

## **A LOAD OF OLD RUBBISH - KAWERUA BEACH LITTER SURVEYS, 1974-1997**

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### **SUMMARY**

Eight litter surveys (1974-1997) of the exposed and remote west coast beach at Kawerua, Northland, New Zealand, suggest that the quantity of non-timber anthropogenic items being washed up is increasing, whereas the quantity of dressed timber is relatively stable. The quantity and relative abundance of litter that is definitely derived from boats has increased significantly over this period, although the amount of Asian-labelled litter has remained constant. It is not possible, however, to estimate reliably the total proportion of litter derived from shipping or land sources.

Significant changes in the litter composition over these 23 years include: increasing quantity of hard plastic, foam plastics, plastic sheets and fibre, plastic bottles, containers, lids, buckets, baskets, polystyrene floats, blue strapping loops, and nylon lines and twine. There has been a relatively constant quantity of items made from glass and metal, but a significant decrease in their relative abundance.

These trends are attributed to introduction of new products and changes in product packaging (plastic icecream containers, yoghurt and margarine tubs, 1-2 litre soft drink, 3 litre juice and 1-2 litre water bottles, plastic corks, straws, cardboard wine caskets) and changes in fishing boat practices and packaging.

**Keywords:** Northland; Kawerua; beach litter surveys; marine debris.

### **INTRODUCTION**

While staying at the Auckland University Field Club Scientific Station at Kawerua, on Northland's west coast (Fig.1), in the 1970s, Field Club students became concerned at the amount of litter being washed ashore on its remote and exposed beaches. Out of interest, we undertook two beach clean-ups and litter surveys in 1974 and 1975. The results were recorded in the station log book.

In the early 1980s, I decided that it would be interesting to repeat these surveys to determine whether the problem was still as serious and whether there was any changing trends in the composition and source of the litter. Two further



surveys were undertaken in 1981 and 1982 and the results and trends published in *Tane* (Hayward 1984).

Since then, I have undertaken a further four beach litter surveys (often with assistance of colleagues) at regular 3-4 yearly intervals (1987, 1990, 1993, 1997). Details of all eight surveys are presented in Table 1.

Now, 23 years after the first survey, it seems appropriate to again review the results and trends over this longer period, especially as there is now far more interest in the topic (Coe & Rogers 1997) with community groups organising beach litter clean-ups and surveys around the country under the guidance of the NZ Marine Debris Network.

### Location

Kawerua, formerly the site of the Auckland University Field Club's Scientific Station, lies on the exposed west coast of Northland, 17 km south of the mouth of the Hokianga Harbour. The beaches surveyed are uninhabited and largely border the Waipoua Forest. As such these are among the least-visited stretches of beach in the North Island, providing an ideal place to investigate beach litter, away from the potential interference of casual beach-combers or input of litter from beach users.

Being located on one of the remotest stretches of coast, the beach litter is also less likely to include rubbish sourced from our major cities than most other places around our coast.

### Survey technique

The same methodology and litter categories (Table 2) were used in all but the 1975 survey (as I was not present). Each survey involved one or more people walking slowly along the beach identifying and counting all items of anthropogenic litter visible between the sea and the *Spinifex* in the foredunes or the base of the eroding sand cliffs. Dressed timber and posts were recorded but trees and branches that had been felled but not utilised were not recorded. The majority of litter occurs at the back of the beach above storm high tide mark.

**Table 1. Details of beach surveys carried out on the Kawerua coast, 1974-1997**

1974	May	Waimamaku R to 1 km N of Ohae Stm & Kawerua Pt to Muriwai Stm	10 km	5 people
1975	March	Kawerua Pt to 1 km N of Waipoua R	4 km	7 people
1981	June	Kawerua Pt to Waipoua R	5 km	3 people
1982	June	Kawerua Pt to 1 km N of Muriwai Stm	7 km	2 people
1987	January	Kawerua Pt to Waipoua R	5 km	1 person
1990	January	Kawerua Pt to Waipoua R	5 km	1 person
1993	June	Kawerua Pt to Waiarara Stm	3 km	5 people
1997	May	Kawerua Pt to Waipoua R	5 km	2 people

**Table 2. Number of litter items per km of beach surveyed. NR = not recorded**

	1974	1975	1981	1982	1987	1990	1993	1997
Survey length (km)	10	4	5	7	5	5	3	5
Timber (dressed)	21	NR	5.4	12.4	15	28	10	23.4
<b>Hard plastic</b>	17.2	52.3	20.4	16.1	45.2	59.8	66.3	67.6
bottles	7.8	10.5	9.6	11.6	21.6	29.6	32.3	39.4
buckets, baskets	0.8	0.3	0	0.6	1.2	2.2	1.7	1.8
buoys & floats	0.3	1.5	0.2	0.1	0	0.2	0.7	0
fish bins	0.1	0	0	0.5	0	0	0	0.2
fragments indet.	6.2	32	5.4	NR	11.4	13	14.3	10
lids 1.2	6.2	3.8	2	5.6	12.2	12.3	11.2	
toys 0.4	0.8	0	0.1	0.4	0	0.3	0.2	
miscellaneous items	0.4	1	0	0.1	2	1.4	3.7	3.4
<b>Foam plastics</b>	1	4	1.8	1	4.8	3.8	13.3	9.2
floats	0.1	0	0	0	0.4	1.4	2.3	0
foam rubber	0	0	0	0	0	0	0	1.6
polystyrene pieces	0.9	4	1.8	1	4.4	2.4	11	7.6
<b>Plastic sheet &amp; fibres</b>	17.1	15.8	7.6	6.9	12	29.4	19.3	50.6
plastic bags, sheeting	14.6	15.5	4	3.6	5.6	17.8	4.3	29.8
polythene sheet	0.1	0	0	0	0.4	0	0	0
plastic netting	0	0	0.8	1	0.2	0.2	0.7	1.6
fishing nets	0	0	0	0	0	0.2	0.3	0.2
lines and twine	0.8	0.3	1	1.3	1.8	9.8	8.7	10.8
strapping, blue	1.6	NR	1.8	1	3.8	1.2	5.3	7.6
<b>Glass</b>	6.4	10.8	2.6	3.8	11.4	10	6	7.6
bottles	4.5	8.2	2	3.1	10.2	8	5	6.4
- alcoholic 2	3.8	0.8	1.8	4.2	3.4	2.3	4.6	
- non-alcoholic	0	1	0	0.5	5.2	2	2	1.2
- coffee	0.3	0.8	0.2	0.1	0	0	0.3	0.2
- indet.	2.2	2.6	1	0.7	0.8	2.6	0.3	0.4
light bulbs & tubes	1.9	2.6	0.6	0.7	1.2	2	1	1.2
<b>Metal</b>	1.7	1.3	0.4	0.6	1.2	1	2.7	0.6
cans - soft drink	0.6	0.5	0.4	0	0	0	1.7	0
cans - beer 0	0	0	0	0.4	0	0	0.4	
cans - aerosol	0.6	0.5	0	0.5	0.6	0.8	0.7	0.2
<b>Other</b>	1.4	3.9	3.2	2.8	1.8	1.4	1.9	3.2
footwear	0.5	1.1	0	0.5	1	1.2	1	2
miscellaneous items	0.9	2.8	3.2	2.3	0.8	0.2	0.9	1.2
<b>TOTAL</b>	<b>44.8</b>	<b>88.1</b>	<b>36</b>	<b>31.2</b>	<b>76.4</b>	<b>105.4</b>	<b>109.6</b>	<b>138.8</b>
Asian origin	1.4	2	0.2	1	1	1.6	1.3	1.8
Boat origin	5.5	5.2	3.6	3.8	8.2	15.2	18.7	21.2

All litter, other than dressed timber, was collected and removed from the beach in 1974 and 1975, but this has not been repeated in subsequent surveys. No other beach clean-ups are known to have occurred during the period of study and thus it is possible that some individual litter items have been recorded in successive surveys.

All surveys included the 3 km stretch of beach from Kawerua Point to Waiarara Stream and the majority continued 2 km further south to the mouth of the Waipoua River. Two surveys were extended south and/or north (Table 1).

## RESULTS

A copy of the basic data is available on request from the author. For clarity and brevity, the data has been lumped into selected categories and is presented as items per km of beach, and as a percentage of the total litter observed during each survey (Tables 2-3, Figs. 2-4).

### **Quantity of litter** (Table 2)

#### Litter other than dressed timber

There was a substantial decrease in litter recorded on the Kawerua beach from the two 1970s to the two 1980s surveys. Since 1982 however, the amount (items per km) has increased each survey, compared with the preceding one. In the most recent survey (1997), 138 items of litter were recorded per km of beach. This is 300% higher than that recorded in 1982, when the least litter was recorded, and 70% higher than the 1975 peak (88 items per km).

#### Dressed timber

There appears to have been no major increase comparable to that for non-timber litter. The amount of dressed timber in 1997 (23 per km) is not significantly different from that recorded in 1974 (21 per km).

### **Composition of litter** (Tables 2, 3, Fig. 2)

The litter being washed up on this remote west coast beach is remarkably diverse. It is dominated in decreasing order by items made of: hard plastic (38-60%), plastic sheet and fibres (16-38%), dressed timber (8-32%), glass (6-15%), foam plastics (2-12%) and metal (0.5-3%).

Of the identifiable items, plastic bags and sheeting, bottles, containers and their lids for drinks, containers for household cleaners, shampoo, deodorant and suntan cream, blue strapping loops and lines and twine are the most common.

**Table 3. Categories of beach litter in each survey as a percentage of the total number of litter items (not including dressed timber). Percentage of dressed timber items is given as percentage of total litter including timber. NR = not recorded**

	1974	1975	1981	1982	1987	1990	1993	1997
<b>Timber (dressed)</b>	31.9	NR	13.0	28.4	16.4	21.0	8.4	14.4
<b>Hard plastic</b>	38.4	59.4	56.7	51.6	59.2	56.7	60.5	48.7
bottles	17.4	11.9	26.7	37.2	28.3	28.1	29.5	28.4
fragments indet.	13.8	36.3	15.0	NR	14.9	12.3	13.1	7.2
<b>Foam plastics</b>	2.2	4.5	5.0	3.2	6.3	3.6	12.2	6.6
<b>Plastic sheet &amp; fibres</b>	38.2	17.9	21.1	22.1	15.7	27.9	17.6	36.5
plastic bags, sheeting	32.6	17.6	11.1	11.5	7.3	16.9	4.0	21.5
lines and twine	1.8	0.3	2.8	4.2	2.4	9.3	7.9	7.8
strapping, blue	3.6	NR	5.0	3.2	5.0	1.1	4.9	5.5
<b>Glass</b>	14.3	12.3	7.2	12.2	14.9	9.5	5.5	5.5
bottles	10.0	9.3	5.6	9.9	13.4	7.6	4.6	4.6
- alcoholic 4.5	4.3	2.2	5.8	5.5	3.2	2.1	3.3	
- non-alcoholic	0.0	1.1	0.0	1.6	6.8	1.9	1.8	0.9
<b>Metal</b>	3.8	1.5	1.1	1.9	1.6	0.9	2.4	0.4
<b>Other</b>	3.1	4.4	8.9	9.0	2.4	1.3	1.7	2.3
Asian labelled	3.1	2.3	0.5	3.2	1.3	1.5	1.2	1.3
Definite boat origin	12.3	5.9	10.0	12.2	10.7	14.5	17.2	15.1

Items that turn up frequently include glass light bulbs and fluorescent tubes, plastic buckets and netting, polystyrene floats and broken footwear. Unusual items that have been found on more than one occasion include shot gun cartridges, docking rings, plastic cigarette lighters, ball-point pens, torches and flare holders.

#### Footwear

Jandals and lesser numbers of shoes are frequently washed up, but seldom as pairs. Often heard, but unsubstantiated claims that far more left jandals are washed up than right ones were checked during the four most recent surveys. Our results support the claim with 70% of 21 jandals and shoes being for a left foot (Table 4).

#### **Land-sourced litter**

It is not easy to assign the washed-up litter to a definite source. The rare users of the beach probably contribute less than 5% of the litter, with only a few pieces of surfers' wax and fresh beer cans as definitely attributable to them.

Most of the dressed timber probably comes from land sources, as did the shot-gun cartridges, docking rings, decoy duck head, car head lamp and car tyres.

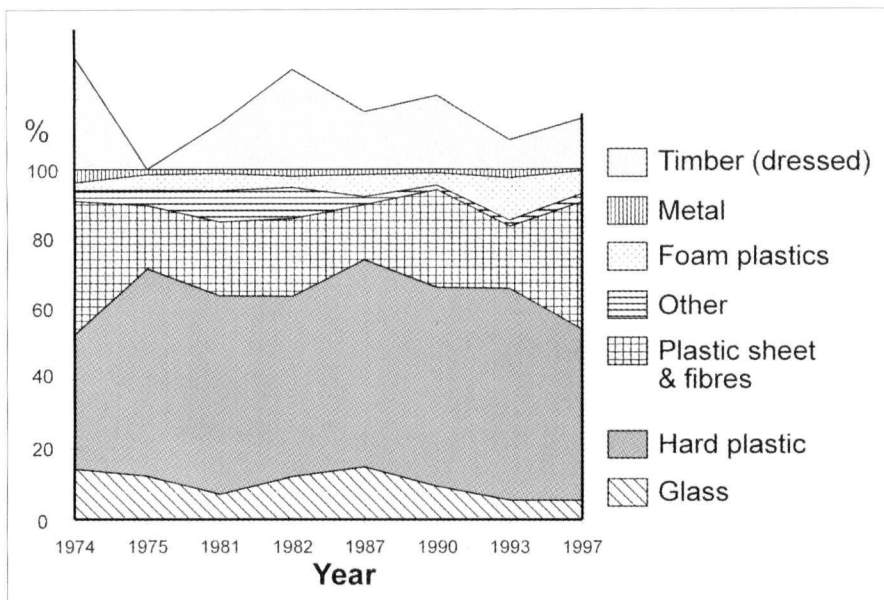


Fig. 2. Graph showing changes through time of the relative abundance (as % of total litter excluding dressed timber) of the major classes of litter categorised by composition. Changes in the relative abundance of dressed timber (as % of total litter including timber) is shown along the top.

### Boat-sourced litter

Litter attributable to boats includes floats, flare holders, fishing nets, lines, twine, strapping loops, fish crates, light bulbs and fluorescent tubes, footwear, and items with Asian brands. Most of the plastic bags and sheeting probably also come from boats but have not been attributed to them here. All the other items could have come from land or sea sources and cannot be distinguished.

The items directly attributable to a boat source have been summed (Table 1) and show a definite increase in abundance on the beach from the 1970s and early 1980s (4-6 per km) to the late 1980s and 1990s (8-21 per km). The increase is less significant when expressed as a percentage of the total litter (6-12% to 11-17%).

### Asian-sourced items

Most identifiable litter has labels in English and is sold in New Zealand shops. It could have either a land or boat origin. A small amount of litter has labels with

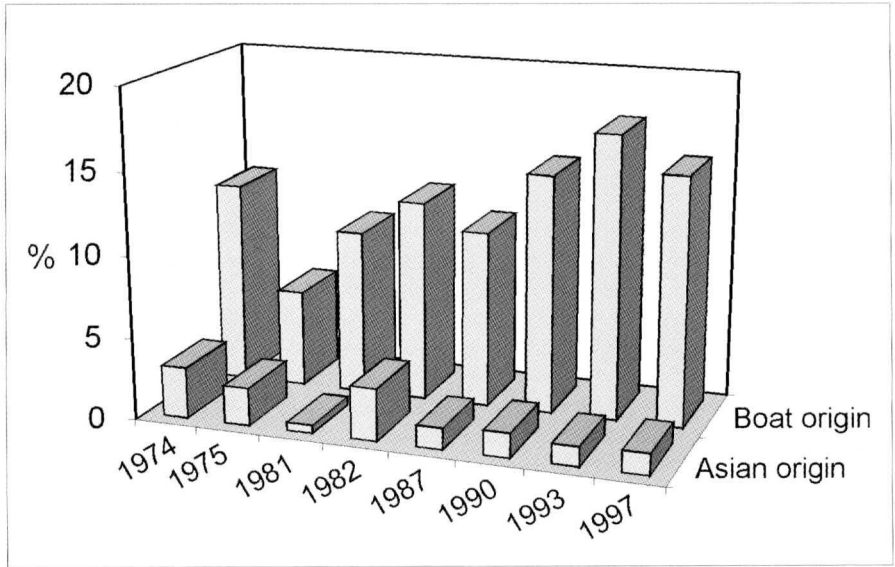


Fig. 3. Bar graphs showing the changing relative abundance (as % of beach litter excluding dressed timber) through time of items with definite Asian labelling and definite boat origin.

Table 4. Number per km of identifiable specialty hard plastic items recorded during each survey.

	1974	1975	1981	1982	1987	1990	1993	1997
corks, plastic	0	0	0	0	0.2	0.4	0.3	0
icecream tubs & lids	0	0	1.4	0.8	2.6	1.2	0.3	0.8
juice bottles, 3 litre	0	0	0	0	0	0	0	0.4
margarine tubs	0	0	0	0	0	0	0	0.2
milk bottles, 2 litre	0	0	0	0	0	0	2.7	2.4
soft drink bottles, 1-2 litre	0	0	0	0	4.2	1.6	5.0	3.8
straws, plastic	0	0	0	0.1	0	0	0.3	0.2
water bottles, 1-2 litre	0	0	0	0	0	0	0	0.8
wine casket tap	0	0	0	0	0.2	0	0.3	0
yoghurt tubs	0	0	0	0.3	0	0	0	0.4
yokes, 6 pack	0	0	0	0	0.2	0	0.3	0
<b>FOOTWEAR</b>								
left	NR	NR	NR	NR	0.2	1.2	0.7	1.2
right	NR	NR	NR	NR	0.2	0	0.3	0.8



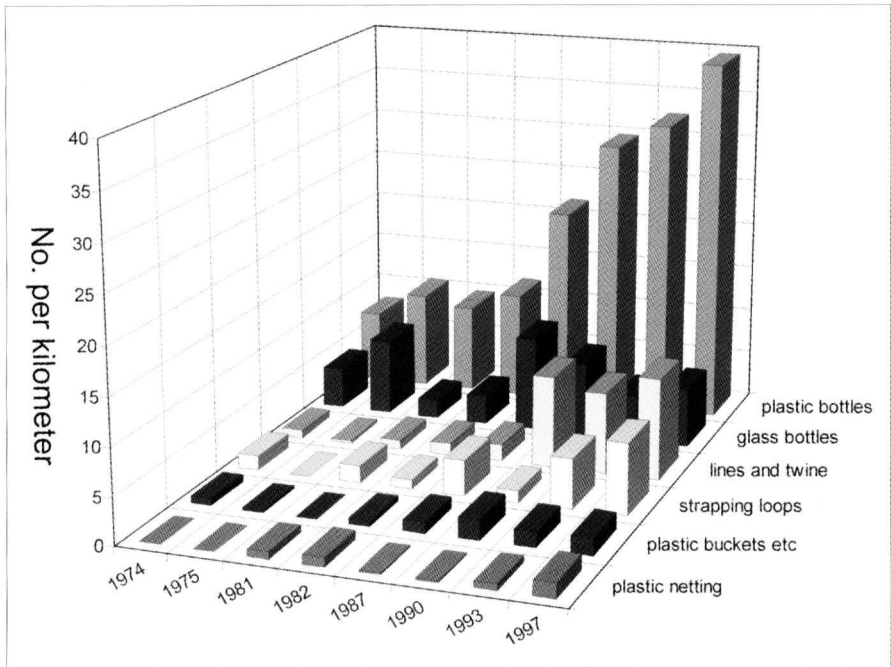


Fig. 4. Bar graphs showing the changing relative abundance (as % of beach litter excluding dressed timber) through time of selected categories of litter.

an Asian script and often no English and is almost definitely sourced from Asian fishing or commercial vessels. The quantity of Asian labelled items has remained relatively constant throughout the last two decades (1-2 per km) but their relative abundance in the litter has decreased (2-3% to 1.2-1.5%).

### CHANGES IN LITTER COMPOSITION

Results from the eight surveys over 23 years show the following changes in beach litter from 1970s to 1990s:

- Increasing quantity of items made from hard plastic, foam plastics, and plastic sheets and fibre (Table 2), although only slight increase in relative abundance (Fig. 2).
- Significant increase in quantity of plastic bottles and containers through time (Fig. 4). Their relative abundance increased from the 1970s (12-17%) to early 1980s (27-37%) but has remained relatively constant since (Table 3).

- c. Increase in quantity of plastic buckets, baskets and plastic lids, polystyrene floats and blue strapping loops (Table 2, Fig. 4)
- d. Significant increase in amount and relative abundance of nylon lines and twine from 1970s (0.5-2%) to 1990s (8-9%).
- e. Relatively constant quantity of items made from glass and metal, but significant decrease in relative abundance (glass 12-14% to 6%; metal 2-4% to 0.5-2%, Fig. 2).
- f. Decrease in relative abundance of glass bottles (Table 3) from 1970s (9-10%) to 1990s (5-8%).
- g. The following new categories of litter made their first appearance during the survey period (Table 4) - 2 litre plastic ice-cream tubs and lids (1981), plastic yoghurt tubs (1982), plastic netting (1981), plastic straws (1982), 1-2 litre plastic soft drink bottles (1987), plastic corks (1987), wine casket plastic tap (1987), 6 pack yoke (1987), 2 litre plastic milk bottles (1993), plastic margarine tubs (1997), 3 litre plastic juice bottles (1997), 1-2 litre plastic water bottles (1997).

## DISCUSSION

### **Is the amount of beach litter increasing?**

Previously I suggested that there may be a correlation between the amount of litter recorded and the number of people involved in the survey (Hayward 1984), but the more recent surveys show no such correlation. More litter was recorded by one person in 1990 and by 2 people in 1997 than was recorded by 5 people in 1974 or by 7 people in 1975.

Taken at face value, the results indicate that the quantity of non-timber litter being washed up on the beach has increased considerably in the past 15 years (1982-1997). But is this so? A variety of factors must first be considered. The quantity of litter being washed up and remaining visible on the beach and in the foredune is likely to be strongly influenced by:

1. the incidence of recent floods on land which would bring increased amounts of land-derived rubbish down into the sea;
2. the recent incidence of on-shore winds or storms that would carry floating rubbish shorewards and throw it up on the beach;
3. a passing vessel discarding its rubbish up-wind or up-current from the beach could result in a localised washup of litter;
4. removal of litter during beach cleanups may influence subsequent results;
5. rates of degradation of different types of litter material will influence results;
6. if the beach and foredune is in a stable phase, then litter will tend to accumulate on the surface;

7. if the beach is in an aggradation phase, then earlier litter will be buried by the build-up of sand;
8. if the beach is in a degradation phase, then buried litter will be exhumed and may either be swept away with the sand or alternatively redeposited at the top of the beach in "lag" deposits of litter.

Removal of all surface beach litter (other than dressed timber) in 1974 appeared to have negligible impact on the 1975 results which showed a major increase in litter over the preceding year. The absence of beach clean ups over the last 20 years may have contributed to the increasing quantity of litter on the beach. Dressed timber appears to have multiple origins, mostly from on land, and its abundance on the beach should fluctuate with climatic conditions in a similar way to other litter. The fact that the quantity of dressed timber has not increased significantly over the last 20 years, but other litter has, provides support for the conclusion that there is now more litter getting into the sea and washing up on the beach.

### **Reasons for changing composition of litter**

The observed changes in beach litter over the last 23 years appear to reflect changes in society, particularly in the materials being used for packaging and new items being developed and marketed. Glass packaging has been decreasing, especially for soft drinks, household cleaners, deodorants and juice, and has been completely replaced by plastic and cardboard for milk.

These results remind us that new packaging media and consumer items that we are all so familiar with in the 1990s have only appeared in the last 2-3 decades, such as yoghurt, plastic tubs of icecream, "chateau cardboard" wine caskets, 6 packs of beer cans, plastic straws, throw-away plastic cutlery and plastic corks.

The beach litter may also reflect changing practices on fishing boats, with more blue strapping loops and large quantities of nylon twine now being used. Polystyrene floats appear to be increasing at the expense of hard plastic floats and buoys which even earlier replaced metal and glass floats. Changing fishing patterns and management of this stretch of coast may also have influenced the litter composition over time.

### **Comparisons with other New Zealand surveys**

The apparent ratio of boat-derived versus land-derived litter on this remote west coast beach is considerably higher than on beaches around the Waitemata Harbour in the middle of Auckland City (ICNZT 1996) and somewhat lower than on the even more remote Chatham and Stewart Islands (Gregory 1999). One striking observation is the very low percentages of confectionary wrappings

and cigarette butts encountered at Kawerua compared with their prominence on beaches near Auckland City (ICNZT 1996).

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