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FISHERIES MANAGEMENT DIVISION

MINISTRY OF AGRICULTURE AND FISHERIES

AUCKLAND

C O N T E N T S

SEASONAL CONDITION OF ROCK OYSTERS, *CRASSOSTREA GLOMERATA*, IN NORTH AUCKLAND

SUMMARY

The cycle of condition in the New Zealand rock oyster, *Crassostrea glomerata* (Gould 1850), was followed month by month from late Spring 1972 to early Autumn 1974 in four localities of Northland. Direct comparisons were made by distributing oysters of known year class (2+) drawn from a single source (Oneriri, Kaipara) and held in trays at fourteen stations. Two natural foreshore (wild) stations were also sampled. Condition generally reached a peak during October/November, dropped sharply in the summer but returned to over 50% by Autumn, after which there was an increase before a new peak the following Spring. The cycle was not altered by location or amount of tidal exposure. Best condition and growth was obtained at Bay of Islands. Condition was not closely associated with spat settlement.

INTRODUCTION

In order to obtain a maximum return it is important for shellfish farmers to be able to assess the quality of their products. Rock oysters are said to be in "good condition" when they are plump, creamy and opaque in colour and completely fill the shell cavity. Those in "poor condition" are usually thin, almost translucent or darkish in colour, very watery and only partly fill the shell. There can be many "in between" stages when visual assessment is both subjective and open to wide interpretation.

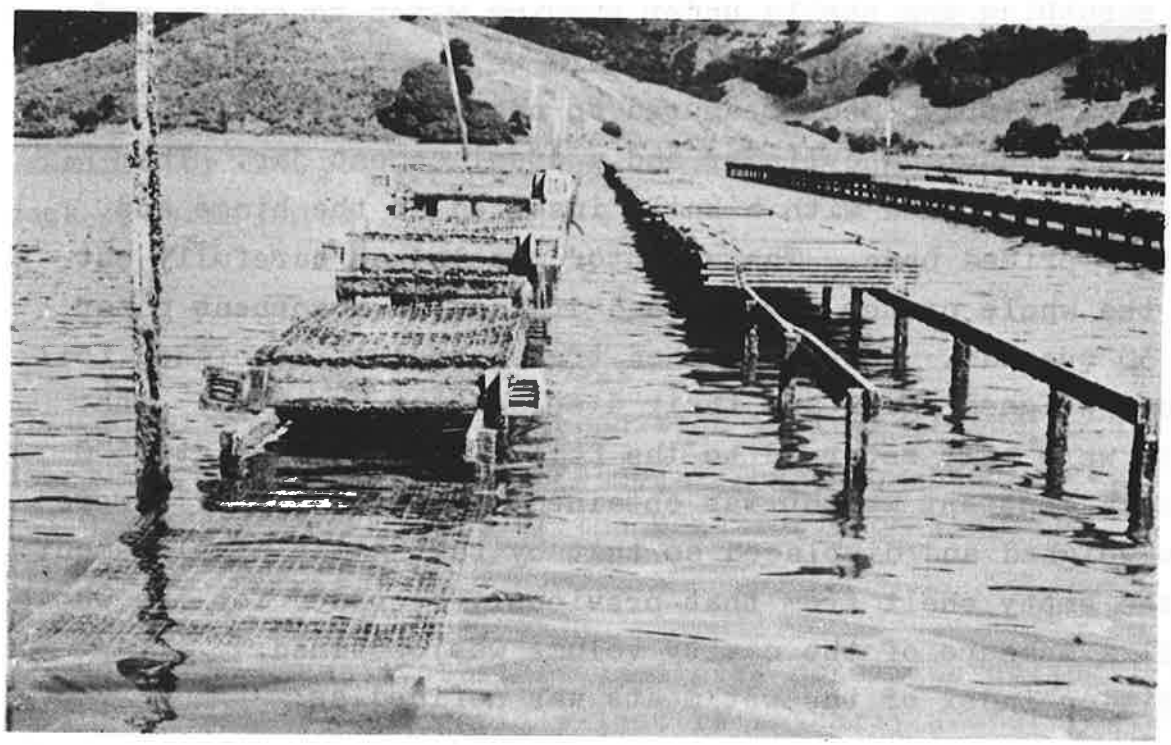
Oyster condition indices, expressed as volume of wet oyster meat or as dried weight of meat, both measured in relation to internal shell volume, are established methods for objectively describing the quality of oysters, (Medcof and Needler 1941, Baird 1958, Haven 1962).

The condition index (C.I.) effectively compares the meats with their theoretical maximum size. Thus, the higher the average numerical value for C.I. the greater will be the yield of meats from any given quantity of similar unshucked oysters. In the following account it is only this aspect of oyster condition which is under investigation. No regard has been paid to health qualities since these are governed by bacteriological standards and require quite different appraisal.

Variation in condition of oysters can be associated with a number of factors such as the sexual cycle, presence of parasites, salinity, temperature, turbidity, availability of food and possibly "racial" differences within the stock. The following study was designed to investigate the cycle of condition index at several localities in the rock oyster farming areas of Northland and to make comparisons between them.

METHODS

Four widely dispersed major rock oyster growing areas were chosen for setting up sampling stations. In Mahurangi Harbour three closely adjacent stations at Huawai Bay, G. Brown's Bay and Dyer's Creek (Fig. 1a) were chosen. In Kaipara Harbour the stations were distinctly separate, Whakapirau and Batley (Fig. 1b) as also were the Bay of Island stations, Te Tii and Orongo Bay (Fig. 1c). A single station was chosen at Coromandel, located in the M.A.F. farm (Fig. 1d). For each station a "standard level" of tidal exposure at two hours before mean low water springs was set for holding the oysters. At Mahurangi (Huawai Bay) and Kaipara (Whakapirau) three additional stations at 30 cm and 60 cm levels above and 30 cm below the standard level were also established. (Plate 1).



Rock Oyster holding trays at Huawai Bay - Mahurangi

Each station consisted of a 1.8 m x 0.9 m oyster tray. The bottom was covered with 19 mm^2 plastic mesh and the top by 50 mm^2 mesh to prevent oysters being lost through wave action whilst still allowing adequate water circulation. The trays were stocked with cultivated 2+ year old rock oysters taken from Departmental concrete slabs (Curtin 1970) at Oneriri (Kaipara) and were replenished from time to time. On transfer to a new station at least one month was allowed for acclimatisation before a sample was drawn. Towards the close of the investigational period in 1974 these oysters became 3+ year olds. During the investigation there was no worthwhile over settlement by oyster spat in Kaipara, so the stock remained virtually as one age class throughout the period.

Samples for condition index were taken at monthly intervals by removing 30 oysters from each station after the tray had been thoroughly raked and mixed. They were then processed in 10 groups of three oysters each. The oysters were carefully cleaned by removing barnacles and modiolids and scrubbing the shells under running water to remove mud and silt. The cleaned whole shells were weighed to 0.01 g and their displacement measured to nearest millilitre using a 250 ml measuring cylinder and a displacement jar. The shells were opened with a knife inserted at the hinge and lightly prised open. The adductor muscle was carefully cut and the whole oyster removed and drained on absorbent paper for 30 seconds. They were then transferred to a weighed foil dish , weighed again and their displacement measured. The meats were next returned to the foil dish and dried at 85°C until a constant weight was obtained. The empty shells were also weighed and displaced so that by taking the displacement of the empty shell from that previously recorded for the whole shell a measure of the cavity volume was obtained. Condition index of the wet meats was defined as:

$$\frac{\text{Meat volume (ml)}}{\text{Shell cavity volume (ml)}} \times 1000$$

and of dried meats:

$$\frac{\text{Dried weight of oyster meats (g at } 85^{\circ}\text{C)}}{\text{Shell cavity volume (ml)}} \times 1000$$

Checks were made by comparing means and standard deviations of 30 individually processed oysters with those obtained by processing groups of three. These were found to be in reasonable agreement despite the variability of the oysters.

During the anticipated period of rock oyster spatfall (late November 1973 to April 1974) some asbestos cement spatcatchers were placed at the corners of sample trays in Coromandel, Mahurangi (Huawai Bay - Plate 1), Whakapirau, Batley, Te Tii and Orongo Bay. Half were changed at the times when condition samples were collected and the other half remained in place throughout the period. Each collector consisted of three small lengths of asbestos cement 10 x 5 cm spaced 1 cm apart and held in a square wooden frame open at the ends. The 50 cm^2 undersurface of each collector was examined by low powered microscope and the number of settled rock oysters noted.

RESULTS

Figures 2-17 graph the condition indices of the 16 stations using the dried meat weight method. They show the range, mean and 95% confidence limits of the mean for each sample of 10 x 3 oysters.

In most cases oysters reached peak condition during late spring (November) and rapidly lost it in early summer (December) gradually returning to good condition during the following Autumn and Winter months. A major exception occurred at

Coromandel where condition did not drop completely until April. However even this station showed a steep decline during the following December into January 1974, in line with other stations. The greatest losses and gains in condition were shown by the tray held, cultivated oysters. Those taken from natural foreshore populations were less variable.

During the 14 month period February 1973-March 1974 comparable samples were available from all stations. Mean indices, using wet and dried meat results for the 16 stations are shown in Tables I and II. As might be expected, correlation between these is high at 0.9591, P = 0.001. Both Bay of Islands stations had markedly increased average index (25%) over the remainder. The latter only showed smaller differences which were not so consistent although the two foreshore populations both averaged less than any of the others. Figure 18 compares the mean whole shell displacements at the standard level stations and also the two foreshores. Again Bay of Islands stations were 19% better than Mahurangi, 20% on Kaipara but only about half this at 11% on Coromandel. Significant quantities of young oyster spat were only taken at Mahurangi (Huawai Bay).

A peak count of 0.9/cm^2 occurred in early February 1974. Light settlement continued into March at 0.1/cm^2 and a second peak occurred during late March and early April yielding 0.3/cm^2. These figures refer to the standard level at Huawai Bay but larger counts were made at the bottom level and lesser amounts at the two higher levels. Elsewhere extremely light (0.05/cm^2) or nil settlement was obtained.

DISCUSSION

Naturally occurring populations of rock oysters are very variable from one locality to the next. By using oysters from

one area of more or less similar age class several sources of variation may be lessened or even eliminated. Reaction by the oysters to local environmental factors is made directly comparable when they are transferred to other localities. Also differences due to changes in reproductive behaviour linked to age become uniform and hence cyclical changes less liable to confusion.

Dinamani (1974) investigated the reproductive cycle and gonadial changes in rock oysters at four stations in the Bay of Islands. He concluded that there is evidence of only a single annual reproductive cycle in these oysters and that gonadial changes follow a cyclic pattern. The cycle of condition index found in the present investigation is very similar at all stations and follows closely the gonadial phases shown by Dinamani. The marked drop in condition during December and January oorresponds well with his transitional period between "fully ripe, pre-spawning phase" and the following, "post spawning phase". As might be expected it is the reproductive cycle which plays the dominant role in governing overall condition of these oysters. The cycle operates fairly uniformly throughout widely dispersed areas and also at different levels of exposure. Where differences have occurred such as at Coromandel, they have been of degree not pattern. There the main drop in condition was delayed until April/May 1973 but even so a significant drop did occur during the previous November/December period in unison with the other stations. Although the mean condition indices do not differ much over most other stations and are not greatly affected by different tidal exposures, the Bay of Islands oysters are in approximately 25% better condition than the rest. The reason for this is not known but is possibly associated with slightly warmer water temperatures and better feeding conditions. Certainly over the past four or five years it has become a common practice amongst oyster farmers to transfer Kaipara caught rock oysters to Bay of Islands areas for fattening purposes before sale, with worthwhile results.

During the course of these investigations very few naturally diseased oysters were encountered although approximately 8,000 oysters were opened. However heavy mortalities were suffered through puncturing of lower shell valves when these were stripped from the settlement spawls. The problem was worse at the beginning of the investigation and lessened as the oysters developed and grew from 2+ into 3+ year olds.

In some cases new shell was laid down over the inside of the hole, whilst others though not visibly fractured, developed degeneration of the adductor muscle. This appears to be associated with the jarring caused by stripping with hammer and chisel. It is reported as being a quite common occurrence in similar oyster cultivations in Australia, (Curtin - pers comm).

Although racial differences were not directly investigated it appears these may play a much smaller part than environmental factors. This is shown through the gains in average condition and size at Bay of Islands compared to other stations, the original stock of oysters being the same throughout. There are however indications that growth rates within the stock can be very variable but it is unlikely, due to the mixing which took place, that any one station received a disproportionate number of fast or slow growers than another. The significant difference between the means of the two natural foreshore populations shown in figure 18 is probably accounted for by differences in age structure. The Mahurangi population at Huawai Bay has received annual recruitment over most years (Curtin, 1971, 1973). The samples taken from there are likely to include much older stock than that available from Kaipara where recruitment is irregular and several years can intervene between successful spatfalls. The Batley foreshore population is likely to be of similar age to the experimentally distributed 2+ Oneriri year class.

This originated in the good Kaipara settlement of Summer 1969/70 (Curtin 1970) and was followed by a very poor settlement in 1970/71 (Curtin 1971).

CONCLUSIONS

1. There is a close relationship between condition and the reproductive cycle.
2. The cycle follows a similar pattern in widely dispersed areas with generally only minor variation of degree.
3. Condition is not greatly affected by different amounts of tidal exposure.
4. The main drop in condition might be used as an early warning for possible settlement, however it is not likely to be of much use as a precise tool since time lags between a significant loss in condition and following spat settlement are of the order of a month or more.
5. Oysters are generally in poor condition during January, February, March and in peak condition, September, October, November.
6. Both growth and condition are markedly better in the Bay of Islands than elsewhere.
7. Environmental factors causing this could be worth future detailed investigation.

ACKNOWLEDGEMENTS

Thanks are due to the Rock Oyster Advisory Staff for help in the field.

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Medcof, J.C. & Needler, A.W.H. 1941: The influence of temperature and salinity on the condition of oysters (Ostrea virginica) J. Fish. Res. Bd. Canada, 5(3).

TABLE I - MEAN CONDITION INDICES FROM FOUR LOCALITIES DURING THE PERIOD FEBRUARY 1973 - MARCH 1974 USING WET VOLUME OF OYSTER MEATS.

Location	Tray levels				Foreshore (natural)
	-30 cm	Standard (2 hrs exp. before M.L.W.S.)	+30 cm	+60 cm	
Coromandel		641			
Mahurangi					
Huawai Bay	643	663	681	639	620
G. Brown's Bay		664			
Dyer's Creek		688			
Kaipara					
Batley		639			
Whakapirau	664	668	664	672	619
Bay of Islands					
Te Tii		741			
Orongo Bay		730			

TABLE II - MEAN CONDITION INDICES FROM FOUR LOCALITIES DURING THE PERIOD FEBRUARY 1973 - MARCH 1974 USING DRIED WEIGHT OF OYSTER MEATS.

Location	Tray levels				Foreshore (natural)
	-30 cm	Standard (2 hrs exp. before M.L.W.S.)	+30 cm	+60 cm	
Coromandel		100			
Mahurangi					
Huawai Bay	94	100	103	92	87
G. Brown's Bay		98			
Dyer's Creek		110			
Kaipara					
Batley		96			
Whakapirau	105	105	110	107	89
Bay of Islands					
Te Tii		141			
Orongo Bay		134			

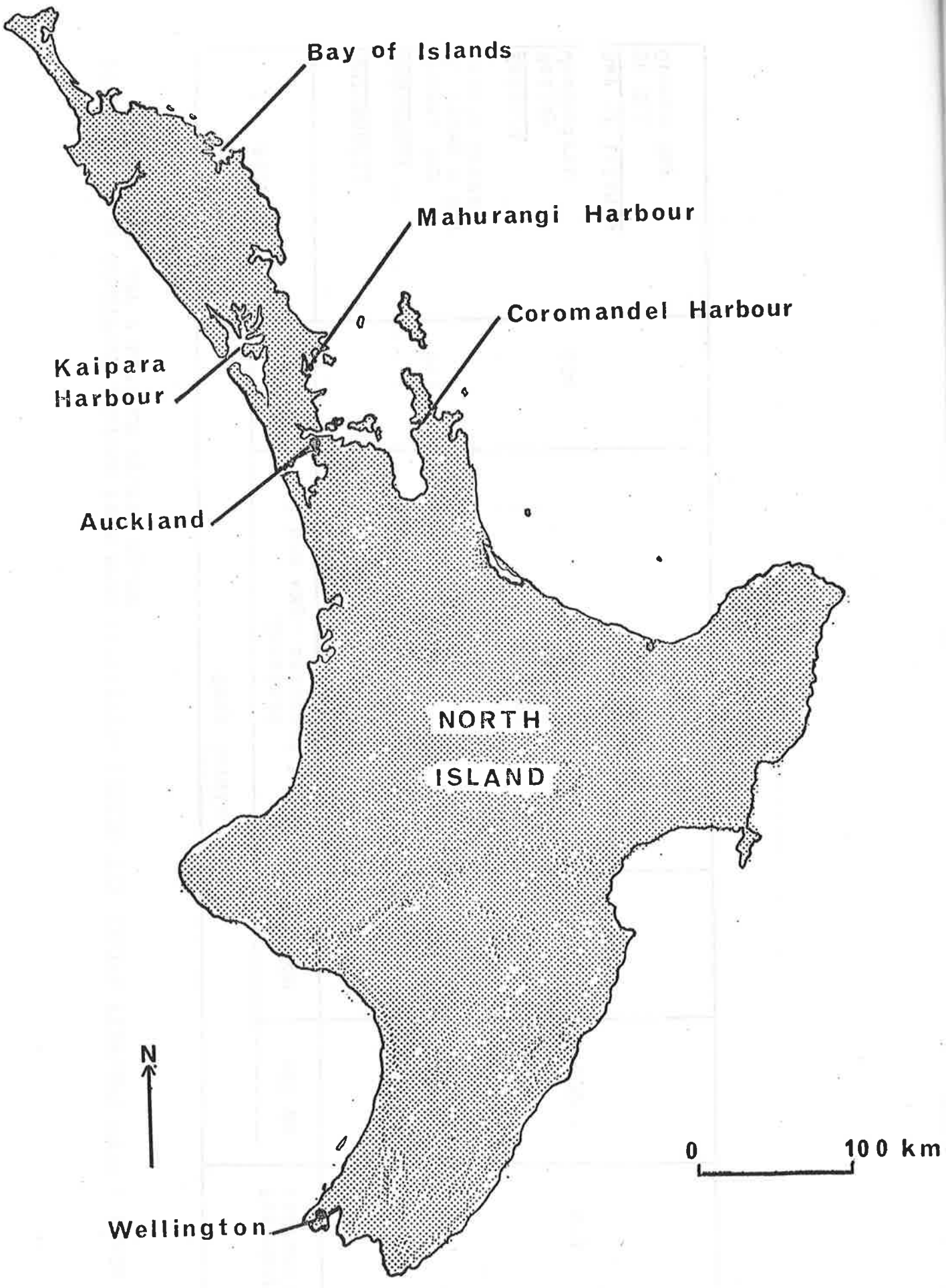
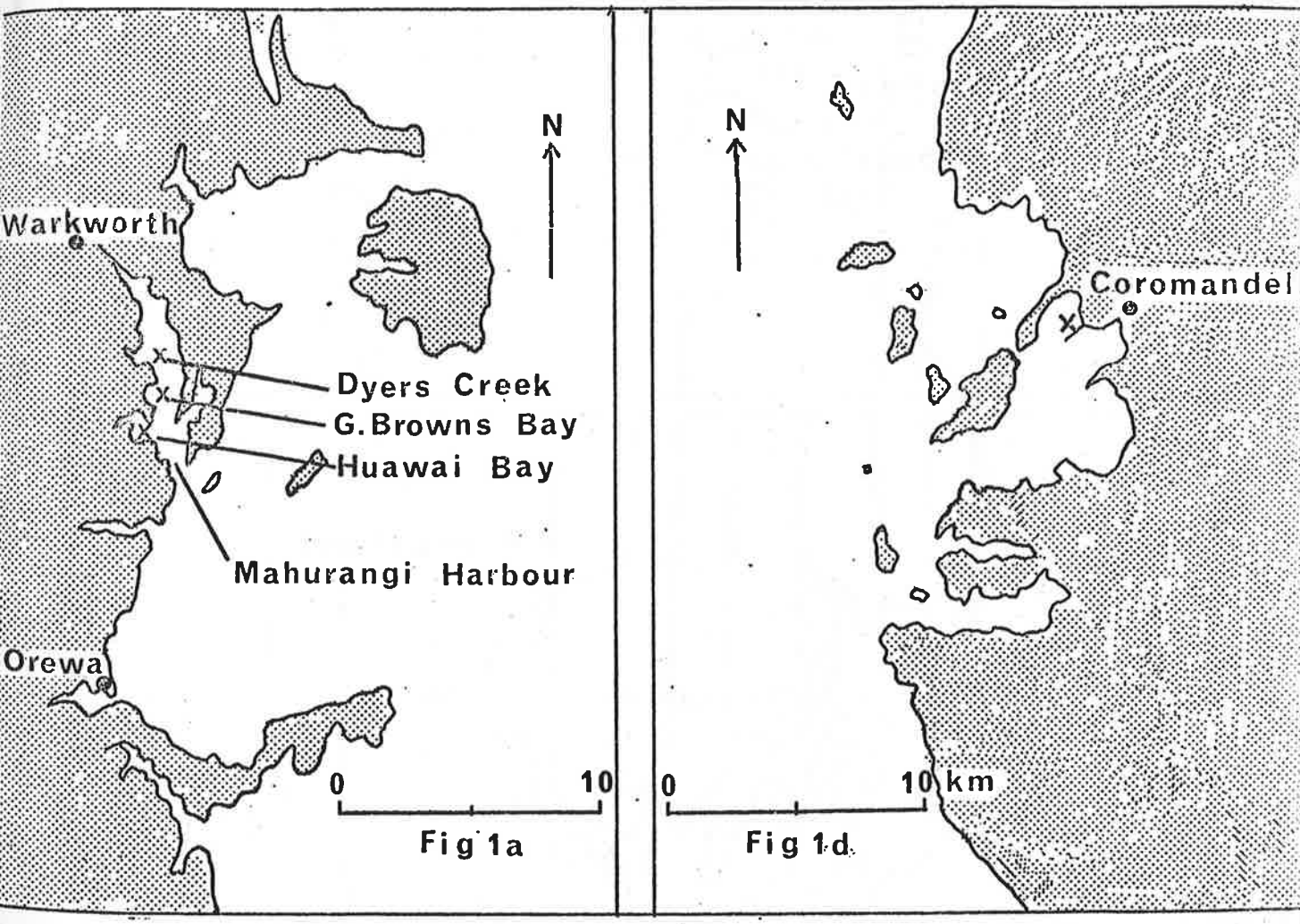
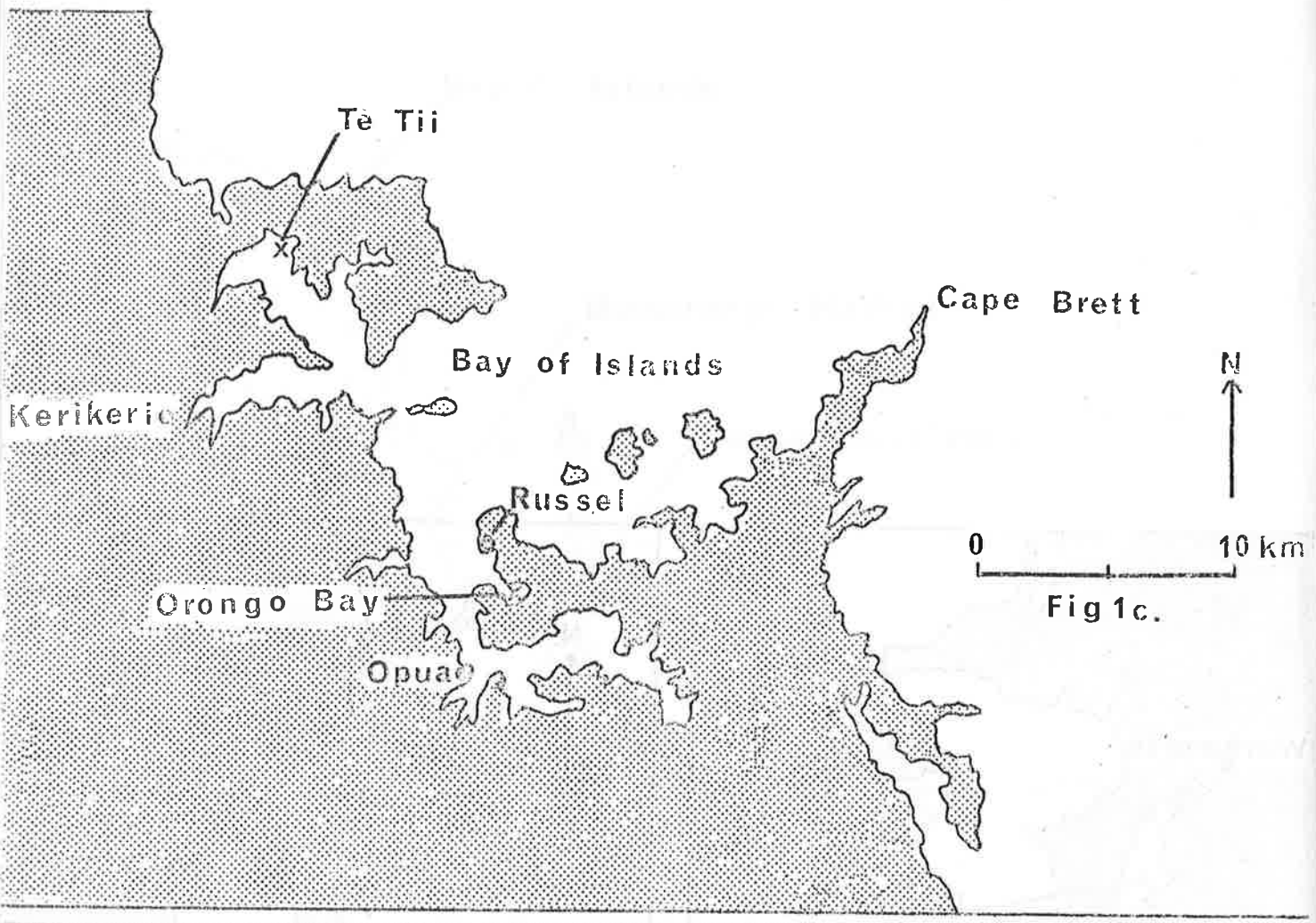
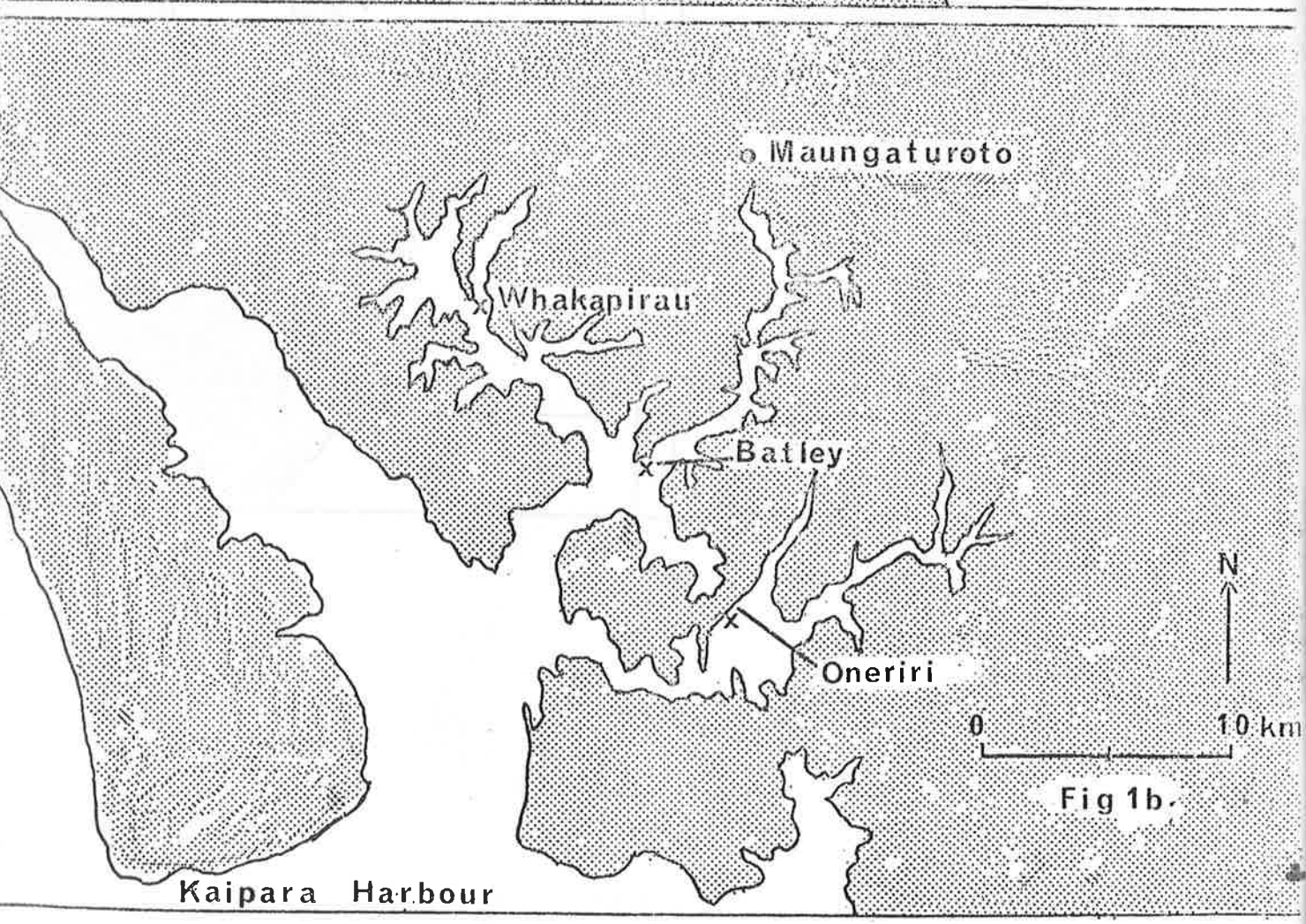


Fig 1.

LOCATION MAP.


N
Warkworth
Dyers Creek
G.Browns Bay
Huawai Bay
Mahurangi Harbour
Orewa
0
10
Fig 1a
N
Coromandel
0
10 km
Fig 1d


Te Tii
Cape Brett
Bay of Islands
N
Kerikeri
Russel
0
10 km
Orongo Bay
Fig 1c.
Opua


Maungaturoto
Whakapirau
Batley
N
Oneriri
0
10 km
Fig 1b.
Kaipara Harbour

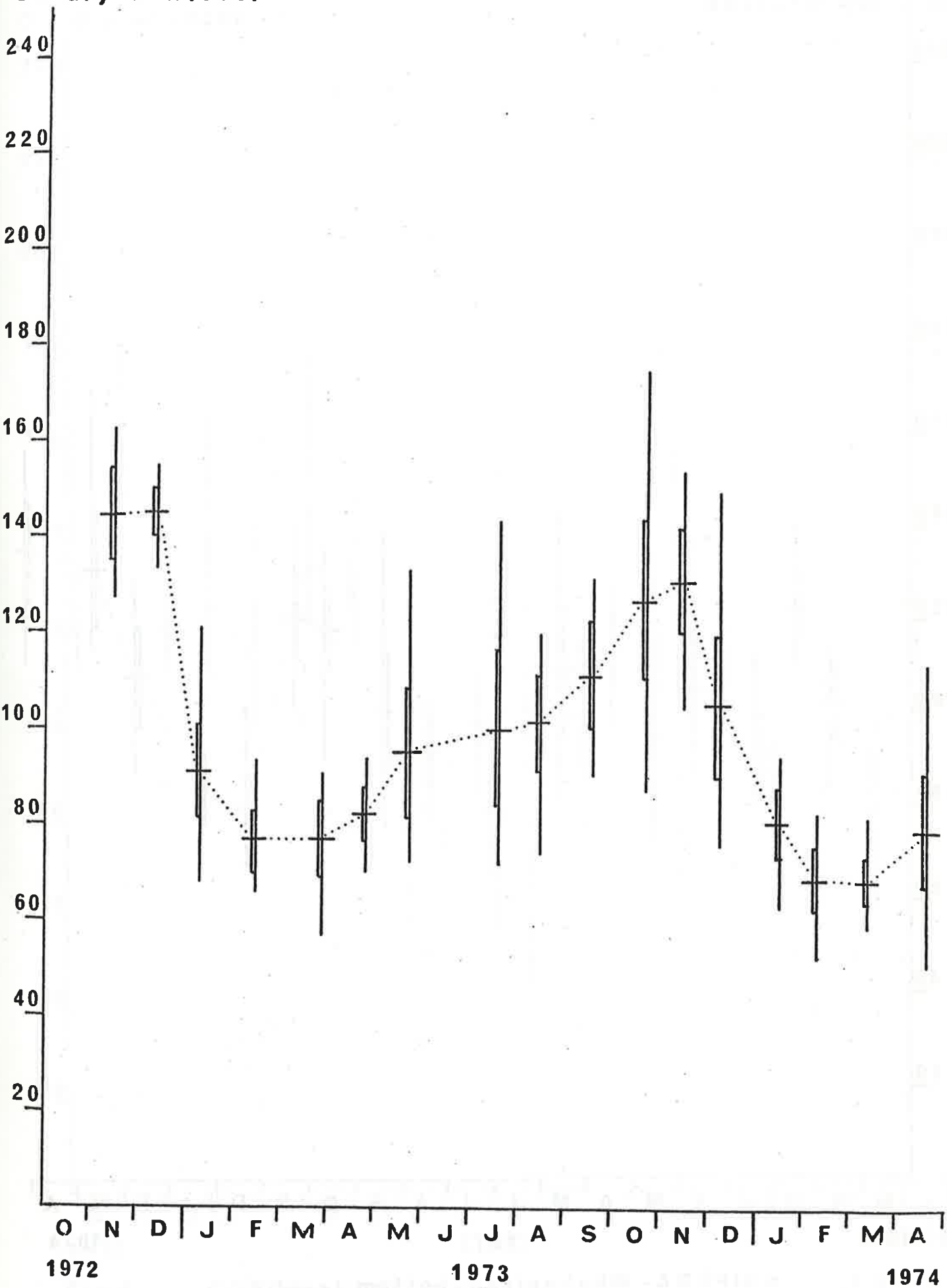


Fig 2. MAHURANGI-Huawai Bay-bottom level.

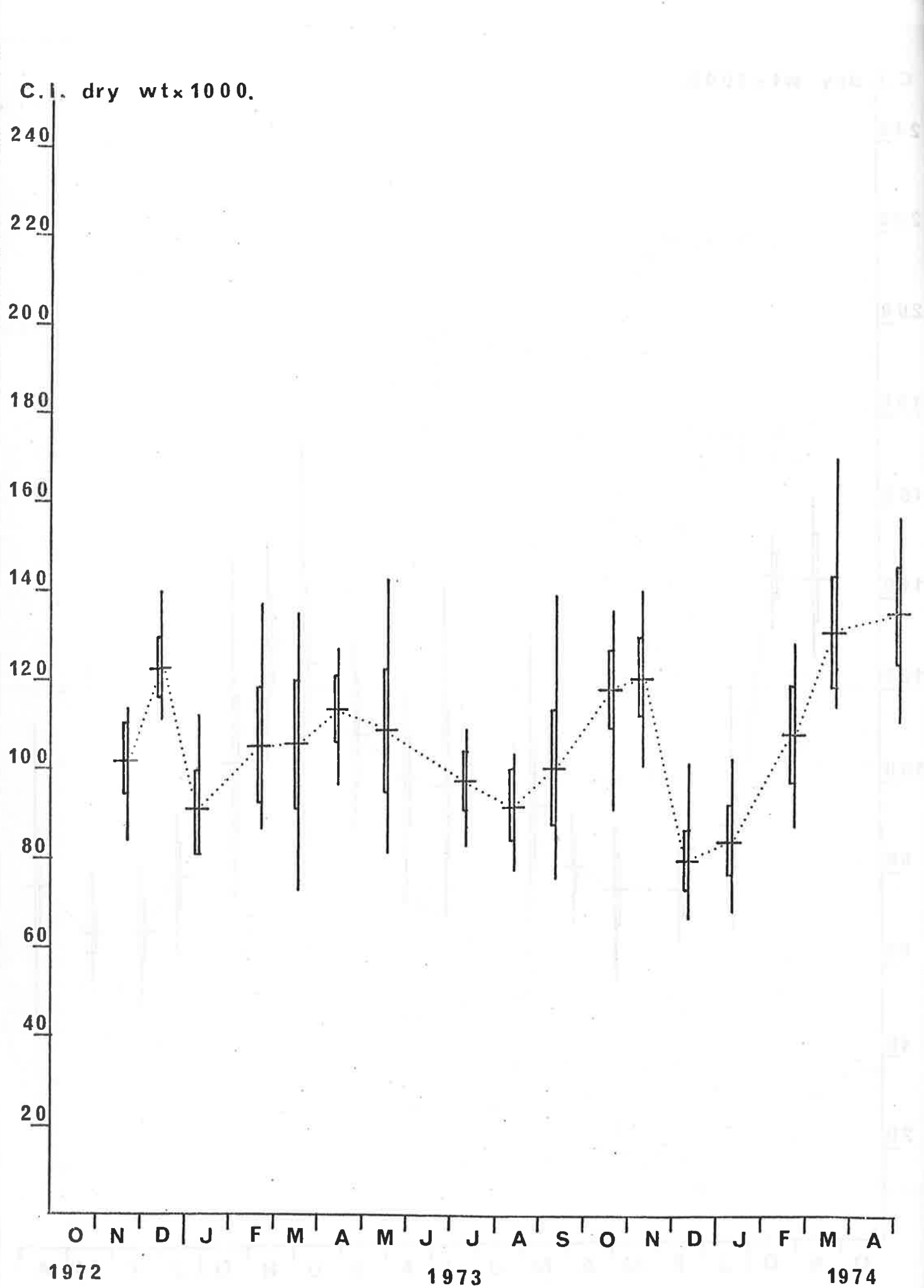


Fig 3. KAIPARA-Whakapirau-bottom level.

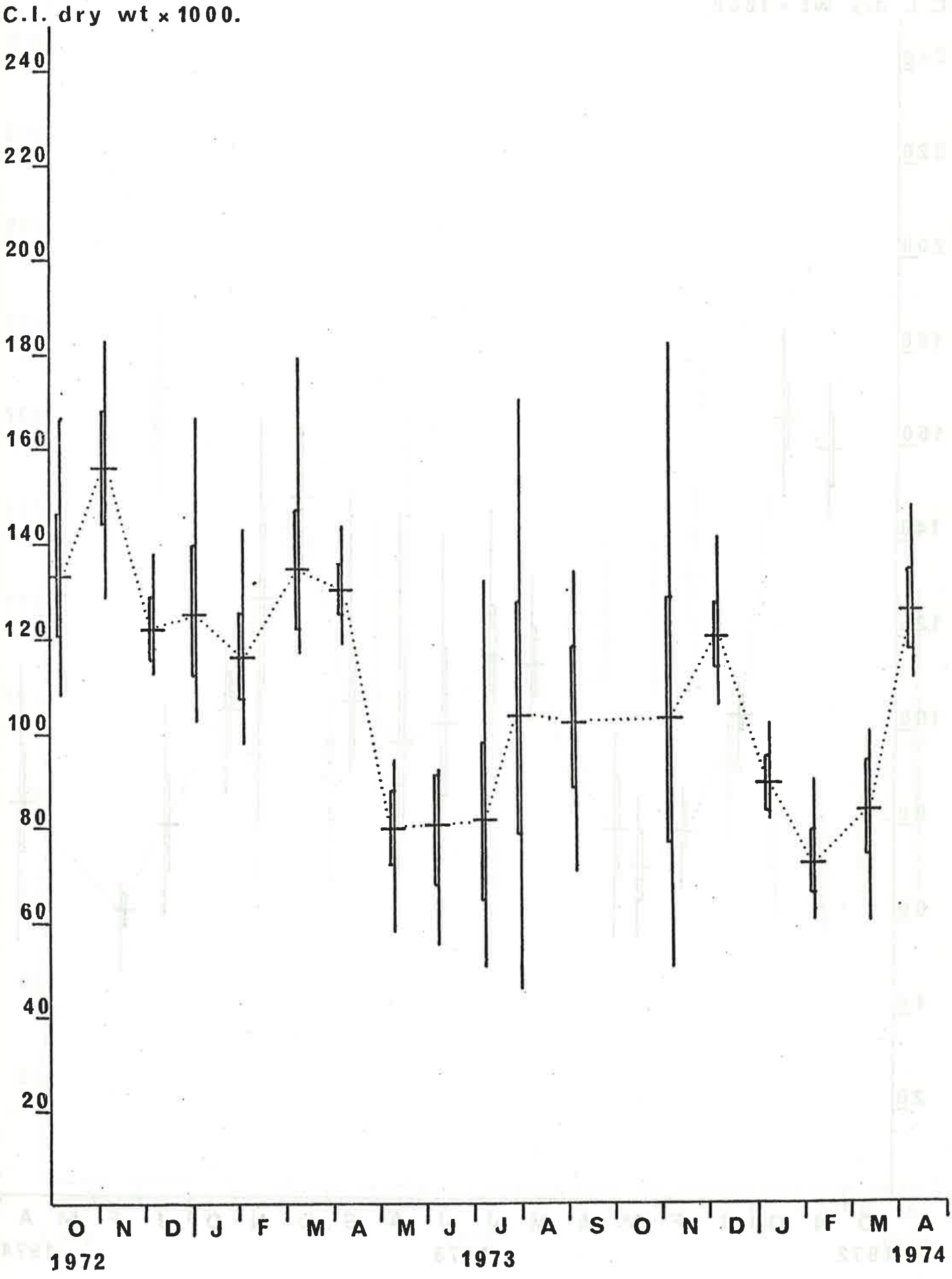


Fig 4. COROMANDEL - standard level.

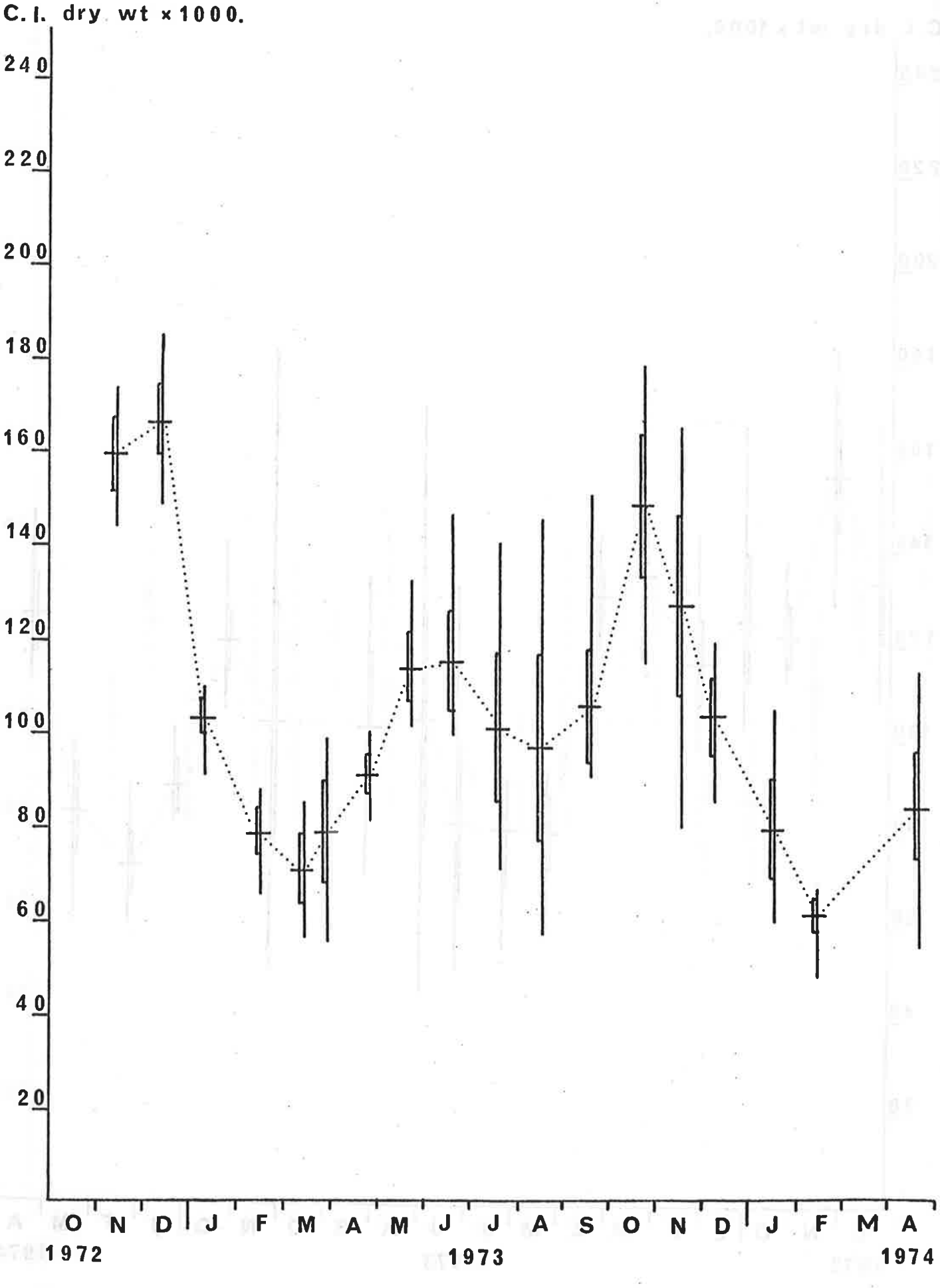


Fig 5. MAHURANGI-Huawai Bay-standard level.

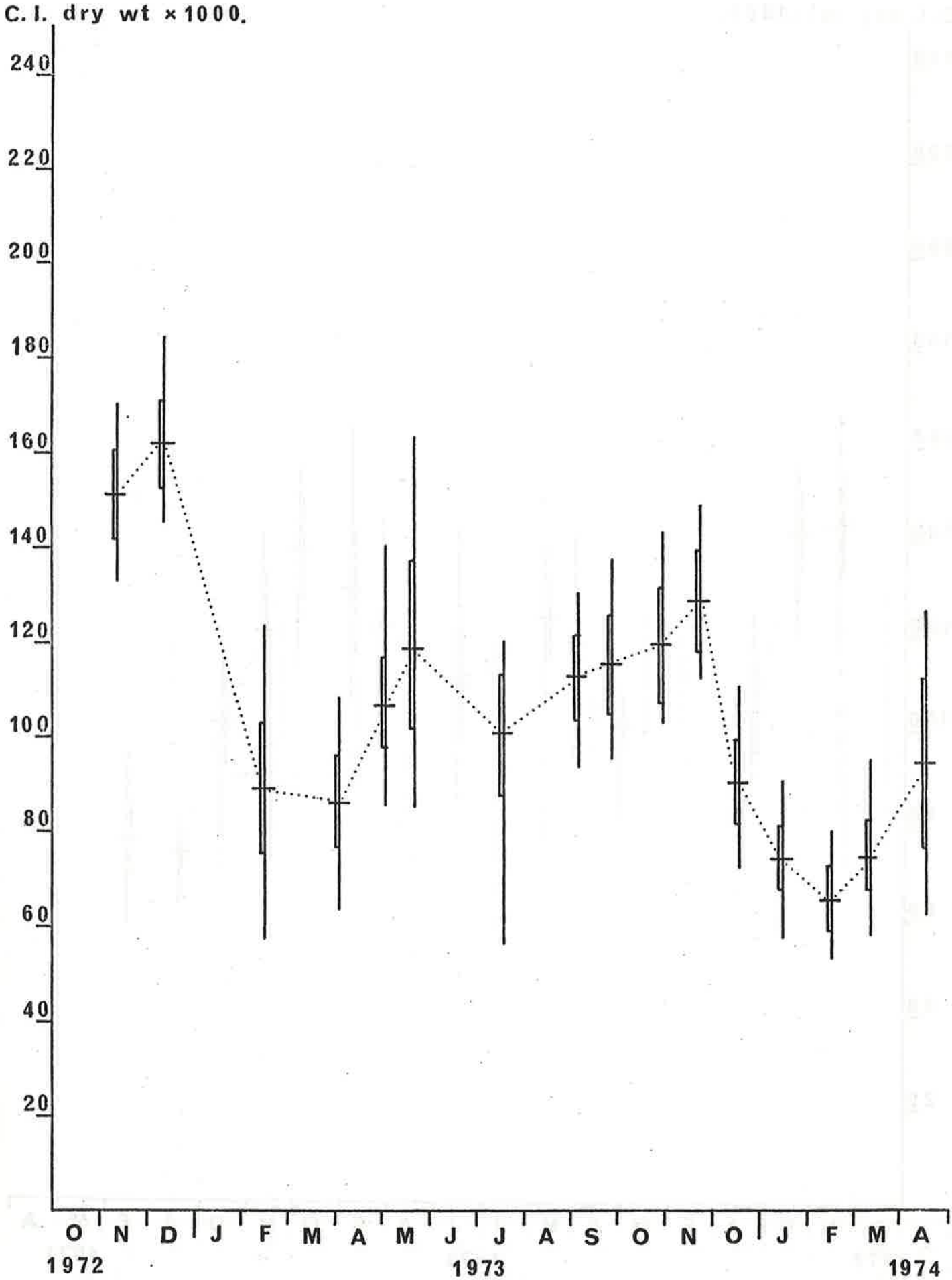


Fig 6. MAHURANGI – G. Brown's Bay – standard level.

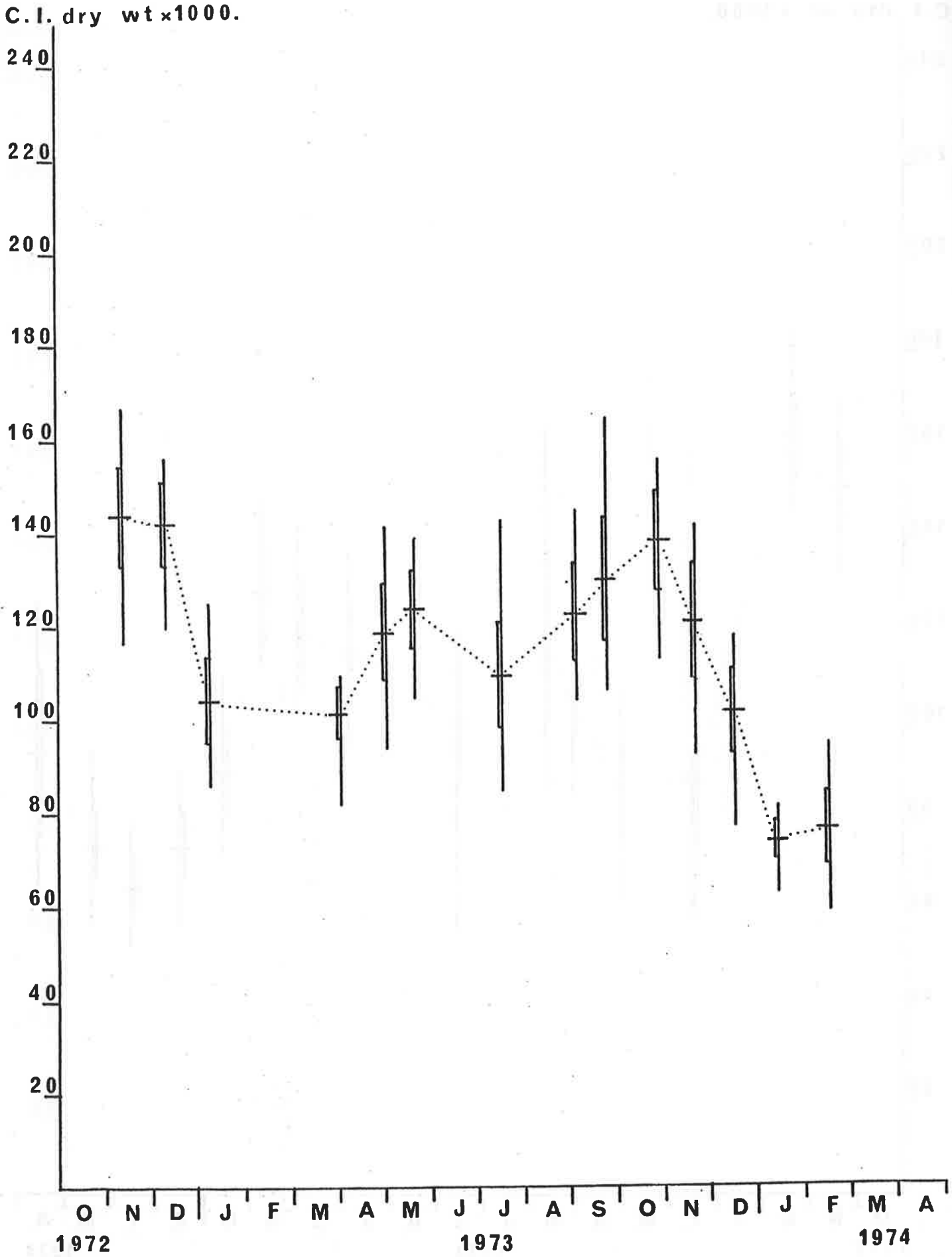


Fig 7. MAHURANGI–Dyer's Creek–standard level.

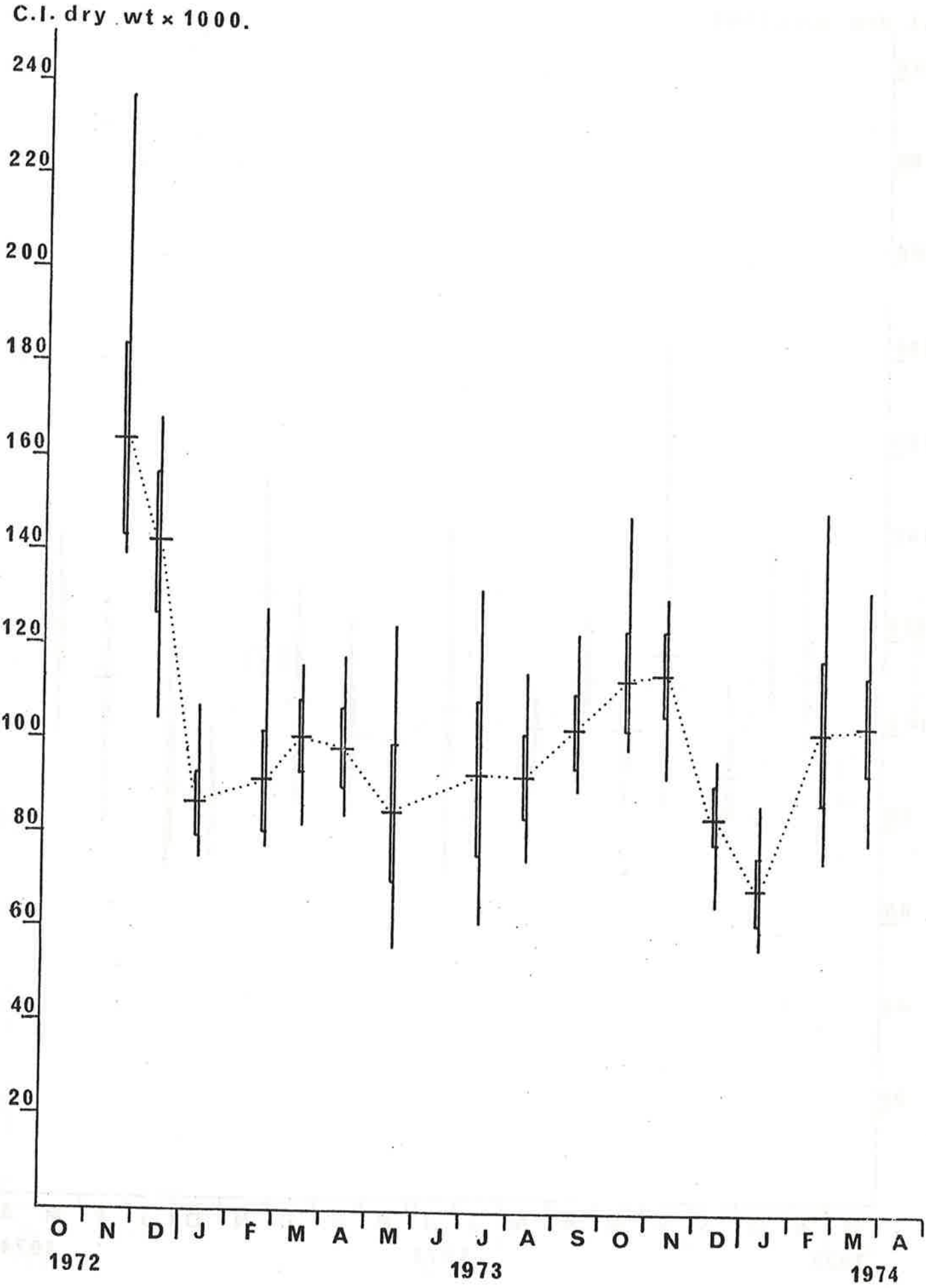


Fig 8. KAIPARA-Batley-standard level.

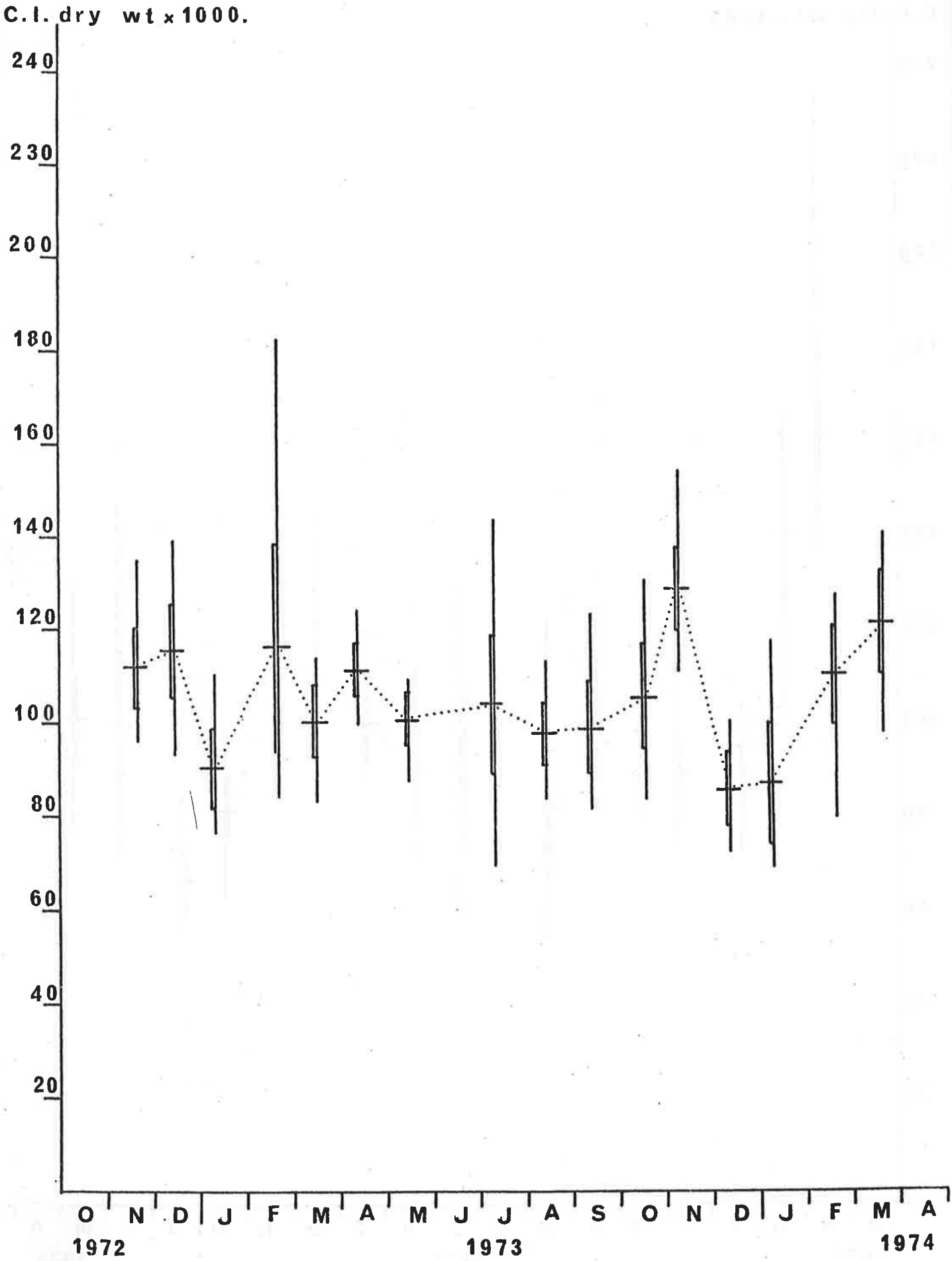


Fig 9. KAIPARA- Whakapirau - standard level.

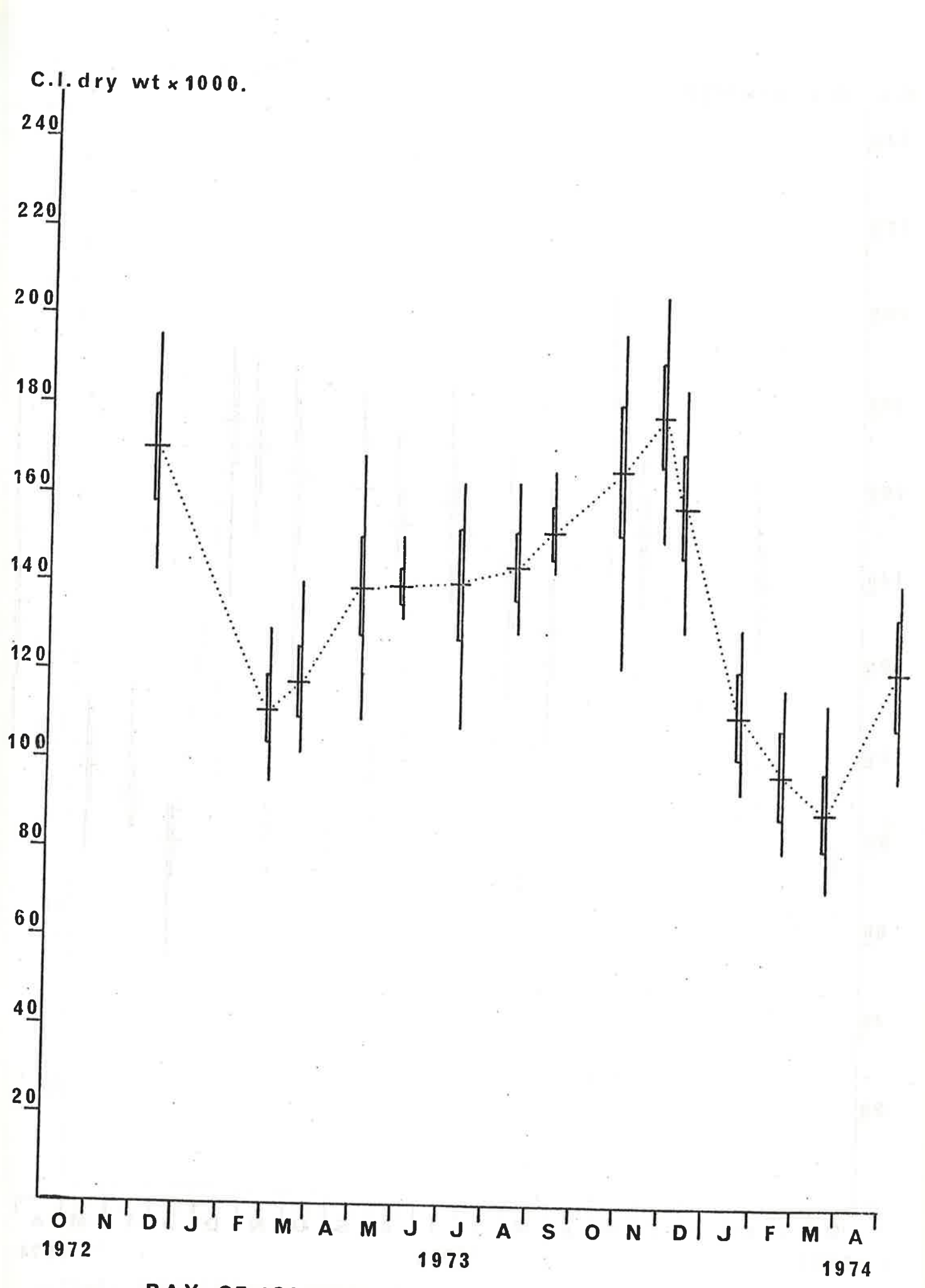


Fig 10. BAY OF ISLANDS - Orongo Bay - standard level.

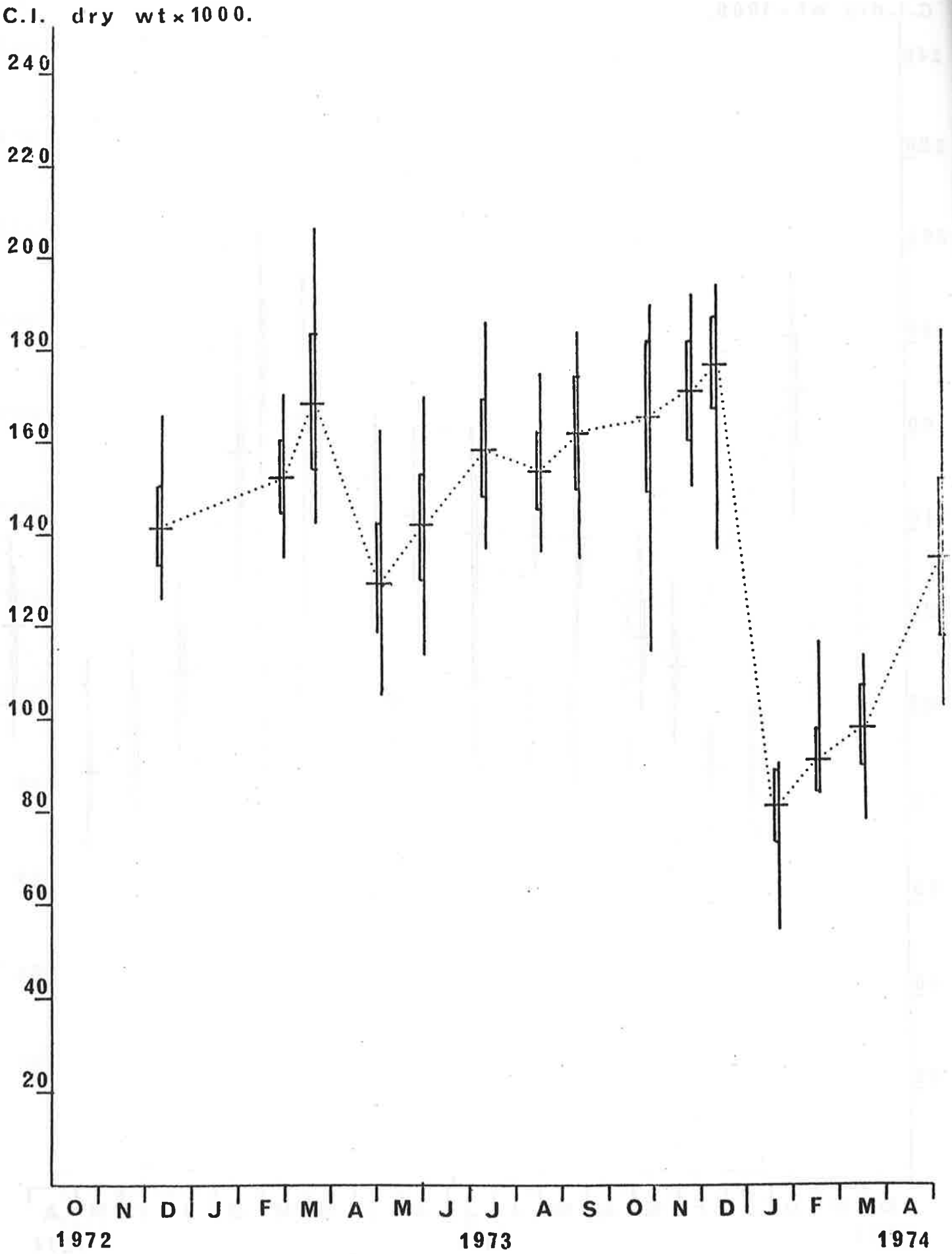


Fig 11. BAY OF ISLANDS - Te Tii - standard level.

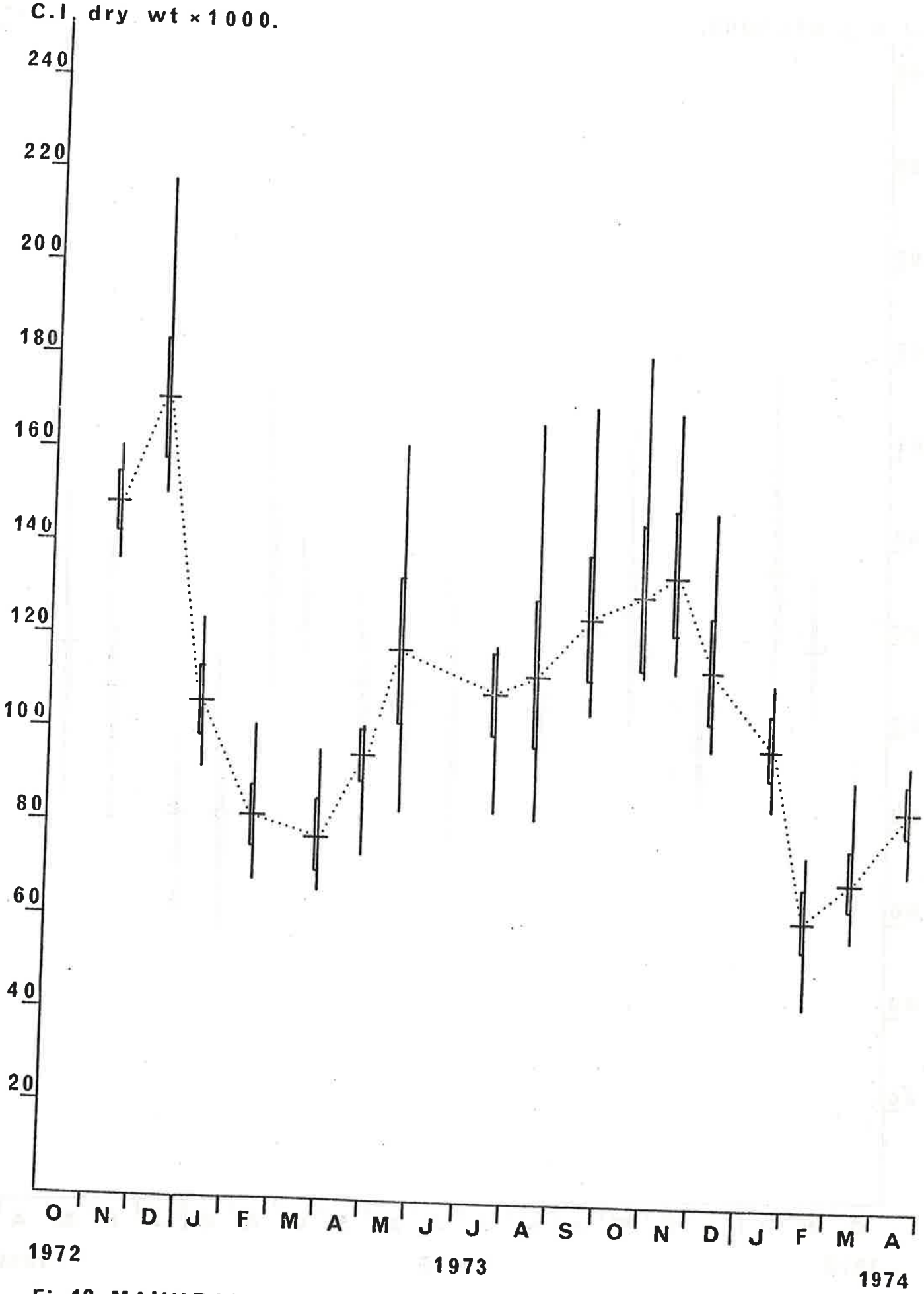


Fig12. MAHURANGI – Huawai Bay – +30 cm level.

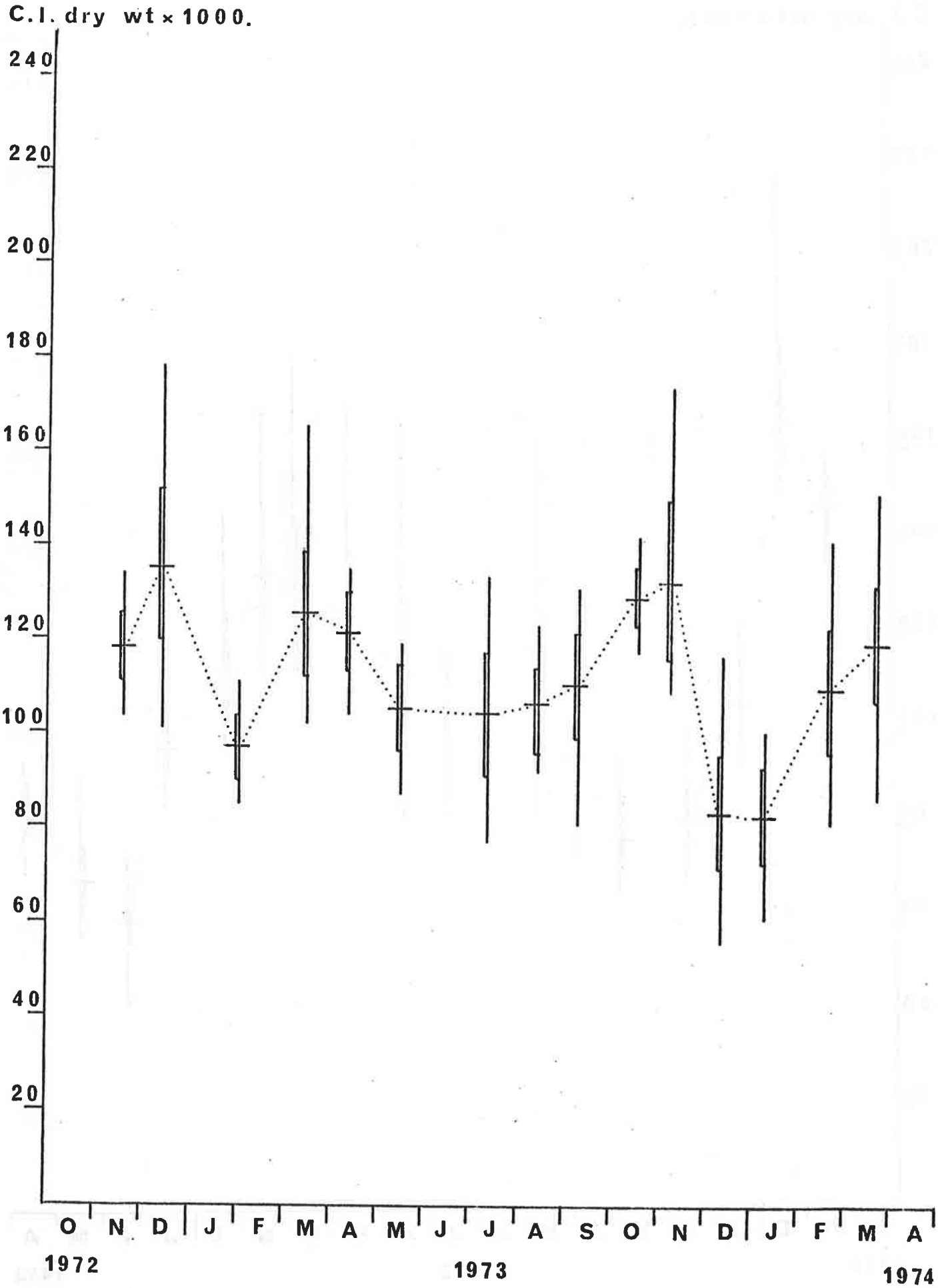


Fig 13. KAIPARA – Whakapirau – +30 cm level.

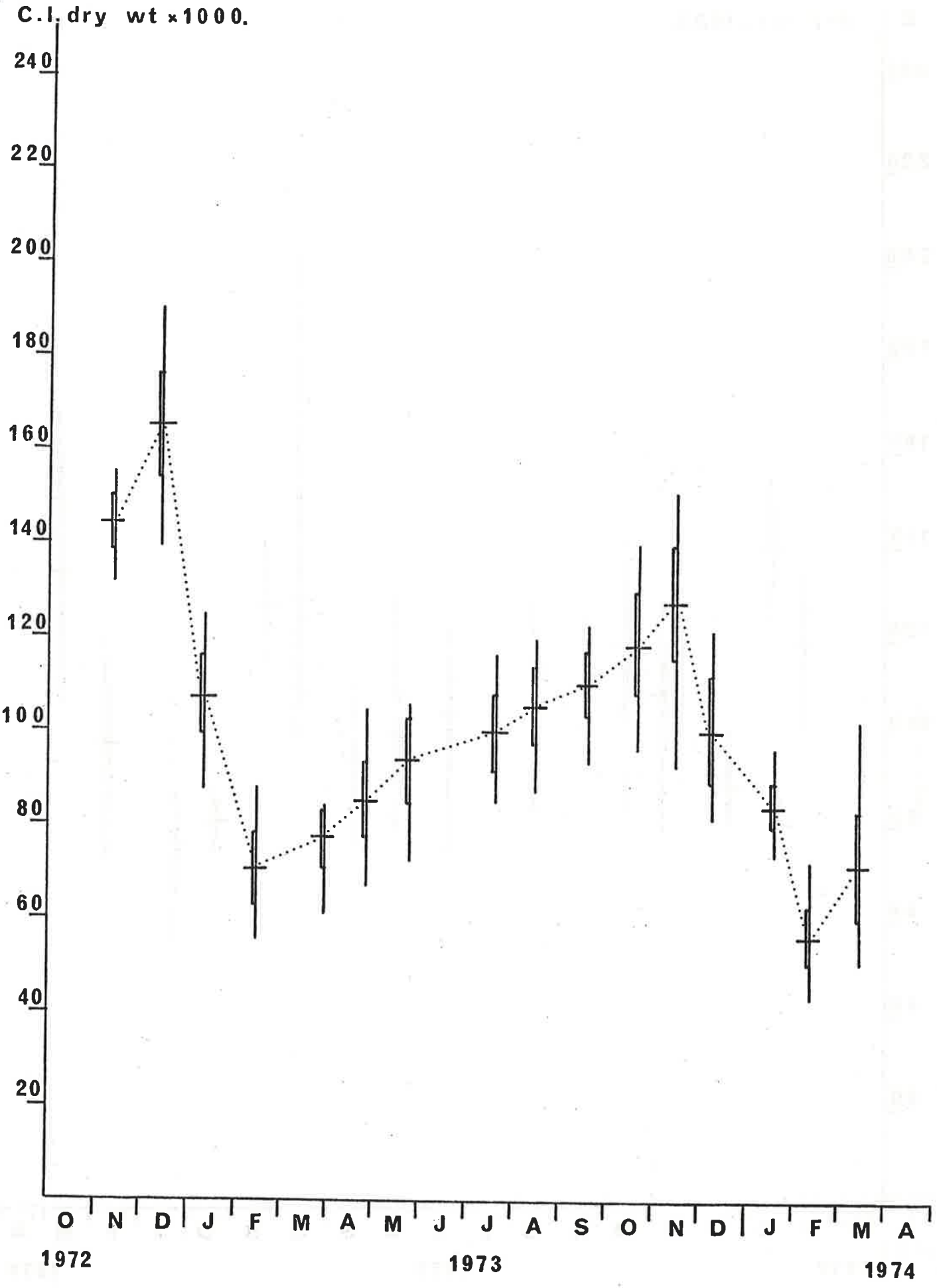


Fig 14. MAHURANGI-Huawai Bay- +60cm level, top.

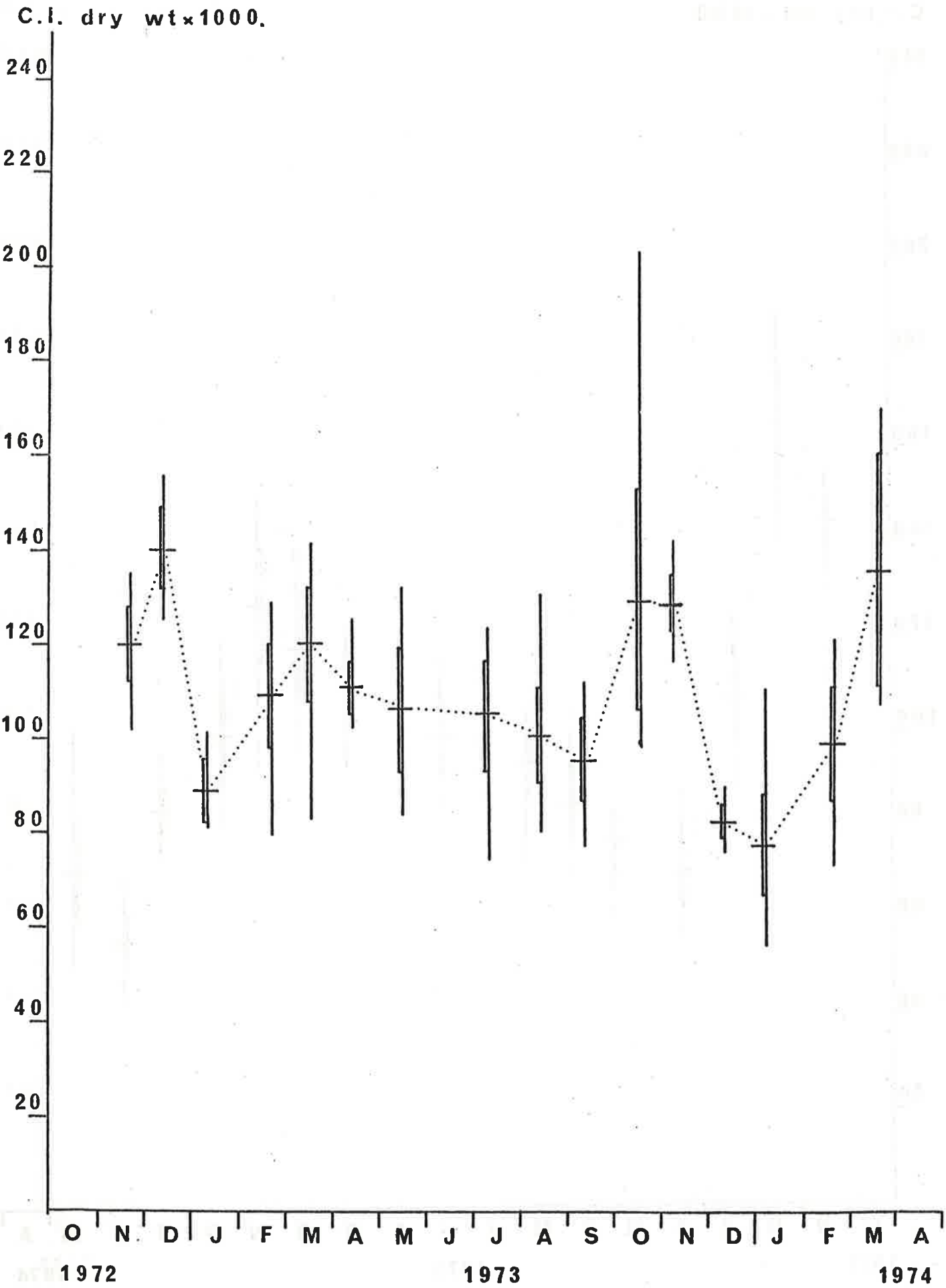


Fig 15. KAIPARA-Whakapirau- +60cm level, top.

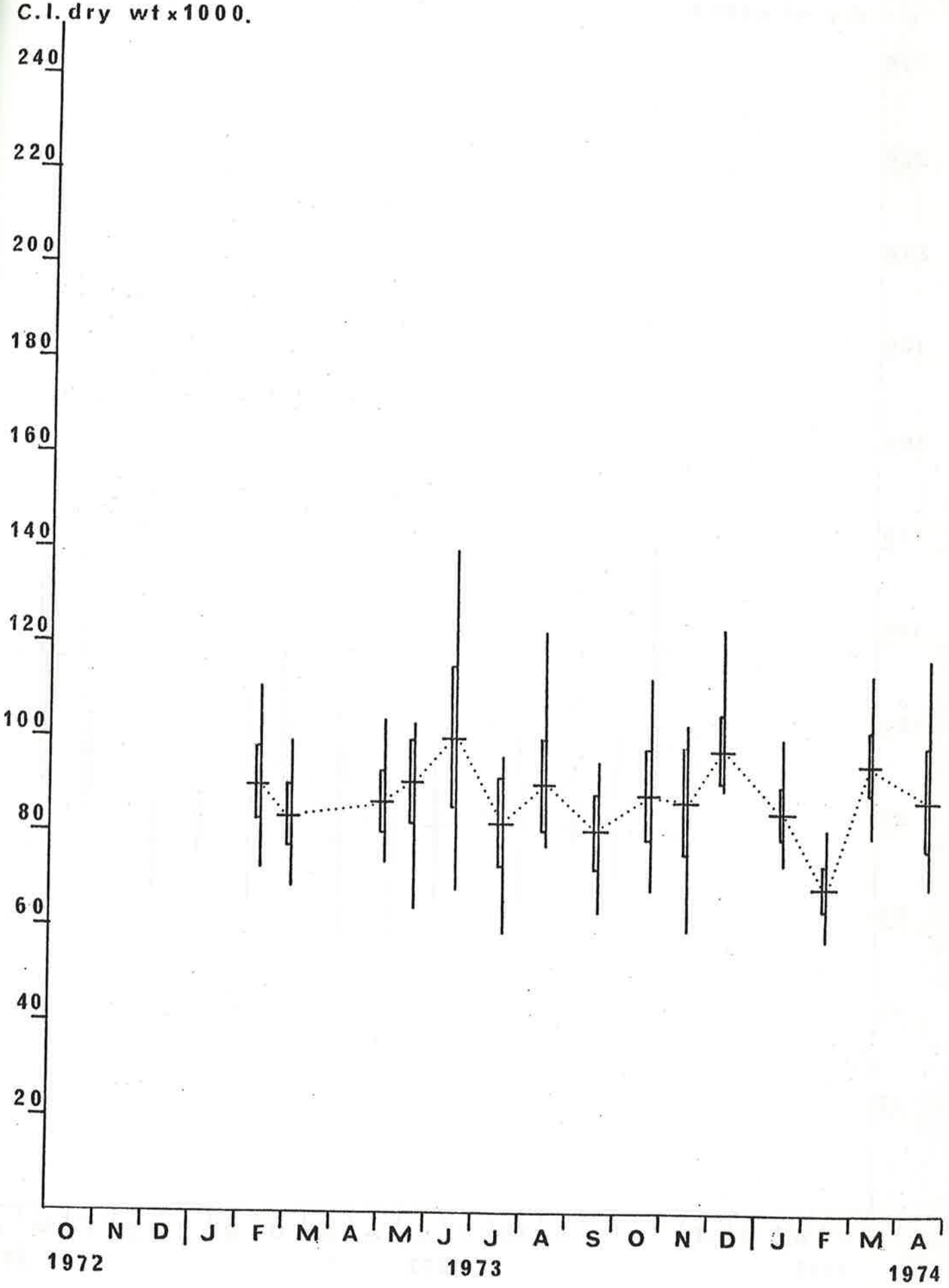


Fig 16. MAHURANGI – foreshore (wild).

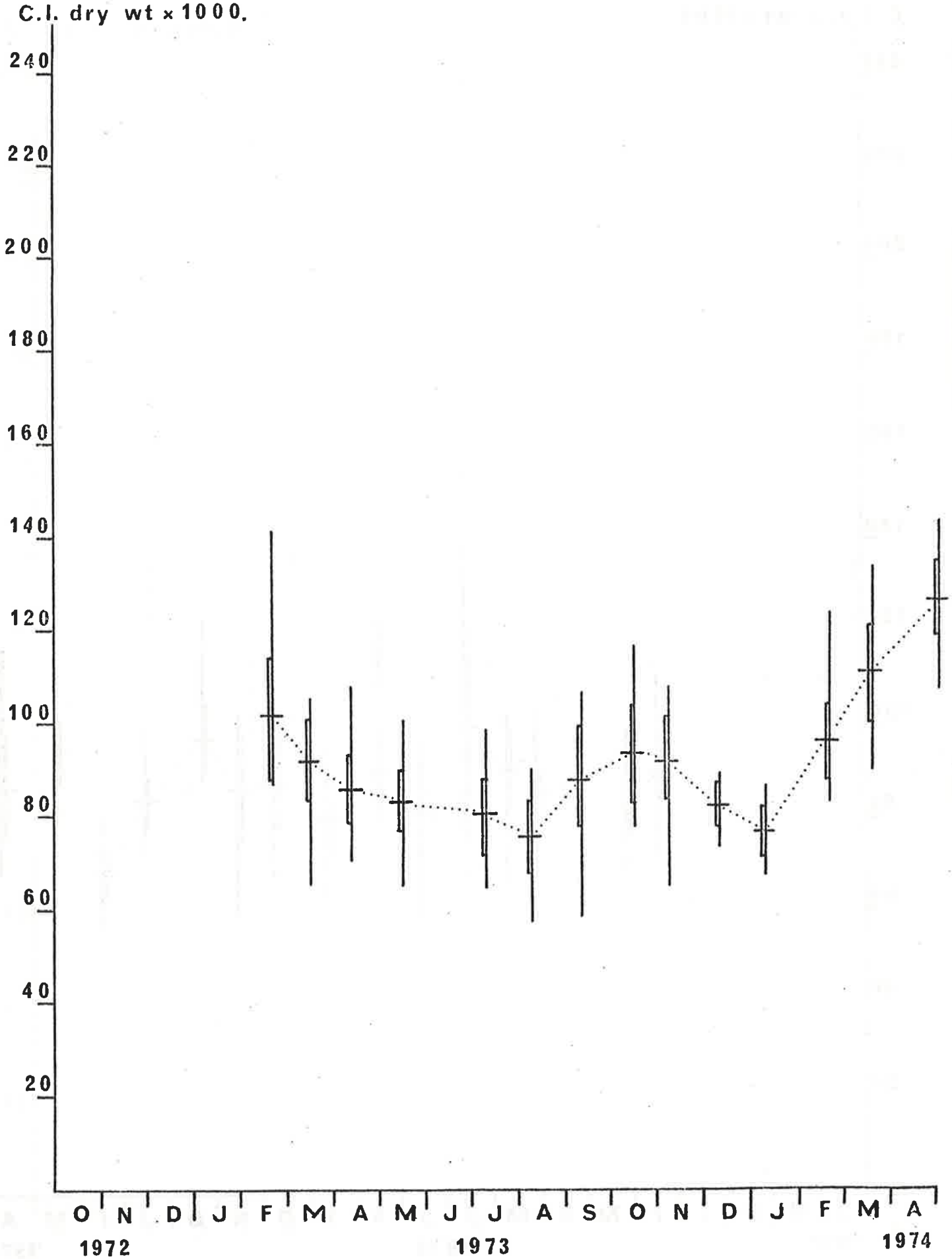


Fig 17. KAIPARA-Batley-foreshore (wild).

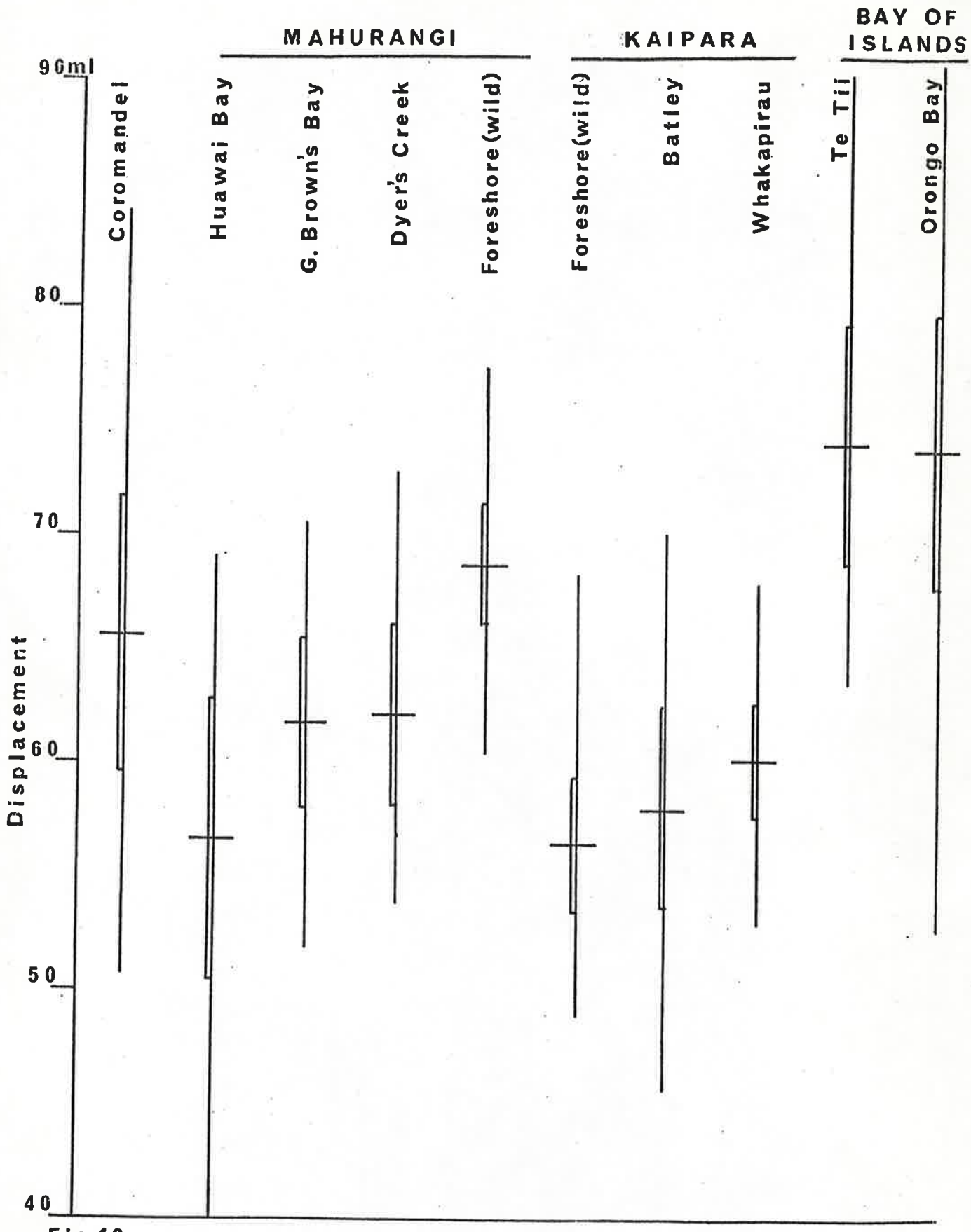


Fig 18.

MEAN WHOLE SHELL DISPLACEMENTS FEB'73-MAR'74.

(N.B. All stations standard level except Foreshores, range and 95% confidence limits shown.)