NEW ZEALAND MARINE DEPARTMENT

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SETTLEMENT AND GROWTH OF A COLONY OF THE LARGE GREEN MUSSEL FROM A PONTOON IN TE KOUMA HARBOUR, COROMANDEL

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SETTLEMENT AND GROWTH OF A COLONY OF THE LARGE GREEN MUSSEL (PERNA CANALICULUS, GMELIN) FROM A PONTOON IN TE KOUMA HARBOUR, COROMANDEL

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SUMMARY

Settlements by mussels, (Perna canaliculus) were observed on a pontoon carrying various suspended surfaces in Te Kouma Harbour during the years 1967-1969. Initial settlement occurred near to the water surface. Subsequent colonisation took place over the whole water column, but with densest aggregation remaining within 1m of the surface. Very rapid early growth rates were obtained and some of the first settled mussels reached a length of 100mm within the year. Two main settlements were observed, a primary one in spring and a secondary during summer. Very little settlement appeared to take place during autumn and winter. A tentative schedule for cultivation is proposed.

INTRODUCTION

With the virtual eclipse of bottom dredging for mussels in the Firth of Thames during the middle 1960's, described by Greenway (1968), there arose a need to develop culture techniques to replace (and possibly increase) the lost production. Cultivation of mussels is extensively practised in Spain and has recently been described by Waugh (1968). Much interest in raft culture is also being shown in the United Kingdom and successful experiments in Scotland have recently been described by Mason (1969).

Although in New Zealand only the Marlborough Sounds area appears configuratively akin to the rias of north-western Spain or Lochs of Scotland, there are some bays and inlets around Auckland and Northland which could be investigated. One such inlet is Te Kouma Harbour, just south of Coromandel. It has reasonable shelter and a minimum depth of three fathoms can be found at the lowest tide. In the past, quantities of the large green mussel have been dredged at Coromandel. Te Kouma itself is not a navigational fairway, but does have the disadvantage of being a popular boating enthusiasts' anchorage. However, for purposes of a small scale experiment, it was considered reasonably satisfactory.

METHOD

A simple pontoon was constructed out of four large oil drums, strapped by metal bands to tanalised wooden members, from which ropes and chain could be hung (Plate 1). The structure was moored in three fathoms close to the shore in Te Kouma Harbour (Fig. 1). Mooring chains were attached to the drums above water level so as to avoid the chance of wild mussels moving from the bottom to colonise the pontoon. In order to ensure that additional mussel larvae would be in the area, about fifty large mature mussels, between 14-16cm in length, were dredged near Ponui Island.

These were enclosed in chicken-wire bags and attached to the bottom of four chains suspended from the pontoon. Samples were taken from the pontoon at fairly frequent intervals, but this depended upon availability of transport and other work commitments.

RESULTS

(a) Settlement and growth of the colony as a whole

The pontoon was placed in position during June 1967, and the first visit made on 13 September. All surfaces were then found to have received a coating of algal slime. However, no mussel settlement was observed. About this time gonad condition in wild mussel stocks generally appeared full with the possibility of imminent spawning taking place. A further visit on 10 October still failed to reveal young mussels but by the time of the next visit on 22 November, there was a light settlement confined to structures within about 15cm of the water surface. A length frequency of these is shown in sample (1) of Fig. 2. Subsequent growth and development of the colony can be traced from the modes in samples (2)-(13) in Fig. 2. The majority of these samples were taken from the lower submerged surfaces of the flotation drums. Samples (1)-(4) were all taken from structures within 15cm of the water surface, but in sample (5), taken on 20 March 1968, the smaller group marked (b) was found about halfway down lengths of 3m hanging rope. Subsequently mussels were found at all levels, but the densest oversettlement and aggregation continued to take place near to the surface. During a visit on 23 January 1968, it was noted that only six small (2.5cm) recently attached mussels, were found amongst the large mature ones which had been placed originally near the bottom in chicken-wire bags.

(b) Settlement on various surfaces:

Manilla rope of 2½" (63mm) circumference, "weathered" mooring chain of 1½" (38mm) link and 2" (50mm) diamond mesh galvanised fence netting were hung from the pontoon. Apart from the flotation drums and a submerged wooden plank, only the ropes received a settlement of mussels.

(c) Difference in growth between mussels at the surface and near the bottom - oversettlement:

On 9 October 1968, a clean 2½" (63mm) circumference sisal rope 3m long was enclosed in a sheath of ¼" (6mm) diagonal mesh plastic netting. Samples of 20 marked and measured mussels were "sewn off" at five 60cm intervals along the rope and within the netting sleeve. The total of 100 mussels ranged in length from 4.5cm to 12.0cm. The mean lengths of the five sub-groups ranged from 8.30 - 8.75cm. Unfortunately the rope was interfered with, the netting slit open and most of the larger mussels removed, between visits paid in late February and early June 1969. Therefore no measurement of possible growth difference (if any) surface to bottom was obtained. However, in June the rope was stripped of all remaining mussels and their length frequency compared with that of the original placement (Fig. 3). It is obvious that considerable oversettlement took place and the majority of smaller mussels were taken near the top part of the rope. No marked mussels were recovered.

(d) Extraneous Growths:

No special effort was made to keep surfaces clean. When the pontoon was finally dismantled large numbers of encrusting sponges, ascidians and polyzoa covered the structure. Hydroids and algal growths, especially on the ropes, had attracted a slimy deposit of suspended mud. This could be washed off to a degree by plunging

the ropes up and down in the water. Only a very few (<20) blue mussels, (Mytilus edulis aoteanus) were found mixed with the Perna when the pontoon was finally dismantled.

DISCUSSION

(a) Time of Settlement and Surface Preference:

In both years settlement appears to have taken place over a period of about eight months (September to April) with very small numbers occurring in the remaining four months (May to August). Furthermore, major settlements occurred within two fairly distinct peaks. The first, which appeared to be the heaviest, attached in spring and was concentrated more in the surface water, whilst the second followed on during summer and was lighter and more widespread and not confined to near the surface. This timing is similar to that found by Castellanos (1962) for Mytilus platensis in a comparable latitude of Argentina. He found that these mussels began to spawn in September and that by December about 90% had spawned. The apparent preference at least for the spring settlement of our mussels, to attach to structures near the water surface has not been satisfactorily explained. Paul (1967) found that, "in spring and summer the Hauraki Gulf became thermally stratified with warmest temperatures in the shallow areas. However, thermoclines were generally irregular in position and size". No bathymetry was attempted during our experiments in Te Kouma, but the presence of an early seasonal discontinuity and subsequent change could possibly account for some variation in the location of attachment by the young mussels. It seems strange that our lengths of mooring chain hung from the pontoon failed to attract any settlement when elsewhere dense settlements have been noted on chains. However, chain is heavy to handle and ours was lost early in 1968 when it worked loose in bad weather. It does not appear

very suitable for cultivation purposes. Later a good settlement was obtained on the actual mooring chains of the pontoon itself.

(b) Rate of Growth and Condition:

Early growth appears to be very rapid with some slowing down in winter (Fig. 2 and Plate 2). Mussels which attached during October-November 1967, had reached a size of about 100mm by October 1968. A further 7-8 months later they had added another 20mm to their length. Individuals were well in excess of this size (approximately $4\frac{3}{4}$") when they would find a ready market in New Zealand. This contrasts with the Spanish growth described by Andreu (1958) where 80mm was obtained in 14 months. Even if our rapid growth was obtained only under conditions of plenty in virgin settlement, there is leeway for at least equalling the Spanish rates when competitive conditions follow intensive cultivation. In both seasons at Te Kouma the October settlement had reached 80mm by the following June, i.e., in eight months.

Unfortunately, satisfactory measurements of condition were not obtained until the experiment terminated in June 1969. Then a sample in the range 48mm - 64mm (mean 56.2 mm) yielded a condition of 62.3%. Larger mussels were in comparable condition and really "fat": these would be very acceptable for market. At no time when samples were taken did the condition of the pontoon mussels taken appear poor or watery.

(c) A Tentative Cultivation Schedule

Mussel culture can be practised both on and off the bottom and has been described by Havinga (1964). The advantages of hanging mussel culture off the bottom have been fully described by Waugh (1968) and Mason (1969). If hanging ropes are chosen, in view of the initially sparse and surface located settlement found in the Te Kouma experiment; it might be advisable to seed the ropes with mussels taken from wild stocks. These could be stripped from rocks and bound on to the ropes with

fine plastic netting or even cotton. Mussels lightly bound on to ropes in this manner have been found to put out fresh byssus threads and securely attach themselves to the main rope almost overnight. However, as they grow they must be able to break through the binding medium. In this way new ropes would be made more attractive to oversettlement and a more even spread of mussels might take place down the ropes. Ropes should not be more than about 5m (16ft) long or else when covered in mussels they will be too heavy to handle. They should be placed one foot or more apart and short lengths of 2.5cm (1") diameter titree, cut green, inserted between the lay of the rope at 1m (3ft) intervals. The latter will help prevent the sheer weight of mussels from oversettlements simply sliding down the ropes and dropping off the bottom. A rough guide schedule for operations is set out below.

1st Year -	July	Set out "seeded" settlement surfaces, initial weathering.
	August	
	September	
	October	Expected 1st major settlement.
	November	
	December	
	January	Expected oversettlement, remove extraneous growths.
	February	
	March	
	April	
	May	Separate the settlements obtained and transfer smaller mussels to fresh ropes.
	June	Check extraneous growth and mud.
2nd Year -	July	
	August	

September, October, November	Expected 2nd major settlement.
December, January, February, March	Expected oversettlements, much work in transferring small mussels to fresh ropes.
April, May, June	Cull and sell large 1st year mussels; replace with small 2nd year mussels.

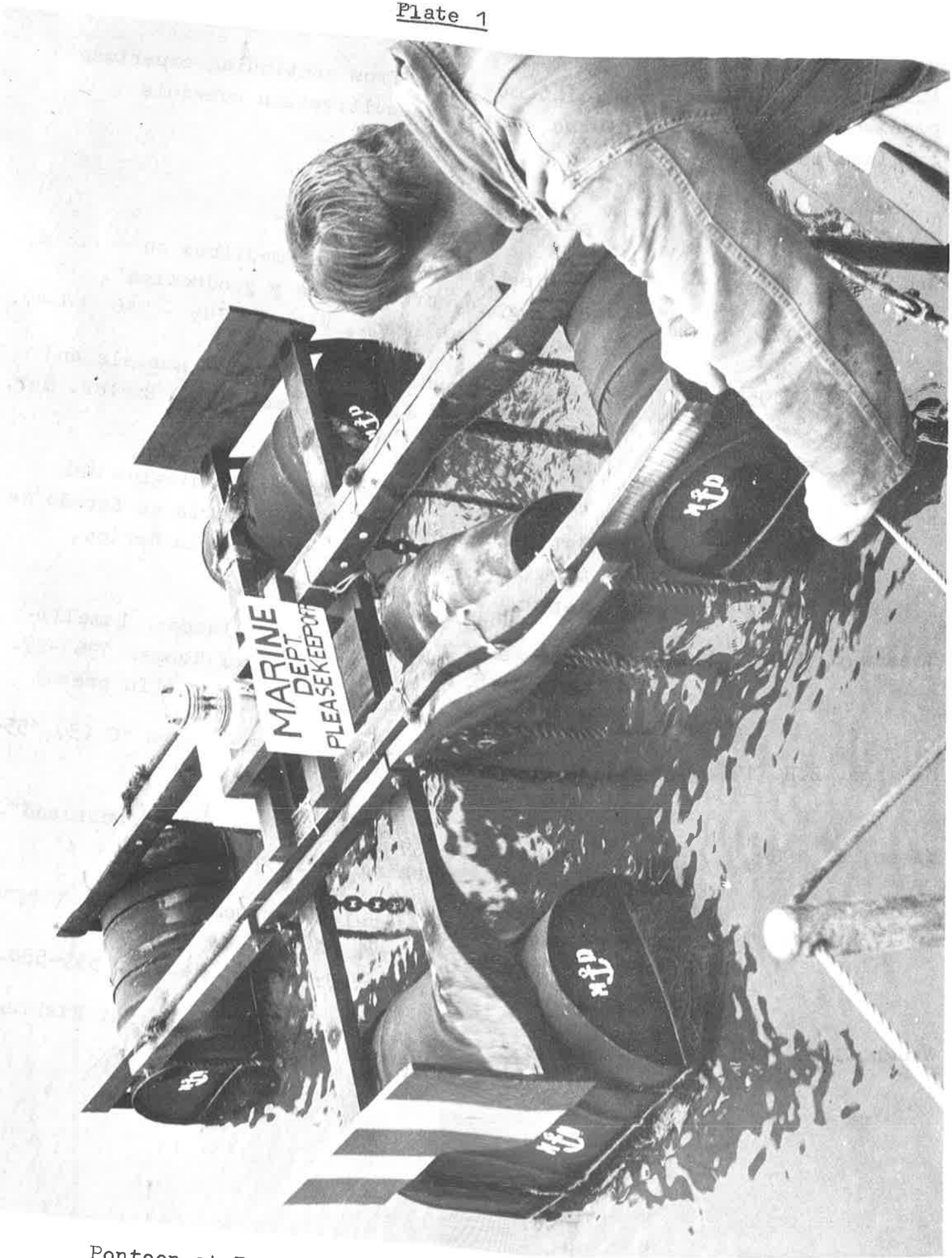
From this point on the cycle should broadly repeat itself with fully grown mussels coming to hand most of the time for sale, and fresh oversettlements taking place. The likely months for mussels to show loss of condition are October, November and possibly December.

The Te Kouma experiment produced a counted total of very nearly 6,000 mussels. About half of these were accounted for by the samples (1) - (12) in Fig. 2, and the remainder were taken on dismantling the pontoon in June 1969. The latter are represented by the sub-sample (13). Due to the variety of surfaces, differing age groups and sampling without replacement, any estimate of a total yield from this experiment could be misleading and has not been attempted.

CONCLUSION

An excellent growth potential has been demonstrated for the large green mussel. Initial settlement might be improved by seeding new ropes. There is need for frequent culling, cleaning and inspection of surfaces. This is in fact cultivation and should enhance the maintenance of a maximum growth rate. Although no calculation of yield has been possible, the results are encouraging.

Plate 1



Pontoon at Te Kouma Harbour, Coromandel.

Answers to this important point may come from continuing experiments planned along the lines of the tentative cultivation schedule outlined above.

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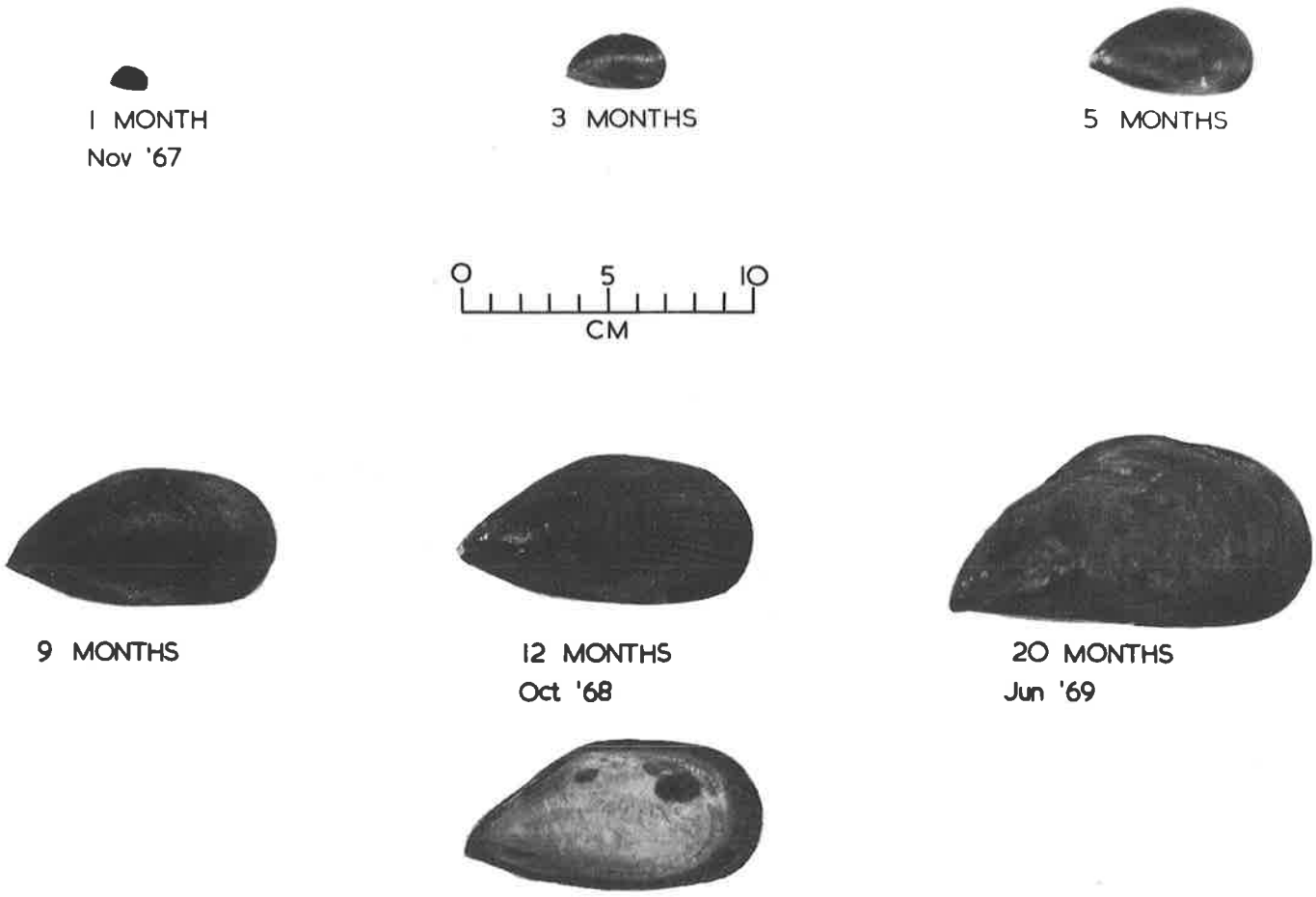
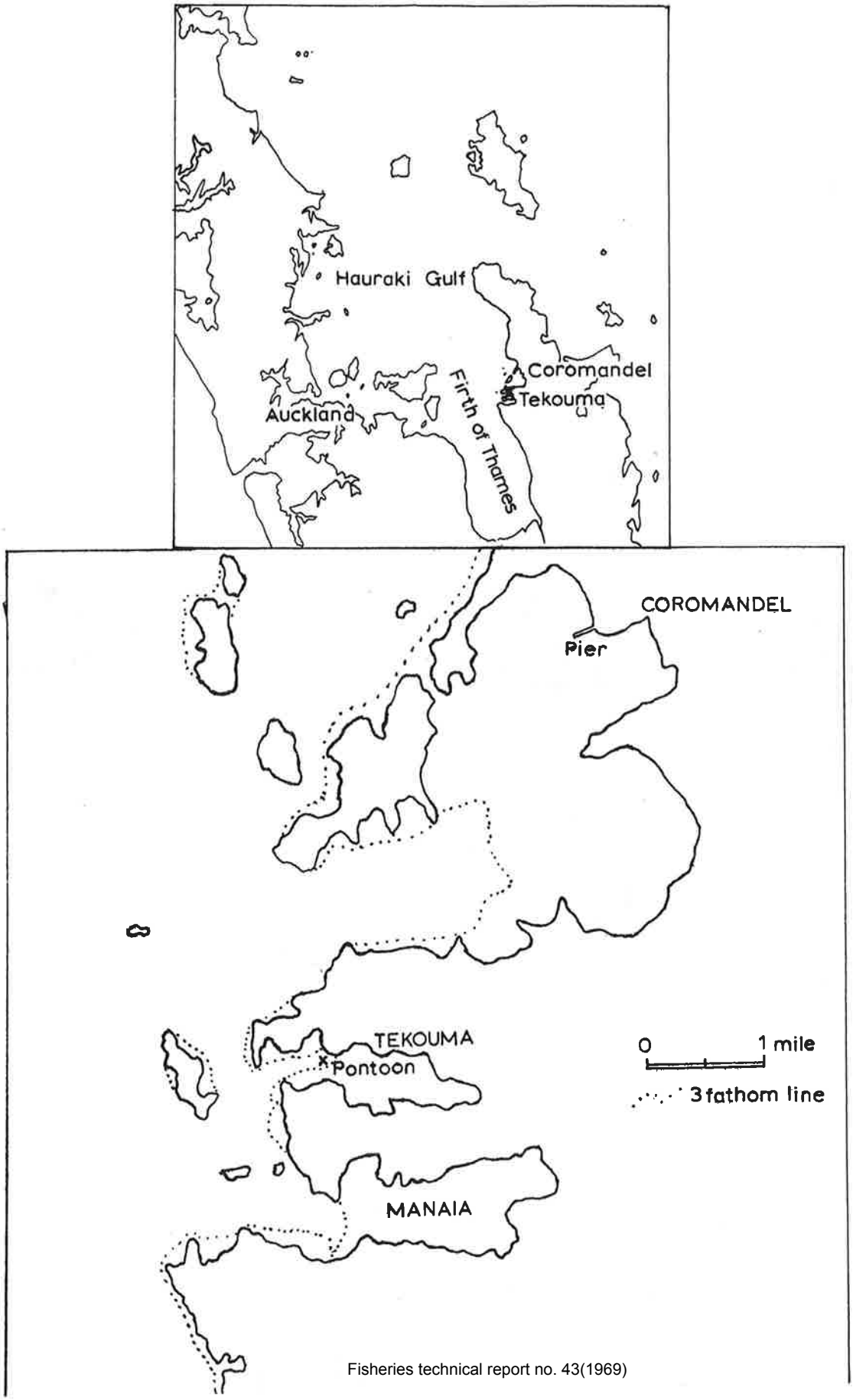
Plate 2



Representative growth of mussels from Te Kouma Harbour, Coromandel.

(Note: Bottom centre, an opened mussel showing "fat" condition, but discoloured due to preservation in formalin. When fresh it was creamy-white.)

Fig 1. LOCATION OF PONTOON.



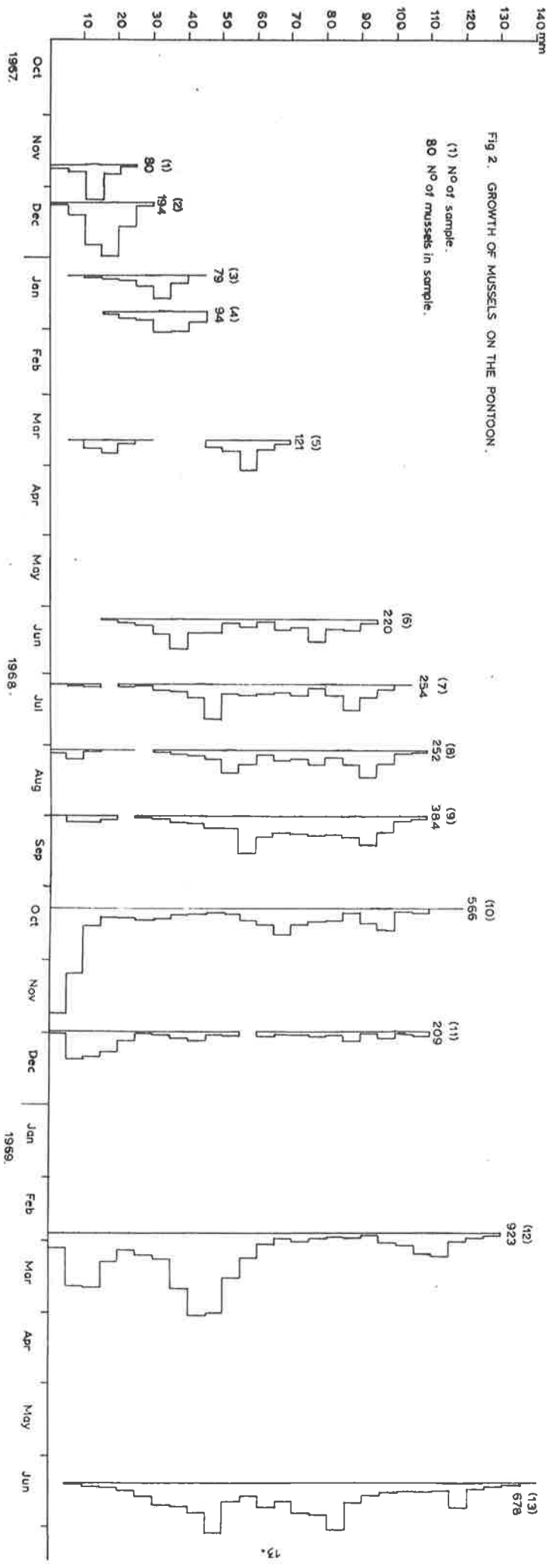
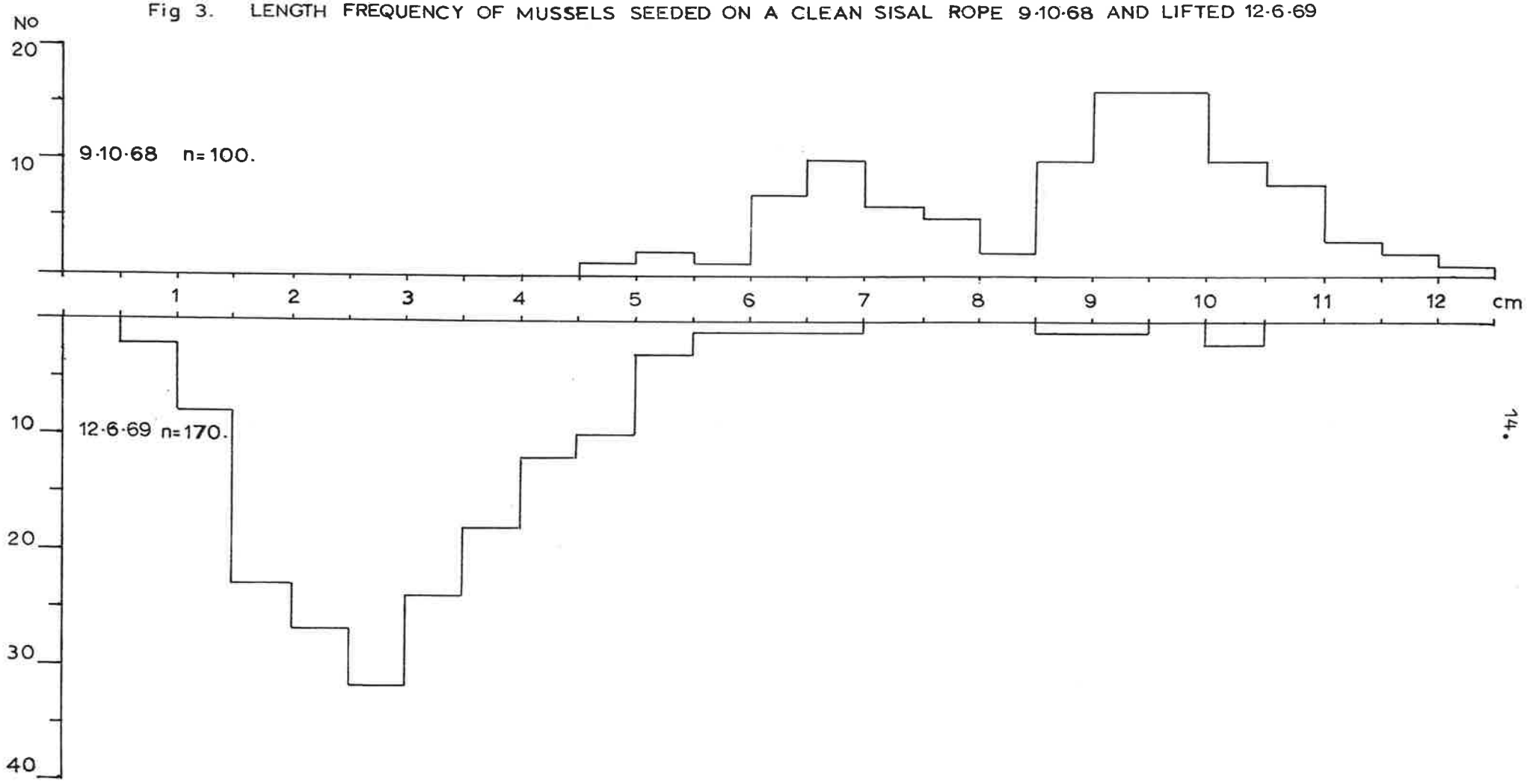


Fig 2. GROWTH OF MUSSELS ON THE PONTOON.

(1) Nº of sample.
80 Nº of mussels in sample.

Fig 3. LENGTH FREQUENCY OF MUSSELS SEEDED ON A CLEAN SISAL ROPE 9·10·68 AND LIFTED 12·6·69



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