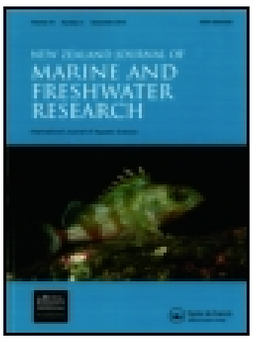

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FURTHER EVIDENCE FOR THE EXISTENCE OF SUB-LITTORAL POPULATIONS OF TOHEROA, *AMPHIDESMA VENTRICOSUM* GRAY (EULAMELLIBRANCHIATA), OFF THE WEST COAST OF NEW ZEALAND

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SUMMARY

The finding of shells of toheroa (*Amphidesma ventricosum* Gray) which had been drilled by gastropods absent from the littoral zone, is presented as evidence for the existence of sub-littoral populations of toheroa.

INTRODUCTION

The toheroa (*Amphidesma ventricosum* Gray) is found on surf-washed, sandy beaches and is particularly plentiful on those of the west coast of the North Island (Rapson 1952). It is a highly prized shellfish which in recent years has been heavily exploited by the public, and to a less extent by commercial interests (Marine Department 1956–1966). In the littoral zone the animals are restricted to a fairly narrow band at about half-tide level where they bury themselves in the sand and form beds whose density and distribution fluctuate very considerably (Mestayer 1921; Rapson 1952).

Attempts to conserve the stocks by establishing a minimum size of three inches, and by limiting the period of the digging season and the individual take, have not always succeeded. The littoral stocks have sometimes declined to a very low level. These declines have generally been attributed to over-exploitation, destruction of the beds by wave action, spatfall failures, and mass mortalities (Hefford 1927–45; Rapson 1954; Cassie 1955).

Almost equally sudden recoveries have been quoted by Rapson (1954) and may possibly be attributed to successful spatfalls. However, young stages up to one year old are only occasionally found in quantity on the beaches. Cassie (1951) drew attention to the abnormal age

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frequency distribution of the intertidal stocks and in 1955 commented that in some places they appeared ". . . to represent an incomplete portion of some larger total population". In addition he pointed out that despite the considerable reductions in the littoral populations as a result of mass mortalities, there were still sufficient adults left to provide the vast numbers of spat necessary to repopulate the beaches. For these reasons he postulated the existence of sub-littoral populations of toheroa which could contribute to the littoral stocks either directly by an onshore movement or indirectly by breeding. Mestayer (1921) also mentioned possible migration and a longshore movement but Rapson (1952) on the other hand seems to have discounted both the existence and the importance of a sub-littoral population.

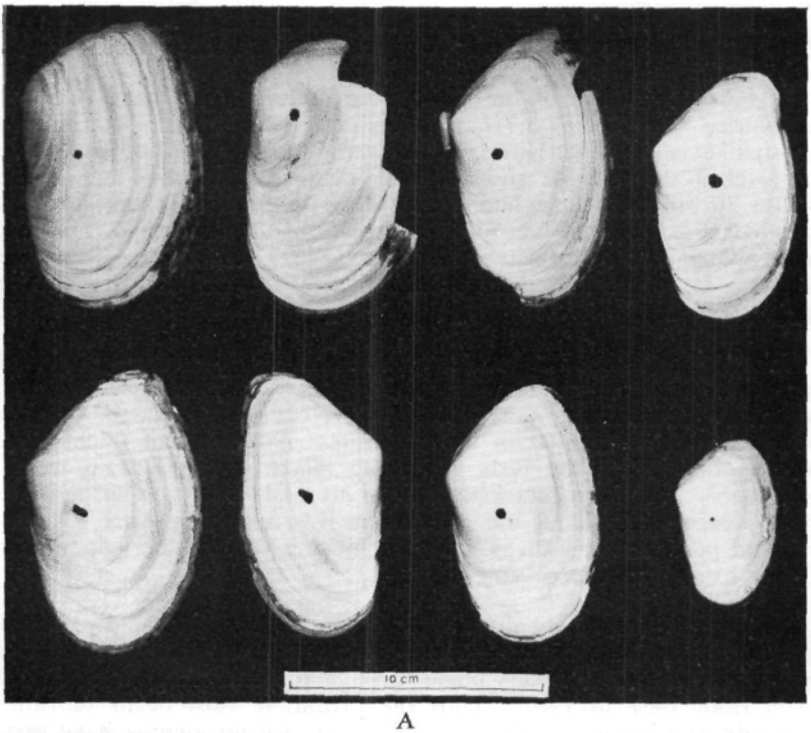
Since the publication of Cassie's (1955) work, one attempt has been made by the Marine Department to locate sub-littoral toheroa. Scuba-equipped divers explored a limited area in the surf zone just off Dargaville beach in 1963, but conditions were particularly difficult and the exploration was unsuccessful. Since then no further attempt has been made to test the supposition but recent observations provide indirect evidence for the existence of sub-littoral stocks.

OBSERVATIONS

On 18 and 19 July 1967 a brief visit was made to the Dargaville beach. The area covered was the 45 mile stretch of coast between Maunganui Bluff and North Head at the entrance to Kaipara Harbour. Adult toheroa were few in number and generally very scattered. Beds of the density described by Rapson (1954) were only rarely encountered and these were very limited in extent. None of the beds contained 0+ shellfish and there were only occasional specimens of the 1+ class. On this beach both Rapson (1952) and Cassie (1955) had described the younger age groups as occurring higher on the shore than the older groups but despite several searches no 0+ individuals were found.

At, and just above high tide mark there were scattered deposits of shells in a few places. These had been uncovered either by the shifting sand or, possibly, by scouring from exceptional tides. The chance discovery of a single shell with a hole 3.4 mm in diameter led to a closer examination of the deposits.

Time on the beach was limited and approximately 40 minutes were spent in searching amongst the scattered shells in six or seven places along the length of the beach. From these, eight toheroa shells and one each of the shells of *Mactra discors* and *Angulus gaimardi* were found with similar holes. None of the shells of tuatua, *Amphidesma subtriangulatum*, which were common in the deposits, had such holes. Tuatua shells are relatively thick and heavy, unlike those of toheroa which are relatively brittle and do not last long on the wave-pounded beaches.



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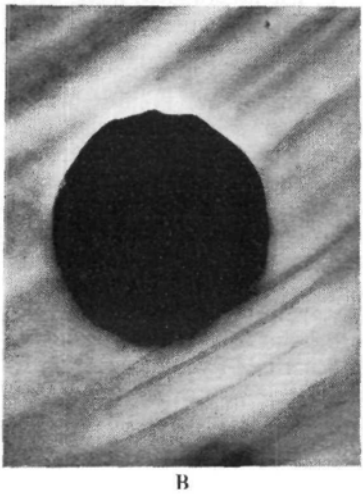

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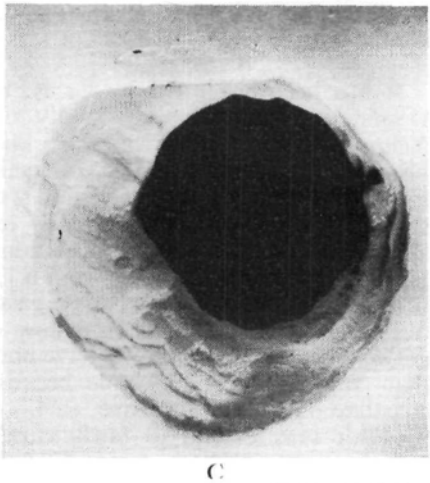

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Photos: J. Bahler

FIG. 1—A. Toheroa shells collected from above high water mark showing characteristic holes. All taken on North Dargaville beach.
B. Shell showing the smooth rounded outline of a hole as viewed from the outside.
C. The same shell showing broken layers on the inner side.

Quantitative sampling was not attempted but it is considered that the eight shells represented about 0.5% of all those examined.

The holes in five of the shells were uniformly circular in outline and varied from 1.4 to 3.7 mm in diameter with the smallest hole in the smallest shell (Fig. 1a). All were in a similar position, just below the level of the umbone and between one-quarter and one-half of the shell width from the hinge line. The outline on the outside was smoothly rounded (Fig. 1b) and typical of drill holes of the Muricidae, Thaidae, and Naticidae as described by Carriker (1961), but on the inside the prismatic layer was irregularly broken as if by external pressure causing flaking (Fig. 1c).

There is no doubt that the holes were made by a predatory gastropod capable of burrowing in the sand and of penetrating the toheroa shells. Such penetration seems most likely to have occurred when the toheroa were normally orientated in the substrate. Animals that might have been scoured from the beds and lying loose on the bottom would presumably have been attacked in a variety of positions. Furthermore the evidence that part of the penetration was due to pressure suggests that the predator as well as the prey must have been buried, for the former to apply the necessary leverage.

In discussing mortality due to predators Rapson (1954) discounted gastropods, and one of us (J.P.G.) has never seen gastropods despite many hundreds of transects made through the toheroa beaches in the years from 1961 to 1967. Thus the predation must occur offshore, probably well below normal low-water mark, for no toheroa have been found in the zone at, or immediately beyond, low water of extreme spring tides.

It has been suggested by Dr R. K. Dell and Mr W. Ponder of the Dominion Museum, who kindly examined the toheroa shells, that *Xenophallium pyrum*, which is known to occur off the west-coast beaches, might be capable of making the holes that were found. However, the depth at which this species may occur is uncertain. The surf zone has never been properly explored on the New Zealand coast and there is no published information on the occurrence of marine snails in this region. Cassie (pers. comm.), as a result of underwater observations, is of the opinion that these gastropods are probably absent or rare out to at least 100 yards from low water off the toheroa beaches. In general, benthic communities have not been described from closer inshore than approximately one mile because of the dangerous nature of the coastline and the extensive surf. It is possible therefore that the predator may extend to fairly close inshore.

CONCLUSIONS

A quantitative examination of shells along the shore line could give an indication of that proportion of the toheroa mortality which is due

to gastropod predation. However, the evidence of such predation is in itself indicative of the occurrence of stocks of toheroa below low-water mark.

The location of such stocks of animals which bury to a depth of 5 to 10 cm in the substrate, on such a difficult coastline, will present many problems. From a conservation point of view it will obviously be important to demonstrate and, if possible, estimate the abundance of these reserve stocks. It will also be important to know how much, if at all, they contribute to the littoral population, either by larval production or by direct onshore movement.

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