible litter problem in rural environments. In 2002 the Irish plastic bag levy was introduced, levying all plastic bags with a 0.15 euros (A$0.27) tax. The levy applies to all plastic bags, including biodegradable polymer bags, with the exception of those used to contain fresh produce, and those designed for reuse and sold for more than 0.70 euros (A$1.27). The levy is aimed at the consumer, with the retailer legally obliged to pass on the levy directly to the consumer, and itemised on the customer's receipt. Retailers collecting the levy make payments quarterly, which are paid into an Environment Fund, used to support waste management and other environmental initiatives.

With the introduction of the levy it has been reported that the use of plastic bags has fallen by 90-95%. The major retailers predict that rather than experience an increase in plastic shopping bag consumption over time, the reduction rate will stabilise at 95-96% of pre-levy consumption.

South Africa

Plastic bags have been so prevalent in the South African litter stream that they have been termed the country's "National Flower". In response to litter concerns, the initial proposal from the South African Government was to ban plastic bags outright, but this has been "watered down". In September 2002, a Memorandum of Agreement was signed between the Minister for Environmental Affairs and various labour and business organisations. The Agreement established a non-government body with revenue collection responsibilities – a compulsory levy was to be placed on plastic bags with revenue going to the new body. The new body has the following objectives:

- to promote efficiency in the use, re-use, collection, recycling and disposal of plastic bags;
- to receive a levy from all registered plastic bag manufacturers;
- to investigate the development of new markets for recycled material;
- to establish plastic bag collection points within easy walking distance of all major settlements;
- to support government in the removal of plastic bag litter from environmentally sensitive areas.

The Government also banned the thin light plastic carrier bags, requiring them to be thicker and hence more durable for re-use. Nolan-ITU noted that the South African system hints at the dilution of emphasis from consumer behaviour to post-consumer behaviour.

European approaches

In Europe, the principal measures implemented to deal with packaging, which includes plastics, are the Extended Producer Responsibility mechanisms – these do not target plastic bags specifically but aim to encourage the recycling and recovery of plastics.

Extended Product Responsibility (EPR) is one of many strategies for moving toward sustainable development. EPR challenges multiple players in the product chain to reduce the life cycle environmental impacts of packaging products.

5. Existing and emerging technologies and alternatives to plastics

It is important that the Australian seafood industry is aware of the options available for reducing plastics and makes all attempts to operate as a responsible industry in this regard. The seafood industry needs to adopt an integrated approach to the plastic issue, in partnership with other wholesale and retail industries. By changing the way plastics are distributed, used and disposed of the Australian seafood industry can play an expanded role in protecting the marine and terrestrial environment.

The packaging industry internationally is at the forefront of research and development of new and alternative packaging and food storage options. Customer demands, financial gains and the requirement to decrease or remove detrimental impacts on the environment are the main drivers to improve and further develop packaging products.

The Australian seafood industry continues to benefit greatly from these developments and improvements. A number of factors however, restrict the alternative options that are available for seafood packaging and handling, including:

- seafood is wet in nature and smells;
- some produce is spiky;
- there are stringent health requirements for seafood handling and quality; and
- customer satisfaction.

Even with these restrictions the Australian seafood industry can take advantage of the technical advances in packaging. Again plastic bags and food containers stand out as the main and obvious areas where alternative options can be investigated. It is necessary however, as part of this investigation to examine whether substitute packaging available can/does meet the requirements of not only the industry operators and the consumer, but also the regulators.

5.1 Degradable plastics

Earlier introductions of degradable packaging products saw seafood customer and retailer dissatisfaction. A number of factors created a mistrust and weariness to degradable products, including:

- the packaging products available broke down too quickly in the wet environment of the seafood industry; and
- earlier products were more than ten times the price of their plastic equivalent.

Today's degradable plastic bags cost three to five times more per unit to purchase than high-density polyethylene (HDPE) plastic bags. For example, a gusseted singlet bag (540mm x 300mm) degradable bag costs $56.10 per 2,000, while a non-degradable version costs $35.47 per 2,000 (pers comm. with bag suppliers).

In the past, biodegradable packaging products have been opaque or coloured resulting in customer and retailer resistance and dissatisfaction. Simply, people want to see what they are buying. The introduction of clear biodegradable packaging alternatives will be of benefit to the seafood industry, especially with the packaging of bait products. The December 2005 edition of Seafood Services Australia E-Newsletter announced a German based company, BASF's latest range of biodegradable plastic films. Amongst their new range of products is a clear biodegradable plastic film (SSA 2005).

A number of bait suppliers are currently examining biodegradable bait bags. From discussions with some of them, biodegradable bags have a number of properties that render them non viable as a commercial option including;

- transparency- consumers cannot see the product;
- porous- they need a vacuum effect for good bait presentation;
- sealing properties- weld tear; and
- cost - 3-5 times more expensive than PE bags.

With all alternatives is the need to carefully consider the full implications of using products labelled "environmentally friendly". It is all too easy to supply customers with biodegradable carry bags, but studies have clearly indicated that degradable bags have similar greenhouse and eutrophication impacts to conventional HDPE bags (James and Grant 2005). The real advantage of using degradable bags comes in disposal methods. Greenhouse gases will be reduced, but not eliminated if the product is kept out of landfill and disposed through composting.

At the 4th Australian Life Cycle Assessment (LCA) Conference, February 2005, James and Grant presented a paper titled *LCA of Degradable Plastic Bags*. In this paper background information was provided on the types of degradable polymers and results from a streamlined life cycle assessment that compared degradable polymers and alternative materials such as:

- HDPE (High Density Polyethylene, shopping bags);
- LDPE (Low Density Polyethylene, shopping bags);
- PP (Polypropylene, Green Bags);
- Kraft paper (Paper handled shopping bags); and
- Calico (Reusable cloth shopping bags).

All of the above bags types have an application in the seafood industry. HDPE and LDPE are already commonplace in most retail seafood outlets. As alternatives to plastic bags, non-plastic carry bags, including green bags, calico, string and even paper bags can be used to carry seafood. However, once again the nature of seafood restricts their use to a *second skin* carry bag.

Figure 7 Some examples of biodegradable packaging available for seafood.

James and Grant (2005) also developed a useful tool, as found in Table 5 for selecting degradable polymers. This checklist provides some considerations that should be made by the Australian seafood industry before moving to adopting degradable packaging alternatives.

Table 5 Checklist for selecting degradable polymers (James and Grant 2005)

Question	Things to Consider
Does degradability add real value?	• Does it provide added functionality (exploiting degradability e.g. controlled release of a substance from the resin)? • Does it provide reduced environmental impact e.g., reduce waste, litter, hazard to wildlife etc)? • If not, use an alternative strategy such as design for its ability to be recycled.
Where will the product be expected to degrade (in use or at end of life)?	• In the terrestrial environment, i.e., composting, buried in soil, above the ground, discarded (litter)? • In the aquatic environment, i.e. freshwater, seawater, sewerage system? Will it float or sink?
Where will the product be expected to degrade (in use or at end of life)?	• Will it contaminate an existing polymer recycling system?
What are the mechanical property requirements?	• How fast or slow do you want it to degrade? • How will it be processed?
What are the cost parameters?	• Can the market absorb a cost increase? • Does the material add sufficient value to justify a cost increase?
Design the product to ensure degradation and avoid dispersion of toxic substances in the environment	Critical issues for degradability: • Wall thickness • Pigments and coatings (particularly heavy over-printing & lacquers)
Critical issues for toxicity	• Heavy metals in pigments, e.g. lead, cadmium, mercury, chromium • Heavy metals in printing inks • Residues of pro-degradant additives
Design marketing and communications strategy	• Claims should be accurate and not mislead • Consumers should be advised on appropriate disposal route

Degradable plastic products have the ability to break down by bacterial, thermal or ultraviolet action. Degradable products, in particular plastic bags are required to degrade rapidly at the end of their useful life. To gain acceptance as a useful alternative in the seafood industry, degradable plastic will need to be competitively priced and have the strength and appearance of HDPE plastic products.

Ninety nine percent of the stakeholders who took part in the desktop feasibility study usage survey (Appendix B) indicated that they would use alternatives if they were available. It is interesting to note that a number of retailers stated that they had tried biodegradable bags, but found them to be *"useless because they started to decompose when they got wet"*. The earlier forms of biodegradable bags were found to be unsuitable and unstable in most applications (8-10 years ago), however the bags that are now available have a stable lifespan of at least 4-6 months under most conditions. This assumption by respondents indicates that manufactures and distributors of these products need to demonstrate to the retailer the advancement and benefits of these products.

5.2 Paper, cardboard and sugarcane fibre

A number of seafood retail outlets are already using paper based or cardboard serving trays and takeaway food containers. A number of cooked seafood outlets were observed using waxed cardboard and "envirotray" type serving trays. Again however, the nature of seafood limits the practicalities of paper based plastic alternatives. Similar to the issues of comparison between degradable plastics and HDPE plastics the true benefits of paper verses plastic have to be considered.

Paper bags take more energy to manufacture and cannot be reused as often as plastic. Paper bags however, can be recycled and they are more degradable if they end up in landfill. Most paper bags are manufactured in Australia and some contain up to 50% recycled content. The debate over paper versus plastic is a common one. In 1990, Franklin Associates completed a life-cycle energy analysis comparing the two common grocery bags. There were two critical measures. The first was the total energy used by a bag, which included both the energy used to manufacture a bag, called process energy, and the energy embodied within physical materials, called feedstock energy. The second measure was the amount of pollutants produced. Using energy and pollutants from all stages of a bag's life, both measures result in favor of plastic bags (Institute for LEA 2004).

At current recycling rates two plastic bags use less energy and produce less solid, atmospheric, and waterborne waste than a single paper bag. Moreover future improvements only increase the preference of plastic bags. Increasing recycling rates and reducing the 2:1 ratio through proper bagging techniques would further the energy preference for plastic bags (Institute for LEA 2004).

A selection of cardboard products suitable for cooked seafood.

A selection of cloth and paper bags for a second skin bag.

A selection of sugarcane packaging suitable for cooked seafood.

Alternative packaging with inbuilt thermal properties to keep products cool.

Figure 8 Some examples of alternative packaging available for seafood.

Paper food wrap coated with either wax or cornstarch film has applications in the seafood industry and is commonplace in some fresh seafood retail outlets. Re-useable insulated consumer carry bags are another option available at a number of seafood and grocery retail outlets. The washable/reusable qualities of insulated carry bags make them ideal for the transport of seafood. Insulated carry bags are available in various sizes and vary in cost from $3 - $12. Consumer acceptance, as with other alternatives, will create demand and reduce current prices. It is interesting to note that Newcastle Commercial Fishermen's Cooperative reported large volumes of insulated carry bag sales were being purchased, compared to low acceptance on similar bags at Sydney Fish Market. It is unclear why this has occurred although it is suspected that promotion and the demographics of visitors are contributing factors.

Alternative fish transport boxes

Seafood Services Australia (SSA) recently released information on the development of an improved fish box (SSA e-news January 2006). The alternative to hard plastic fish transport boxes was developed collaboratively by SSA, Neptune's Seafood in Kalbarri, WA and Sud Chemie Australia Pty Ltd Performance Packaging. Neptune's Seafood needed an alternative pack that was;

- light weight with integrated lid;
- with reasonable insulation properties to ensure maintenance of temperature throughout the trip;
- stackable for safe handling and storage;
- printable and facilitated product traceability – i.e. branding, species, weight, etc; and
- a flat pack reusable system offering cost savings.

With Sud-Chemie's packaging R&D experience and Neptune's Seafood transport requirements and specifications a 30 kilogram trial fish box was developed. The box, constructed from cardboard with a water resistant coating, was road tested showing promising results. The boxes are stored and delivered flat and can be assembled in five seconds. Bio-degradable plastic liners guard against quality loss due to contamination and cross-contamination. Used boxed can be knocked flat and returned for reuse. The trial box will be evaluated for air transport of seafood in the future. Further information, www.seafoodservices.com.au/news/news.item.php?pid=91

Figure 9 Trial Boxes stacked and loaded ready for transport and the prototype Sud Chemie box (SSA 2005)

5.3 Opportunities for recycling

The technology for recycling plastics has been in existence for some time, however in terms of application has been extremely costly. As the technology has improved however, the cost efficiency of recycling has also improved. There are now a number of companies that provide recycling services. Recycled plastics are being used to manufacture new products with the new applications often very different from those of their original use. The opportunities and applications for recycled plastics in Australia are continually growing (PACIA 2005). Table 6 provides a summary of the use of recycled plastics in 2004.

OceanWatch Australia in conjunction with the Natural Heritage Trust funded Carpentaria Ghost Nets program in northern Australia is currently investigating recycling options for discarded fishing nets being collected and other plastics, including nylon. To date, a number of recycling organisations have expressed an interest in taking the nets and nylon lines for a scrap value. A trial is to be conducted shortly to explore the full cost to industry and the project of getting the net/line from the site where it is found to the recycling processing plant. The potential implications for the industry in being able to enter into a partnership with a recycling organisation who can produce a recycled product such as ThermoFuel (diesel from recycled plastics), produced by Ozmotech are obvious in reducing the costs of operation. A ThermoFuel plant can produce up to 9,000 litres of high-grade diesel fuel from 10 tonnes of waste plastics. System modules range from 10 to 20 tonnes per day, and larger systems can be built from multiple modules. A major advantage of the process is its ability to handle unsorted, unwashed plastics and its high efficiency. This means that most contaminated plastics can be processed without difficulty including kerbside e separated, silage wrap, trickle tape, agricultural plastics and manufacturing excesses. Other normally hard to recycle plastics such as laminates of incompatible polymers, multilayer films or polymer mixtures can generally be processed with ease unlike many other plastic recycling techniques. Ongoing discussions with Ozmotech are continuing with the Australian seafood industry.

Table 6 Uses of recycled plastics in 2004 (Source PACIA 2005)

Polymer	Major Uses	Other Uses
PET	**Beverage bottles**	Clothing, geo-textiles, yarn, strapping, pallets and fenceposts.
HDPE	**Film, blow moulded containers**	Storm and agricultural pipes, pallets, wheelie bins, extruded sheet, moulded products, shopping and garbage bags, industrial film, drip sheets for water, wood substitutes and mixed plastics products (e.g. fence posts, bollards, kerbing, marine structures and outdoor furniture), and roto-moulded water tanks.
PVC	**Pipe, floor coverings**	Hose fittings, garden hose, pipes, profiles & electrical conduit, clothing, fashion bags and shoes.
L/LLDPE	**Film (inc. builders & ag film, concrete lining, freight packaging, garbage bags, shopping bags), ag piping.**	Trickle products, vine cover, pallets, shrink wrap, roto-moulding, and building industry applications.
PP	**Crates, boxes and plant pots**	Building panels and concrete reinforcement stools (bar chairs), furniture automotive parts, irrigation fittings, agricultural & garden pipe, builders film, concrete reinforcing and a wide variety of injection moulded products.
PS	**Bar chairs and industrial spools.**	Office accessories, coat hangers, industrial packing trays and wire spools.
EPS	**Waffle pods used in building, and wall panels.**	Produce boxes.
ABS/SAN	**Injection moulded products**	A wide range of moulded products, sheet extrusion, coffin handles, drainage covers, and auto parts.
Polyurethane	**Carpet underlay**	Mattresses.
Nylon	**Injection moulding compound**	Furniture fittings, wheels and castors.
Other and Mixed	**Agricultural piping**	Fence posts, bollards, kerbing, marine structures and outdoor furniture.

An EPS industry group known as 'Recycling Expanded Polystyrene Australia (REPSA)' represents 24 companies throughout Australia spread across 36 sites. Membership to REPSA consists of EPS manufacturers from around Australia producing: packaging for produce and seafood, foodservice products, building and construction products such as insulative sandwich panels and under slab void filler pods and raw material suppliers/distributors. REPSA is committed to the continued success of this manufacturing sector and provides a forum for discussion and resolution of the environmental issues relating to the use and recycling of expanded polystyrene. Expanded Polystyrene is completely recyclable.

Over the past decade, REPSA has established a National Collection Network to facilitate EPS recycling in Australia. While limited end-use markets and economies of scale make recycling in this country a difficult operation, there are a variety of uses recycled EPS can be put to. A collection site has been established in the capital city of each mainland state capable of accepting all types of EPS from both packaging and building applications. All EPS is accepted at the collection centres providing it is clean and free of contaminants, a potential problem for the seafood industry.

It is now possible to cost effectively hire or purchase portable polystyrene compaction and granulator facilities for onsite compaction. This is an option for the seafood industry to reduce the volume of polystyrene going to landfill (where it is not possible to give it to a recycling centre).

There are many examples of companies that can recycle the key plastics being consumed by the Australian seafood industry. The main barrier to industry utilising these companies to "close the loop" on the life cycle of plastics used is the cost of transport or setup to establish onsite shredding, compacting or processing facilities. In addition, for items such as polystyrene boxes, the contamination from seafood produce does not make the boxes an attractive feedstock for recycling companies to take.

6. Recommendations

The following recommendations are made to move the Australian seafood industry forward with respect to reducing its plastics usage:

1. Conduct a comprehensive plastic usage survey specific to the Australian Seafood Industry and develop a strategic approach for the industry to adopt cost effective sustainable solutions to plastics usage.

Any strategic industry approach to moving the industry forward with respect to reducing its plastics consumption and improving cradle to grave assessments for materials used during production, processing and consumption of seafood should be overseen by the Australian Seafood Industry Council.

One challenge in undertaking this desktop feasibility study was the lack of baseline data to support plastic usage trends in Australian and international seafood industries. It is assumed that the cost of purchasing plastics, in particular packaging, to the seafood industry represents a material cost of production. Most stakeholders, however, could only provide rough guesses at the volumes consumed and total costs incurred. Web searches on industry specific volumes consumed led to general estimates, with most information referring to plastic bags only.

A comprehensive usage survey that focused on understanding the volumes and types of plastics and waste management/reduction initiatives being used by the Australian seafood industry and the alternatives to plastics currently being trialled or used would provide good baseline data to focus any pilot projects and education campaigns related to additional phases to this project and to assist the industry to develop a strategic approach to moving forward with respect to plastics usage.

2. Undertake a 3-6 month pilot study at Sydney Fish Market to investigate the volumes of plastic currently used, waste separation and waste recycling opportunities and subsidise trials of alternative products across the entire supply chain

Sydney Fish Market (SFM) is unique in that it provides access to the seafood supply chain within a confined and easily accessible area, from harvest through to consumption. SFM offers the perfect opportunity to study waste volumes, market floor waste types, alternative packaging and handling products and customer reaction to waste reduction education campaigns. The site also offers classroom facilities to educate personnel and provide training on environmental impacts and recycling. SFM generate large quantities of polystyrene and plastics that are currently being disposed of to landfill. As part of a pilot study, it is envisioned that a supplier from each step in the supply chain would be identified to participate in a trial to collect baseline data, work with partner packaging or

recycling organisations to trial alternatives and assess consumer perceptions and attitudes. Targets for reducing plastic volumes and recycling or reuse would also be a component of the pilot program. Partnerships with packaging suppliers, recycling organisations, government and conservation groups would form the basis from which such a trial is conducted. Such a pilot program would provide great opportunity to promote the industry to the community, conservation groups and the government as an environmentally responsible corporate citizen.

3. Subject to the findings from a Sydney Fish Market pilot study, explore opportunities to roll out suitable alternatives and lessons learned across the post harvest sector nationally. Develop an education program and undertake training to post harvest seafood industry members with an emphasis on environmental impacts and recycling

Following an assessment of the pilot study at SFM, a feasibility study would be required to determine the benefits of rolling out the lessons learned to all retailers at SFM and other sections and members of the post harvest sector across Australia. It may be beneficial to stagger a roll out according to State, subject to State specific regulations etc. In addition, any rollout to the post harvest sector would require a targeted marketing and education campaign with post harvest sector members to promote the benefits of moving to alternatives to plastic or to adopt recycling opportunities. Opportunities that would arise as part of this roll out, to promote "good news" stories to the general community, conservation groups and the government could also be capitalised on. It is envisioned that any rollout would be tailored and occur over a 2 year period.

4. Undertake a feasibility study and pilot study with key plastics and nylon recycling companies for recycling of waste fishing net and line. Further investigation for reducing the impacts and volume of polystyrene boxes should be undertaken.

Polystyrene is a key waste product generated by the Australian seafood industry. Currently, polystyrene crates, for example, cannot be reused due to food safety requirements and crates are therefore, sent to landfill rather than recycled. The technology to recycle these crates exists and steps should be taken to trial a variety of recycling alternatives. Any trial could be conducted at Sydney Fish Market in conjunction with the pilot study recommended above.

Ongoing discussions with recycling companies to establish recycling opportunities for discarded fishing nets, lines and other plastics should continue with the intention to undertake a number of trials and seek cost effective means to establish commercial ventures for recycled product. Recycled product markets should be explored, including internal markets for the supply of diesel fuel produced from recycled plastic materials.

A list of potential partners is available in Appendix C.

5. Undertake a pilot study at the port of Mooloolaba to investigate the feasibility of recycling monofilament line and tuna bags with longline fisheries.

It is estimated that the tuna fishing fleet out of Mooloolaba, QLD consumes in excess of 600,000 plastic tuna bags per annum. As the primary waste product from the Eastern Tuna and Billfish Fishery, the bags are used to store individual fish on ice whilst the vessel is at sea, prevent ice burn and reduce abrasion against other fish. The bags are used once then disposed of in local landfill. Monofilament fishing line is the second largest waste product from this industry. A pilot study to establish onboard sorting of bags, line and general waste should be undertaken. The line, when sorted and cleaned, potentially has a scrap value of between 25 - 35 cents per kilogram. The waste fishing line can be recycled into a number of products including fence posts and park furniture. It's scrap value, if any is yet to be determined.

6. Assist, through the provision of resources and expertise those sections of the harvest and post harvest sectors currently investigating alternatives to plastics or to reduce marine debris.

There is opportunity to assist and support trials being undertaken by various sectors or individuals within the industry such as those incorporating cradle to the grave analysis with comparative product road testing of alternate produces. For example, in an attempt to reduce volumes of polystyrene, the Coffs Harbour Fishermen's Cooperative in NSW have recently commenced trials of alternative 10 kilograms fish boxes. A Melbourne based company have supplied the Co-operative with 100% recyclable/reusable end sealed fluteboard boxes, marketed as CoolSeal.

In addition, industry programs such as the SeaNet Environmental Extension Service should continue to assist seafood harvesters in the adoption of cost effective alternatives to plastics use at sea, thereby reducing the impacts of seafood industry generated marine debris on marine ecosystems.

7. The Master Fish Merchants Association to become a member of the Retail Traders Association, representing the seafood industry.

It is recommended that the Master Fish Merchants Association become a member of the Retail Traders Association to represent the Australian seafood industry (post harvest sector). The seafood industry needs to approach plastic reduction and the use of plastic alternatives as a united industry. Closer alliance with similar industries will assist in achieving reduction goals.

7. Conclusion

This project has clearly identified that the Australian seafood industry does not have an integrated strategic approach to reducing the use of plastics. The desktop feasibility study findings indicate that a great deal of research and development in Australia and internationally has been/is being undertaken to develop alternative packaging and handling products or to recycle plastic items. The Australian seafood industry can be one of the greatest beneficiaries of this R&D with the introduction of numerous cost efficient, environmentally acceptable packaging products or recycling options now available. Any reduction in the use of plastics, or the acceptance of alternatives by the Australian seafood industry will however, require commitment from all within the industry. The answers to how to reduce the use of plastics and non-recyclable waste in the Australian seafood industry are available here and now, but for these products to become common place they need to be:

- affordable;
- acceptable and beneficial to the consumer and the producer;
- able to withstand harsh storage and transport conditions; and
- meet Australian health and safety standards.

This desktop feasibility study has shown that there are opportunities for all sections within the Australian seafood industry to reduce its plastics usage, whether by adopting alternates, recycling or reuse schemes. From the discussions held with industry members during this project, a high percentage of those involved in the industry are prepared to trial and use plastic alternatives and some are investigating recycling opportunities, however the majority are generally not aware of the options available. This indicates the need to promote the already available alternative products and trial those options that appear most feasible.

In most industries the extra cost of alternative packaging has excluded products from the market place. The Australian seafood industry is no different. Given the current economic climate of the seafood industry it is imperative that competitive advantage, primarily driven through price, is maintained. For tangible reductions in the use of plastics or the adoption of recycling opportunities the Australian seafood industry needs to set attainable goals with respect to reducing its plastics consumption and contribution to marine debris and landfill volumes. It is likely that the cost of alternative options will only be acceptable where economies of scale can be achieved from a united industry approach to drive suppliers of alternatives to reduce their prices.

This project should be advanced to the next phase to adopt the recommendations made in Section 6 of this report.

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Useful websites

Australian and New Zealand Environment and Conservation Council. www.deh.gov.au/about/councils/anzecc

ACT Now. www.nowaste.act.gov.au

Australian Department of Environment and Heritage. www.deh.gov.au

Australian Retail Traders. www.ara.com.au

Clean Up Australia, www.cleanup.org.au www.noplasticbags.org.au

Coastcare. www.nht.gov.au/nht1/programs/coastcare

Department of Environment and Heritage. www.deh.gov.au/settlement/publications/index.html

Environmental Protection Authority. www.environment.nsw.gov.au

Environmental Protection and Heritage Council. www.ephc.gov.au/ephc/plastic_bags.html

European Regions for a Safe and Clean Coast.

Institute for Lifecycle Environmental Assessment. www.ilea.org

Ocean Watch Australia. www.oceanwatch.org.au

Pacific Whale Foundation. www.pacificwhale.org

Packaging Council of Australia. http://www.packcoun.com.au

Planet Ark. www.Planet Ark.com.au

Plastics New Zealand. http://www.plastics.org.nz

Save Our Sea Life, South Africa. http//seacoast.uwc.ac.za

Seafood Services. www.seafoodservices.com.au

SeaNet. www.oceanwatch.org.au/SN_100.asp

Sustainable Victoria. www.sustainability.vic.gov.au

Zero Waste South Australia. www.zerowaste.sa.gov.au

Zero Waste Western Australia. zerowaste.com.au

Glossary

Aerobic degradation
Degradation in the presence of air. Composting is a way of aerobic degradation.

Anaerobic degradation
Degradation in the absence of air, as occurs in dry landfills. Anaerobic degradation is also called biomethanisation.

Biodegradable
The American Society of Testing and Materials defines biodegradable as "Capable of undergoing decomposition into carbon dioxide, methane, water, inorganic compounds, or biomass in which the predominant mechanism is the enzymatic action of microorganisms, that can be measured by standardised tests, in a specified period of time, reflecting available disposal condition." For practical purposes claims about biodegradability of plastic should specify a timeframe.

Bioerodable
Polymers that exhibit controlled degradation through the incorporation of prodegradant additive masterbatches or concentrates. Such polymers oxidise and become brittle in the environment and erode under the influence of weathering.

Compostable
Compostable materials are capable of undergoing biological decomposition in a compost site, to the extent that they are not visually distinguishable and break down to carbon dioxide, water, inorganic compounds, and biomass, at a rate consistent with known compostable materials (e.g. cellulose). See also 'compostable plastic'.

Compostable plastic
A polymer is 'compostable' when it is biodegradable under composting conditions. The polymer must meet the following criteria: a) Break down under the action of microorganisms (bacteria, fungi, and algae).b) Total mineralisation is obtained (conversion into CO_2, H_2O, inorganic compounds andbiomass under aerobic conditions).c) The mineralisation rate compatible with the composting process and consistent with known compostable materials (e.g. cellulose).Australian Standards for compostable plastics are currently under development by Standards Australia, and will provide greater clarity to performance expectations.

Composting
The activity of breaking down plant and animal material using microorganisms under aerobic conditions. For successful composting there must be sufficient water and air to allow the microorganisms to break down the material, and the compost should reach and maintain a warm temperature.

Decomposer organism
An organism, usually a bacterium or a fungus, that breaks down organic material into simple chemical components, thereby returning nutrients to the environment.

Degradable
Degradable materials break down, by bacterial (biodegradable), thermal (oxidative) or ultraviolet (photodegradable) action. When degradation is caused by biological activity, especially by the enzymatic action of microorganisms, it is called 'biodegradation'.

Ecotoxicity
Ecotoxicity refers to the potential environmental toxicity of residues, leachate, or volatile gases produced by the plastics during biodegradation or composting.

Ethylene vinyl alcohol
A water-soluble polymer.

Foamed starch
Starch can be blown by environmentally friendly means into a foamed material using water steam. Foamed starch is antistatic, insulating and shock absorbing, therefore constituting a good replacement for polystyrene foam.

High-density polyethylene
A conventional (not biodegradable) plastic, as used commonly in single-use plastic carry bags (HDPE).

Humus
The solid organic substance that results from decay of plant or animal matter. Biodegradable plastics can form humus as they decompose. Humus in soil provides a healthy structure within which air, water and organisms can combine.

International Organisation for Standardization
An international standardisation body.

International Standard
A standard published by the International Organisation for Standardisation and commencing with ISO (eg ISO 16929).NB for electrical products the International Electrotechnical Commission (IEC) is the main international standardization body.

Life Cycle Analysis
A procedure which involves assessing the impacts of a product or material throughout its life cycle - i.e. from raw material extraction or production through manufacture and use, to disposal or recovery. Also called Life Cycle Assessment.

Life Cycle Assessment
A procedure which involves assessing the impacts of a product or material throughout its life cycle - i.e. from raw material extraction or production through manufacture and use, to disposal or recovery. Also called Life Cycle Analysis.

Low-density polyethylene
A thick conventional (not biodegradable) plastic, as used commonly in more durable plastic carry bags that carry logos (LDPE)

Mineralisation
Conversion of a biodegradable plastic to CO_2, H_2O, inorganic compounds and biomass. For instance the carbon atoms in a biodegradable plastic are transformed to CO_2, which can then reenter the global carbon cycle.

Organic recycling
Organic recycling is either the aerobic (i.e. composting) or anaerobic (bio-methanisation) treatment of the biodegradable materials under controlled conditions, using microorganisms to produce stabilised organic residues, methane and carbon dioxide.

Performance standard
A standard that references one or more test methods and stipulates the results required.

Photo-biodegradation
Degradation of the polymer is triggered by UV light and assisted by the presence of UV sensitisers. In this process the polymer is converted to low molecular weight material (waxes) and in a second step converted to carbon dioxide and water by bacterial action.

Photodegradable
A process where ultraviolet radiation degrades the chemical bond or link in the polymer or chemical structure of a plastic.

Phytotoxicity
Phytotoxicity refers to toxic effects on plants. Plant phytotoxicity testing on the finished compost that contains degraded polymers can determine if the buildup of inorganic materials from the plastics is harmful to plants and crops and if they slow down soil productivity.

Plastic
A term used throughout this report to describe any of the group of polymer's.

Plastics and Chemicals Industries Association of Australia
An industry association representing member companies in the plastics and chemicals industries in Australia (including both degradable and conventional plastics member companies).

Polybutylene succinate
Biodegradable polyester used in degradable plastic products.

Polybutyrate adipate terephthalate
Biodegradable polyester used in degradable plastic products.

Polycaprolactone
Biodegradable polyester for degradable plastics eg Tone, CAPA or Placeel trade names. PCL can be used in starch-blends (eg Mater-Bi) where it provides water resistance and added strength. It is biodegradable through the action of nonspecific enzymes found in soil.

Polyesters
Polymers with ester groups in their backbone chains. All polyesters degrade eventually, with hydrolysis being the dominant mechanism. Degradation rates range from weeks for aliphatic polyesters (e.g. polyhydroxyalkanoates) to decades for aromatic polyesters (e.g. PET).

Polystyrene
Polystyrene is a strong plastic created from erethylene and benzine that can be injected, extruded or blow moulded, making it a very useful and versatile manufacturing/packaging material.

Polyethylene
A conventional (not biodegradable) plastic, as used commonly in plastic carry bags in the form of either high or low density polyethylene.

Polyethylene tetraphalate
PET - A rigid polymer (as used in soft drink bottles and other rigid applications).

Polymer
A long molecule that is made up of a chain of many small repeated units (monomers).

Prodegradant
An additive that can trigger and accelerate the degradation of a polymer. Typically prodegradants (or degradation promoters) are catalytic metal compounds based on iron, cobalt and manganese.

Product standard
A standard that sets out what is expected from a particular product category. It should reference separate standards or include both test methods and performance requirements.

Standards Australia
The peak non-government standards development body in Australia. Standards Australia represents Australia in the International Organization for Standardization (ISO).

Styrofoam
What we commonly call Styrofoam, is actually the most recognizable form of foam polystyrene packaging. Styrofoam ® is a Dow Chemical Co. trademark.

Thermoplastic polymer

Becomes soft and 'plastic' upon heating and firm when cool, with this process able to repeated without the material becoming brittle.

Totally Degradable Plastic Additives

Commercial name for controlled degradation masterbatch additive produced by Environmental Plastics Inc (EPI).

Appendix A

Staff and Board members engaged in this project

The following staff or Board members of OceanWatch Australia and Seafood Services Australia have been involved in this project:

Roy Palmer - Board of SSA and retailer
Alan Snow – Sea Food Services Australia
Kerry Strangas - OceanWatch Australia Board member and Master Fish Merchants Association of Australia Chair
Michael Kitchener - CEO of Master Fish Merchants Association
John King - OceanWatch Australia
Anissa Lawrence – OceanWatch Australia
Emma Bradshaw – OceanWatch Australia
Louise Smith – OceanWatch Australia
David Kreutz – OceanWatch Australia

Appendix B

Results of industry plastics usage survey

Reducing Plastics in the Australian Seafood Industry

Plastics Usage Survey Results

Fourteen surveys were conducted in various locations around Australia including Ulladulla, Eden, Portland, Melbourne, Bermagui, Newcastle, Mooloolaba, Harrington, Blackfellows Cave (SA) and Narooma. Most businesses surveyed were a mixture of industry types eg. boat, transport, wholesale. A few had a single focus eg.retail or crayfish boat. A summary of the results obtained from each question are provided below.

Examples of plastics currently used: The plastic product most used by the survey group is the fish box, followed by foam boxes and floats. Then came a group of products consisting of nets, lines, fish bags, produce bags and plastic carry bags. Plastic sheets, cutlery, takeaway boxes, transport crates, pallets and export bags were the least used items in this survey group.

Are any of these resources recyclable? Most respondents (9) were aware that at least some of the above items were recyclable. Five indicated that the products they used are not recyclable, (when in fact they are probably were) and two were not sure.

Are you aware of any alternatives to the current plastic products used? Eight were aware of alternatives, and 6 were not.

Would you use an alternative to plastic if one was available? Eight said 'yes', 1 said 'no'. A crayfish fisherman did not believe it was not applicable as all the plastic he used was recycled. Two of those who answered 'yes', also indicated that cost could be an obstacle and one referred to durability. One said it 'depends' and ticked all the options below.

If no, why not? All suggested reasons provided were stated, being possible extra cost, customer acceptance, availability, product durability, strength and reliability.

Would you use alternatives if the costs were subsidised? Thirteen said 'yes', 1 said 'no'. One mentioned that OH&S and QA were relevant considerations.

Estimated yearly cost of plastics to your individual business or industry
Costs ranged from less that $500 for a single focus business up to $100,000 for larger multi focus businesses. One business did not know.

Would you consider trialling alternative products? *(at no cost)* Thirteen said 'yes' with 1 'not sure'. Similarly, all but one would be interested in receiving information or product samples, with one wanting product samples only.

Reducing Plastics in the Australian Seafood Industry

Plastics Usage Survey

Industry Type ……..
(boat, transport, Co-op, market, retail, wholesale, export, sea food outlet, fresh or cooked, seafood processing.)

Location ……..

Examples of plastics currently used ……

……..
(nets, lines, floats, fish boxes, tuna mats, fish bags, foam boxes, produce bags, plastic sheets, plastic carry bags, serving plates, takeaway boxes, plastic cutlery, export boxes, export bags, transport crates, pallets)

Are any of these resources recyclable? yes† no• not sure†

Are you aware of any alternatives to the current plastic products used? yes• no•

Would you use an alternative to plastic if one was available? yes• no•

If no, why ……..
(possible extra cost, customer acceptance, availability, product durability, strength and reliability)

Would you use alternatives if the costs were subsidised? yes• no•

How do you current disposal of plastic packaging and/or unserviceable plastic products in your business or industry ……..
(rubbish bin, industrial waste collection)

Estimated yearly cost of plastics to your individual business or industry $.....

Would you consider trialling alternative products? *(at no cost)* yes• no•

Would you be interested in receiving information and/or alternative product samples relevant to you business or industry? yes• no•

Name: ……
Mailing address: ……
……
E-mail address: ……..

Thank you

Appendix C

Alternate packaging suppliers and potential pilot program partners

Alternative packaging suppliers and pilot program partners

Listed below are suppliers of alternative plastic packaging products. This list is not comprehensive.

For large quantities	For small quantities
PCC Packaging Cardiff NSW Contact: Brian Hunt Ph: 02 4954 8844	Marvic Packaging Australia Perth WA Contact: Leonie van-Hamburg Ph; 08 9272 9499
Jonmar Plastics Yatala Queensland Contact: Andrew Huntley Ph: 07 3807 8300	Environmental Enterprises Campbelltown, Sydney NSW Contact: Tao Triebles Ph: 02 4620 9248
Allviron Campbellfield, Melbourne. Victoria Contact: Jonathan MacMillan Ph: 03 9357 9744	Earth basics Canberra, ACT Contact: Maryke Booth Ph: 02 6280 4128
Q.I.S. Packaging Archerfield. Queensland Contact : Megan Davies 1800 555 343	
Convex Plastics Hamilton, New Zealand Contact: Andrew Sheerin Ph: 00 11 64 79581770	
BioFilm Sydney NSW Contact: Neil Thomson Ph: 02 8257 3338	

Listed below are potential pilot program partners. This list is not comprehensive.

Ozmotech Pty Ltd Clayton, Victoria Contact: David Henry Ph: 03 9550 3300	Mcoy Global Resources Pty Ltd Frenchs Forest, NSW Contact:Peter Eady Ph: 02 9401 9672
Astron Plastic Recyclers, Brisbane	Replas/ Repeat Plastic Australia
Corex Plastics Australia	