NEW ZEALAND MARINE DEPARTMENT

FISHERIES TECHNICAL REPORT
No. 70

STUDIES ON TOHEROA AT TE WAEWAE BAY, SOUTHLAND

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SUMMARY

Toheroa surveys were carried out at Te Waewae Bay twice yearly from May 1966 to March 1970. Toheroa are distributed over 11.25 kilometres (7 miles) of beach. Large sized toheroa are typical of the population. Heavy spatfalls occurred in December 1968, March 1969, and November 1969. The total population varied in size between 1,993,000 plus and 3,333,000 plus. The numbers of legally takeable sized toheroa have shown a downward trend since May 1966. Pied oyster catchers are important predators on small toheroa. Divers searching the sub-littoral zone failed to find any toheroa.

INTRODUCTION

Toheroa occur on numerous beaches in the North Island, principally on the west coasts of Auckland and North Auckland, and in the Manawatu area. In the South Island toheroa are present in significant numbers only in Southland, at Te Waewae Bay and Oreti Beach (Fig. 1). In North Otago, a small bed is located at Hampden Beach, and single specimens have been found by the writer at both Waikouaiti Beach and Long Beach.

The Tewaewae Bay toheroa population is the larger of the two in Southland, and preliminary observations in 1965 had shown that concentrations of large sized toheroa were present. The area is 68 miles from Invercargill and being remote from large population centres the toheroa beds were not formerly heavily exploited. However, within the last decade an increasing population with more leisure time coupled with improved road access to the beach have resulted in a greater number of toheroa being taken. In view of the increasing rate of gathering, it was considered necessary to conduct regular surveys of the beaches to determine the abundance of toheroa, the size composition and density of the population, and to assess any changes taking place.

Two preliminary surveys of the beach were made in 1965. Since then surveys have been carried out in 1966, 1967, 1968 and 1969, before and after the two months open season and before the season in 1970.

Regulations governing the taking of toheroa in Southland specify a minimum size limit of 3 inches, an open season in August and September and a quota of 20 per person over 5 years of age each day, with a maximum of 100 per vehicle. Digging can only be carried out between the hours of 7 a.m. and 6 p.m. and implements of any kind are prohibited. Toheroa must not be opened below high tide mark.

METHODS

The 11.25 kilometres (7 miles) of toheroa beach was sampled by traverses every 321 metres (.2 miles) apart. The distance between traverses was measured either by a vehicle milometer or by pacing. The position of each traverse was measured only approximately and therefore traverses in different survey periods do not exactly coincide.

Traverses were dug at right angles to the water-line and between the upper and lower limits of toheroa distribution (Fig. 2).

Thirty-five traverses, numbered consecutively from east to west were sampled by pushing a one metre by half metre frame about 15 cm into the sand and digging the area within the frame with a potato fork. Samples were taken at 5 metre intervals along each traverse. The sand from each sample was broken up to reveal any small toheroa present.

The total length of each toheroa in each sample was measured to the nearest .5 cm by using a toheroa measuring board (Fig. 3); the position of each frame within the traverse was also recorded.

It is necessary to sieve the sand to find all the toheroa smaller than 2.5 cm long. The numbers of small toheroa present were therefore under-estimated as time did not allow sieving the sand in all samples. The extent of this under-estimation was gauged by comparing the numbers of toheroa from sieved traverses with those from unsieved adjacent traverses.

Underwater observations of the sea bottom below low water were made by SCUBA divers. The areas searched for toheroa extended to 250 metres offshore from the low water spring tide level.

Samples of sand were mechanically sieved for ten minutes through six different mesh sizes, to allow the grain size composition to be established.

RESULTS AND OBSERVATIONS

(a) The Beach

Te Waewae Bay is a shallow exposed surf beach, subjected to heavy seas and swells from the southwest to the south-east. Toheroa occur mainly from 1.93 kilometres (1.2 miles) east of the Grove Burn, westwards along 11.26 kilometres (7 miles) of sandy beach to the Hump Burn (Fig. 1). East of the Grove Burn the beach grades from a sandy to a gravel beach. Four small rivers and several creeks run on to the beach. Seepage of fresh water on the toheroa beds is apparent in places. The beach is backed by either sandstone or mudstone cliffs, sand dunes or boulder banks.

Grain sizes of the sand, taken from the mid-position in six traverses spaced 1.6 kilometres (1 mile) apart, are shown in Fig. 4, together with the distribution pattern of toheroa along the beach. No clear relationship between toheroa distribution and grain size is apparent. In coarser sand, large toheroa over 12.5 cm in length are often found at the lower end of traverses. (Fig. 8).

Shellfish other than toheroa are seldom found in the inter-tidal zone. Only small numbers of Macomona liliana were seen. Tuatua do not occur in Te Waewae Bay. Below the low water mark, trawlers sometimes net considerable numbers of Mactra discors and Spisula aequilateralis. The burrowing shrimp, Callianassa filholi, and several species of polychaete worms and isopods are common on the beach.

Phytoplankton is usually present as a thin layer on parts of the beach. Dense blooms have often been seen in some areas. These give an olive-brown discolouration to the surf and sometimes form deposits of up to about 1 cm deep on the sand. The phytoplankter most abundant is a Chaetoceros species.

Pied oyster catchers are always present on the beach in considerable numbers when small toheroa are abundant. They have been observed feeding on toheroa smaller than 3 cm long, which they easily obtain with their long beaks.

Wave action often exposes small toheroa and moves them up and down the beach. Toheroa exposed in this way fall easy prey to oyster catchers. Smaller numbers of black-backed and red-billed gulls have also been noted feeding on such exposed small toheroa. Flatfish may also eat small toheroa.

(b) The Toheroa

The number of toheroa present on the beach was estimated by multiplying the numbers present in the 35 traverses by the distances between each frame and traverse. Population estimates for the eight survey periods are shown in Table 1. Toheroa have been divided into four different size groups so that metric measurements correspond approximately to inch equivalents. Numerically the total population did not decline during the last few years and varied between approximately 2 and 3 million. However, the increased numbers of toheroa present in the three surveys from December 1968 to November 1969 was due to heavy spatfalls. There is a fall in the numbers of toheroa between 7.5 cm and 12.4 cm (3-5 inches) from about 1,800,000 in May 1966 to 900,000 in November 1969. The numbers of large toheroa over 12.5 cm (over 5 inches) have remained fairly stable since December 1966, and varied between 120,000 and 180,000, but between May and December 1966 numbers declined from 375,000 to 190,000.

The size composition of the toheroa population in each of the nine survey periods is shown in Fig. 5. On two occasions comparisons were made between traverses from which the sand was sieved and an adjacent traverse dug in the normal manner. These showed that in one case only 15% and in the other only 30% of toheroa under 2.5 cm in length were revealed by the normal method of digging. Times does not allow sieving as normal practice during the survey.

Large toheroa are characteristic of this population and there are principal model peaks between 9-12 cm in all the nine surveys made between April 1966 and March 1970. Figure 6 illustrates a sample of large (over 12.5 cm) toheroa. Substantial numbers of small toheroa below 5 cm were present in December 1968, March 1969, and November 1969. Large numbers of small toheroa were also present in April 1965 when a preliminary survey of the beach was made.

The length frequency histograms (Fig. 5) show that mortality on young toheroa is very high especially as the numbers of small toheroa are based on gross under-estimates. In March 1970 comparatively few spat were present, and there was no larger size group that could have resulted from the growth of the small toheroa that were abundant in November 1969. A similar observation was made in December 1965 when few of the small toheroa so numerous in April 1965 remained.

Figure 7 shows the number of toheroa present along the beach in series of five grouped traverses. Small toheroa below 7.5 cm (approximately 3" size limit) are shown separately from toheroa over 7.5 cm. The most hea ily populated area in all surveys is between traverses 6 and 15. Toheroa are particularly dense along the stretch of beach between the Grove Burn and the Rowallan Burn, in the vicinity of a small creek known locally as Whisky. The numbers of toheroa present decline sharply close to the outlets of the Grove Burn and Rowallan Burn.

A marked decline is apparent in the numbers of toheroa larger than 7.5 cm in traverses 10 to 15 between March and December 1968. There is some evidence that natural mortality contributed to this. In April and June 1968, many dead and moribund toheroa were seen to the west of traverse 10. Considerable numbers of Mactra discors (which normally occur only sub-littorally), were present on the beach in a similar condition.

The average width of each traverse, from the upper to the lower limit of toheroa is shown in Table 2. Toheroa beds have their greatest width between traverses 6 and 20, where the mean width in the different surveys was 70 metres.

The number of toheroa which occur in each 10 metre section of traverses where the population was most dense in December 1968 (Nos. 6, 7, 8, 11 and 15) are shown in Figure 8. Small toheroa below 2.5 cm were concentrated mainly within the upper 16 metres of the traverses. Toheroa between 2.5 cm and 7.4 cm were also most numerous in the upper sections of the traverses. Toheroa between 7.5 cm and 12.4 cm occurred over the entire traverse, but were concentrated in the mid-section, while large toheroa over 12.5 cm in length were most dense at the lower end of the traverses.

Cassie (1965) suggested that toheroa occurred in the sub-littoral zone, on the basis of certain size groups being absent in the littoral zone, and the large fluctuations in numbers occurring on some beaches. Obviously direct underwater observation is the most ready way of checking on the occurrence of sub-littoral toheroa. The first diving observations took place off Dargaville Beach in 1963. Conditions were reported by Waugh and Greenway (1968) to be particularly difficult, and the search was unsuccessful.

Waugh and Greenway (1968) also postulated the occurrence of toheroa in the sub-littoral zone, basing this on their finding some toheroa shells which had been bored by gastropods absent from the littoral zone.

Underwater observations were made on four occasions in Te Waewae Bay. The first of these inspections was made in December 1967. The sub-littoral zone below the heavily populated region around traverse 7 was examined. The lower limit of the toheroa bed was some 80 yards above the low water spring tide mark. There was an adequate underwater

visibility of 1.5 metres and observations ranged out seawards for a distance of 250 metres below low water and then shorewards to cover a half-circle. No toheroa siphon holes were seen in the search area, and prodding a knife into the sand also gave negative results.

The second observation was made in December 1968, opposite traverse 15, where in April and June 1968 numbers of dead and dying, large (over 12.5 cm) toheroa were lying exposed on the surface of the sand. It was thought possible that these toheroa may have originated from the area below low water where Mactra are found. However, in the December 1968 survey there was a marked drop in the numbers of toheroa over 7.5 cm in length, on the section of beach between traverses 10 and 15 (Fig. 7). It is now thought that these dead toheroa came from the littoral zone. The low water mark opposite traverse 15 was 60 metres below the lower limit of the toheroa bed. A half-circle path extending 250 metres seawards was covered, the visibility was adequate, but again no toheroa were located.

The third area covered, in March 1970, was about 1,000 metres east of the Grove Burn. No toheroa were found.

In March 1970 there was a noticeable increase in the amount of sandy beach exposed eastwards of traverse 1. Small numbers of toheroa were found over a distance of about 800 metres along this stretch. They were large specimens (12-14 cm) and like most toheroa found near to low water, had a lighter coloured shell than those found higher up the beach. It was envisaged that these toheroa could possibly have come from below low water. The sub-littoral zone was inspected out to 200 metres below low water, but no toheroa were present. The gradient of the beach is considerably steeper here than usual, and the toheroa present in March 1970 may always have occurred near to low water, but with the build-up of sand they were more obvious when there was little surf.

Underwater observations will be continued at different positions along the beach but the work carried out to date indicates that toheroa are not present sub-littorally in any significant numbers.

DISCUSSION

The toheroa population in Te Waewae Bay is not separated into distinct beds such as occur on North Auckland beaches (Greenway 1969). The survey method used, i.e., spacing of traverses every 321 metres, (.2 miles) was considered to give satisfactory sampling of the toheroa population on the beach.

The size of toheroa in Te Waewae Bay is larger than that currently occurring on North Island beaches, as recorded by Tunbridge (1967) and Williamson (1969), in the Manawatu area, and Greenway (1969) in North Auckland. A feature of the North Island beaches is the sparcity of small toheroa. This had been commented on earlier by Hoby (1933) and Cassie (1955). In Te Waewae Bay there is a more balanced population, with large concentrations of small toheroa occurring periodically. Heavy spatfalls were noted in April 1965, December 1968, March 1969, and November 1969. In the absence of data on growth rate it is not possible to relate secondary modal peaks to year classes. Work is now in progress to establish growth rate by tagging toheroa and by interpreting growth rings on sectioned shells.

Figure 5 shows that the numbers of toheroa between 9-12 cm long in each survey are much greater than those of smaller toheroa. This indicates that the toheroa forming the mode between 9 and 12 cm are from several year groups.

As a result of heavy spatfalls the total population of small toheroa 0-2.4 cm (approximately 0-1 inch) in length increased substantially in December 1968, March 1969 and November 1969. The population calculations of 669,000, 601,000 and 1,007,000 for the three periods are probably under-estimated (see p.5). The numbers measuring between 2.5 cm and 7.4 cm (approximately 1-3 inches) increased substantially between March and November 1969, the lowest numbers in this size group were recorded in May 1966.

The main size group taken by diggers, between 7.5 cm and 12.4 cm (3-5 inches) shows a trend of gradually declining numbers since May 1966 although in March 1968 the numbers approached those of two years previously. Large toheroa over 12.5 cm (5 inches) have declined to half the abundance recorded in May 1966, but most of this drop had occurred by the December 1966 survey. There has not been any progressive decline in the quantities of toheroa over 12.5 cm, but this is not the main size group selected by the public. Large toheroa generally occur further towards low water and good tides are often necessary for their gathering.

The numbers of dead toheroa which are sometimes washed up indicate that there is periodically considerable natural mortality on the adult population. It has not been possible to determine the extent to which changes in the adult population are due to natural mortality. An increasing rate of gathering by the public would be expected to cause some reduction in stocks, and a downward trend in the numbers of legal sized toheroa since May 1966 is apparent. Only future surveys will determine whether or not recent heavy spatfalls maintain the population.

RECOMMENDATIONS

In view of the increasing rate of gathering by the public and continuing decline in the numbers of legal sized toheroa, some further restrictions on gathering appears to be necessary. This could be achieved by either reducing the quota or shortening the season.

ACKNOWLEDGEMENTS

Thanks are due to Mr G.S. Crowther, Marine Department, Bluff; Mr R.A. Downes, formerly Marine Department; and latterly Mr J.S. Kirkman, Marine Department, Dunedin, who carried out the field work jointly with the writer. The late Mr Jack Te Au, former Honorary Fisheries Inspector on the beach gave valuable background information on the toheroa beds. Dr D. Eggleston constructively criticised the manuscript and Mr D. Williamson prepared some of the diagrams.

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TABLE 1

ESTIMATES OF TOTAL POPULATION IN EACH SURVEY PERIOD

Survey Dates	Size Group (Cm)				
	0-24 cm (0-1 inch)	2.5-7.4 cm (1-3 inches)	7.5-12.4 cm (3-5 inches)	12.5 + (5 inch +)	Total 1 inch +
May 66	45,000 plus	277,000	1,789,000	375,000	2,441,000
Dec 66	61,000 plus	608,000	1,670,000	190,000	2,468,000
April 67	112,000 plus	450,000	1,590,000	119,000	2,159,000
Nov 67	55,000 plus	389,000	1,407,000	142,000	1,938,000
March 68	293,000 plus	592,000	1,754,000	182,000	2,528,000
Dec 68	669,000 plus	637,000	1,439,000	116,000	2,192,000
March 69	601,000 plus	531,000	1,239,000	177,000	1,947,000
Nov 69	1,007,000 plus	969,000	900,000	171,000	2,040,000
March 70	148,000 plus	777,000	1,034,000	167,000	1,978,000

TABLE 2

AVERAGE WIDTH OF TRAVERSES IN METRES

Survey Dates	Traverse Number						
	1-5	6-10	11-15	16-20	21-25	26-30	31-35
May 66	40	75	85	80	45	35	30
Dec 66	25	70	85	75	40	25	20
April 67	15	55	70	75	45	20	30
Nov 67	30	50	65	85	35	15	30
March 68	35	65	80	80	40	10	30
Dec 68	45	55	80	60	45	20	35
March 69	35	45	85	50	25	20	35
Nov 69	30	50	60	85	25	20	10
March 70	25	70	65	65	25	10	25

LIST OF FIGURES

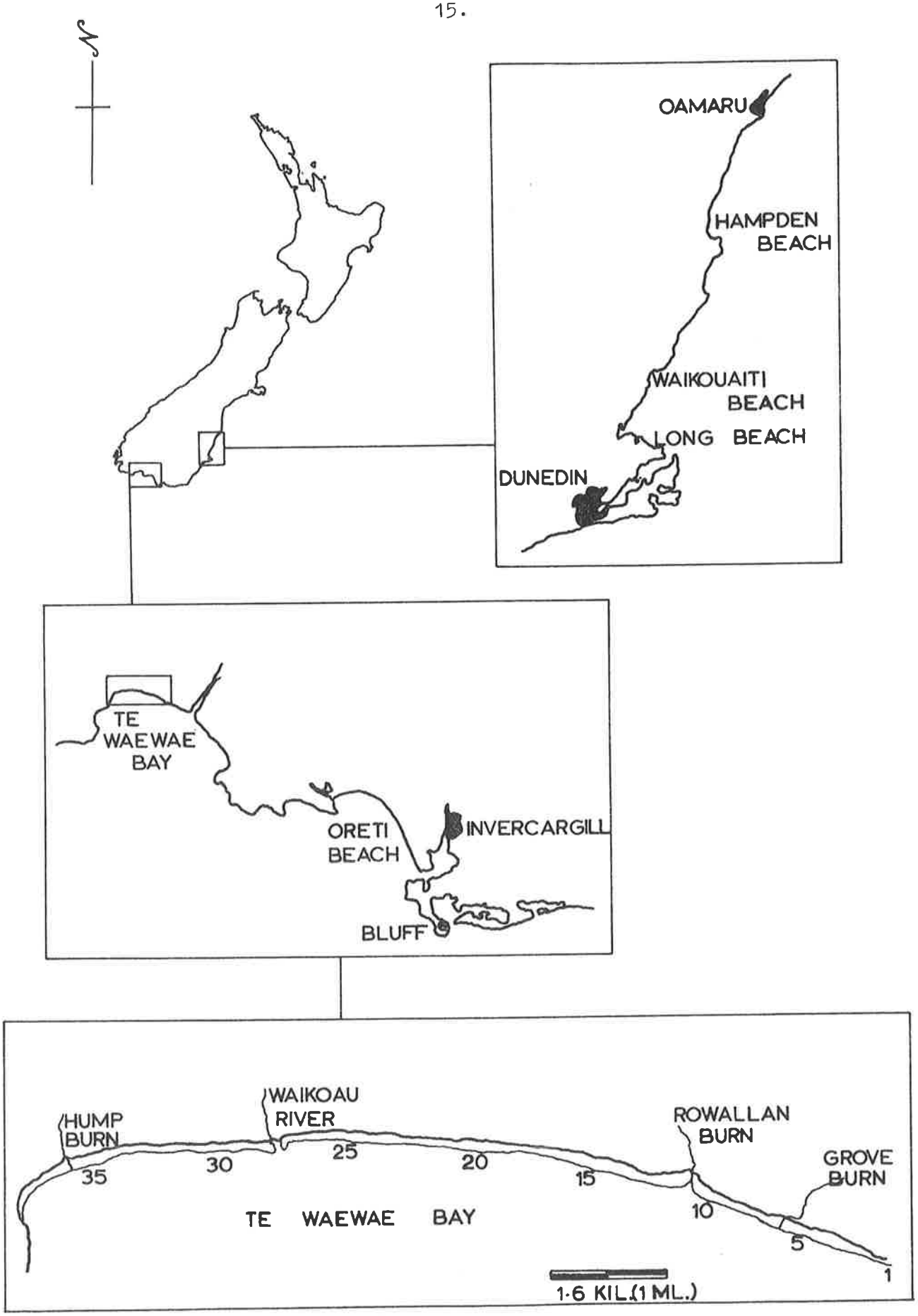

FIG. 1. LOCATION MAP

Figure 2. Method of digging traverses

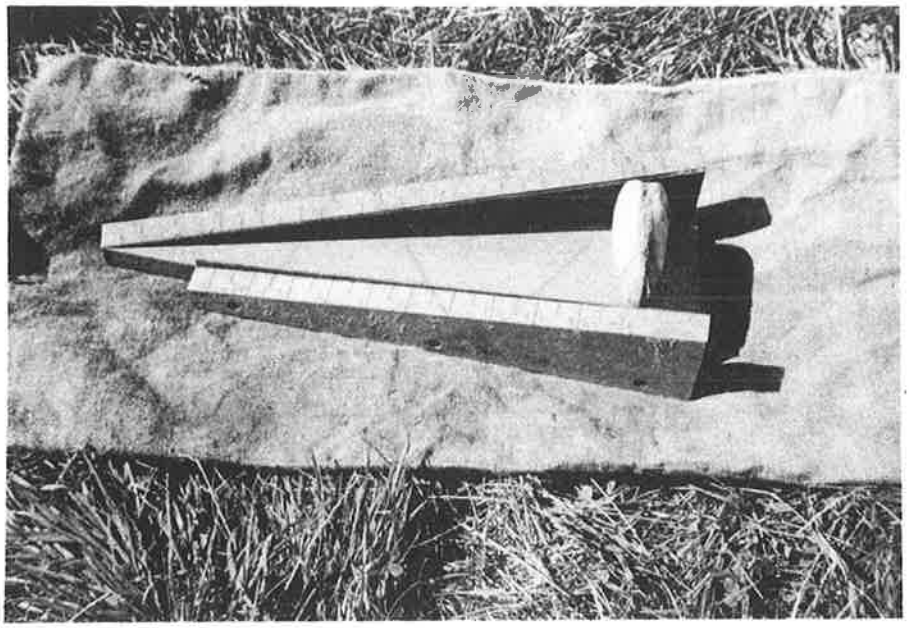

Figure 3. Toheroa measuring board

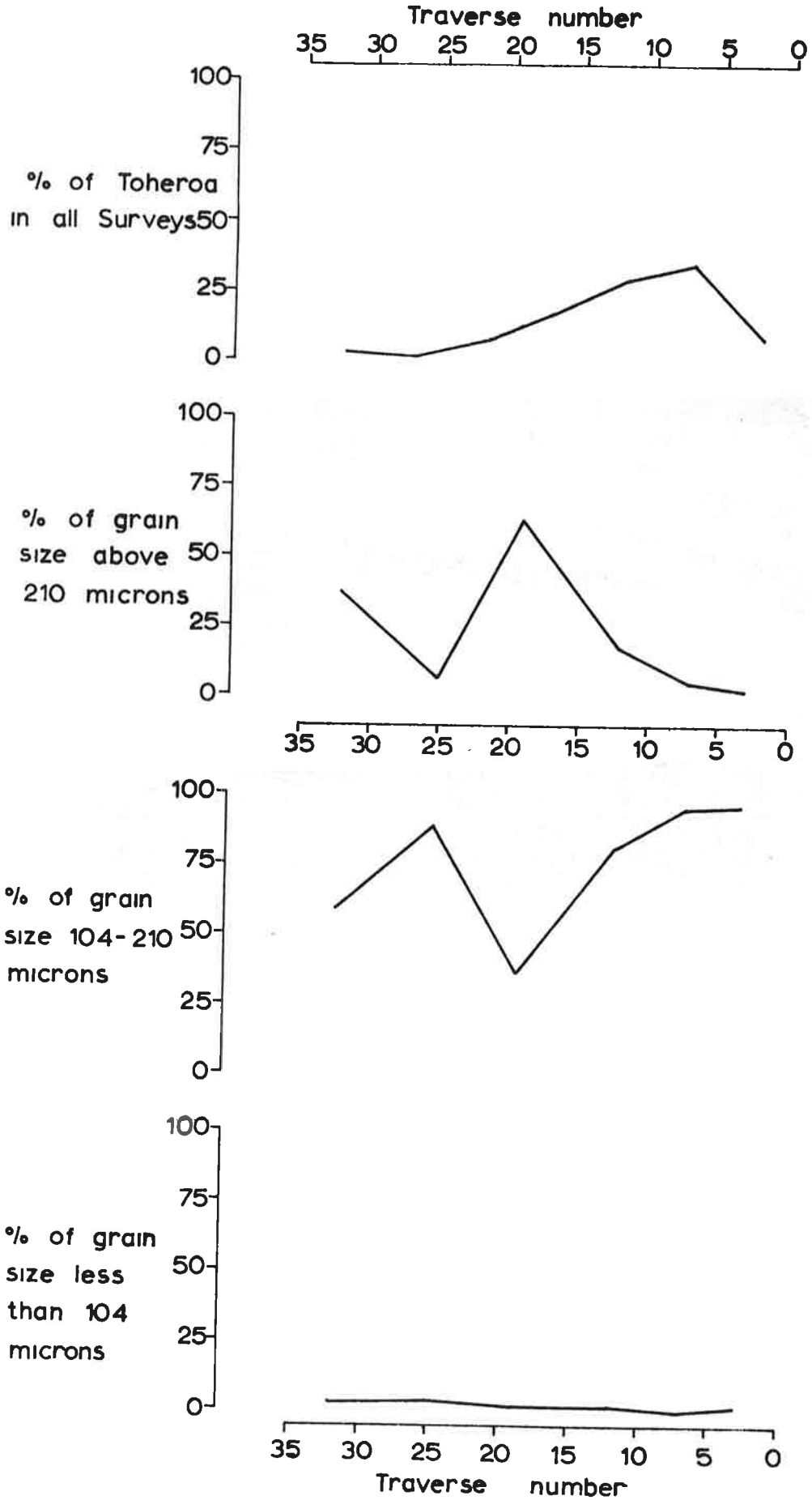

FIG. 4 TOHEROA DISTRIBUTION BY SAND GRAIN SIZE

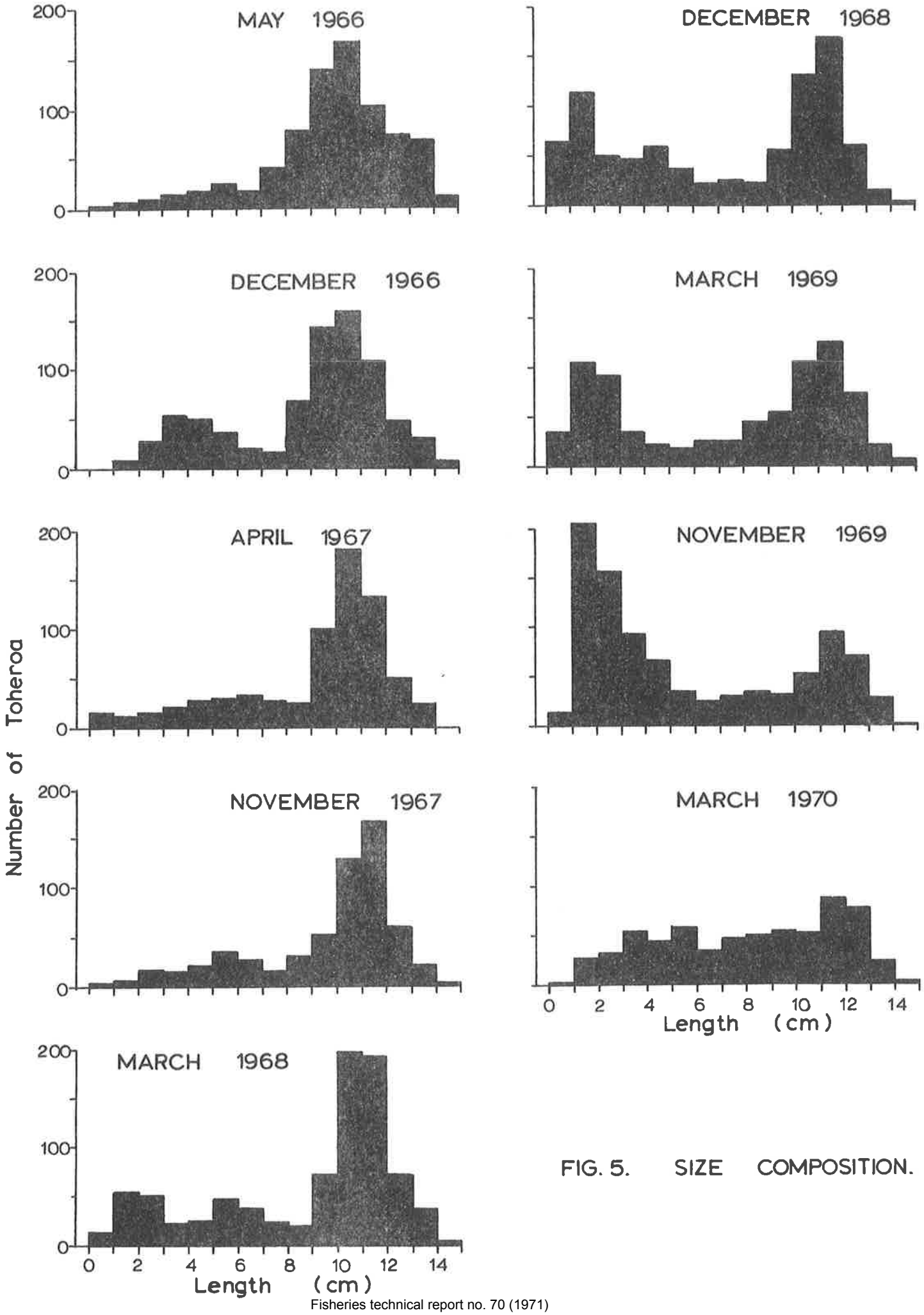

FIG. 5. SIZE COMPOSITION.

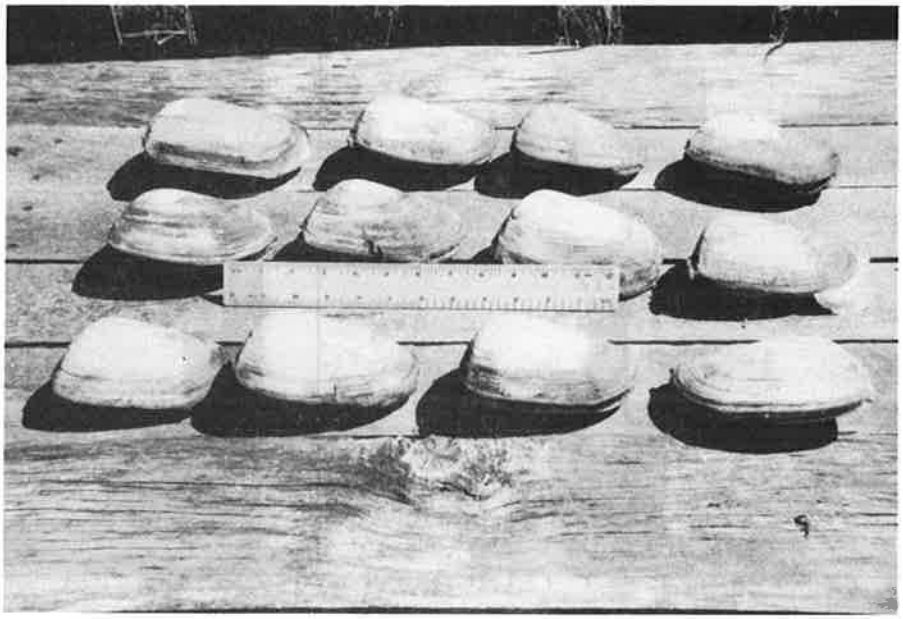

Figure 6. Large toheroa 12.5 cm +.

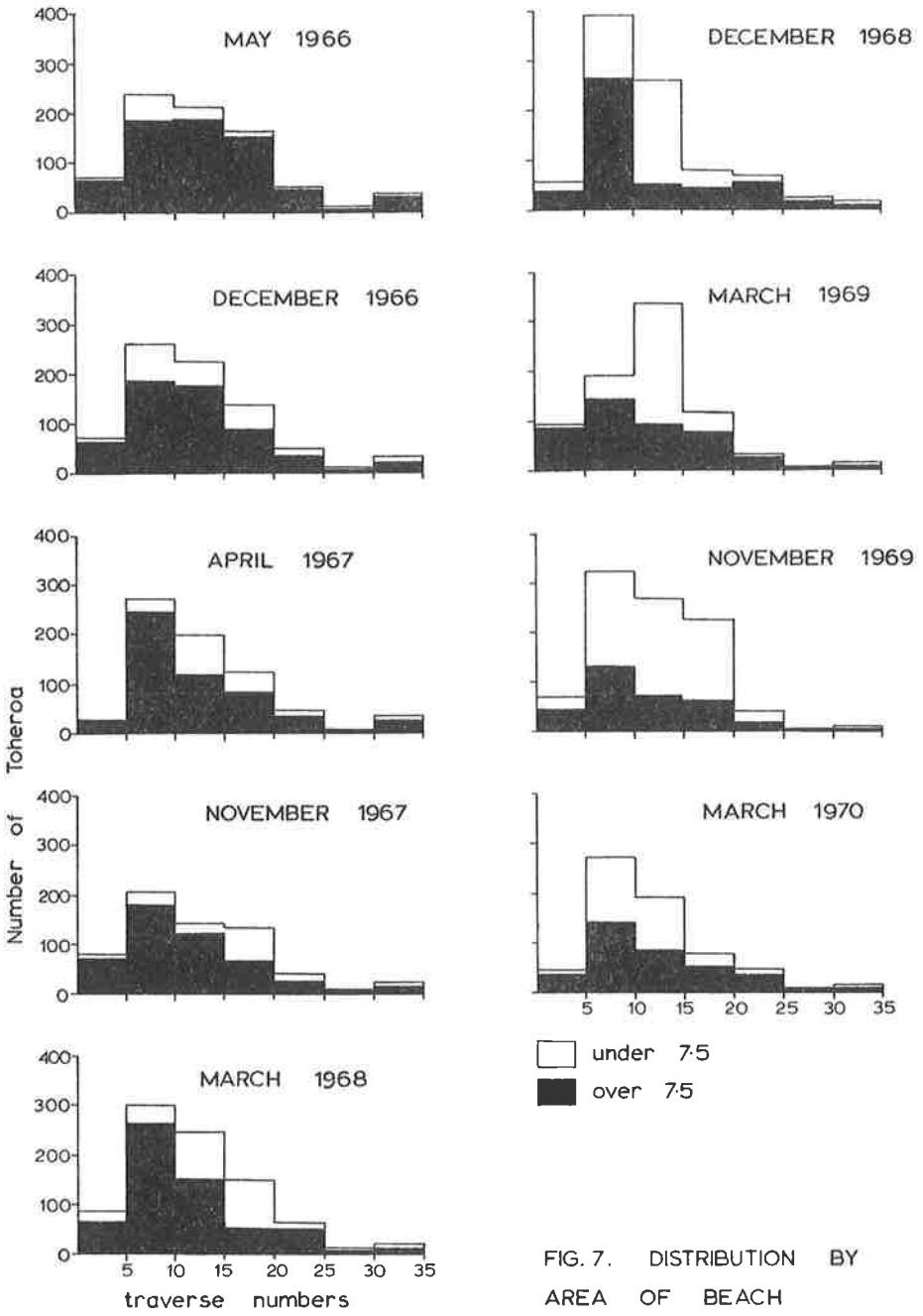

FIG. 7. DISTRIBUTION BY AREA OF BEACH

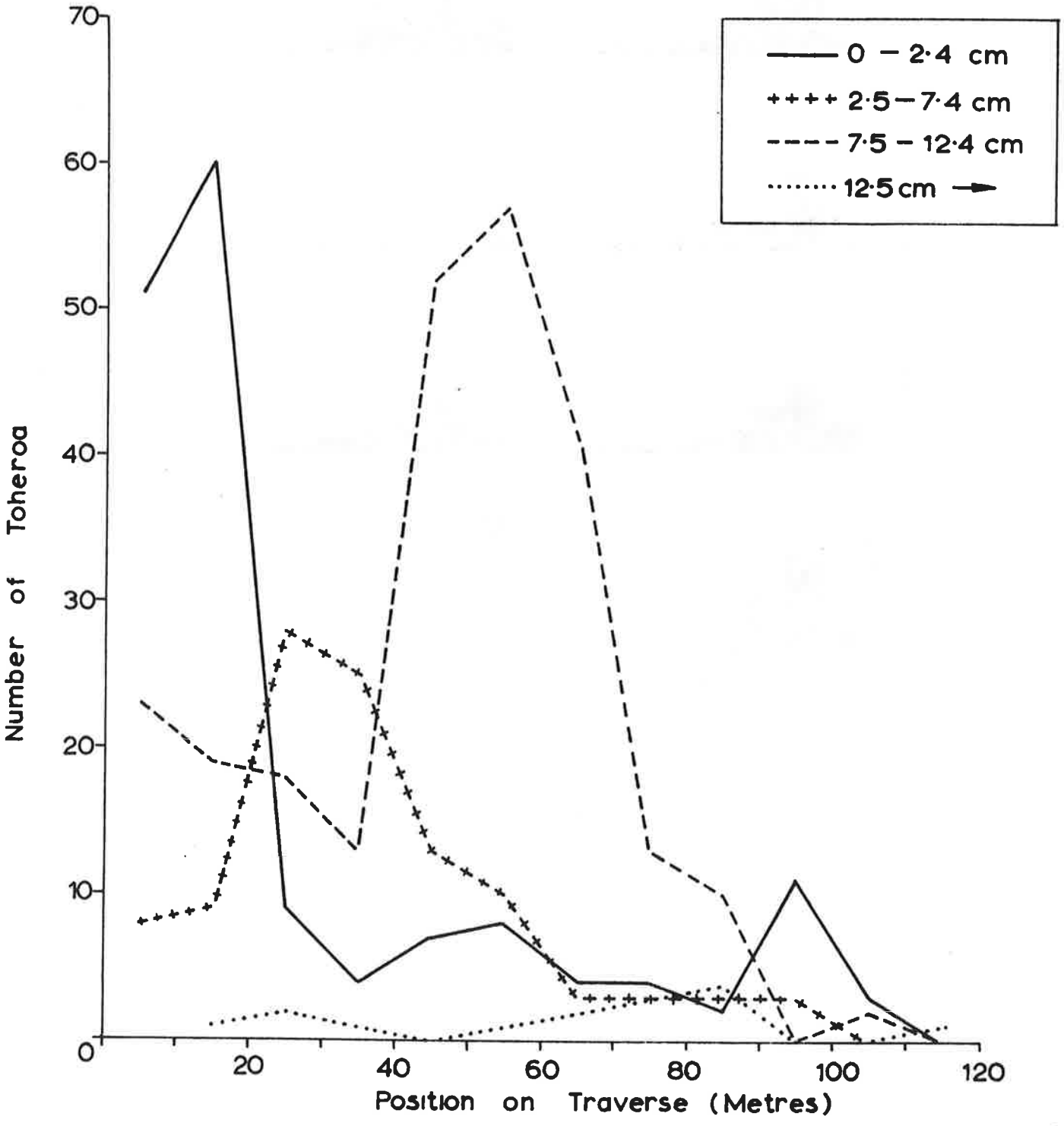

FIG. 8. SIZE BY POSITION ON TRAVERSE

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