

RUBBISH TRENDS - BEACH LITTER SURVEYS AT KAWERUA, 1974 — 1982

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SUMMARY

Four beach litter surveys carried out in 1974, 1975, 1981 and 1982 at Kawerua on the west coast of Northland, New Zealand, show that the dominant litter being washed ashore is (in order of decreasing abundance) dressed timber, fragments of moulded plastic and polystyrene, plastic bags, plastic bottles, plastic bottle tops and glass bottles. Slightly in excess of 50% of all items appears to be derived from fishing vessels and most of the remainder has been washed down flooded rivers and into the sea.

Significant differences in litter composition over the 8 year period are attributed to changes in product packaging (increased use of plastic at the expense of cardboard, glass and metal), trends in product consumption (increased popularity of yoghurt and wine), introduction of new items (plastic straws and plastic netting) and changes in fishing boat operations following the introduction of New Zealand's Exclusive Economic Zone (evidenced by a decrease in Asian items).

The potential for over-interpretation of limited data is shown to be very real and demonstrates the need for a careful approach in prehistoric midden interpretation.

INTRODUCTION

In some respects beach litter is a modern equivalent of prehistoric midden. Archaeologists analyse middens in order to learn more about the lifestyle of prehistoric peoples and how these may have changed through time. Modern beach litter provides an opportunity to analyse present day rubbish in a similar way and by repeated surveys to note any temporal changes in its composition. Unlike prehistoric midden analyses, any interpretations from the beach litter observations can be checked against known trends in our present society.

This article records and attempts to analyse the results of 4 beach litter surveys (Appendix 1) undertaken between 1974 and 1982 in the vicinity of Kawerua. Kawerua is the Auckland University Field Club's Scientific Station, situated 17 km south of the entrance to Hokianga Harbour on Northland's west coast (Fig. 1). The station is located in the middle of 12 km of uninhabited coastline that borders the Waipoua State Forest and as such is one of the least-visited stretches of beach in

northern New Zealand. Because of this, it is an ideal place to investigate the composition of beach litter, away from the potential interference of casual beach combers. This coastline was also sampled by Gregory (1978) in his survey of polystyrene granule distribution.

The Surveys

Each survey consisted of a small group of people walking along the beach recording all items of anthropogenic litter visible between the sea

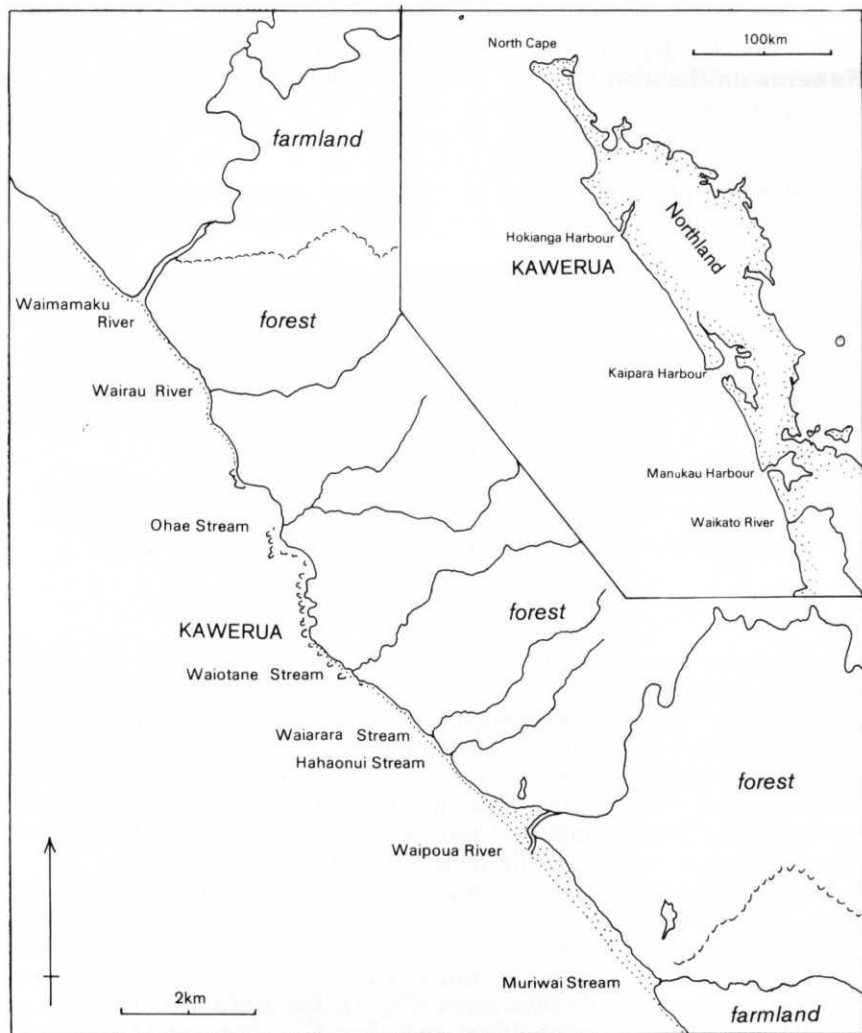


Fig. 1. Location of the beach litter surveys on the beaches around Kawerua, west coast Northland (Appendix 1).

and the *Spinifex* at the front of the foredune. Dressed timber and posts were recorded but trees or branches that had merely been felled but not utilised, were not recorded. In 1974 and 1975, all non-wooden litter was collected and removed from the beaches. Lack of assistance prevented this being repeated in 1981 and 1982, but it is not thought to have greatly influenced the 1982 results because of the impermanence of many litter forms and seasonal mobility of the beach sand.

RESULTS

Copies of the basic data are available on request from the author, should anyone wish to continue or extend this monitoring programme. For brevity and comparability the data have been categorised, summarised and presented as item units per kilometre of beach and as a percentage of the total litter observed during each survey (Tables 1, 2, Fig. 2).

Quantity of litter

Nearly double the quantity of litter per kilometre was present in the 1974 and 1975 surveys than in 1981 and 1982 (Table 1). This can be partly explained by the differing intensities of the survey for there is a strong correlation between the number of small items (e.g. bottle tops, fragments of plastic and polystyrene) recorded and number of people searching (e.g. 7+ people recorded 32 fragments of plastic per km in 1975 whereas three people recorded 5.4 pieces per km in 1981). Even deleting these small items from the totals, there was still a significant reduction in litter recorded in the 1980s compared with the 1970s. The quantity of dressed timber on the beach was also significantly less.

It is tempting to deduce that people littered less in the early 1980s than the mid 1970s, but such a conclusion would require many, more regular surveys to test. More likely the quantity of litter at any one time is strongly correlated with climatic events of the preceding weeks or several months. A major flood would result in an increase in land-derived litter and onshore winds and storms would increase the amount being deposited on the beach from both sea and land sources. A decrease in the number of boats offshore and therefore a decrease in the quantity of sea-derived flotsam and jetsam could also be an explanation.

Composition and source of litter (Table 1)

Litter washed up on west coast beaches around Kawerua is remarkably diverse but dominated by pieces of dressed timber, fragments of moulded plastic and polystyrene, plastic bags, plastic bottles and bottle tops, glass bottles and blue container ties and tapes. A variety of unusual 'novelty' items comprised 2-15% of the surveyed litter.

Table 1. Summary of categorised litter recorded during each beach survey. Presented as number of items per km and (percentage of total litter, except that asterisked*, in each survey).

	1974		1975		1981		1982	
dressed timber & posts*	21	(-)	NR	(-)	5.4	(-)	12.4	(-)
plastic - bags	14.6	(41)	15.5	(39)	4.0	(19)	3.6	(14)
bottles	6.6	(19)	4.3	(11)	5.8	(28)	9.6	(36)
bottle tops*	1.2	(-)	6.2	(-)	3.8	(-)	2.0	(-)
buckets	0.8	(2)	0.3	(1)	0		0.6	(2)
buoys	0.3	(1)	1.5	(4)	0.2	(1)	0.1	
combs	0		0.5	(1)	0		0	
crates (milk, fish)	0.1		0		0		0.5	(2)
flare holders	0.4	(1)	0.5	(1)	0		0	
ice-cream tubs & lids	0		0		1.4	(7)	0.8	(3)
netting	0		0		0.8	(4)	1.0	(4)
straws (drinking)	0		0		0		0.1	
tapes, ties (blue)	1.6	(4)	NR	(-)	1.8	(9)	1.0	(4)
toys	0.4	(1)	0.8	(2)	0		0.1	
yoghurt tubs	0		0		0		0.3	(1)
fragments indet*	6.2	(-)	32	(-)	5.4	(-)	NR	(-)
polystyrene - buoys	0.1		0		0		0	
fragments*	0.9	(-)	4.0	(-)	1.8	(-)	1.0	(-)
polythene sheets	0.1		0		0		0	
nylon - ropes	0		0.3	(1)	0.6	(3)	1.3	(5)
lines (fishing)	0.8	(2)	0		0.4	(2)	0	
glass - bottles - alcoholic ²	2.0	(6)	3.8	(10)	0.8	(4)	1.8	(7)
non-alcoholic	0		1.0	(3)	0		0.5	(2)
coffee	0.3	(1)	0.8	(2)	0.2	(1)	0.1	
indet.	2.2		2.6	(6)	1.0	(5)	0.7	(3)
total	4.5	(13)	7.0	(18)	2.0	(10)	3.1	(12)
light bulbs	1.6	(5)	1.8	(5)	0.4	(2)	0.3	(1)
fluorescent tubes	0.3	(1)	0.8	(2)	0.2	(1)	0.4	(2)
metal - cans - drink & food	0.6	(2)	0.5	(1)	0.4	(2)	0	
gas & fuel	0		0.3	(1)	0		0.1	
aerosol	0.6	(2)	0.5	(1)	0		0.5	(2)
total	1.2	(3)	1.5	(4)	0.4	(2)	0.7	(3)
buoys	0.2	(1)	0		0		0	
oil drums	0.3	(1)	0		0		0	
corks	0.2	(1)	0		0		0	
footwear - jandals	0		0.3	(1)	0		0.4	(2)
shoes	0.4	(1)	0.5	(1)	0		0	
gumboots	0.1		0		0		0.1	
flippers	0		0.3	(1)	0		0	
miscellaneous novelty items	0.7	(2)	2.8	(7)	3.2	(15)	2.3	(9)
Total (including * items)	64.6		81.7		37.4		41.8	
(excluding * items)	35.3		39.5		21.0		26.4	

1. NR = not recorded.

2. see Table 2

The beach litter comes from several sources:

a. Beach visitors. The small number of visitors to the surveyed beaches, together with the composition of the litter, make it unlikely that much of the litter was left by people using these beaches. Only two items (a flipper and a lump of surfer's wax) may definitely be attributed to beach visitors. Several plastic toys and small buckets may have been lost by young beach visitors elsewhere and carried here by longshore currents before being washed up.

b. Land. An indeterminate percentage of the litter (probably 20-50%) originated from a land source, having washed down rivers (generally when in flood) into the sea and then carried by currents to the Kawerua area.

Very few of the local rivers or streams are likely to have contributed much litter, as most drain uninhabited forest. The Waipoua River passes several small forestry settlements and much of the catchment of Muriwai Stream is sparsely populated farmland and neither would contribute much litter of human origin. The largest local river is the Waimamaku (Fig. 1) in the north which flows mostly through farmland with many inhabitants and undoubtedly contributes a significant proportion of the land-derived litter to the Kawerua beaches.

No other rivers of any consequence discharge directly on the west coast within 100 km of Kawerua, but many large rivers flow into the tidal Hokianga and Kaipara Harbours. Although much of the litter carried into these is washed up on their very extensive harbour coastlines, undoubtedly some is carried out through their harbour entrance on the outgoing tide and is eventually thrown up on Kawerua beaches. Debris carried down the North Island's largest river, the Waikato, and into the sea 220 km south of Kawerua (Fig. 1), has been shown to be carried north and into the Manukau Harbour (Hatch 1983). Some of the Kawerua litter may also be from this source, as evidence by the scattered pumice pebbles (from the upper Waikato Valley) thrown up on the beach. Alternatively, pumice may originate from mid-Tasman submarine volcanoes.

Only a small number of items have a definite land origin (e.g. wooden fence posts and battens, car head-lamp, plastic decoy duck head), but a number of other items no doubt also come from there (e.g. oil drums, large planks of timber).

c. Boats. A large percentage of the litter (probably 50% or more) appears to have been discarded by boats and washed ashore. These boats are probably mostly fishing vessels, as only a few coastal ships or small pleasure craft sail along this coast. Items that definitely originate from this source include buoys, nylon ropes and lines, flare holders and items with Asian labels (from Japanese and Korean fishing boats). Many of the other items probably also come from boats, but not indisputably so. Some of the more likely are plastic buckets, fish crates, ice cream tubs, blue container tapes, miscellaneous fragments of polystyrene, light

bulbs, fuel containers, footwear and many bottles, cans and plastic bags.

The occurrence of several charred items (bucket, teapot) and an empty fire extinguisher washed up on the beach in 1982 points to a fire on a small boat not long before.

Knowledge of transport patterns of floating debris in the sea off the west coast of Northland is virtually nil. It is therefore impossible at the present time to suggest a source direction for any of the litter. Transport paths are undoubtedly influenced not only by a north-flowing oceanic surface current well offshore, a south-east flowing coastal current (Schofield 1970) and variable longshore drift patterns in the swash zone, but also by strong wind and storm wave directions.

CHANGES IN LITTER COMPOSITION (Fig. 2)

As only 4 surveys have been made and as each has been influenced by many immeasurable variables, no indisputable conclusions can be reached about the validity of observed changes in the composition of the beach litter over the past 8 year period. The data does suggest however several plausible trends:

a. There was a general increase in the proportion of plastic items (excluding plastic bags) from the mid 1970s to early 1980s, with corresponding slight decreases in the proportion of glass and metal objects.

b. There was a major decrease in the proportion of plastic bags (41% in 1974 to 14% in 1982) and slight decrease (possibly not significant) in the proportions of glass bottles, metal cans, fishing buoys, and spirits bottles.

c. There was a visible increase in the proportion of plastic fish and milk crates, 1-2 litre plastic bottles and nylon ropes.

d. Of the identifiable foreign material (from overseas boats) there was a slight decrease in the proportion of items of Asian (mostly Japanese) origin between the 1970s and early 1980s, with a marked low in 1981. Several items from European countries (e.g. France, Belgium) appeared in the 1980s.

e. In the 1980s several new categories of litter made their appearance - notably plastic soft drink bottles, two litre plastic ice-cream tubs and lids, plastic yoghurt tubs, plastic netting and plastic drinking straws.

DISCUSSION

The 5 trends in litter composition listed in the previous section may appear plausible to present-day readers because they are familiar with modern society. In archaeological analysis the researcher does not have

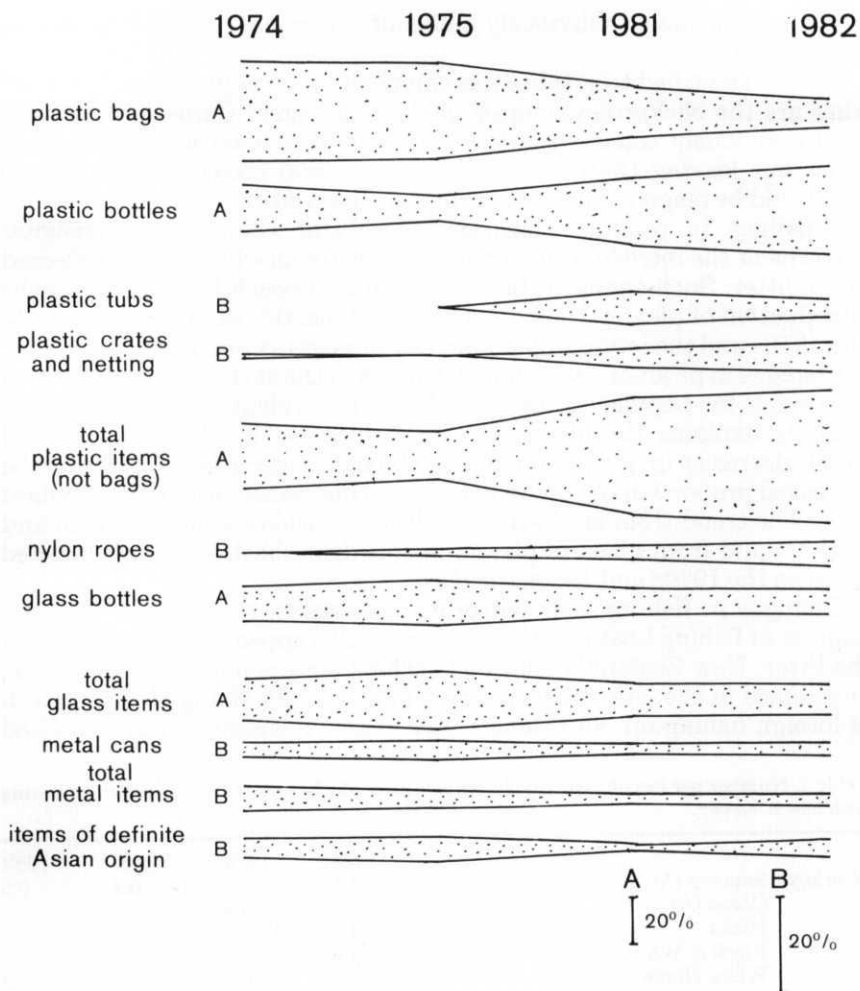


Fig. 2. Histograms illustrating changes in the percentages of various categories of litter recorded in the four beach surveys. Dressed timber, posts, bottle tops, and unidentified fragments of moulded plastic and polystyrene have been excluded from the totals.

this advantage of modern perspective and the possibility of over-interpretation arises, especially where data is meagre. These beach litter results provide an excellent illustration of this. The data in Tables 1 and 2 could be used to show that ice-cream and yoghurt were invented in the late 1970s, that in the 1980s (compared with the 1970s) coffee was drunk-less, lemonade more, beer and Johnny Walker whiskey were no longer drunk and that jandals replaced shoes and gumboots as the

dominant footwear. Obviously none of these conclusions have any factual basis.

If the 5 identified trends in litter composition do approach reality then what are the background causes of these changes? Climatic influences would obviously cause variation in the input of land and sea derived litter, but leaving these aside there are several society-linked factors that could be responsible for some of the observed changes.

a. Changes in product consumption. Major changes in consumer patterns or the introduction of popular new items will often be reflected in the litter. Such changes that appear in this beach litter data are the introduction of plastic drinking straws and plastic netting in the mid to late 1970s and the increasing popularity of yoghurt and wine.

b. Changes in product packaging. Changes in the style or composition of packaging for popular items should also be evident in the litter. This possibly explains the observed overall increase in plastic items and slight decrease in glass and metal objects, especially evident in the increased proportion of plastic bottles and decreased proportion of glass ones. The trend from cardboard to plastic containers for ice-cream and yoghurt and from glass to plastic in soft drink bottles is very marked between the 1970s and 1980s surveys.

c. Changes in fishing boat patterns. Changes in the composition and number of fishing boats off the west coast also appears to be reflected in the litter. New Zealand's 200 mile exclusive economic zone (EEZ) was introduced in the late 1970s and this undoubtedly changed the pattern of foreign fishing off Northland's west coast. It seems to have resulted

Table 2. Number per km of identifiable, empty, alcoholic beverage bottles recorded during each beach survey.

	1974	1975	1981	1982
Whiskey - Suntory (A)	0.6	-	0.2	0.5
Ocean (A)	-	0.2	-	-
Nikka	0.2	-	-	-
Black & White	0.1	-	-	-
White Horse	0.2	0.2	-	0.3
Johnny Walker Red	0.6	0.3	-	-
King George IV	0.1	-	-	-
Dewars Scotch	-	0.8	-	-
Grousse Scotch	-	-	-	0.1
Challis Stern & Co	-	-	-	0.1
Cognac - E. Remy Martin (F)	-	-	-	0.1
Gin - Gordon's Dry	0.1	0.2	-	-
Vodka - Cossack	-	0.2	-	-
Cherry Brandy (A)	0.1	-	-	-
Beer	-	1.8	-	-
Wine or indeterminate spirits	-	0.1	0.6	0.7

A = Asian F = French

in a slight reduction in litter of Asian origin (Japanese and fewer Korean boats are the main foreign fishing vessels in this area). Beach litter results seem to suggest a slight increase in proportion of local fishing boats operating off the coast in the 1980s, but this may be caused partly by the fact that since the EEZ was emplaced foreign boats have been required to visit New Zealand ports (and hence acquire potential litter of New Zealand origin).

REFERENCES

- Gregory, M.R. 1978: Accumulation and distribution of virgin plastic granules on New Zealand beaches. *New Zealand Journal of Marine and Freshwater Research* 12(4): 399-414.
- Hatch, E.D. 1953: A note on the wet-land plants of the Kakamatua Estuary. *Auckland Botanical Society Newsletter* 38(2): 22.
- Schofield, J.C. 1970: Coastal sands of Northland and Auckland. *New Zealand Journal of Geology and Geophysics* 13: 767-824.

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APPENDIX I. Details of four beach surveys carried out on the Kawerua coast from 1974 to 1982, including number of participants.

1. May 1974. Waimamaku River to 1 km north of Ohae Stream, and Kawerua to Muriwai Stream (10 km of beach). Five people.
2. March 1975. Kawerua to 1 km north of Waipoua River (4 km). Seven people.
3. June 1981. Kawerua to Waipoua River (5 km). Three people.
4. June 1982. Kawerua to 1 km north of Muriwai Stream (7 km). Two people.