TOHEROA PREDATION BY BLACK-BACKED GULLS ON DARGAVILLE BEACH, NORTH AUCKLAND, NEW ZEALAND

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Factors causing predation of the clam *Paphies (Mesodesma) ventricosa,* the well-known " toheroa," by Black-backed Gulls are described. Counts of Black-backed Gulls made at approximately monthly intervals along a 23 kilometre stretch of beach between January 1970 and January 1971 and in December 1972, together with further observations between 1968 and 1975 show that Black-backed Gulls are important predators of toheroa.

INTRODUCTION

The toheroa, *Paphies (Mesodesma) ventricosa,* is the largest of a group of New Zealand beach clams and provides the basis for an important amateur fishery. Gulls and other seabirds have been known for many years to be predators of these clams, (e.g. Mestayer 1921) but there is uncertainty of the importance of various species of birds and the stage of the life cycle of toheroa at which they are vulnerable to such predation.

Both Black-billed and Red-billed Gulls (*Larus bulleri* and *L. novaehollandiae scopulinus*) were often seen by Dawson (1954) feeding on small or broken tuatua *(Paphies subtriangulatum)* along the shore of Pegasus Bay. Red-billed Gulls were noted by Rapson (1954) to paddle in streams on Northland beaches for young toheroa which came to the surface, and they were found also by Street (1971) to take young toheroa washed from the sand by wave action.

Oystercatchers (*Haemotopus* spp.) have been observed feeding on tuatua (Falla 1939), and Pied Oystercatchers *(H. ostralegus finchi)* are important predators of young toheroa at Te Waewae Bay, eating both animals removed from the sand and those exposed by wave action (Street 1971).

Rapson (1954) observed that Black-backed Gulls were less common than the Red-billed Gulls and ate only toheroa left stranded on the surface or those incompletely covered. Greenway (1969) recorded a comment by E. K. Saul that at Muriwai before 1966 Black-backed Gulls *(L. dominicanus)* took only toheroa that had been left by diggers. By 1966 the whole population had learned to dig small toheroas from undisturbed beds. In 1962 Greenway saw " gulls " taking toheroa from shallow water on Ninety Mile Beach.

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Although all these birds are predators of toheroa, their effect seems limited by the small size of the bird population. Only Street (1971) considered one species (the Pied Oystercatcher, which was always present in large numbers when toheroa were on the beach) as an important predator.

During observations on the biology and distribution of toheroa on Dargaville Beach between 1970 and 1972 (Redfearn 1974), it became apparent that Black-backed Gulls were considerably more adept at eating toheroa than had previously been realised and even though their numbers were not great, gull predation was a significant cause of both juvenile and adult mortality. Systematic observations on these gulls and their feeding behaviour were therefore carried out until 1975.

Dargaville Beach is an exposed sandy beach often pounded by heavy surf, lying on a north-west - south-east axis (Fig. 1). It was visited between 1968 and 1975. Counts of gulls between January 1970 and January 1971 and in December 1972 were carried out from a stationary or slow moving vehicle, using 7 x 35 binoculars when necessary.

FACTORS CAUSING TOHEROA TO BE VULNERABLE TO PREDATION

On first settling at about 2 mm., toheroa are distributed randomly over the littoral zone. They are soon collected by the surf and carried up the beach to form a band just below the high tide mark. As the juveniles grow, they gradually move down the beach to settle near the mid-tide level. Toheroa are scattered along the beach, but often form dense aggregations known as beds. Greatest densities are found in small bays (Redfearn 1974). The largest of these bays has probably been formed by streams which flow through them. Although sorted into these bays by coastal water movement, such placement around streams probably provides the moisture necessary for toheroa to withstand adverse environmental factors which often cause high mortalities on other sections of the beach.

Toheroa change levels on the beach by using wave movement, and sometimes whole beds of toheroa emerge in advance of a wave to be carried up the beach. Such migration seems to be confined to night time when bird predators are generally absent. The frequency of the behaviour is so far unknown. Many toheroa, however, are exposed during daylight hours, for their requirement to remain superficially placed in the sand while feeding can cause them to be partly exposed or dislodged through wave action. Some with their shell margins showing on the sand surface (Fig. 2) probably float out even under small waves.

Redfearn (1974) noted that heavy vehicular traffic semi-liquifies the sand, and toheroa are floated upwards towards the sand surface,

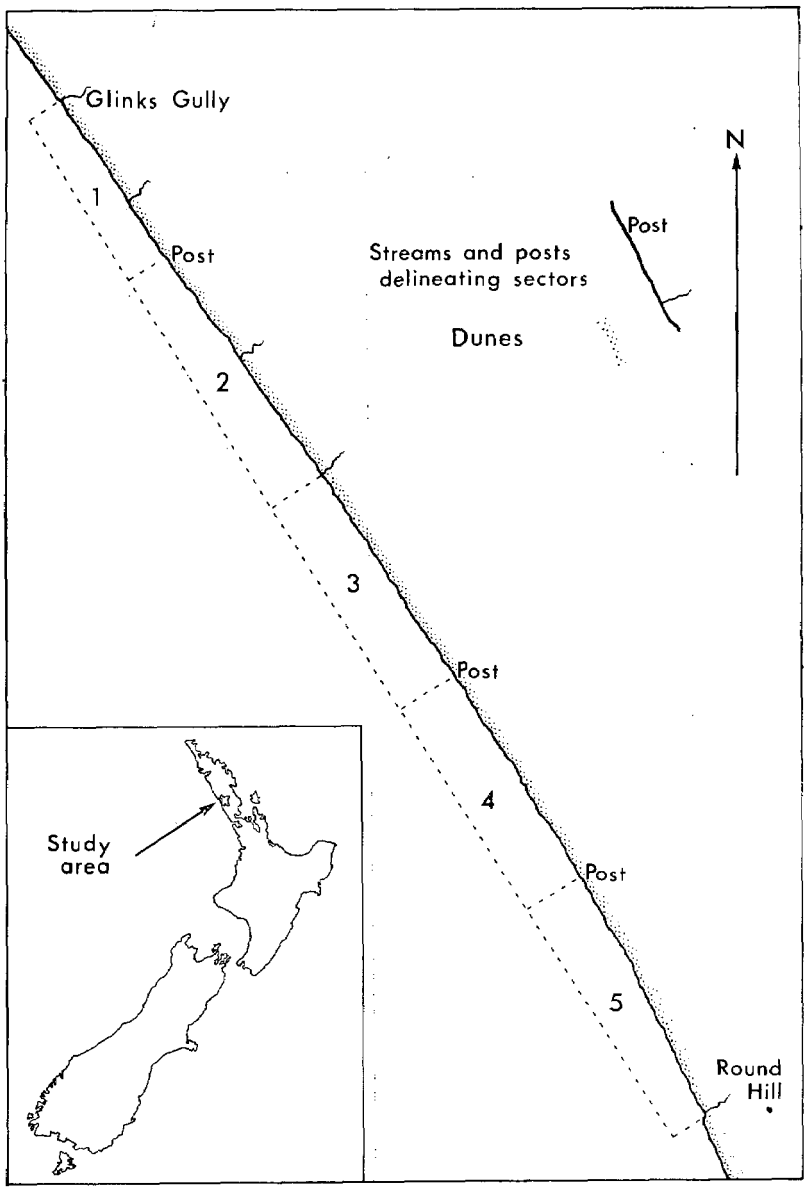

FIGURE 1 — Study area Dargaville Beach, North Island, New Zealand, showing beach sectors.

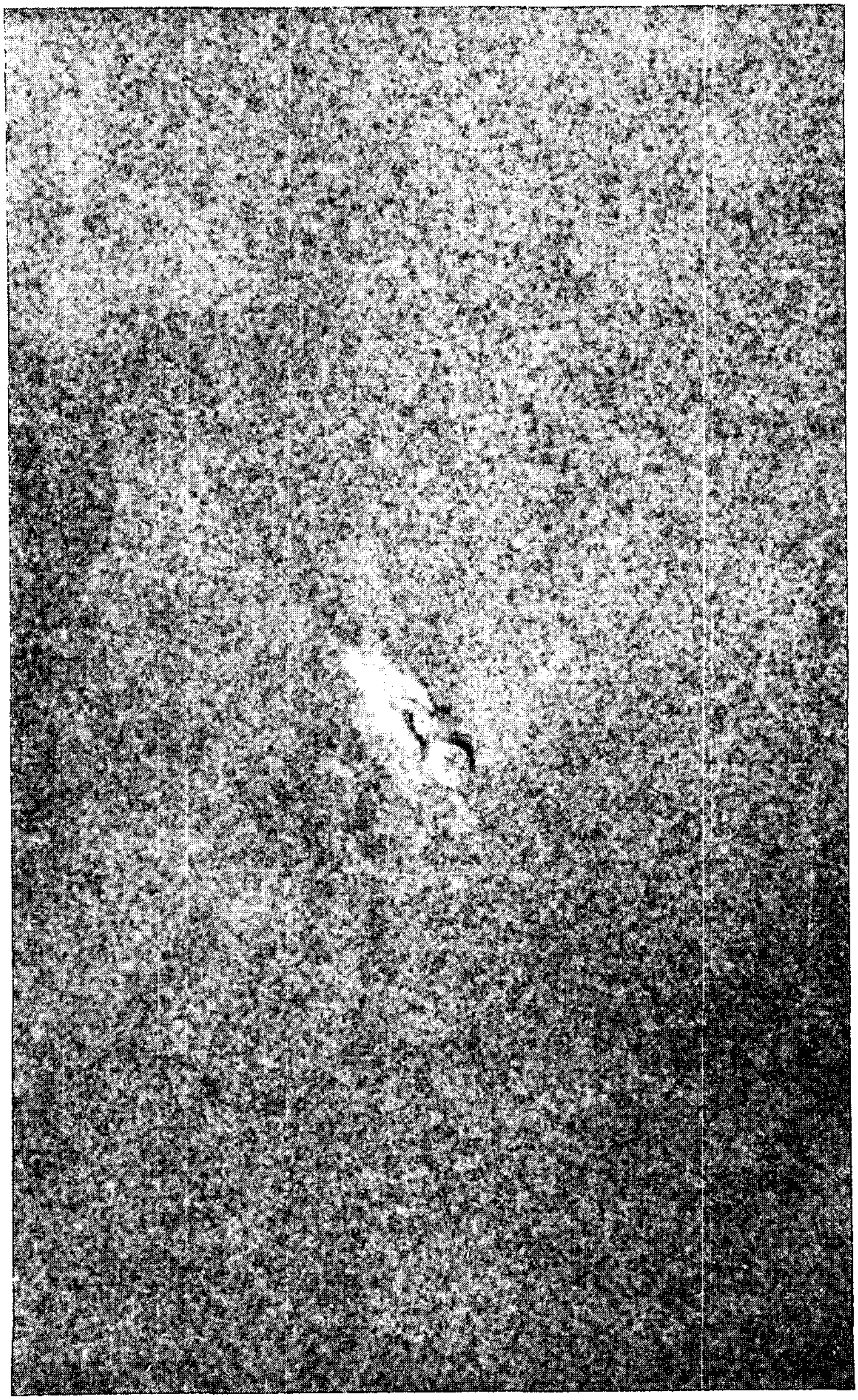

FIGURE 2 — A toheroa superficially placed in the sand and covered by water.

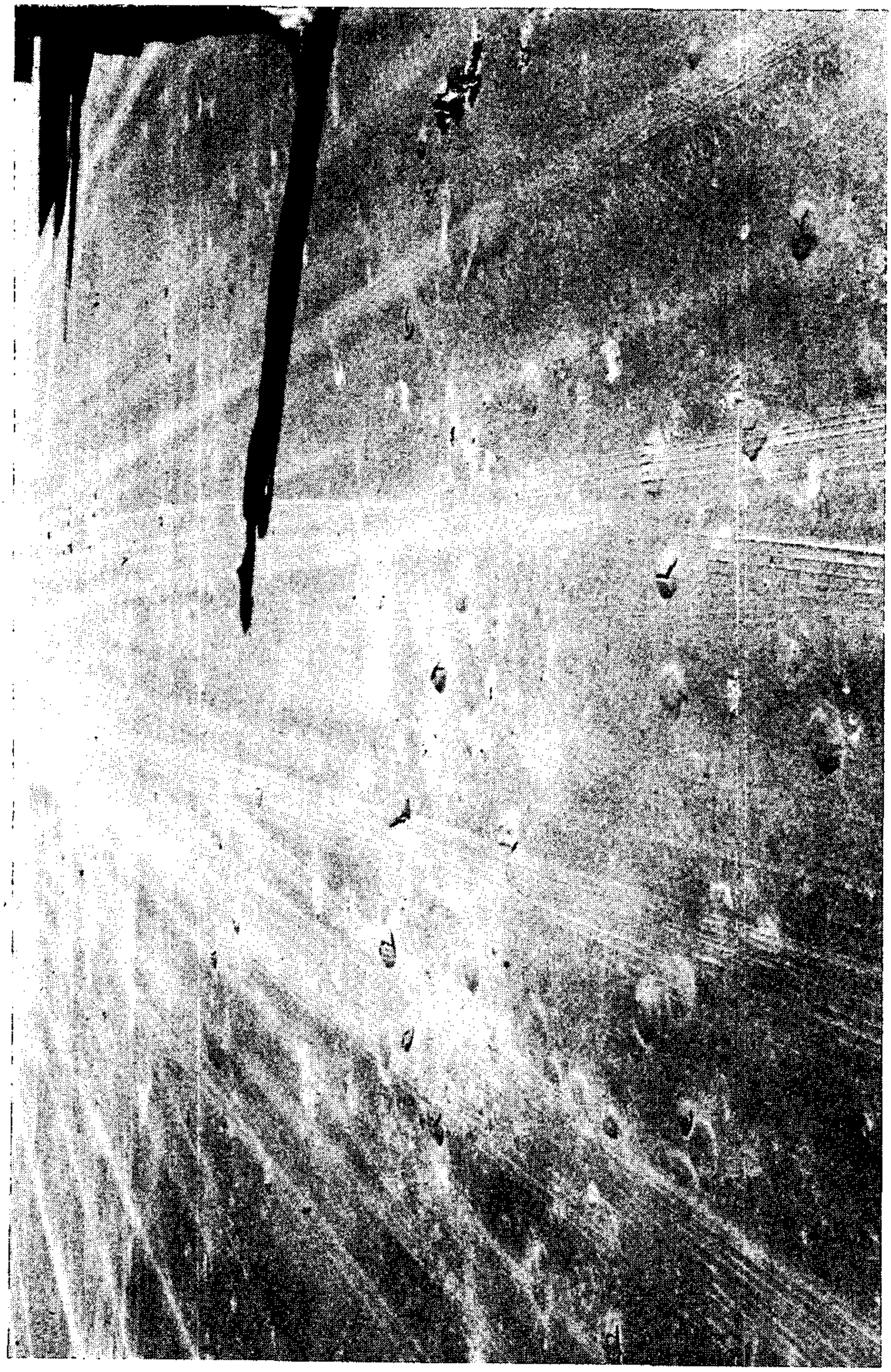

FIGURE 3 — The response that is sometimes observed when vehicular traffic passes over or near a toheroa bed.

forming a small hummock (Fig. 3). I have investigated this phenomenon further and believe that often a more complex mechanism is involved. Toheroa disturbed by the passage of a vehicle actively moved upwards. Some reached the surface quickly while others took several minutes. Toheroa could be heard moving in the sand for at least three minutes afterwards. It was noted that one pass was sufficient to cause a very notable response and that the elevation response occurred mainly during warmer months. Possibly, pressure (of the vehicle in this case, but waves normally) provides a cue which elicites the elevation response in toheroa prior to migration up the beach. Toheroa which have raised themselves in response to a stimulus (e.g. vehicular traffic, or to avoid burial during periods of rapid sand deposition) probably cannot rebury unless there is more than a certain minimum amount of water in the sand (usually when the tide again covers the bed) and so are highly vulnerable to predation.

NUMBERS AND DISTRIBUTION OF GULLS

The Black-backed Gull population was estimated at approximately monthly intervals along a 23 kilometre stretch of Dargaville Beach. To check on the distribution the beach was divided into sectors delineated by streams and permanent posts (Fig. 1). Total numbers are given for each count and the density calculated at numbers per kilometre (Table 1). Histograms of observed numbers per kilometre of each sector as against the mean value for all sectors are given in Fig. 4. It can be seen that above average values reflected a tendency for gulls to congregate near the stream draining the Glinks settlement, especially during the summer, and an increase in the numbers of gulls on the southern end of the beach during the breeding season. Black-backed Gulls were more numerous than Red-billed Gulls (compare Table 1 and Appendix Table).

METHODS USED BY GULLS TO CAPTURE AND OPEN TOHEROA

Observations showed that Black-backed Gulls obtained toheroa by:

1. Catching shellfish washed out of the sand by wave action before they could rebury.
2. Digging into and removing toheroa from hummocks after vehicles had passed over a bed.
3. Eating recently metamorphosed shellfish that had been carried up the beach by the wave front to be deposited along the high-tide line.
4. Consuming shellfish which through adverse environmental factors have been left stressed and dying, as well as those which have been excavated by people and not properly reburied.

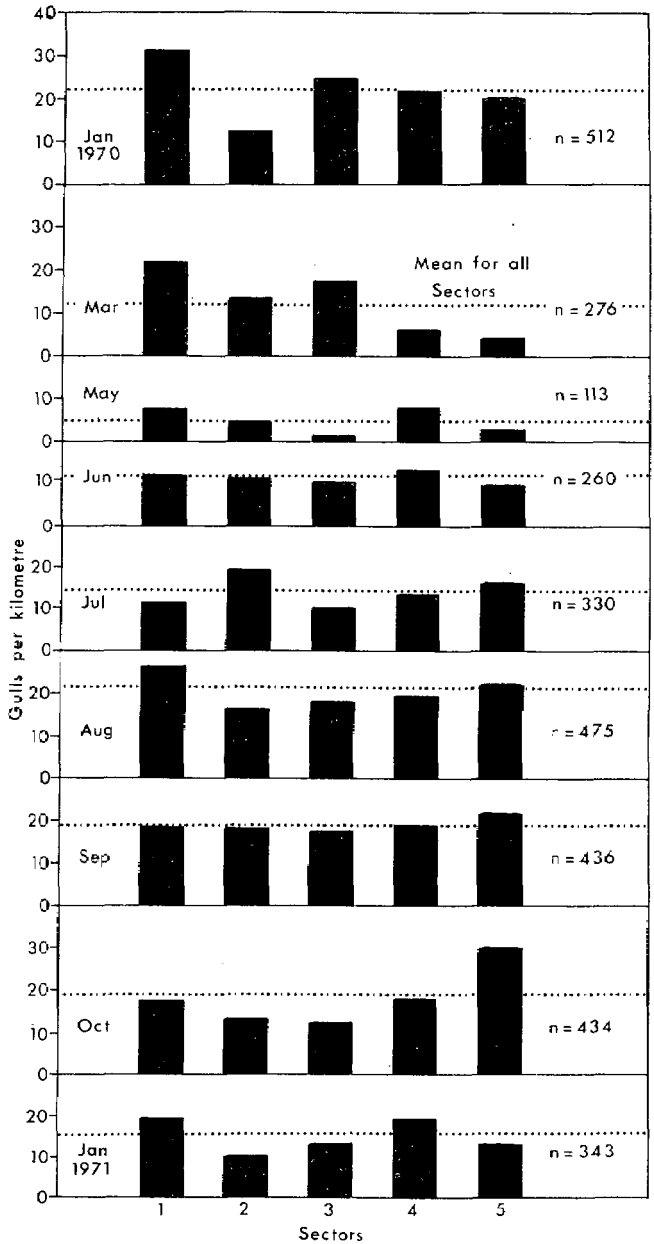

FIGURE 4 — Histograms showing the number of Gulls per kilometre for each section as compared with the mean number per kilometre for all sectors.

Month	Sector	1	2	3	4	5	Total	Mean
	Length	4.0 Km	4.0 Km	4.8 Km	4.8 Km	5.6 Km	No.	No/Km
Jan,1970		125(6)	50(2)	119(20)	105(15)	113(27)	512	
	Per Km	31	13	25	22	20		22
Mar		87(34)	54(6)	84(20)	31(2)	20(0)	276	
	Per Km	22	14	18	7	4		12
May		31(10)	19(1)	6(1)	38(11)	19(5)	113	
	Per Km	8	5	1	8	3		5
Jun		48(2)	46(1)	51(0)	63(0)	52(0)	260	
	Per Km	12	12	11	13	9		11
Jul		46(5)	78(6)	49(0)	65(2)	92(2)	330	
	Per Km	12	20	10	14	16		14
Aug		106(9)	66(2)	86(4)	94(0)	123(8)	475	
	Per Km	27	17	18	20	22		21
Sep *		74(4)	72(3)	85(0)	90(2)	115(4)	436	
	Per Km	19	18	18	19	21		19
Oct		70(10)	53(2)	60(0)	86(3)	165(6)	434	
	Per Km	18	13	13	18	30		19
Jan,1971		77(11)	41(1)	64(0)	91(0)	70(7)	343	
	Per Km	20	10	13	19	13		15
Dec,1972		-	-	-	-	-	600	

TABLE 1 — Counts and densities (No/Km) of Black-backed Gulls by sector and month on Dargaville Beach. Figures in parenthesis are numbers of immature gulls. * = mean of two counts.

5. Taking shellfish that are not visible at the surface. Twenty-four such toheroa were thus removed in 33 attempts by birds in December 1970 on a day during which no traffic had passed over the beach.
6. " Paddling " — a ' marking time ' action (Tinbergen 1953) — was sometimes observed when Black-backed or Red-billed Gulls were standing in streams, shallow seawater or the saturated zone of the beach (characterised by having a continuous water slick on its surface). On Dargaville Beach such an action causes recently settled toheroa to float out of the sand (cf. Rapson 1954).

Small toheroa were eaten whole (Fig. 5), whereas larger shellfish were carried high above the beach and dropped, two or three (up to six) times to break the shell. Once the shell was broken the gull would endeavour to shake the meat free. A snipping action (probably at the anterior and posterior adductor muscles) would finish off the meal.

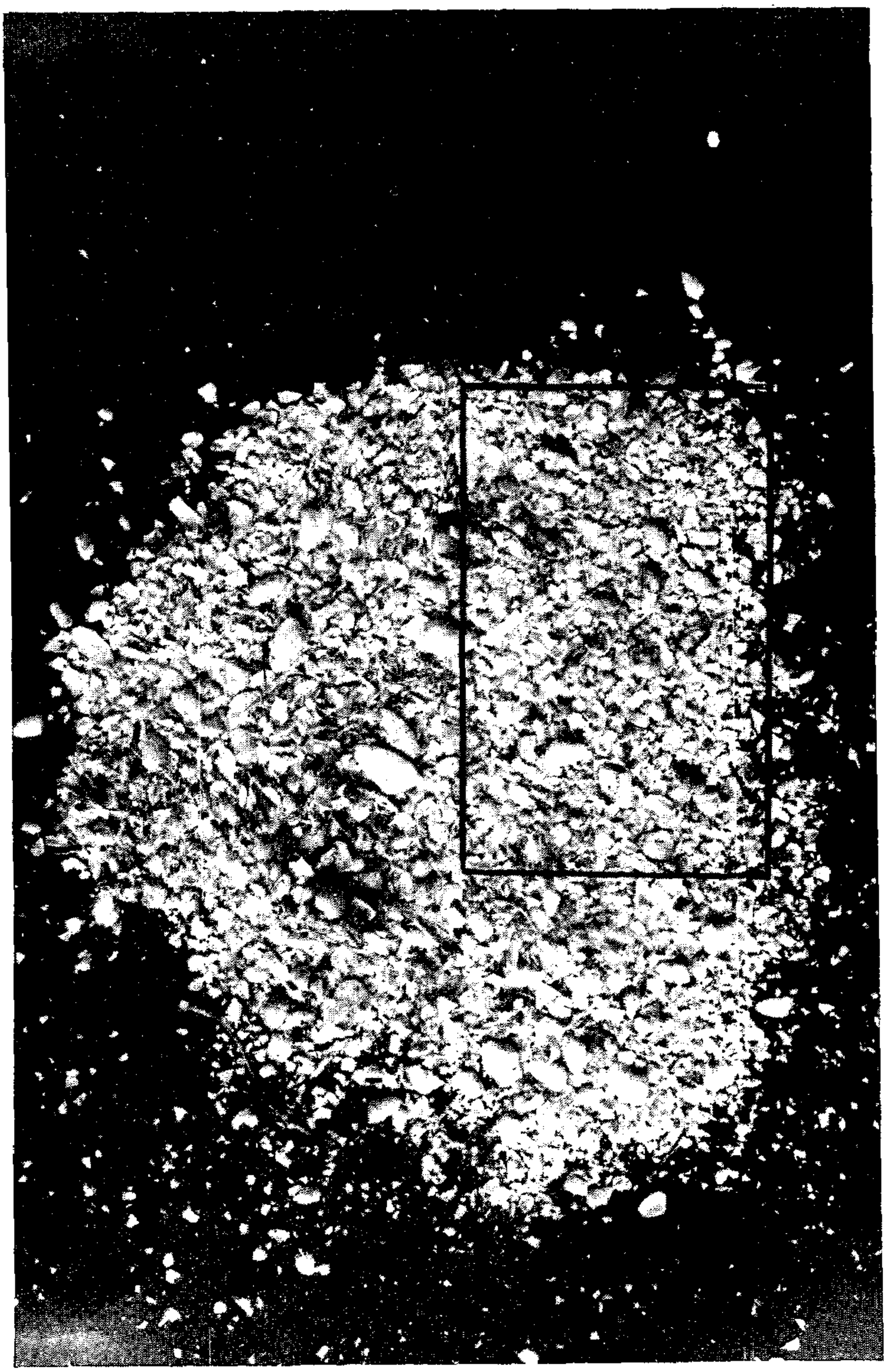

FIGURE 5 — A single Black-backed Gull regurgitation.

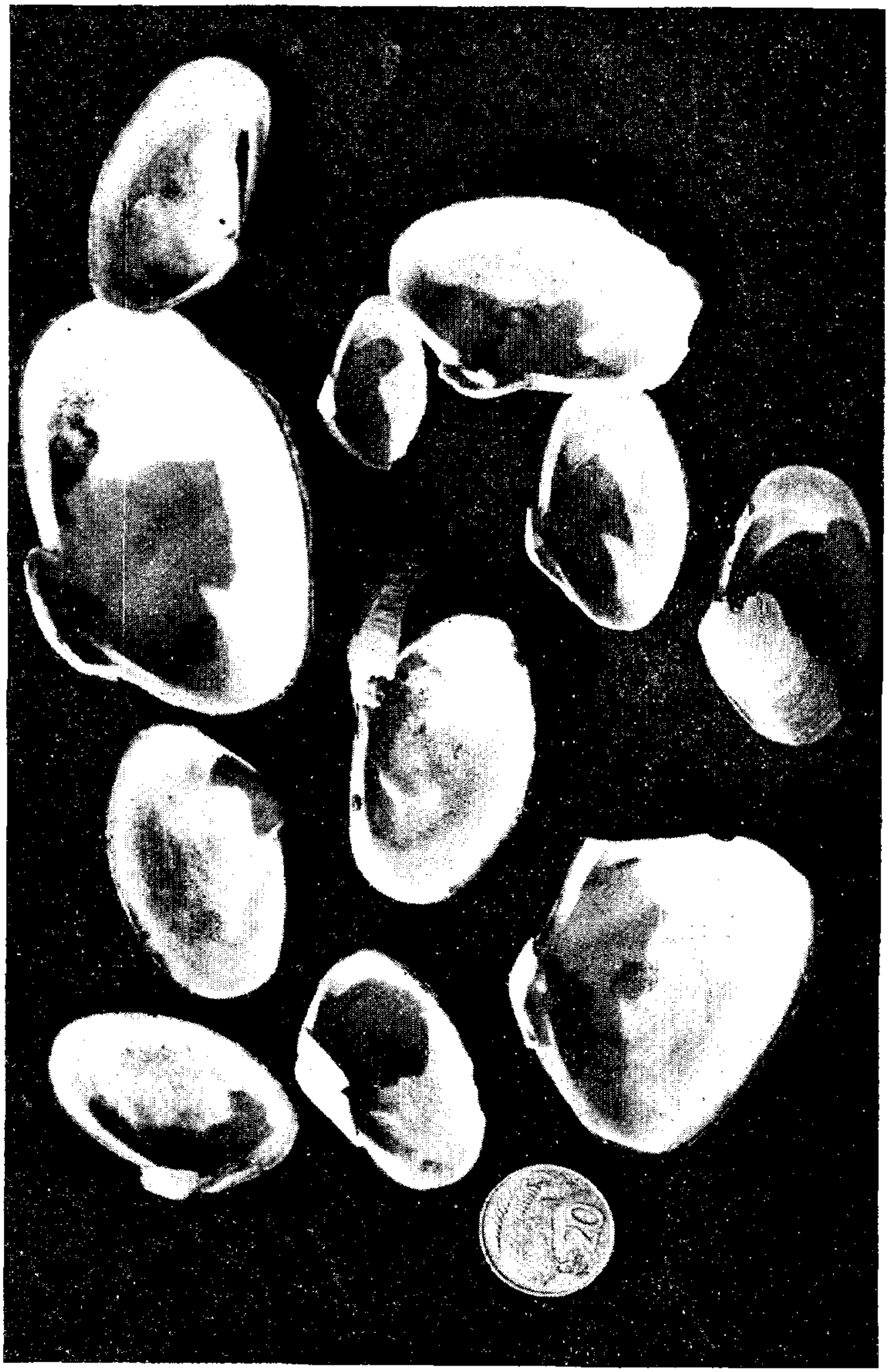

FIGURE 6 — Damage to shells resulting from predation by Black-backed Gulls.

Contrary to Rapson's observations, I found that gulls could readily carry large (120-130 mm) toheroa high enough to break them.

Most shells examined on the beach following predation revealed one fractured and one intact valve (Fig. 6). In an experiment, 20 toheroa of similar size to those being exposed by waves were removed from the substrate and thrown 3-6 m vertically. Examination of the specimens showed all had one broken valve, and in 19 the hinge piece remained attached to the undamaged valve.

To obtain further information on feeding, observations were made over a 3-day period in December 1972 at Glinks and Blackrock Streams, where large numbers of small toheroa occurred at that time.

At the Glinks Stream station, about 180 Black-backed Gulls were scattered along the beach for approximately 500 m north of the stream. Most were feeding just above the saturated zone and were lined-out parallel to the wave front. When a wave of sufficient strength to dislodge toheroa receded, they would fly out to look for shellfish exposed by the backwash. Toheroa not consumed immediately were either picked up while hovering or when the approach of another gull or a wave motivated them into doing so. Numbers of dislodged toheroa well exceeded the demands of the gulls, indicating that, at the time, a much smaller shellfish population would have been an adequate food source.

At the Blackrock Stream station, most of the gulls (of which about 80% were immature) occupied a position close to the stream enabling the whole flock of about 70 birds to be easily observed. Approximately 10% were engaged in feeding with an almost continuous procession of gulls leaving and joining the flock. From time to time, however, the entire flock flew down the beach to begin feeding or searching. During a one-hour period this was observed on four occasions, with virtually all the gulls appearing successful. One bird took 5 shellfish in 1¼ hours, and three others took 3-4 shellfish in 20-25 minutes. The gulls ate a minimum of 20 small (4-6 cm) toheroa on each day of the observations. Gulls fed on both in-coming and out-going tides but were relatively inactive when the tide was below the shellfish bed. Predation was observed throughout the study area, and over the three-day period, toheroa appeared to be the main source of food for the gulls.

Gulls feeding along the tide front may not take toheroa exclusively. In January and March 1975 they were found to be feeding primarily on tuatua. These visits coincided with very low tides when tuatua (which are found below the mean low tide mark) are more vulnerable. Toheroa (except those brought to the surface through vehicular traffic, and juveniles present in the top few millimetres of the saturated zone) were less vulnerable as the wave force was in-

sufficient to expose them. It has been suggested (Redfearn pers. comm.) that gulls on Dargaville Beach generally feed from the tide front. Changing beach and tide conditions brought about by climatic factors or traffic, along with natural changes in the toheroa population structure, would therefore present the gulls with different size groups of toheroa, or a different species altogether.

Occasionally Black-backed Gulls were seen eating other storm-cast molluscs such as *Dosinia* sp., *Mactra* sp. and *Spisula* sp.

DISCUSSION

Contrary to earlier reports, my observations show that Black-backed Gulls on Dargaville Beach have little difficulty taking all sizes of toheroa. Both immature and adult gulls were effective predators. Gull predation was evident on most visits to the beach between 1968 and 1975. During the 3-day visit in December 1972, the 600 gulls present could have consumed 36 000 4-6 cm toheroa (20 toheroa per gull per day). Surf-exposed toheroa provided the gulls with a regular source of shellfish. Meteorological records for Dargaville from 1961-70 show that winds conducive to surf conditions occurred on average about 203 days per year. Hence, in 1970 the gull population (mean number 353) could have eaten about 1.5×10^6 toheroa.

More important than the numbers eaten is the contribution to total mortality. No endemic diseases are known in toheroa, and on Dargaville Beach they are unlikely to die of old age. Specimens 7 years or older are rarely found whereas in a less exploited population in the South Island, New Zealand, 23 year old toheroa are not uncommon. Stock depletion (after human predation) is probably due to gull predation and adverse environmental conditions, the latter of which cause high summer mortalities. My observations suggest that these are not always catastrophic, but because they usually occur over short periods of time, the local effect is high. Gull predation, on the other hand, is continuous.

It seems that on Dargaville Beach, at least, predation by a moderate population of Black-backed Gulls has been found to be potentially a major cause of mortality. The seriousness of gull predation should, therefore, not be underestimated.

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Month	Sector Length	1 4 Km	2 4 Km	3 4.8 Km	4 4.8 Km	5 5.6 Km	Total No.	Mean No/Km
Jan,1970		121	84	103	79	59	446	19.8
Mar		133	136	190	73	80	612	27.2
May		48	39	38	37	1	163	7.2
Jun		34	23	19	25	5	106	4.7
Jul		27	50	36	55	10	178	7.9
Aug		30	51	33	45	6	165	7.3
Sep		* 3	*30	*22	*23	*22	*89	4.0
Oct		-	-	-	-	-	-	-
Jan,1971		20	7	20	19	28	94	4.2
Jan,1970		-	-	-	7	14	21	-
Mar		-	-	-	1	6	7	-
May		-	-	-	-	-	-	-
Jun		-	-	-	-	-	-	-
Jul		-	-	-	2	6	8	-
Aug		-	-	-	2	14	16	-
Sep		-	-	-	-	*13	13	-
Oct		-	-	-	2	2	4	-
Jan,1971		-	-	-	3	3	6	-

APPENDIX TABLE — Numbers of Red-billed Gulls and Oystercatchers, Dargaville Beach, January 1970 - January 1971.
* = mean of two counts; - = 0.

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