



Marine Debris in Northern Australian Waters 2004.



Australian Government

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Damian White
WWF- Australia
Program Officer Coastal and Marine Conservation

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Elcho Island

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Introduction

The contamination of northern Australia's marine environment by man made objects, known collectively as marine debris, is an ongoing concern to all groups utilising, researching and managing this relatively pristine region of Australia. This concern has translated into marine debris being listed;

- in the Recovery Plan for Marine Turtles in Australia (2003) [www.deh.gov.au/coasts/publications/turtle-recovery] as one of main threats to the recovery of marine turtles in Australia, and
- as a Key Threatening Process as *Injury and Fatality Caused by the Ingestion and Entanglement of Marine Life in Marine Debris* [www.deh.gov.au/biodiversity/threatened/ktp/marine-debris.html].

The scale of the problem in northern Australian waters began to be noticed in the 1980s when Aboriginal communities began to become concerned about the quantity of debris in the Gulf of Carpentaria and in particular the number of animals found stranded in derelict fishing nets. However, it was not until the 1990s when Aboriginal communities, industry and state and territory government agencies and non-government organisations began to actively remove and record the fishing nets and other debris on beaches in northern Australia and make their findings public that the extent of the problem became known.

On the Queensland side of the Gulf of Carpentaria various groups became aware of increasing quantities of marine debris in the waters and shorelines and took it upon themselves to remove the debris. In the early 1990s Aboriginal communities and commercial fishers began removing derelict nets without recording their activities, however in 1993, Carpentaria Contracting a private company operating out of Weipa began removing derelict nets from the local area and recording their activities. Further groups also became involved in marine debris removal when in 1997-98 the Mapoon Rangers [www.mapoon.com/section/5.html] and the Queensland Environmental Protection Agency [www.epa.qld.gov.au/publications?id=1293] began examining and removing derelict nets and recording stranded wildlife in the Mapoon region. A further Aboriginal group, Napranum Council and Napranum Rangers [www.napranum.com] also from Weipa began removing and recording derelict fishing nets on local beaches.

In the Northern Territory, two Aboriginal groups, Dhimurru Land Management Aboriginal Corporation [www.dhimurru.com.au] on the Gove Peninsula and Anindilyakwa Land Council on Groote Eylandt began to address the issue of marine debris on their lands. The ongoing Dhimurru "Turtle Recovery Program" was launched in 1996 after concerns were raised by Dhimurru members and rangers. The program monitors a 40 kilometre stretch of coastline each year, retrieving stranded turtles from derelict fishing nets and records biological details of stranded turtles, before releasing the animals (Roeger, Munurju and Wise 2004).

At about the same time as Dhimurru was developing their Turtle Recovery Surveys, the Anindilyakwa Land Council on Groote Eylandt was lobbying the Australian Fisheries Management Authority (AFMA) and Northern Prawn Fishery Management Advisory Committee (NORMAC) about the amount of fishing debris washing ashore on the island. Their lobbying was successful and led to a clean up and survey of all accessible beaches in 1997–1998. This project supervised by AFMA and performed by the Anindilyakwa people recorded the quantity of marine debris present, the sources of this debris and suggested the location of permanent monitoring sites at

strategic locations (Sloan, Wallner and Mounsey 1998). However, these sites were not monitored again until 2002 when WWF and the Anindilyakwa Land Council set up two permanent locations suggested by Sloan, Wallner and Mounsey (1998).

In 1999 the WWF Marine Debris Program began in the Northern Territory. The program began when WWF responded to concerns raised by the Yolŋu people of north eastern Arnhem Land about the impact of marine debris upon their marine turtle resources and the site of the first marine debris survey was Cape Arnhem in 2000. The initial survey proved to be successful and was subsequently expanded to include a network of permanent sites at Groote Eylandt with the Anindilyakwa Land Council, Bing Bong with the Lianthawirriyarr Sea Rangers, Elcho Island with the Gumurr Marthakal Rangers, Cobourg Peninsula with Parks and Wildlife Commission of the Northern Territory and Mapoon in northern Queensland with the Mapoon Rangers.

This report to the Natural Heritage Trust (NHT) and the Department of Environment and Heritage (DEH) is designed to contribute to Australia's knowledge of marine debris in northern Australian waters. The information presented details the quantities of debris present, its sources, areas affected and possible reasons for the distribution of debris, and is designed to assist the Department of Environment and Heritage implement the Marine Turtle Recovery Plan and develop the Marine Debris Threat Abatement Plan.

Survey Methods

Beach Surveys

The survey method used by WWF estimates the quantity, composition at the time of the survey and where possible the origins of the debris. Marine debris surveys performed by WWF and partner groups have been set up primarily with guidance from Aboriginal Sea Ranger groups, local communities and traditional owners involved in the program. The choice of site, therefore, depended on a number of factors such as available resources, access and avoidance of culturally sensitive sites, as well as their representativeness.

Survey teams, which consisted of Indigenous Sea Rangers, local community volunteers, Conservation Volunteers Australia (CVA) and WWF volunteers, were briefed prior to the survey taking place. Each participant was provided with a WWF Marine Debris Survey Information Manual (White, 2003) and the survey team was instructed, through the use of examples, how to collect and record the debris.

The survey technique requires that all anthropogenic (human produced) marine debris other than fragments smaller than the top of a plastic bottle top (9 square centimetres) be collected from the area of beach between the waters edge and the base of the primary sand dune (Figure 1). Teams are instructed to form a line at right angles to the water's edge and walk the survey sites maintaining their relative position to the other members of the team.

Most items were collected by hand, but larger items were dragged down the beach to below the high tide mark for collection by support vehicles. Dragging large debris items such as nets and metal drums down to the lower beach by hand was performed to reduce possible damage to turtle nests and the dunes themselves (Figure 1).

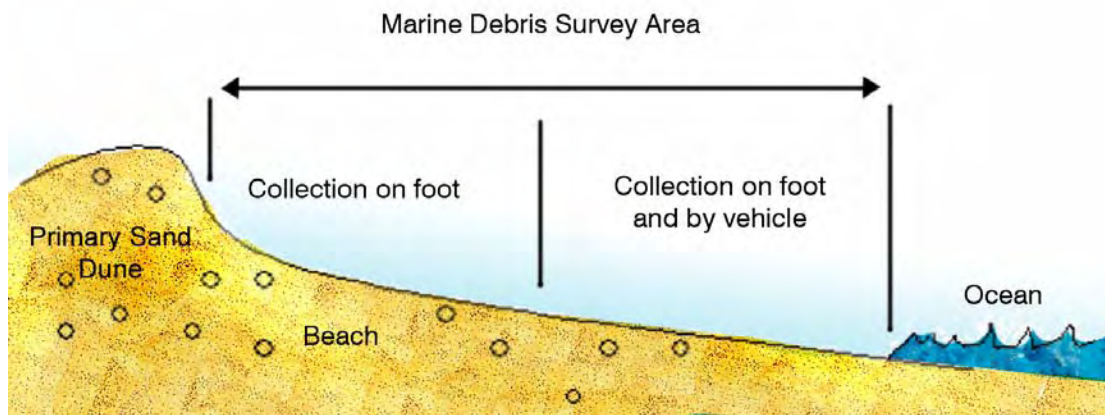


Figure 1. Seaward and landward limits of marine debris surveys

There are three recording sheets used on each survey, 'General Debris', 'Origins of Debris' and 'Fishing Nets'.

The 'General Debris' survey sheet used by WWF and partner groups is pictorial, with photos of the major debris categories of plastic, rubber, glass, metal, paper and cloth. Against these categories the number of items collected and their total weight is recorded.

The second recording sheet, 'Origins of Debris', used on the surveys provides for the recording of information used to identify the items origin. The survey teams were instructed to record any information still present on bottles and other items, such as the manufacturer's name, address, logos and barcodes known as European Article Numbers (EAN International 2003). Once this information was recorded, the barcode information is compared with a list of EAN country codes. The first three digits of any barcode found, identifies the country where the item was sold. The manufacturer's inscriptions can also be used to determine the origin of debris by performing internet searches to find a company's address. The two methods in combination captured most items that had retained some form of identification and were used to cross reference and confirm an item's origin.

The third element of the marine debris survey method was the recording and identification of fishing nets. Fishing nets are recorded on a separate recording sheet. Space is provided for recording the sample number, WWF net code, length and depth, standard net characteristics (colour, twine diameter, stretched mesh size, number of strands making up the twine, absence of knots) and comments such as the presence of entangled wildlife. A sample of each net was also retained for identification against the net archive held by WWF in Darwin. These samples are stored with WWF for future reference.

Upon completion of each survey day, all debris items were removed from the beach and deposited at the local community dump.

Survey objectives

Prior to WWF becoming involved in marine debris surveys in 2000, most surveys undertaken were one-off events. The series of surveys undertaken by WWF and partner groups have the following objectives:

- Assist coastal communities in understanding and addressing a complex regional problem
- On ground research to help understand
 - volume,
 - composition,
 - source and
 - impact of marine debris in northern Australian waters
- Provide consistent monitoring information over time
- Assist in the development of targeted strategies to reduce the problem at its sources
- Generate public awareness of the issue

Results

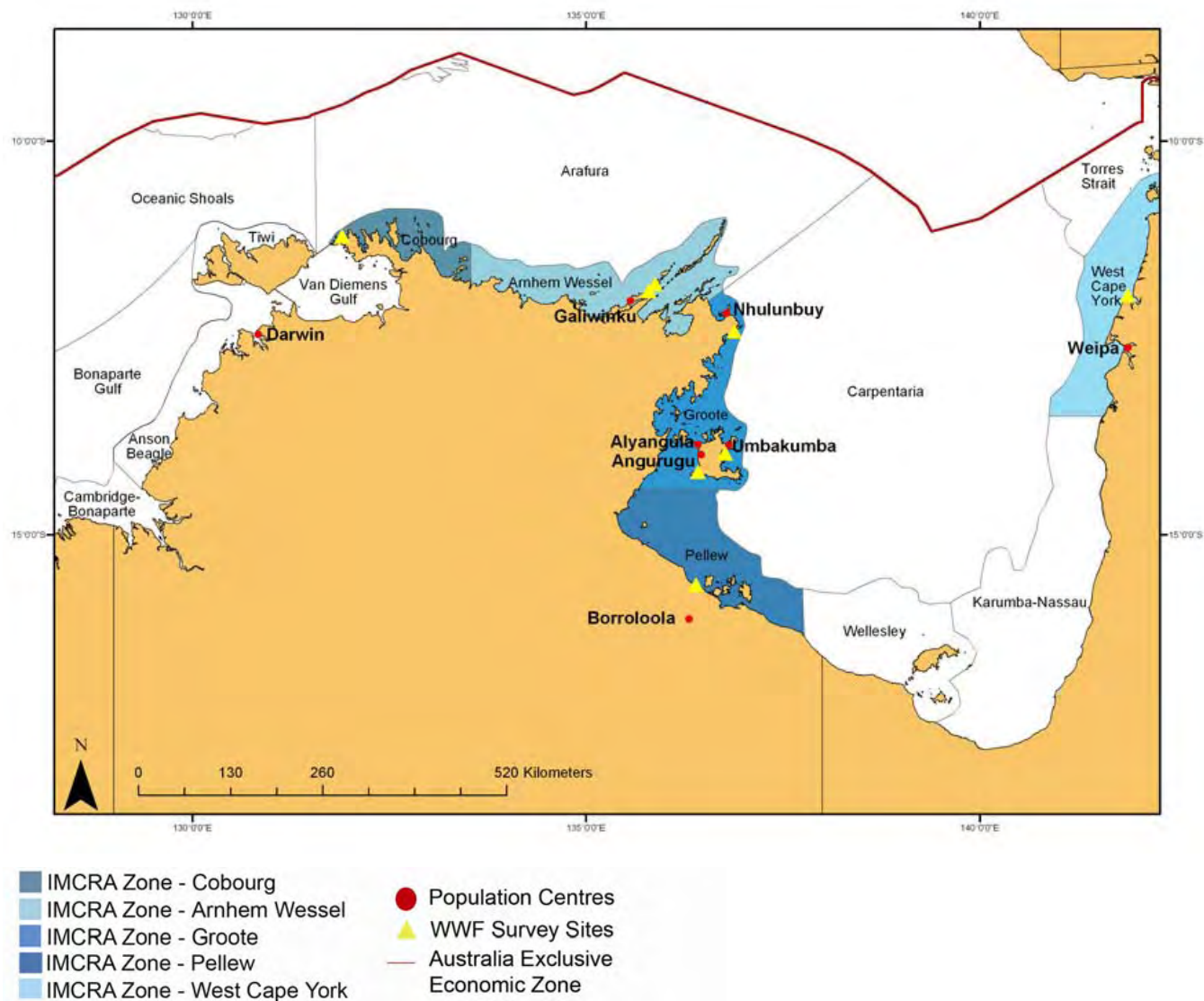


Figure 2. Survey locations and corresponding IMCRA Zones surveyed during 2004.

To compare the monitoring results spatially the Interim Marine and Coastal Regionalisation for Australia version 3.3 (IMCRA) were used and survey results reported as per IMCRA Zone in which they fall (Figure 2). The IMCRA meso-scale regionalisation is an ecosystem based classification of Australia's marine and coastal environments and was developed to provide groups with a regional framework for planning sustainable resource development and biodiversity conservation (Interim Marine and Coastal Regionalisation for Australia Technical Group 1998).

The 2004 marine debris surveys took place in five IMCRA Zones namely Cobourg, Arnhem-Wessel, Groote and Pellew in the Northern Territory and West Cape York in Queensland. A total of 13 sites were assessed for the presence of debris items and six communities were trained in survey techniques and participated actively in the surveys themselves (Appendix 1).

Contamination levels

A total of 57,635 items or 2,015 items per kilometre of beach was collected from the 28.6 kilometres of surveyed sites. These items weighed in at 4,804.2 kilograms or 168 kilograms per kilometre. Contamination levels varied greatly between IMCRA Zones. Sites in the Gulf of Carpentaria generally received substantially greater quantities than Cobourg and Arnhem-Wessel, which are outside the Gulf of Carpentaria. The exception to these results is the site in Pellew, which is within the Gulf, but is sheltered from prevailing winds and currents by the Sir Edward Pellew group of islands (Figure 3).

The most heavily contaminated site was Six Mile Beach on Groote Eylandt, which 6,287 items or 242.1 kg/km of beach. However, the IMCRA Zone with the greatest quantity of debris per kilometre was West Cape York, which contained 3,769 items/km of beach surveyed (Figure 3).

The most numerous items on all sites were those made of plastic and rubber. Common plastic items were lengths of rope, plastic water and shampoo bottles and plastic bottle tops. Quantities of plastic debris per kilometre ranged from 55 items/km in Cobourg and 2158 items/km in West Cape York.

Rubber items were almost entirely composed of rubber thongs (also known as flip flops), which ranged from between 3.5 items/km in Cobourg and Pellew, to 113 items/km in the Groote IMCRA Zone and 1038 items/km in West Cape York (Figure 3).

The other categories of metal, glass, paper and cloth were minor components of the debris collected, with the exceptions of the West Cape York sites where metal items (168 items/km) and glass (397 items/km) were also common (Figure 3).

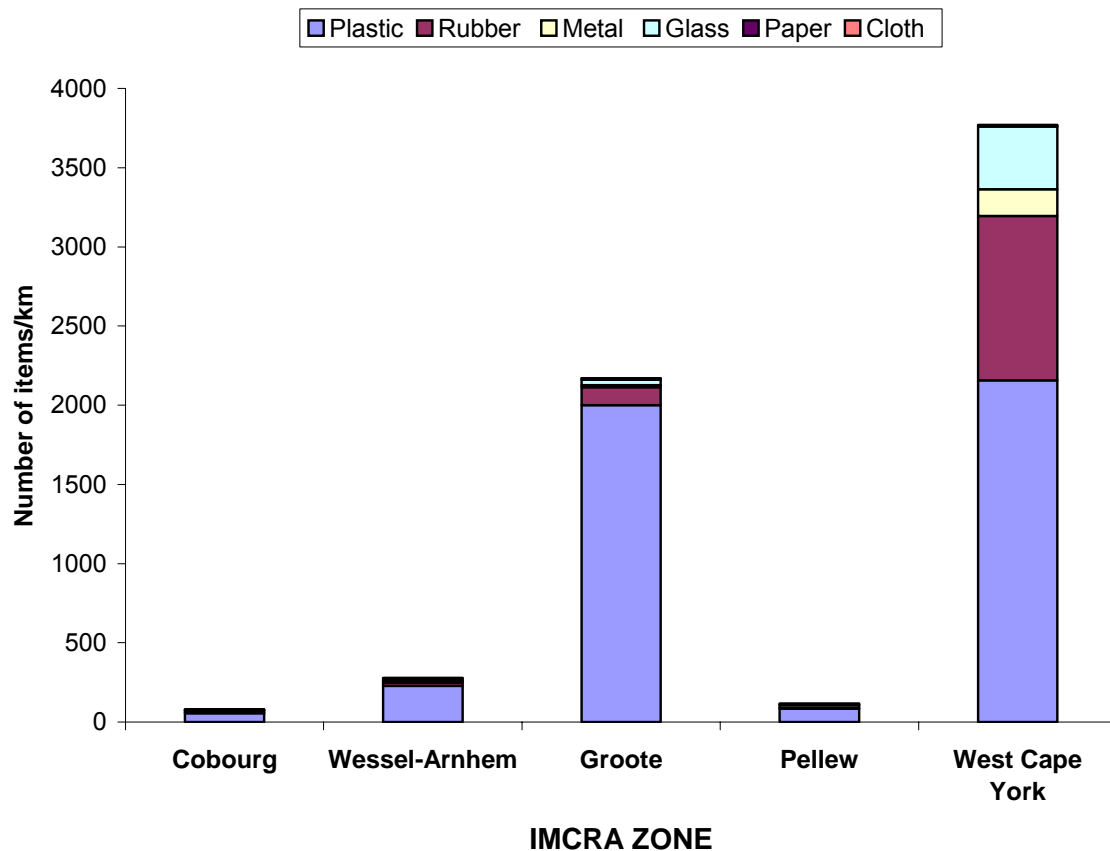


Figure 3. Number of debris items per kilometre from surveyed IMCRA zones 2004

Origins of Marine Debris

General Debris

Marine debris other than fishing nets (general debris) was identified from several nations. In the local region, debris from Australia and Asian nations (Indonesia, China, Singapore, Japan, Taiwan (Peoples Republic of China), South Korea, Philippines, Thailand, Malaysia, Vietnam) were found to be the most common, while debris from other regions (India, Dubai, France, Germany and USA) were also recorded. Debris items from five nations made up about 95% of all identified debris collected. In order of relative significance they were Indonesia (33.5%), China (28.1%), Singapore (15.1%), Australia (12.9%) and Thailand (5%).

The proportion of debris from Australia, Asia and other nations varied between IMCRA Zones. Asian nations contributed the majority of debris items in the Gulf of Carpentaria, with the exception of Pellew, while sites outside the Gulf contained proportionally more items originating from Australia (Figure 4).

Examination of general debris items showed that the majority of items originated from sources outside Australia, although Cobourg, Wessel-Arnhem and Pellew sites contained proportionally more general debris items from Australian sources. The majority of items which originated from Australian sources at Cobourg and Pellew were aluminium beer cans. While at Wessel-Arnhem the major Australian component was food packaging and steel food tins.

The most common general debris items from foreign sources was rubber footwear (both adult and children's), plastic water bottles, shampoo bottles, skin care products and motor oil containers. In addition to the rubber and plastic items found on all sites, West Cape York also had many steel tins of peanut soup from China and glass bottles which previously contained Red Bull and originated from Thailand.

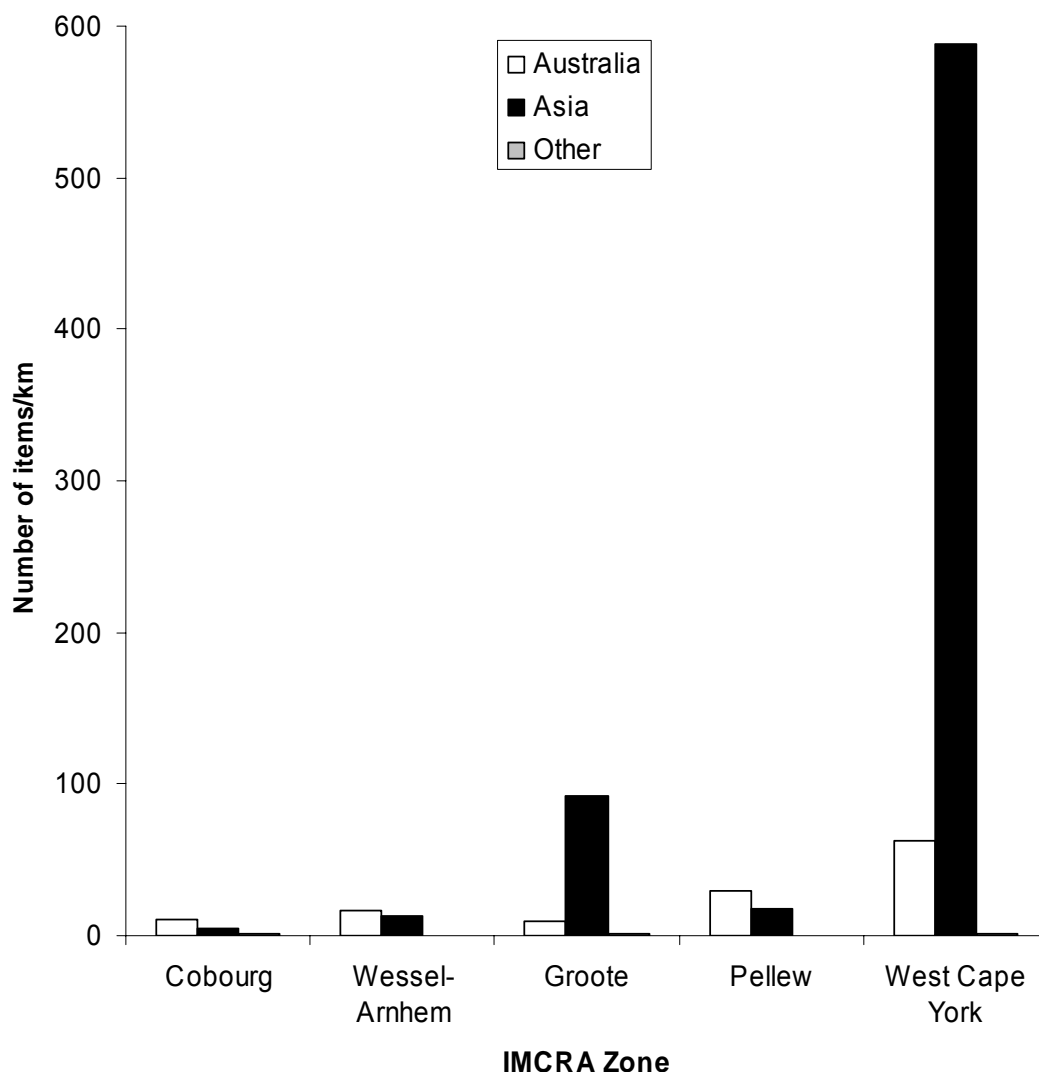


Figure 4. Origins of items per kilometre from survey sites per IMCRA zones

The proportion of items that could be identified also varied between IMCRA Zones. On the exposed sites either side of the Gulf of Carpentaria, proportionally more whole items could be identified in the West Cape York zone (17%) than in the Groote zone (4.6%). While those sheltered sites, which were mostly affected by Australian debris Pellew, Cobourg, and Arnhem-Wessel, 47%, 33.3% and 16.9% respectively could be identified.

Derelict Nets

Derelict fishing nets were one of the most common items in terms of number and the greatest in terms of weight. In total of 406 derelict fishing nets were collected from the 28.6 kilometres of beach surveyed or about 14.2 nets per kilometre of beach surveyed.

The two IMCRA Zones most affected by derelict fishing nets were Groote and West Cape York. Despite most large nets having been removed by the Mapoon rangers prior to the survey taking place, West Cape York still contained about 27.5 nets/km, while Groote contained about 17.9 nets/km.

Within the Groote IMCRA Zone, the Cape Arnhem site had the most derelict nets, with about 30 net/km. The other site which was also heavily affected was Six Mile Beach, with 9.4 nets/km. Both the Cape Arnhem and Six Mile Beach sites had similar numbers of nets greater than 10 m² with 7.4 and 7.7 nets/km respectively. The West Cape York site contained the greatest number of nets per kilometre but lacked the large nets recorded in the other zones. This was due to the Mapoon Rangers removing these large nets earlier in the year. The other IMCRA Zones of Pellew, Wessel-Arnhem and Cobourg contained fewer nets and less large nets per kilometre of beach. Although all sites contained some nets greater than 10m².

The largest net recorded overall was found on Araru Point in the Cobourg IMCRA Zone. This net was a piece of trawl netting that measured 78 metres by 30 metres and weighed 181 kilograms. Although still tied in a bundle when found, it contained the bones of a marine turtle.

Table 2. Origins of derelict fishing nets collected during marine debris surveys

IMCRA Zone	Cobourg	Wessel-Arnhem	Groote	Pellew	West Cape York*	Stranded Wildlife	
Net Size Class (M ²)	n/km	n/km	n/km	n/km	n/km	Turtles	Fish
Australian nets							
0-10	-	-	0.3	0.8	-	-	-
10.1-100	-	0.3	-	-	-	-	-
100+	-	-	-	-	-	-	-
Total	0	0.3	0.3	0.8	0	0	0
Foreign nets							
0-10	1.1	3.6	12.2	3.3	18.5	-	-
10.1-100	0.9	1.2	4.0	-	9	2	11
100+	0.2	0.3	1.7	-	-	3	31
Total	2.1	5.2	17.9	3.3	27.5	5	42
Total number	2.1	5.5	18.3	4.2	27.5		
Total weight	211.1	11.8	80.1	1.8	56.8		

* Most large nets and stranded wildlife had been removed or burnt prior to the Mapoon survey taking place. Therefore the numbers presented in Table 2 is an underestimation.

A total of 398 foreign fishing nets (98% of all nets) were collected during the 2004 survey season, 270 were fragments of less than 10m², 96 were between 10 and 100m² and a further 32 were greater than 100 m².

There were eight nets of Australian origin collected during all surveys. Seven originated from commercial fishing vessels and all were less than 10 m², while one net in the Wessel-Arnhem IMCRA Zone was greater than 10 metres in area and originated from the local community.

A total of 47 animals were recorded stranded in fishing nets on the 28.6 kilometres of beach surveyed. All were found in nets of foreign origin and greater than 10 m² in area. The species found stranded in these nets were; juvenile hawksbill turtles (*Eretmochelys imbricata*), unidentified turtles, catfish (*Arius sp.*), Triggerfish (*Balistidae*) and a shark (*Carcharhinus sp.*) (Table 1).

As well as animals being found in derelict nets, a further three turtles were found dead on survey sites in the Groote IMCRA Zone. These turtles showed no signs of having been caught in netting or other debris. They were a juvenile hawksbill turtle and a juvenile olive ridley turtle (*Lepidochelys olivacea*) both found on the Cape Arnhem survey site and a juvenile green turtle (*Chelonia mydas*) on Six Mile Beach.

Discussion

General Debris

Marine debris sites were chosen for a number of reasons, one of which being scientific. Because sites have been set up for number of reasons, not all could be considered as representative of the entire region. This is particularly true of the sites in Pellew, which are almost completely sheltered by the Sir Edward Pellew Islands and Arnhem-Wessel, which is also on the less exposed side of the Wessel Islands chain (Figure 2). However, as resources in many areas are limited and the goals of the program also include capacity building of local Aboriginal Ranger groups and communities, the sites surveyed have been successful.

Results from the 2004 survey show that marine debris continues to be a significant source of contamination in northern Australian waters. Results from the past five years of surveys show that, although the numbers of items collected per kilometre of survey site have fluctuated, they have not decreased (Figure 5).

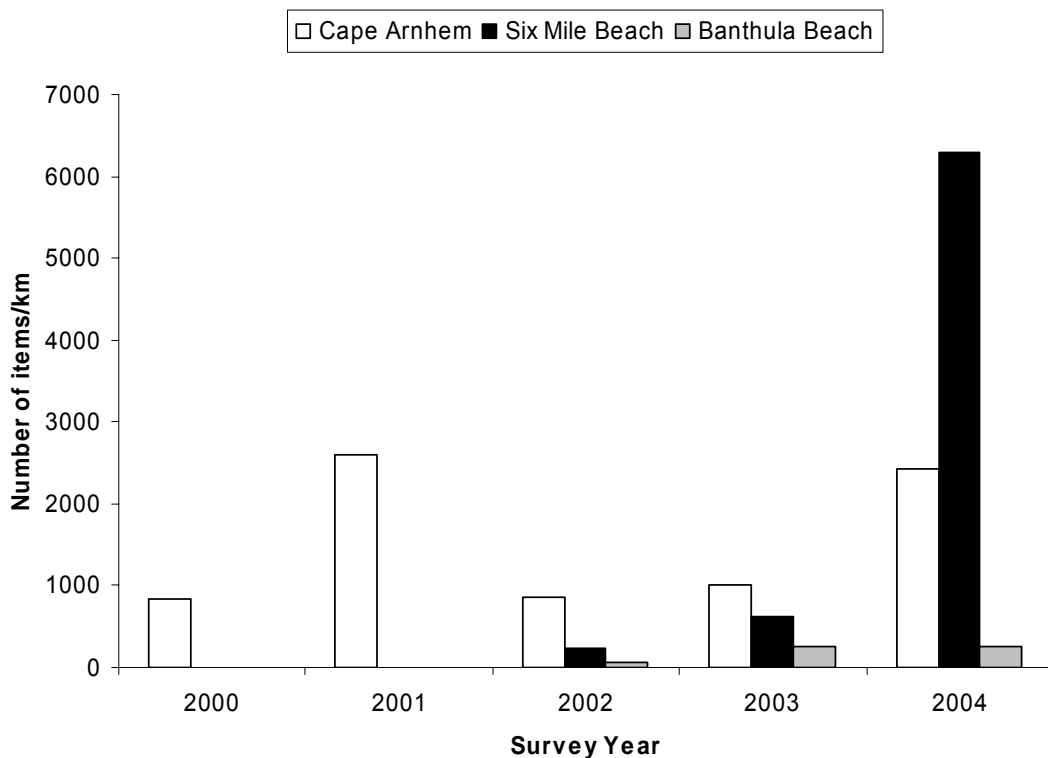


Figure 5. Number of items collected per site between 2000 and 2004 at Cape Arnhem, 2002 - 2004 on Six Mile Beach on Groote Eylandt (Groote IMCRA Zone) and 2002 – 2004 on Banthula Beach Elcho Island (Arnhem - Wessel IMCRA Zone).

The Cape Arnhem site, which is the longest consecutively monitored site, was first surveyed in 2000. During the subsequent year the quantity of debris present increased dramatically in 2001, decreased in 2002 to about the same level at 2000 and continued to increase in 2003 and 2004. This increase is also apparent in two of the other sites which have also been monitored since 2002, although the Six Mile Beach site has increased disproportionately to the other two sites.

The quantity and relative composition of debris present varied between sites (Figure 3). The Gulf of Carpentaria receives comparatively greater quantities of marine debris each year than those sites outside the Gulf. While within the Gulf differences quantities of debris and relative composition are also apparent (Figure 3).

One of the possible explanations as to how differences have occurred between the eastern and western shores of the Gulf and other sites such as those on Cobourg can be gleaned from examining the possible vectors bringing marine debris into northern Australian waters from Asia and the composition of the debris itself. Oceanic currents and monsoonal wind are the likely vectors for the marine debris finding its way in to northern Australian waters. The combination of the Pacific to Indian Ocean Throughflow and yearly Asian-Australian monsoonal winds drive oceanic waters through the Indonesian Archipelago, of which the monsoonal winds are thought to be a major factor in the movement of surface waters (Qiu *et al.* 1999). From this point it is the Gulf circulation pattern (Forbes and Church 1993) and again monsoonal winds that are likely to bring marine debris in a clock wise direction into the Gulf proper where a proportion of the debris makes landfall (Figure 5).

The first area which receives this debris is the West Cape York IMCRA Zone, where during the monsoon, derelict fishing nets and other debris piles up on the coastline (*Pers. Comm.* Lawry Booth and Cecil Woodley, 2004). While the beaches on the western side of the Gulf remain free of new debris until the middle of the year when the winds reverse bringing debris onshore in the Groote IMCRA Zone (*Pers. Comm.* Steve Roeger and Thomas Amagula, 2004). Westerly areas outside the Gulf then receive debris as an unknown proportion leaves the Gulf and moves westward and into the Indian Ocean. Marine debris first washing ashore on the West Cape York IMCRA Zone is a possible explanation for the differences in both the quantity and composition of debris between the two IMCRA Zones on either side of the Gulf. Some of the debris is deposited on West Cape York, while the rest continues down into the Gulf where a portion of this debris is then deposited on the western shore later in the year. The timing of deposition is likely to also be the cause of the differences in composition found on either side of the Gulf. Debris items such as plastic and rubber, which float readily, and will continue to float when broken into smaller pieces, while metal and glass items will drop out of the water column once they loose some of their integrity. Therefore, those areas furthest away from the source of the pollution will have proportionally less metal and glass items compared to plastic and rubber.

The West Cape York IMCRA Zone was found to contain substantially greater quantities of marine debris and proportionally greater quantities of metal and glass items than Groote sites on the western shore of the Gulf and other sites outside the Gulf (Figure 3). This is because West Cape York is closer to the source of the debris than Groote, which had greater quantities of debris than Wessel-Arnhem, which again had greater quantities than Cobourg (Figure 3). A further observation that can be made with regard to distance from sources, is that the relative proportions of debris originating from Australia and Asia also follow roughly the same trend. In areas further from Asia, in terms of time at sea, a greater proportion of debris was found to have come from Australian sources (Figure 4).

While most of the debris found on beaches in the Gulf of Carpentaria originated from foreign sources, the Australian component of this debris is significant and in areas outside the Gulf it was dominant. The majority of this debris was in the form of aluminium beers cans and food packaging and although there is little evidence of it damaging wildlife, it should not be ignored.

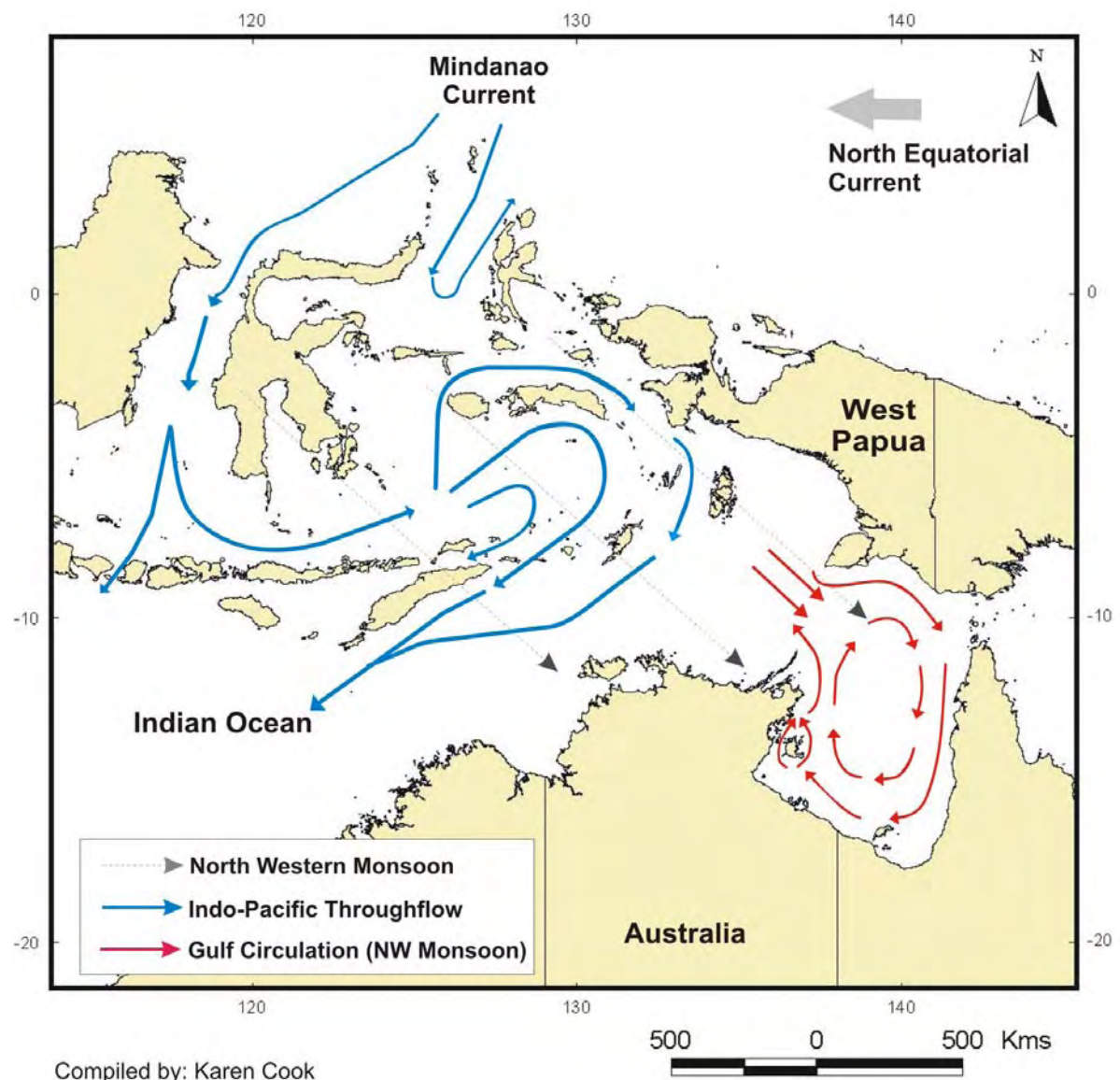


Figure 6. Vectors thought to cause yearly influxes of marine debris into northern Australian waters during the North West monsoon. Diagram of Pacific to Indian Ocean Throughflow after Qiu, Mao and Kashino (1999), Northwest monsoon and Gulf circulation pattern during the North West Monsoon, after Forbes and Church (1993).

Marine debris is considered a key threatening process in Australian waters due to its ability to harm marine wildlife and in particular vertebrate species. There are a number of ways in which marine debris can potentially harm marine wildlife, however, there is little available information other than entanglement reports (National Oceans Office, 2003, White, 2003 & Roeger, Mununggurr and Wise 2004) and circumstantial evidence of ingestion (White 2003).

Derelict fishing nets are an obvious problem in northern Australian waters. Many of these nets are large and their colouration generally makes them stand out on beaches, while images of marine turtles and other wildlife caught in these nets tend to create a lasting impression. The majority of nets recorded on surveys originated from the commercial fleets of several nations fishing in Indonesian waters. The most frequently recorded nets were those that originated from Thai and Chinese trawl

fishing vessels operations in the Arafura Sea and gillnets used by Indonesian fishermen in the Timor and Arafura Seas. These net types were also found to be involved in the majority of stranding events recorded during surveys and from stranding reports received from the public (Table 3) using the WWF Net Kit (White, Cook and Hamilton, 2003).

The species most at risk from derelict nets are marine turtle species. Five marine turtles were found in netting during the marine debris surveys and a further 40 were reported by the public (Net Kit reports) in 2004. This is in contrast to dolphins and whales, which are rarely found stranded in marine debris, and dugong (*Dugong dugong*) which are yet to be confirmed in a derelict net.

Table 3. Net Kit reports received during the 2004 calendar year.

IMCRA Zones										Stranded Wildlife		
Origin	Net Size Class (m ²)	Anson-Beagle	Arafura	Arnhem-Wessel	Cobourg	Oceanic Shoals	Pellew	Sunda Province (b)	Tiwi	Torres Strait	Turtles	Fish
Australian nets												
0-10	-	-	-	-	-	-	6	-	-	-	-	-
10.1-100	-	-	-	1	-	-	2	-	-	-	-	-
100+	-	-	-	-	-	-	-	-	-	-	-	-
Total	0	0	0	1	0	0	8	0	0	0	0	0
Foreign nets												
0-10	-	-	-	5	-	3	7	27	5	1	1	-
10.1-100	-	-	-	34	-	8	2	6	4	-	12	4
100+	1	2	2	4	1	5	1	1	3	-	27*	27
Total	1	2	2	44	1	16	18	34	12	1	40	31

The marine turtle species listed in the nomination of marine debris as a threatening process are the hawksbill (*Eretmochelys imbricata*), green (*Chelonia mydas*), flatback (*Netator depressus*), leatherback (*Dermochelys coriacea*) and loggerhead turtles (*Caretta caretta*). This list was derived from information available at the time of the nomination and although adequate to highlight the issue some revision of this list is required. In the region covered by this report the species that have been reported stranded in derelict nets have been hawksbill, olive ridley, green and flatback turtles respectively, while leatherback and loggerhead turtles are yet to be confirmed in a derelict net or other debris.

In both marine debris surveys and Net Kit reports during 2004 (Table 3), as well as previous years no derelict nets of Australian origin have caused the stranding marine wildlife. There have been 20 net types reported to WWF or recorded on survey sites that caused the stranding of marine wildlife, of which three net types stand out as

frequent offenders. They are a green light weight gillnet GR24, monofilament gill nets WT21 and WT35 which all originate from Indonesia, blue or white fish trawl netting from Thai trawl vessels and green trawl netting from Chinese vessels.

What makes these nets dangerous to marine wildlife is the size of net present and their configuration. The Indonesian gillnets, Thai trawl nets and Chinese trawl nets are the most numerous on all survey sites and tend to be large pieces of netting. Nets of greater than 10 meters in area were responsible for all but one of the stranding events recorded during 2004 and in previous years. These nets also have a stretched mesh size capable of going over a turtles head or flipper (most are caught by both) and not allowing the turtle to withdraw from the net. The most standings are caused by nets with a mesh size between 7.5 and 15 centimetres.

Derelict fishing, because they are obvious and have obvious affects on marine wildlife, have been the major focus of groups working on the issue. However, negligible effort has been directed at quantifying the threat of ingestion. In surveys performed during 2003 plastic items are frequently recorded with bite marks. Within the Gulf of Carpentaria about 25% of white plastic bottles and 15% of rubber thongs have been found to contain bite marks caused by fish and marine turtles (White 2003). However, as few necropsies have been preformed on marine turtles there is scant information available to determine what level of threat ingestion of marine debris poses to marine vertebrates.

Conclusion

Marine debris is continuing to contaminate the waters, reefs, mangroves and beaches northern Australian. The areas most affected by debris are the IMCRA Zones of West Cape York and Groote within the Gulf of Carpentaria. These areas receive each year substantially greater quantities of debris that those monitoring sites outside the Gulf. Monitoring sites within the Gulf also received the majority of debris from foreign sources, while IMCRA Zones outside the Gulf were found to have less debris and the majority of general debris from local sources and fishing nets from foreign fisheries.

The greatest identified threat prosed by marine debris is the entanglement of threatened marine life such as marine turtles in derelict fishing nets, while the level of threat from the ingestion of plastic and rubber items is yet to be sufficiently investigated.

The nets responsible for the entanglement and deaths of marine turtles were all identified as originating from foreign sources and originate from Indonesia, Thai fish trawl vessels and Chinese trawl fish trawl vessels in the Arafura Sea.

While monitoring of the problem is valuable and needs to be ongoing, targeted solutions to the problem in the coastal communities and the fishing industry operating to the north of Australia are urgently required.

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Appendix 1

Site locations surveyed during 2004.

IMCRA Zone Location	Start Latitude	Longitude	Finish Latitude	Longitude	km
Cobourg (COB)					
Araru Point, Site 1	11° 12' 32.4"S	131° 54' 14.1"E	11° 11' 09.2"S	131° 52' 52.17"E	2.7
Araru Point, Site 2	11° 11' 07.9"S	131° 52' 47.5"E	11° 12' 00.1"S	131° 52' 32.7"E	2.0
Arnhem Wessel (AWS)					
Banthula Beach	11° 48' 47.2"S	135° 52' 46.2"E	11° 50' 46.2"S	135° 52' 15.6"E	2.6
Gitan Beach	11° 54' 3.24"S	135° 47' 33.7"E	11° 54' 17.3"S	135° 47' 18.2"E	0.7
Groote (GRO)					
Cape Arnhem	12° 25' 01.2"S	136° 52' 55.2"E	12° 22' 24.5"S	136° 52' 55.2"E	9
Salt Lake Beach	13° 57' 39.6"S	136° 46' 04.0"E	13° 57' 42.6"S	136° 46' 55.2"E	3.62
South Point, Site 1	14° 12' 08.6"S	136° 26' 56"E	14° 11' 49.3"S	136° 26' 16.4"E	1.3
South Point, Site 2	14° 12' 10.5"S	136° 25' 26.4"E	14° 12' 00.4"S	136° 24' 36.7"E	1.6
South Point, Site 3	14° 13' 25.3"S	136° 12' 07.2"E	14° 12' 56.9"S	136° 22' 03.36"E	1.9
Pellew (PEL)					
Bing Bong , Site 1	15° 37' 41.5"S	136° 23' 49.6"E	15° 37' 39.5"S	136° 24' 10"E	0.6
Bing Bong , Site 2	15° 37' 44"S	136° 23' 46.7"E	15° 23' 47.6"S	136° 23' 46.7"E	0.6
West Cape York (WCY)					
Mapoon, Site 1	11° 57' 19.9"S	141° 52' 44.4"E	11° 57' 43.5"S	141° 52' 20.4"E	1
Mapoon, Site2	11° 57' 43.5"S	141° 52' 20.4"E	11° 58' 07"S	141° 51' 58.4"E	1
Total km					28.6