HORUHORU REVISITED
Longevity of the Australian Gannet

By PETER STEIN

EVIDENCE OF THE LONGEVITY OF THE AUSTRALIAN GANNET

On 31 December 1970 an adult gannet was trapped on Horuhoru close to where it had been banded on 20 February 1954. It had been hatched on 19 December 1953, and was therefore slightly over 17 years and one week old.

Here we describe the work undertaken in banding chicks on the islands in the Hauraki Gulf, to find where they go while developing from juvenile to adult plumage, and when and where they return to breed.

In the Hauraki Gulf there are four main areas in which Gannets *Sula bassana serrator* breed. In the far north is Mahuki, a small island off the west coast of the Great Barrier, just over four miles to the south of Wellington Head. The 1946 Gannet Census figures was 325 breeding pairs, but in six visits in the peak of the season, we have twice counted over a thousand and only once less than 900.

Off the Coromandel Coast there are two large groups, one at Motu Karamarama (Bush Island) about three miles to the west of Amodeo Bay, and another one mile further west at Motu Takupu. We think that this is the oldest of all the rookeries in the Gulf. A mile to the north is a tiny colony at the western end of Motuwi Stack (Double Island). On two visits in the middle fifties, we found 24 nests in a confined space with no room for expansion, but when passing on a visit in 1968, we found they had started to build along the south coast too. In the 1949 Census the figure for Motu Karamarama is given as 1513 and Motu Takupu 288. In 1954 we found 2500 at the former and 650 at the latter. Two years later we counted 960 at Motu Takupu.

Last, off the north-east point on Waiheke we have Horuhoru. The Census figure was 1228: on 5/11/49 there were 1503 and on 22/11/58 there were 1573 pairs breeding.

From very early times ornithologists in New Zealand have known that there were gannets on Horuhoru, but up to 1930 they had not been studied in any detail. Although I knew of the rookery earlier, I did not land there until 1919, and another four years went by before I made even a rough estimate of the number of nests on the Terraces, and arrived at some conclusions that later proved to be inaccurate. In the course of the 1946-1947 Gannet Census* several parties counted the nests occupied by egg or chick, but their figures for different dates were so conflicting (1228 in October dwindled to 157 in December) that Dr. Wodzicki at Cape Kidnappers and I in the Hauraki Gulf were asked to make regular visits over a period, and to obtain accurate figures on each trip.

HORUHORU DESCRIBED

When we started our study, the gannets were in six distinct groups separated by rocky outcrops and patches of taupata. At the northern end there is a reef terminating in a mass of bare rock called North Stack. The gannets here are quite close to the sea, and suffer

* Contributors to the Gannet Census visited Horuhoru on seven occasions; in 1946 Oct 2nd Fleming, Dec 1st Cunningham, 29th Clark & Roberts, 1947 Clark & Roberts again, 1948 May 6th Johnson, Dec 12th McKenzie, and 1949 Jan 21st Stein. (See Notornis 2.5: 109-113; 2.7: 152 & 153; 3.2: 42; 3.6: 159 & 3.7: 238.)

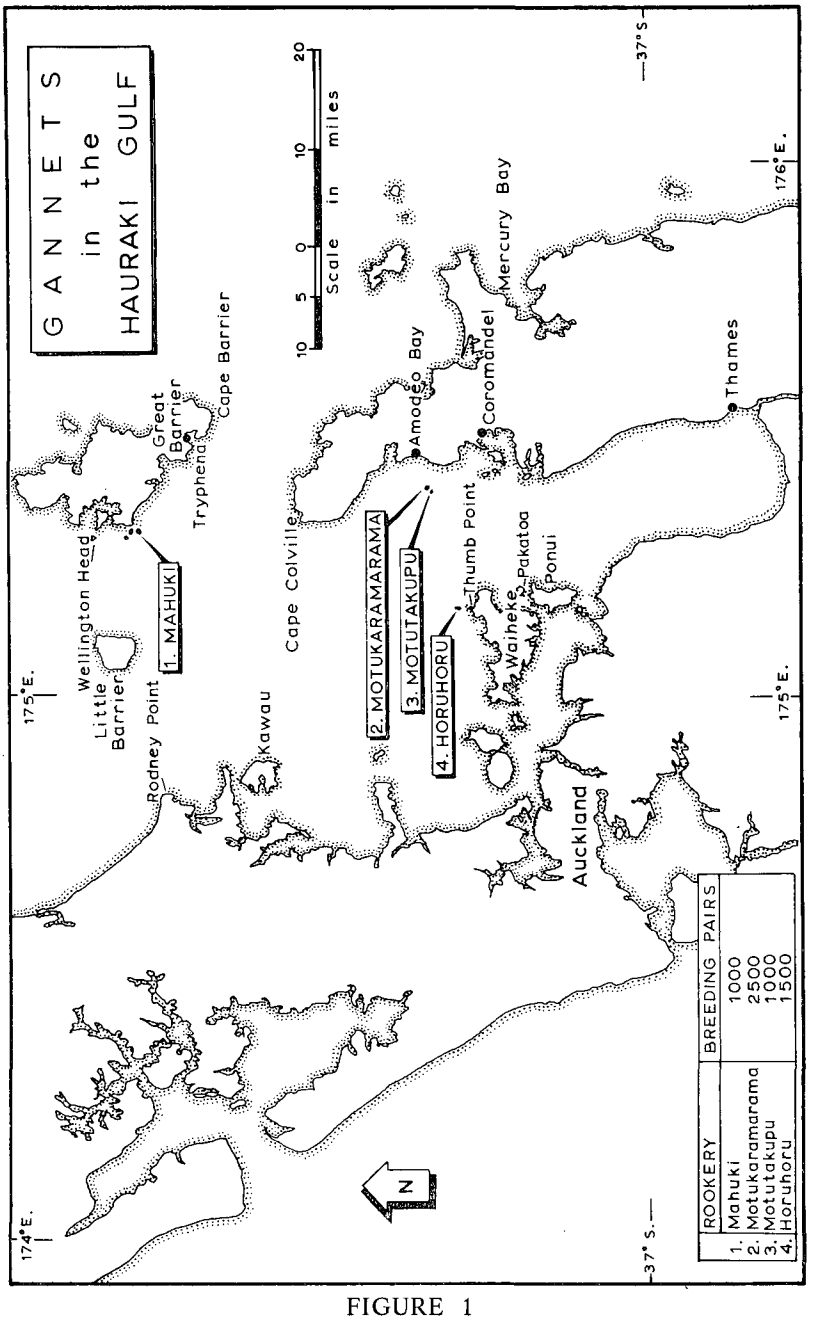

GANNETS
in the
HAURAKI GULF
Scale in miles
10 5 0 10 20
1. MAHUKI
2. MOTUKARAMARAMA
3. MOTUTAKUPU
4. HORUHORU
Great Barrier
Cape Barrier
Tryphena
Wellington Head
Little Barrier
Rodney Point
Kawau
Cape Colville
Amodeo Bay
Coromandel
Mercury Bay
Thames
Thumb Point
Waiheke
Pakatoa
Ponui
Auckland
174°E.
175°E.
176°E.
37° S.
N
ROOKERY | BREEDING PAIRS
1. Mahuki | 1000
2. Motukaramarama | 2500
3. Motutakupu | 1000
4. Horuhoru | 1500

FIGURE 1

from spray in the frequent north-east gales. The remainder of the island is a long narrow ridge rising to a height of about 25 metres. In all but one short section sheer cliffs fall to sea level. Two vigorous growths of taupata divide the summit into three main areas. The two outer divisions are called North Ridge and South Ridge. The middle one is the most extensive. Its eastern side falls straight down to the sea, but on the west there are many shelves and ledges, which dscend gradually to a wave platform where we have an extensive landing place. We call this part of the rookery The Terraces. They contain over 700 nests and by climbing up through them, we have comparatively easy access to the summit of the ridge. To reach the areas lying north and south, we must scramble through the two stands of taupata. The northern stretch is only shoulder high, but the one to the south contains many old gnarled trees up to two metres high. North Stack has 300 nests, and North Ridge and South Ridge have 200 each. North Ridge has a fairly level section on which we have done our best work. On its northern boundary there is another patch of taupata, some of which is only breast high. In it are two small clearings at cliff edge. They, too, have been very important in our study. Between them they have over fifty nests so that in all, we have on Horuhoru fifteen hundred pairs of breeding gannets.

DIVIDED INTO SECTIONS

For his count Fleming had divided the six groups of Gannets into 16 sections, in some cases lettering them (from A to L), and in all but one, he had less than seventy nests. On the Terraces, however, because of the lack of prominent outcrops of rock or ledges, he had 400 nests in his section F. This made accurate counting almost impossible, and forced him to make estimates there. In an attempt to make our maximum 60 or 70 we decided to use the whole alphabet. Starting at the landing place below the Terraces as he had done, we moved up in steps through his first three sections A, B and C until we came to an abrupt drop of ten metres down to sea level again. Turning inland to the east, we climbed up through three more shelves to reach section G at the summit. The rest of the Terraces now lay to the south of us.

We used two faint ridges running north and south to make eight more areas from H to O. On 5th November, when there were over 700 nests here, we found this very difficult, so that on the next visit three weeks later, we came prepared with several long lengths of thin rope. To each end of these we tied a fair sized rock weighing about ten Kg. We lowered these over the cliffs to east and west, so that the lengths of rope were tight and close to the ground. We used these divisions for another four counts, but returning on 14th January after a dry spell, we found that the ropes had become so loose that two chicks had become hopelessly tangled up; we removed the ropes and from then on had to count IJK and MNO together. At the southern end of the Terraces there is a narrow space, and the remaining nests run up into the taupata. This is our area P and Fleming's G. It has many flat rocks under which there is a colony of geckos *(Haplodactylus pacificus)* and many of the earwigs *(Anisolates littorea)* mentioned by Dayton Stoner in the account of the Fiji - New Zealand Expedition.*

* Iowa University Studies in Natural History Vol. X, No. 5, p. 279.

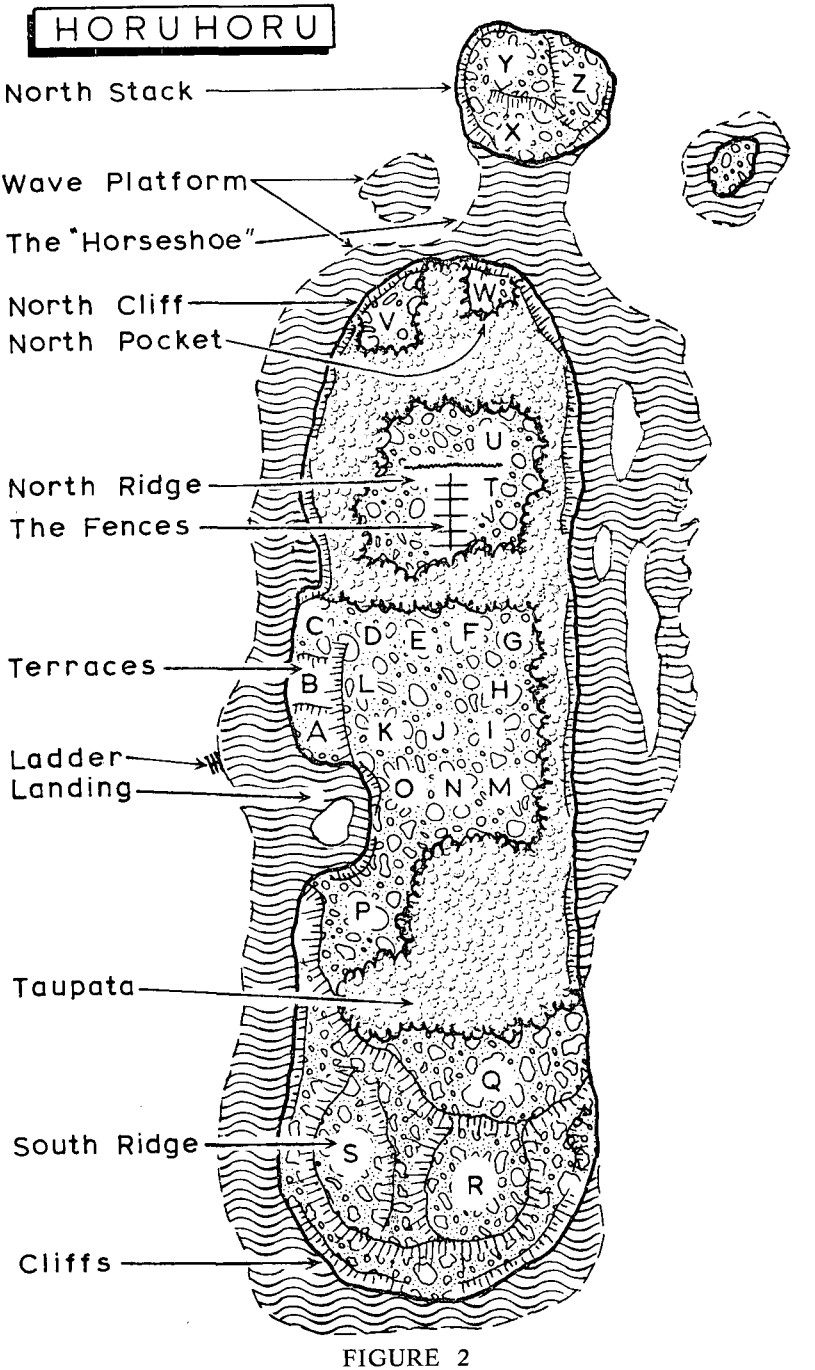

HORUHORU
North Stack
Wave Platform
The "Horseshoe"
North Cliff
North Pocket
North Ridge
The Fences
Terraces
Ladder
Landing
Taupata
South Ridge
Cliffs
Y
Z
X
W
V
U
T
C
D
E
F
G
B
L
H
A
K
J
I
O
N
M
P
Q
S
R

FIGURE 2

[R. F. Attwell

FIGURE 3 — Horuhoru: Gannets on South Ridge

From P we climbed up through the extensive grove of taupata again to the summit, and then south until we could see the whole of South Ridge with areas Q, R and S. Q is a triangular section with its base against the taupata. It slopes down to its apex where it meets the final rocky spine R. There is a small ledge below it on the east, and a much more extensive one S to the west. A sudden drop of over two metres, gives this western area great protection from all the easterly gales which are so frequent in the spring. The whole

of this area is shown in Fig. 3. When R. F. Attwell took the photograph, he was standing on the rocky knob at the southern end of Horuhoru. In the background the extensive grove of taupata to the south of the Terraces is shown forming an effective shield for the whole of Q, sheltering it from the north-east gales which sweep down from Cape Colville seen in the right distance. As I make my way back to the Terraces, I am facing Area Q. The gannet above me, preparing to land, and those close to my feet, are going about their usual duties without taking any notice of my passage.

The group behind me is R on the exposed part of the Ridge, and the nests here are buffeted by both north-east and south-east gales. These were the areas H and I in Fleming's count. Down to the left in complete safety is our area S, sheltered from all easterly weather by the sudden drop of over two metres. This area is ideal for detailed observation, and it was by working here that we first arrived at the "Gannet Rule for Tail Feather Growth." It will be mentioned again when mortality it discussed. Throughout the past twenty years, the nests here have varied from 28 to 32; there were 31 in Fleming's area K and on 25/9/71 there were 29.

We had now to retrace our steps through the taupata, and along the summit of the Terraces to area G. From there we had only a short distance to go, before the whole extent of North Ridge lay before us. First came a fairly level section, and then a slight slope down to the final patch of taupata. So far our areas had contained not more than 70 nests. But here there was a group of over 200, without any marked features to divide it up. There were many loose rocks lying about, so we collected these and made a low wall from east to west, to divide the level area from the slope; the southern part was T and the northern U.

Area T was the highest and most level on the island, so that in 1951, when we started to ring the chicks, we chose it for the work, and sub-divided it by using 6 x 1 timber on edge. Wherever possible we dug shallow trenches and half-buried the boards, so that the little "fences" formed would stand up to the trampling of the gannets, *without upsetting their nesting to any great extent.* As it turned out, we found the birds welcomed the fences for they built close alongside, getting a little shelter from them.

Area T is about 20 metres from north to south and some eight metres wide. We ran a dividing fence down the middle, and then several from east to west, so that we finished up with five pairs of compartments about three metres square. The most southerly pair we called Ta, then came Tb, Tc, Td and Te followed by the wall and beyond it the open area U. We made some small fences there, too. Later on, when we were tracing the movements of pairs of birds from year to year, we defined the position of a particular nest by using co-ordinates. A nest in the right hand compartment of Tc, three feet to the east and then four feet north would be Tc 3.4. and in the left hand compartment, five to the west and then six north would be Tc –5.6.

At the northern boundary of U there was a very light growth of taupata, containing the two small clearings which became V and W. V overhanging the sea at the north-west tip we called North Cliff, and W just above North Stack, became North Pocket. Twenty metres below was the reef running out to North Stack with areas

X, Y and Z. These were on the large size; 300 nests in all. Very soon we learned to refer to any area without chance of misunderstanding.

MORTALITY 1949 - 1950

In the 1949 - 1950 season we made sixteen visits to Horuhoru: on June 4, Aug 4 & 27, Nov 5 & 19, Dec 10, 14 and 31, Jan 7, 14, 18, 21 &29, Feb 18, Mar 25 and on April 8th. From 5 Nov onward we recorded adults, nests, eggs, and chicks in each of the sections A to Z. Table I gives a summary of the totals, but the individual records for each lettered section, have been filed for reference should they be required.

At the left of the table is the number of adults present on each occasion, and before the eggs began to arrive, the number of empty nests is given. These are of interest to the reader, but they were not needed for our main problem: Mortality.

Before the November gales, the percentage dying per week was nearly 5. Then up to the first week in December it doubled

TABLE I

			1 + 2 = 3			4	5	6	7
Adults	Empty nests	Date	Nests with egg	Nests with chick	Breeding pairs	X by 2	Percentage remaining	Percentage decrease	Weekly decrease
8		Jun 4							
1079	808	Aug 4	5		813				
929	706	27	174		880				
1444	6	Nov 5	657	840	1503	3000	100		
1363	2	19	350	1002	1354	2708	90.3	9.7 in 2	4.9
1274		Dec 10	91	822	913	1826	60.9	29.4 in 3	9.8
758		24	18	718	736	1472	49.1	11.8 in 2	5.9
469		31	10	668	678	1356	45.2	3.9	3.9
535		Jan 7	8	658	666	1332	44.4	.8	.8
675		14	1	626	627	1254	41.8	2.6	2.6*
259		18	2	589	591	1182			
68		21	1	572	573	1146	38.2	3.6	3.6*
24		29		499	499	998	33.3	4.9	4.9*
232	5	Feb 18	1	295	301	602	20.1	13.2 in 3	4.4*
138		Mar 25		6	6	12	.4		
14		Apr 8		4	4	8	.3	* Birds departing	

Col 1 + 2 = 3

Col 4 is double 3

To get Col 5 divide Col 4 by 30. This is the percentage of chicks on the island taking 5th November's figure as 100%

To get the percentage decrease between visits in column 6, subtract the number in Col 5 from the one immediately above it. For Nov 19th "9.7 in 2" means 9.7% decrease in the 2 weeks between visits

Divide the decrease in column 6 by the No. of weeks between visits to get Col 7 the "Weekly Decrease."

falling back then to 5.9 before Christmas, and finishing the year at 3.9. The first week in January was beautifully fine and only 12 birds disappeared. In spite of this good weather in the next week it increased again to 2.6%, i.e. 39 birds disappeared in the week.

On 14/1/50 two observers on North Ridge* heard a sudden beat of wings behind them, and a juvenile gannet on its first flight went by, flying unsteadily at about 20 metres above the waves. As it sank towards the water, it beat its wings more frantically and rose a little. And so it went on towards the north-west, until it finally disappeared. The decrease in population on the island was no longer caused by death alone. Some of the full-grown young had started to fly away. We did not know where they were flying to until the next year. During the weeks that followed, more flew away until nearly 5% were going each week. Over 4% a week continued until the middle of February when 300 remained. In another five weeks, all but 12 had gone. Something like 600 flew away in the 12 weeks since their start in January. Nearly all we observed flew towards the north-west; we saw only four that did not. Most of them crash-landed on the water well within a mile of Horuhoru, and failed to rise again. They paddled and flapped along until they were out of sight. We observed this same direction at other rookeries. A case at Motu Takupu is given in Appendix K.

This high mortality rate convinced us that we had experienced a bad season. We had much to learn however. The next two seasons were much worse. Table II will show that about 250 in 1950 - 1951 matured enough to depart, and in Tables III and IV we shall see that only 208 lived to depart and that we were able to band 198 of them.

INCUBATION OF THE EGG

Our main object in the second season was to determine the incubation period for gannet eggs. In Table II columns 1 + 2 are used again to give the number of pairs breeding, but most of the righthand space explains the progress of the egg project. In the 1949 - 1950 season we had seen that the eggs took something over six weeks to incubate. We chose dates in the August Holidays, Aug 24, 25, 26, 31 and Sept 1 and planned to return on October 7 and 14. The first three dates would give periods of 44, 43, and 42 days to Oct 7 and the final two, 44 and 43 to Oct 14.

Our method was to paint a vivid band of gentian violet right round all the eggs one afternoon, and returning early the following morning, we numbered carefully and recorded the positions of all the unmarked eggs, as having been laid overnight. We had been told that the stain would not injure the chicks, and the number of blue eggshells found later beside perfect chicks, reassured us on this point.

By examining Table II we see that after a rough day in June we landed successfully in July, and first saw eggs on 12/8/50. From our visits during the August holidays, we found and marked 9 eggs whose laying dates we knew, and a week later another 9. By 16/9/50 we knew that we must land to transfer our egg-marks to

* Notornis 5.2: p. 42

TABLE II

	1	+ 2	= 3	
1950	Eggs	Chicks	Adult pairs	
June 30				Too rough to land
Jul 22				Adults 126 Empty nests 113
Aug 12	6		560	515 554
24	38			
25	40			2 eggs laid overnight were marked
26	47			7 eggs laid overnight: 9 marked now
31	107			During this 5 days 62 eggs were laid and 2 broken 47 + 62 = 109 - 2 = 107
Sep 1	116			9 more laid overnight: 18 eggs now marked
16	365			Very rough: one hour required to moor ship and land *
Oct 7	899	21	920	Eggs of Aug 24th hatched: 25th some hatching
14	933	52	985	9 six-day-old chicks: eggs from 31st hatching
21	844	102	946	
22	840	105	945	one lost overnight
1951				November - December awful!
Jan 16	0	255	255	Started banding a few for practice
28		208	208	Good weather: 47 departed in 12 days
Mar 28		1	1	Only one lone chick remained. A very poor season.

* Marks had to be transferred from eggs to sites as eggs would be broken in hatching.

nest-marks, for when the eggs hatched, we would lose the numbers marked on the shell. We arranged October landings on the 7th and 14th so that the intervals between our finding the egg's laying date, and our seeing it hatch, varied (as we saw before) from 42 to 44 days. Our findings were that an egg took 43 days or a little more, not 44, to hatch. Eggs that had not hatched by the 44th day were infertile or contained a perfect chick that failed to cut a ring round its shell sufficiently deep to allow it to force its way out.

We also ringed a few chicks to see how best to catch them and fix the rings. It was not until the third year that we made a catcher that gave us complete satisfaction. We started with a crooked stick which we placed round the bird's neck, and forced it down firmly to the ground without hurting it, until another operator picked it up. Holding a bird was easy once you cornered it. A gloved hand holding the beak, and the other hand one wing, kept the chick absolutely still. The wings move in unison, up and down together; when one is held firmly the other remains free but motionless.

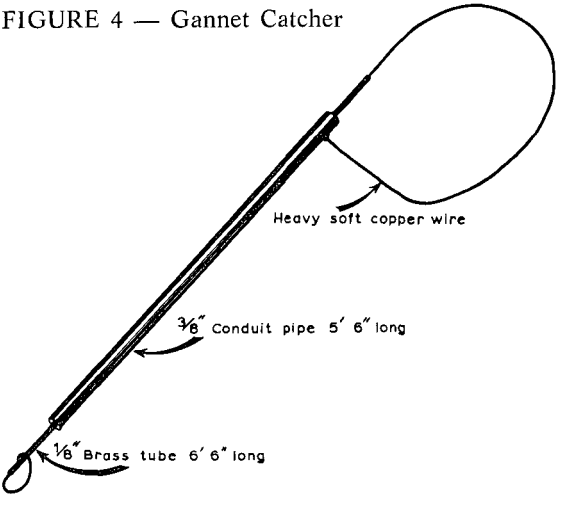
After the crook came a fixed look of wire at the end of a pole. Sometimes it worked, but if a bird was a bit thin and put its two feet on the wire, it swung like a parrot on its swing.

Finally we made a loop that could be made bigger or smaller by running a thick soft copper wire up a tube, fixing it at one end, and having a free end at the other. As the free end was pushed into the tube, the loop at the other end became larger. As it was

pulled out again, the loop became smaller. If the loose loop was put over the gannet's head, down its neck, and back along its body until it came against its legs, tightening the wire pulled the wings together, close to the body, and it was held firmly but without pain.

After a few pushings in and out, the wire tended to buckle in the tube, and its efficiency was much reduced. Finally we ran a No. 7 copper wire through a $\frac{1}{8}$" brass tube, and placed the sheathed wire in a piece of conduit pipe. The wire was fastened at one end of the stiff steel pipe, which was held firmly in one hand. The other hand grasped the brass tube, with the wire inside. Pushing the hands together made the loop bigger, and pulling one away from the other tightened the loop.

FIGURE 4 — Gannet Catcher



This worked very well. Sometimes the loop broke where it met the tube, but we had supplied at the free end, more wire than was required there for the loop. When the loop broke, we pushed through the $\frac{1}{8}$" brass tube some of this extra wire, and we then tied again to the conduit, the wire that came through.

BANDING COMMENCES

In the 1951-1952 season, conditions were even worse. We started on 31/8/51 with 545 nests; 35 of them already had an egg. After this the spring gales kept us from landing for four months, so that on 30/12/51 we found that only 259 pairs remained. We determined to band as many chicks as we could, as they became big enough to retain the rings on their legs. On the left in Table III, we have the usual eggs plus chicks record; while in Table IV on the right, we have tried to relate our banding operations, to the number of chicks departing.

We seem then, to have ringed 198 of the 208 juveniles that departed.

TABLE III

1 + 2 = 3

Date 1951	Eggs	Chicks	Pairs
Aug 31	35		540
Sep			
Oct			
Nov			
Dec 30	7	252	259
1952			
Jan 5	1	249	250
18		239	239
23			
Feb 1		218	218
23		157	157
Mar 8		71	71
Apr 11		1	1

TABLE IV

Date 1951				
Aug 31	515 empty nests			
Sep	Heavy gales			
Oct				
Nov				
Dec 30				
1952	Chicks banded on day	Total to date	Chicks departing between dates	Chicks departing Total to date
Jan 5	22	22	0?	
18	46	68	1	1
23	81	149	2?	22
Feb 1	24	173	50?	72
23			70?	142
Mar 8	25	198	65?	207
Apr 11			1?	208

In 1952, from 5 Jan to 11 April, we made seven visits. We banded 22 on the first day, 46 on the second, 81 on the third and 24 on 1/2/52, many of which have been found in Australia or have been recovered alive at Horuhoru later. On 23/2/52 only 157 remained, and as most of the oldest ones seemed to have been banded already, we did no further banding. On 8/3/52 we made our last March landing, and found 71 remaining of which we banded another 25. One of these, 16-342 banded on the right leg in T, was caught again in T on 30/8/57 when it was rebanded 35-408 on the left leg. It was 5 yrs and 6 mths old and was standing in an empty nest. On 26/12/64 it was caught again in T. This time it had a 4-day-old chick. As 16-342 was wearing a little, it was removed and replaced by M 4309.

When we visited Horuhoru again on 11/4/52 only one chick remained. This was our fortieth trip; we had made twelve trips of 20 miles while holidaying at Waiheke, and 28 of 70 miles (when we had to travel from Auckland). *Waitangi* steamed over 2000 miles to accomplish this.

In the 1952-1953 season we managed to band 260. Then came four good years in which we banded 634, 758, 900 and 742 from the 900 to 1000 chicks that survived each season. Our highest count on Horuhoru, on 22/11/58 was 1573 eggs plus chicks.

PLUMAGE CHANGES

In recording their number of chicks, some contributors to the Gannet Census classified them as small chicks and large, or in first or second plumage. We set out with the idea of finding out something that might prove useful in determining a chick's age by its appearance. From 5th November onwards we counted the chicks in every area by arranging them in age groups according to their

feathering, and then adding the subtotals. We selected names that developed naturally from the appearance of the birds. They would have to be short and distinctive names, names that could be heard easily above the din arising from the calls of the birds, the sound of the breaking waves and the noise of the wind. First of course we had the EGG, and when it hatched the naked chick with its dark skin was obviously BLACK; this stage lasted for about a fortnight. Then as the quills appeared, still sheathed tightly in their *calamus* they covered its nakedness but were not an ample protection until in three or four weeks time it appeared WHITE. Until this stage, the adults on their nests usually succeeded in covering the chicks, so that we had to lift the parents to see what they were hiding underneath, EGG, BLACK or WHITE.

We found this was best done with an oar. The flat blade could be pushed under the adult without disturbing it much, then, when we rotated the oar handle through 90°, the parent was raised two or three inches, enough for us to see what was underneath.

The chick continued to grow without change in colour, until the sheath suddenly burst freeing the downy end of the feather so that, overnight the down fluffed out converting the small white chick to a large white " powder-puff ": we called these FLUFFIES.

So far we had been dealing with the *neossoptyle* plumage. Just over a week later, on the 43rd day, three or four brown dots appeared in the tail and at the tips of the wings. These heralded the change to " second plumage," the *first teleoptyle* in which the chick would finally fly away. These birds we called TRACE. The brown feathers, with a white spot at the end of each, continued to grow and spread until, when the back between the wings was brownish grey, the second plumage had developed enough to term this stage ADVANCED. Although the down had disappeared from most of their bodies, each chick still had a deep muff of white down extending from the head right down the neck, so that it looked as if it were wrapped up because of a sore throat. This down disappeared from the shoulders upwards until in the twelfth week only a prominent tuft remained on top of the head; these birds we called TUFTED. The tuft required a week to disappear entirely and then the chick, nearly as big as its parents, appeared smooth and sleek: its *first teleoptyle* plumage was COMPLETE. These names, egg, black, white, fluffy, trace, advanced, tufted and complete, were used in every count from 5th November onwards. By the end of the year, by looking at a chick we could nominate its age in weeks, with some degree of confidence.

We soon had a dozen or so chicks which we had seen hatching. These were visited every landing from 10th December until 20th Feb. and the state of their plumage was noted. Some of these nests were in North Pocket, and their record is shown in Table V. There were six nests built during the course of the experiment. Nos. 1 to 4 were first seen on 27/8/49 and the first egg was seen in No. 1 on 18/9/49, and those in 2, 3, and 4 followed on 23rd and 30th and 5/10/49.

After the eggs hatched, the age of the chick in days is noted alongside the type of its plumage.

TABLE V

Date	Nest 1	Nest 2	Nest 3	Nest 4	Nest 5	Nest 6
1949						
27 Aug	nest there	nest there	nest	nest there		
18 Sep	egg laid					
23		egg laid				
30			egg laid			
5 Oct				egg laid	nest appeared	
24					egg laid	
1 Nov	hatched					nest
7		hatched				
13			hatched			egg
18				hatched		
6 Dec					hatched	
10	Fluffy (39)	Fluffy (33)	White (27)	White (22)	Black (4)	Lost
24	Trace (53)	Trace (47)	Lost	Fluffy (36)	Lost	
31	Advcd (60)	Trace (54)		Fluffy (43)		
1950						
7 Jan	Advcd (67)	Trace (61)		Trace (50)		
14	Advcd (74)	Advcd (68)		Trace (57)		
18	Advcd (78)	Advcd (72)		Trace (61)		
21	Advcd (81)	Advcd (75)		Advcd (64)		
29	Tufted (89)	Tufted (83)		Advcd (72)		
20 Feb	Complt (110)	Complt (104)		Complt (94)		

When we consider the difficulty of deciding just when a Trace becomes an Advanced, the close agreement in these figures is remarkable. Combined with the results from five birds in other parts of the island, we had a scale that was very accurate. The age in weeks at which each stage ended is shown in Table VI.

TABLE VI

Field name	Variation of age in days	Final age in weeks
Black	0 - 14	2
White	22 - 27	4½
Fluffy	33 - 43	6
Trace	47 - 61	9
Advanced	60 - 81	11
Tufted	83 - 89	12
Complete	94 - 110	15½

SUMMARY

During the first three months at their rookery, gannet chicks develop two types of plumage; a downy stage comes first: the *neossoptyle* plumage, which is white. After 43 days this whiteness is sullied by dark dots which appear first in the tail and wingtips. These herald the change to the second type of plumage (the *first teleoptyle*), the dark spotted plumage in which the bird will first fly. Dr. C. A. Fleming came north from Wellington to join

the party which landed at Horuhoru on 14/1/50. After that we sent him a copy of the weekly reports which our Recorder, H. Ross McKenzie, was filing at Clevedon. Dr. Fleming expressed concern lest the Field Names which we found so convenient at Horuhoru would not be acceptable to ornithologists in England and America. Consequently he consulted Dr. R. A. Falla and Dr. K. A. Wodzicki, and together we developed the more scientific names which appear in Appendix A. There you will find that the names during the development of the *neossoptyle* plumage contain the noun "down" with a qualifying adjective, and the *first teleoptyle* names mention "fledgling" or "feathered."

AGE OF EGGS

For some of the work it has been necessary to know the chick's age exactly. There is no problem when the egg is seen hatching. We hoped to learn more by considering eggs that had been hatched in the past three or four days. For years we have kept records of the eggs in North Pocket (six breeding pairs increased slowly to ten) and in area S seen in Fig. 3 where the 28 to 32 nests are easily identified, and the chicks cannot wander away into other areas. We have marked dozens of eggs, and nominated when they would hatch, mainly for fun. A young gannet laying for the first time often leaves large streaks of blood on the shell. Some find it so difficult that they are completely exhausted and lie for some minutes with their legs stiff and still and their necks and head along the ground on the other side of the nest. Streaks of blood on the shell can be a great help. By experiment we established the following points:—

(1) If the shell has distinct streaks of blood.
   (a) the blood is quite fluid up to 2 hours.
   (b) a wet finger will smear the blood up to 4 hours.
   (c) after 6 to 8 hours the smear dries before the wet finger spreads it more than 5 mm.
   (d) some blood keeps very red up to 6 to 8 hours. Most blood is brown after 10 hours and certainly after a day.

(2) If there is a lot of very thick blood on the egg it appears almost black at the end of 2 days.

(3) If there is no blood. The egg has a faint blue tinge and it seems translucent and "alive." This "living" quality disappears in the second day and the egg becomes opaque even if it is still quite clean.

(4) If the egg is stained with footmarks. The amount of staining depends on the surface of the ground and the state of the weather. It varies from place to place and from day to day. There is however a limit to the amount of discolouration, and in a muddy area it may be reached in a week. Eggs a week old differ little from those that are four weeks old. It may be possible to arrange the eggs in the correct order of age, without being able to say if they are one or four weeks old.

These observations are from over a hundred eggs, marked in different seasons. One may say with confidence "that egg was laid yesterday" or "last night," or "this morning" knowing that one

will prove correct when the egg hatches. Eggs that I have nominated as being laid two days before or three before may be a day out. I have been right with some four day eggs but only in fine weather. Anything older than that is beyond me, and although I can name sixteen eggs in the correct order, I will be a week or so out with the older eggs. Here is the result when I estimated the age of sixteen eggs in area S when there were 20 nests, and then examined them 44 days later.

My estimate	10, 9, 9, 8, 6, 4, 4, 3, 2, 2, 1, 1, 1, 0, 0, 0.
Age as shown by the chicks after they had hatched	21, 16, 15, 10, 5, 4, 3, 2, 2, 2, 1, 1, 1, 0, 0, 0.

A rather different experiment was carried out in 1954. On 9/9/54 we selected twenty-one eggs in different parts of the island. I was fairly confident that these had been laid between 7th and 9th. We marked each egg and recorded its position with reference to some well recognised landmark. The record was kept in seven columns. First there was the egg's number, the section in which it had been laid, and the time it had been laid expressed thus:— 7 meant some time on the 7th. L8E9 meant between mid-day on 8th and mid-day on 9th, while 8-9 meant I was uncertain. (By the evidence given by the appearance of the egg I was not prepared to state which.) We returned on 23/10/54, 44 days later. It was wild and stormy; the parents were snuggled hard down on their egg or chick. Before my son Peter raised each adult, I nominated what we would find underneath. Egg I was hatching and the egg-tooth could be seen through a ½" hole. Egg II was addled. In III the chick had opened its shell ¾ way around, but Egg IV had a four-day-old chick. We continued with V, VI and VII: then my son ceased making critical remarks, and acknowledged that I was making the grade. With Egg IV I was quite wrong, two eggs were addled, one that I expected to be a day old had died in the shell just before hatching; the embryo was quite fresh, perfect, but dead. Two eggs disappeared, the nests were empty and neglected. One nest had two eggs, one of them recently laid compared with the other (which was old but not addled). When we returned on 4/12/54 there was a 16-day white chick in this nest, but no chick from the earlier egg. Of the remaining fourteen eggs, 8 were hatching and 5 contained chicks of the age I had predicted; thus we had 15 out of 16 correct.

A copy of the page from my Field Book will be found in Appendix B. In defining the position of the egg we have referred to a well known mark or another numbered egg and stated the number of feet from it and the compass bearing to the egg. The final (seventh) column shows what we found there.

GROWTH OF TAIL FEATHERS

Our main project for 1954 was to find if there existed a clear relationship between the length of a juvenile gannet's tail and its age. Area S was again chosen for the main experiment. On 9/9/54 there were 29 nests and these were mapped out and numbered from east to west in rows arranged from north to south. At the north there was a trianguar group of ten nests arranged —

FIGURES 5, 6, 7 — Area S nests in September, October and December

1
2 5
3 6 8
4 7 9 10

The southern group of 19 was arranged in 6 rows of from two to five thus:—

17
11 18 22
14
12 19 23 25
15 28
13 20 24 26
16 29
21 27

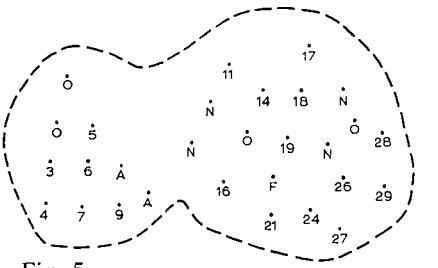


Fig. 5

Fig. 5 — On 9/9/54 there were —

	Marked Nests	Nos.
4 old eggs	(O)	1, 2, 15, 25
4 new eggs	(N)	12, 13, 22, 23
1 fresh egg	(F)	in 20
2 late afternoon eggs	(A)	in 8 & 10

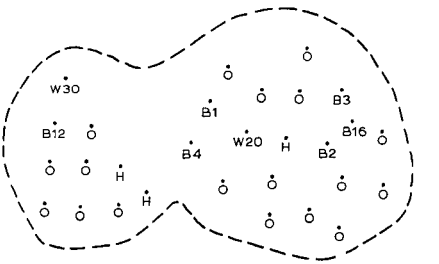


Fig. 6

Fig. 6 — On 23/10/54 all nine eggs had hatched, giving —

	Nests
2 Whites W30, W20 from	1, 15
6 Blacks B12, B16	2, 25
B4, B3, B2, B1 from	13, 22, 23, 12
3 hatching H H H in	8, 10 20

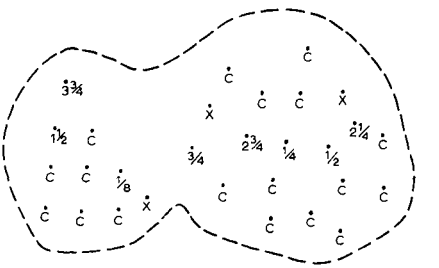


Fig. 7

Fig. 7 — On 4/12/54

By Dec 4th H1, B1 & B3 in 10, 12, 22 had disappeared.

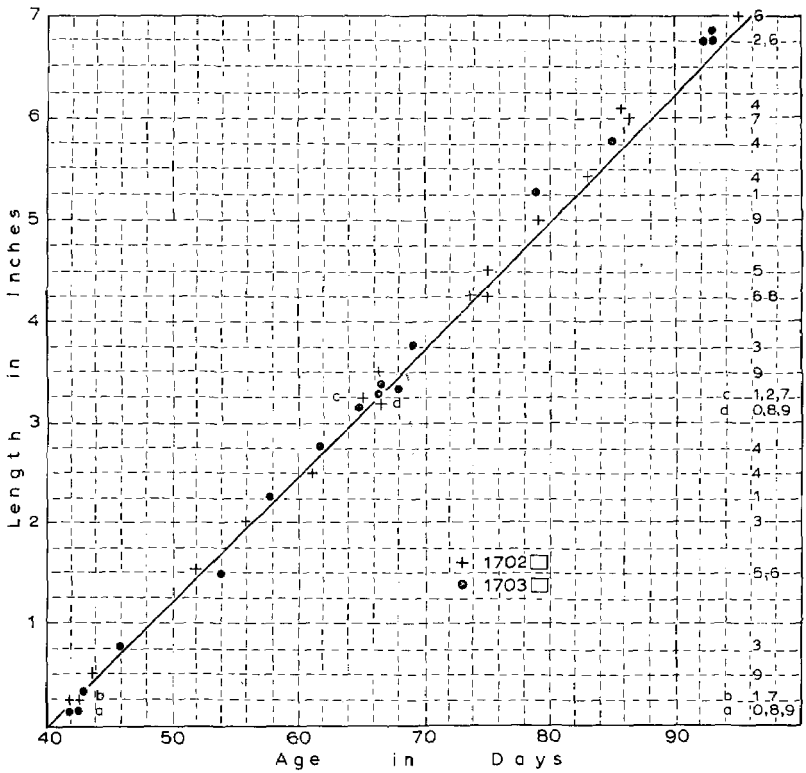
The other 8 chicks were now 1 Advanced and 7 Traces.

Seven were banded, see Table VII. The other 18 eggs had hatched giving 10Wh & 8 Fluffies.

TABLE VII

Nest number	Band number	Age of chick in days	Length of tail in inches
1	17032	72	3¾
2	17036	54	1½
8	17035	42	⅛
13	17033	46	¾
15	17034	62	2¾
20	17030	42	¼
23	17029	44	½
25	17031	58	2¼

FIGURE 8 — Age of Gannet Chicks from length of tail feathers.



Throughout the season we continued to measure these tails and all others banded from 17021 to 17039. During the course of the experiment birds numbered 17035 and 17037 were lost. The readings obtained from the others will be found in the Graph, Fig. 8. (The length of tail in inches is plotted vertically against horizontally the age in days.) All points plotted + are for birds with band numbers 17020 to 17029 and those marked • for bands 17030 to 17039. The units figure is shown in a column on the right. The readings marked a, b, c & d are multiple plottings. The straight line drawn from 0″ at 40 days to 6″ at 88 days gives the readings for a bird whose tail grew $\frac{1}{8}$″ per day. From this we may state the "*Gannet Rule of T F G.*"* If D be a juvenile gannet's age in days and t be the number of inches in the tail: D = 8t + 40.†

From 1955 onwards when banding we recorded the length of the bird's tail and entered the corresponding age in the Banding Schedules on return to Auckland.

* Tail Feather Growth.

† In the metric system if m be the tail length in mm; D = 1/3m + 40. This would be accurate if $\frac{1}{8}$″ = 3mm. A better relation is $\frac{1}{8}$″ = 3.175 mm. There is therefore an error to allow for which we should add 1 day at 60 days old and 2 days at 80 days old.

CHANCE OF SURVIVAL

We have seen that a young gannet's chance of living through the spring gales until the flying-away stage is reached, is often a very slim one. Even if the egg is laid by mid-August (and that is very early), and the parents keep their chick alive to mid-January, there would be no time to raise a second chick even if they wanted to. Sometimes the first egg is lost before it hatches. If this happens early in the season, a second egg may be laid. In one case we found "Gertie" (area G), who laid an egg early in August, and in September I saw her make a clumsy landing and she smashed it. There was yellow on her chest for over a day. The pair did not desert the nest, and in October I found her sitting on a second egg. But in early November the nest was again empty. She laid a third egg before the end of the month, and it hatched in January. Although it grew steadily for some weeks, we lost sight of it in March. This pair laid three eggs in the season, without raising a single chick.

In most cases the first egg laid does hatch. In our experiment in area S, all 29 eggs were fertile. In another experiment extending over two months and involving 1350 eggs, we found that 98% hatched. In the spring the easterly storms come often twice a month, and decimate the population. Fifteen hundred pairs in early November rarely produce a thousand surviving chicks and eggs at Christmas: by the time they start to fly off in mid-January, 700 to 800 is a good tally. Then too, a great many must fail to make the Tasman crossing. (They find little to eat on the way and arrive thin and weak, and are easily killed in the surf if they try to land on Australian beaches.) And then, after developing for a year or two they have the perilous crossing back to New Zealand. From the eggs laid in one spring on Horuhoru, it would not be surprising if we found that less than five percent had returned to the rookery from which they originally came, to start raising families of their own.

ADULT MISHAPS

Some pairs seem to have a long run of misfortune. In area P there is a stump with two surface roots running back up the slope. The hollow between them is an ideal place to have a nest. The same pair used it for some years. On 14/1/54 I banded the adult 19860 and her chick 19861. On our next visit (19/1/54) the adult on the nest had no ring, so I banded it 20002. On the 24th it was again 19860. Between them they raised the chick to the flying-away stage. In the 1954-1955 season, these two birds had another chick in the same nest, but it died before it was large enough to band, and they did not lay again. In 1955-1956 they did not appear, and no other birds used the nest. In 1956-1957 19860 sat on an egg in the nest for over three months, and when I opened it I found that no chick had developed.

On 30/8/57 I caught 19860 near the site, but no nest had been started. On 27/10/57 there was a bird without a ring on the nest; it was nervous of me and flew off leaving the egg. On 29/12/57 I caught 19860 on the nest (seventh time of catching). She was on an egg, so they must have lost the first and laid another. They succeeded in hatching this second egg, but the chick died within a few weeks. In the 1958-1959 season they succeeded in raising a

chick. In the spring of 1959 the nest site was vacant on each visit, and on 15/1/60 19860 was found sick on a beach near Warkworth which is 40 miles north-west of Horuhoru: she died next day. She must have been well over twelve years old and in the seven seasons in which we observed her, with the help of two husbands, she managed to raise only two chicks.

ADULT BANDING 1957 - 1958

In the spring of 1957 we made four landing on 30 Aug, 3 Sept, 21 Oct and 23 Nov, and we caught 21 adults (5 + 5 + 4 + 7 = 21). These were banded 35-407 to 35-427. Of these, twelve had been ringed as chicks and nine as adults. The chicks had been aged to the nearest week and grouped by months were, one 4 yrs and 10 mths, five as 5 yrs, two 5 yrs 1 mth, two 5 yrs 9 mths, one 5 yrs 9½ mths and the oldest was 5 yrs and 10 mths. Three of the adults three years before the present season,one 3 yrs, one 4 yrs and four 5 yrs before the latest months in 1957. The 4/10 bird was alongside an empty nest. The rest were all nesting and had an egg or chick. Some were therefore in their fifth year and some in their sixth. (We thought that it would be safe to assume that the birds ringed as adults were all at least five years of age at that date. Their ages on being banded in 1957 therefore, ranged from four over 7 to four over 10 years old.) In later years we found several birds building in their fifth year, many in their sixth, a few in their seventh and two in their eighth year after hatching. Later still we were to find that although many were nearly six, many more were seven years old and a fair number were eight. The average was 1 yr and 4 mths. We finally moved the 5+ for an adult when first caught, up to 6+.

CATCHING ADULTS

Catching these ringed birds took a lot of time. If you set out to catch only ringed birds, you found that a gannet rarely stands so that you can see both legs at the same time. After examining a bird from a distance and seeing no ring, you had to creep round in a circle without making a fuss, so that you could see the other leg without alarming the bird. If the bird you select is sitting, you have to lift it to see if it has been already banded. The time wasted was considerable. Determined to get some benefit from our efforts, we marked out an area on North Ridge, and starting from one end, we worked along systematically banding every bird that allowed us to catch it.

During the remainder of the 1957-1958 season, we made four more visits to Horuhoru, on 29 Dec, 7 and 30 Jan and 5th April 1958. On these days we banded 35, 83, 15 and 31 chicks, 164 in all. Fifty-nine were banded near the landing on the Terraces and 105 on the top in the North Ridge area. On the first three days we banded 12, 27 and 13 adults as well, eight on the way up, and 44 on North Ridge. Only five of these had been banded before, two as adults and three as chicks. All three had been hatched in 1952 and were known to be, 5 yrs and 3 mths old, 5/3 and 5/2½. The adults, both caught on 7/1/58, were more interesting.

In October 1957, an apparently sick gannet had been taken from the water in the Waitemata, and brought to me in Ponsonby. After banding it 28836, I released it again in the Ponsonby Boatharbour.

If an adult gannet is caught on its nest and banded alongside, even if it has been handled with great care, when it feels itself released, it spreads its wings and beats them on the ground, so that it can get as far away as possible. Before it gets airborne, it knocks eggs and small chicks out of their nests, and causes a lot of damage. To avoid this, when we have finished the banding process, we use two hands to keep the bird's wings close to its body, and then with a mighty swing, we launch it upwards as high as possible. All birds immediately spread their wings, and within seconds are safely airborne and instinctively glide out over the sea. After a very small circle, they come in to land close to us again. They have been surprised to be caught, but they are not resentful. Standing on the Westhaven Jetty, about 3 metres above the surface of the water, I managed to hoist the gannet 28836 upwards about six metres. But it had forgotten that it could fly. Keeping its wings folded, it fell into the sea with a mighty splash. It did not sink. It just sat on the water. After a few minutes it decided to leave us; it paddled away a little and then managed to get airborne.

As it staggered away I remember saying, "Well, we won't be seeing you again," but we did. Three months later on 7/1/58 we found it again, on the best nest-site in square Tc, sitting proudly on a three-day-old chick. We gave it a second ring; 35444.

Quite close to 28836/35444 was the oldest bird of which we could guarantee the age (16-244). On a new egg in square Tc was a bird which we had banded as an adult in Tc six years before on 5/1/52: it must now be well over 11 years old.

AGE OF CHICKS AT DEPARTURE

On our final visit to the Rock in the Autumn of 1958, besides banding another 31 chicks, we found that seven banded on 30th Jan were still on North Ridge. Their numbers were 36746, 47, 48, 50, 52 and 36758. By adding 65 days to their ages we found that they were now 100, 95, 97, 103, 105, 107 and 95 days old. Over the years we have found that chicks fly away on their 107th, 108th or 109th day.* Only two have been found to be older. One year a chick apparently 120 days old, was the last remaining on the island. its parents were still in attendance, and there were only three other adults over the whole of Horuhoru. We caught this chick quite easily, and found that it had a bad injury to one foot.

Another season when only 16 remained, we found that we had banded 15 of them, and knew that their ages lay between 95 and 108 days. While we were working on the Rock, two chicks aged 107 and 108 days flew off. Later we carried a 102 day chick from high up on the Terraces down to the landing, and putting it in the dinghy, we rowed it some fifty yards out to the north-west and let it go. We rowed well away and watched to see what would happen. After two or three minutes it paddled back to the Rock, was washed up on a swell and tried to climb back up to the top. Although it was only a week under age, it had no wish to leave.

* In Appendix J comparison is made with departure of Shetland Island chicks.

SEASON 1958 - 1959

In the spring of 1958 we made a first visit on August 23rd. It was too early to band any adults. After nearly three months of blustery weather, we landed again on 22/11/58 and used 80 rings, Nos. 37003 to 37082. We caught 87 adults, of which 21 already had one ring, and nine had two. The two "ringers" had been banded in 1957, and on one other occasion before that. One of them was 35406/19860 which I was catching for the eighth and last time. She was something over 11 years old. Another was "Gertie," who laid the three-eggs-in-one-season. Her two rings were 35427/28793. The older was becoming too thin, so we replaced it with 37006. She had now been caught over twelve times quite willingly, and was over eight years old. Three of the others were over seven years and three over six. Among the 21 one-ringers, there were two that had been ringed as adults in January. Each now had a chick, 18 and 26 days old. They themselves were something well over six years old. The other 19 had been ringed as chicks so that their ages were known. The youngest had been ringed in January 1955 so that their ages could be given in days:— four years and eight days, four years and 24 days. The elder was definitely roosting. The younger was alongside a nest containing a banded adult; it was not clear that it was the other parent. Of the remaining one-ringers, two were now 5 yrs 1 mth, one 5/11, two 6/1, three 6/2, three 6/3, two 7/0 and the last one, hatched about 20/8/51, was 8 years and 1 month old.

In another landing on 30/12/58, 21 adults were caught and banded from 45001 to 45020. Of these, seven had been ringed before and were given a second ring, the other with two rings did not require another. Of the seven, two had been ringed as adults in the preceding January. They were now well over six years old and had chicks 12 and 24 days old. The other five had been banded as chicks, four of them from 1952 to 1954. Their ages were 5/1½, 6/2, 6/3, and 7/3. The final bird was the only four-year gannet we have ever found breeding. It had been hatched on 13/10/54, banded on 8/1/55 aged 87 days, and now sitting on a black chick it was 4 yrs and 78 d old.

The two-ringer was the most interesting of all, a really old friend. Hatched about 2/12/53, it had been banded 20007 on 19/1/54 and then caught on North Ridge when it was almost three years old. It was then banded 35403. Now just over two years later, it was on a nest very near the same spot. It had a 5-week-old chick in its nest. As ring 20007 was badly worn we replaced in with 37061.

On 3/1/59 we banded 200 more chicks on North Ridge. At the same time we banded another 12 adults (45021 to 45032), three of them originally banded as adults and four as chicks. These latter had an egg or 8 to 10 day old chick and themselves were 5/2, 5/2½, 5/3 and 6/2. Two of the adults banded in 1956 were 8+ years old. The other had been banded on 22/11/58.

OTHER ROOKERIES

While all this had been going on, we still had been taking an interest in Mahuki, and the Coromandel rookeries. Only a few hundred chicks had been banded there, but they had been following

the same courses to Australia as our Horuhoru birds, and taking the same times to make the Tasman crossing. None of them was returning to Horuhoru instead of to its own rookery. At Mahuki on 17/1/59 28101 was guarding a 68 day old chick, within two metres of where it had been banded as an adult on 26/11/55. There was no sign that any of the 99 chicks banded with it three years before, had returned to Mahuki. On 1/1/60 however, three were found unemployed on the northern boundary of the rookery, and in 1961 several of them were found nesting.

SEASON 1959 - 1960

In the 1959-1960 season Horuhoru was visited only four times. On 26/8/59 we circled the rock with the Ecological Society Expedition, and counted well over a thousand adults ashore as we went slowly past, but there was no chance of landing. On 3/9/59 we made a quick run across the Gulf to all the Coromandel rookeries. Nesting was in full swing, and there seemed to be the usual number of pairs (up to 2500), but it was too rough to land anywhere, although we could get close in to all the nesting places. On 5/9/59 we managed to get back to the Great Barrier, and spent most of the afternoon of the sixth in examining Mahuki with great care. We had the highest count there to date:— Census Estimate 325; nests with egg or chick on 6/9/59 1032, and there were several other nests still being built. No. 28,101 was seen again, but he has not been seen since.

The most interesting sight was a 12-day-old chick, which must have come from an egg laid on 12/7/59. This would have been weeks earlier than we have ever seen before.

HORUHORU ADULTS BANDED

And when we got back to Waiheke, Horuhoru made up for all the previous disappointments. We landed on 12/9/59 and again on 13/9/59 and managed to catch 109 adults of which 38 had been ringed before. Of these 23 had been ringed as adults in the two preceding years. We had recorded the position of their nests on North Ridge using the co-ordinates method, so that we could now state the position of their nests of the year before, to the nearest foot. We learned a great deal about their movements from year to year. The ages of those originally banded as adults are given on the 5+ system in Table VIII. The week-end weather until the end of the year was frightful, so that we did not get ashore again until 5/1/60 when another four adults were banded and added to the record in Table VIII.

TABLE VIII

Landings	Number caught	Dates when first banded as adults				as chicks		Ages of adults			
		1953	1956	57/58	58/59	1952-55	Total	6+	7+	9+	11+
12/9/59	103	1		4	19	9	33	19	3	1	1
13/9/59	6					5	5				
5/1/60	4		1			3	4				
	113	1	1	4	19	17	42				

Once again the ages of the birds that had been first ringed as chicks, could be given accurately. They may be of little use here, but they are included as an item of interest. In our Field Books the ages were worked out at the date of ringing, but to give a more accurate comparison, the ages in Table IX are all given as on 12/9/59.

TABLE IX

Ages of ADULTS originally banded as CHICKS

Years	Months/Days						Nearly
4	10/19	10/20	11/ 4	11/12			5 years
5	9/24	10/15	11/ 5				6 years
6	9/21	10/ 0	10/17	10/24	11/11	11/30	7 years
7	9/ 4	9/12	9/15	10/ 3			8 years

AGE OF BREEDING

In Table IX there is something remarkable about the age of birds first banded as chicks, and now caught breeding for the first time. Four are four years old but nearly five; they will be five before they rear their first chick. Three are nearly six, six nearly seven and four nearly eight. In 17 birds there are 10 over six years old, average age is 6 yrs 5 mths. Since 1951 we have caught few adults that were under five years old. There was a three-year-old obviously unemployed, a few fours, one near a nest in which another adult was brooding a chick (was it the other parent?). Only one four year has been found incubating an egg. There have been some nearly five, a lot nearly six, more nearly seven, and a few nearly eight years old. We cannot guarantee that they were breeding for the *first* time. To do that we would have to catch two birds a nest over a long period, and still there would be no conclusive proof. Up to the present, we have been recording adults of unknown age caught breeding for the first time as 5+. From now on they will be 6+.

NEST BUILDING

During the course of years, we have often wondered as we see adults carrying seaweed about, and dumping it near the nest site they have chosen, "how much energy and time goes into the building of your nest?" The effort required must be terrific. The adults in the second nest in area A have always been easy to catch, and I have wondered if they would remain so co-operative, if they realised the great disservice I once did them. One August holidays we had as a guest Dr. Vivienne Cassie, noted authority on seaweed and algae. It occurred to me when she was with us on Horuhoru, that this would be a splendid time to find out what work went into collecting the weed and building the nest.

Their nest had just been completed; it was spotless. I had in Waitangi a very clean sack that had been used to deliver ti-tree blocks. Just before we left on the return trip to Arran Bay, I slipped ashore again to pack the nest into the sack. It was a tight squeeze, but we managed to get it in without much damage. Then we fled. What happened after the pair of gannets returned I cannot imagine. I am sorry that I could not get out again to see if they built another nest.

Next morning we sat on the sand in the sun, and as I took it to pieces bit by bit, the Doctor named and recorded each part of the nest. There were 542 items in all: from the three most common Carpophyllum 376, from other things with more than 10 examples 117, from others with less than 10, 49. This means over 250 trips per bird. At six trips an hour, this would require from each of the pair, forty hours of travel. The most interesting specimens were on two pieces of seaweed. One was an alga not previously known in New Zealand. The other a protozoon whose nearest known habitat was in South America. On a later visit, Dr. Cassie found the alga growing in profusion in the pool shown in our Map of Horuhoru, at the Landing. Fresh seawater gets into it only at high water when there is a south-west gale. The protozoon was not identified until it was sent to Cambridge University. Our gannets must be wonderful collectors. The individual items in the nest are set out in Appendix D.

BANDING ADULTS

When we are preparing to band adult gannets, we take a thick piece of Whakatane Board, and rule it up in lines and columns. The left hand column has a numerical list of the numbers on the rings we propose to use. Then come two columns headed Left leg Right. If the bird has already been ringed we write the band's number in the correct column, and the new number in the other. If there is no ring, we place the new one on the bird's left leg. If it already has two rings, the older is removed and replaced by a new one. Then comes the exact location of the nest, followed by its status (i.e. egg, or 10 dc = 10 day chick). Finally there is a column headed "Tail."

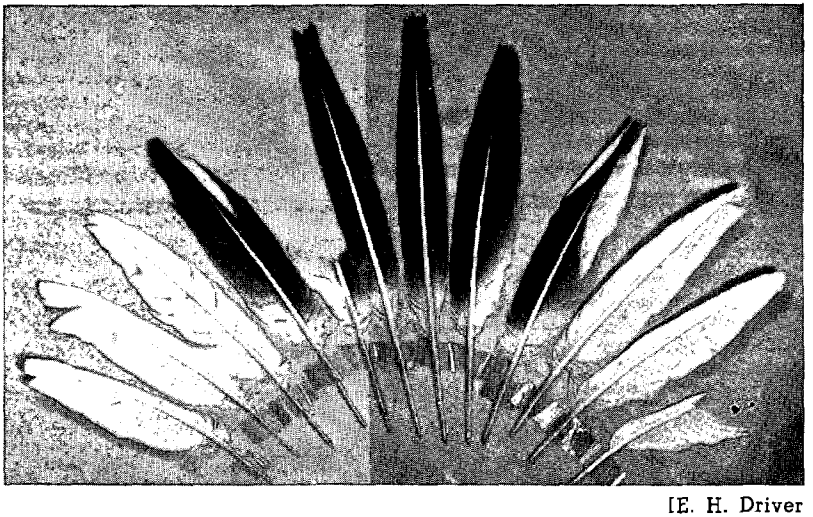
This has a cryptic set of figures we call the bird's "tail code." It gives the distribution from left to right of the white feathers which are on each side of the tail, and the dark brown or black feathers in the middle. Sometimes there is between the white and dark feathers a dark one with white diagonal stripes indicated by the letter "v."

It all arose from another theory that did not work out. After a storm up north, an observant youth found a gannet washed up dead, and found it had a band on one leg. He promptly forwarded the ring to Wellington and I was informed the same day. The young man was only fifty miles away, so I rang him to find if he had noticed anything about the bird's plumage. We had been getting news from Australia, of young birds that had been killed in landing in too high a surf. This bird was four years old, and obviously on its way home to Horuhoru. The finder said he had pulled the corpse well up above high water, so it might still be there. It was only eighty miles away, so he went for it on his motor-cycle the same evening. He sealed it up in a tin, and posted it to me. Its tail feathers had been damaged, but I managed to arrange them in order, and they may be seen in Fig. 9. We always read the feathers from the bird's left to right. Here then, you must look from right to left. First we have a smashed white and two whole ones, then a variegated one, three whole and one broken black or dark brown (at times it is hard to say which), another variegated one and three whites. This bird's feather code would be (taking no notice of the broken feathers), 3+1v+4+1v+3. The tail of the text book*, 444 is seldom

* Oliver: N.Z.Birds, p. 236, Tail of 12 feathers; p. 238, four central feathers black, remainder white.

found. Other examples may be seen in Appendix C, which gives five examples of Recoveries and Repeats from the 1959-1960 Season. The ½ which is seen in (2), Bird 37 007 (left leg), means that on 22/11/58 it was moulting, and three small feathers were showing among nine fully grown ones.

Ever since this bird was found, the tail of each adult has been recorded. I thought for a while, that we had discovered a way of telling that a bird was a sub-adult, but it was not to be. A bird may have 12 feathers one year, and 10 the next, and after an interval return to 12. We have photographed all types of tail, one with ten coloured feathers between two whites; the only constant feature has been, that every bird so far, has at least one white feather on each side of its tail. Mr. E. H. Driver made me a colour-slide of these feathers, and I have used it frequently.



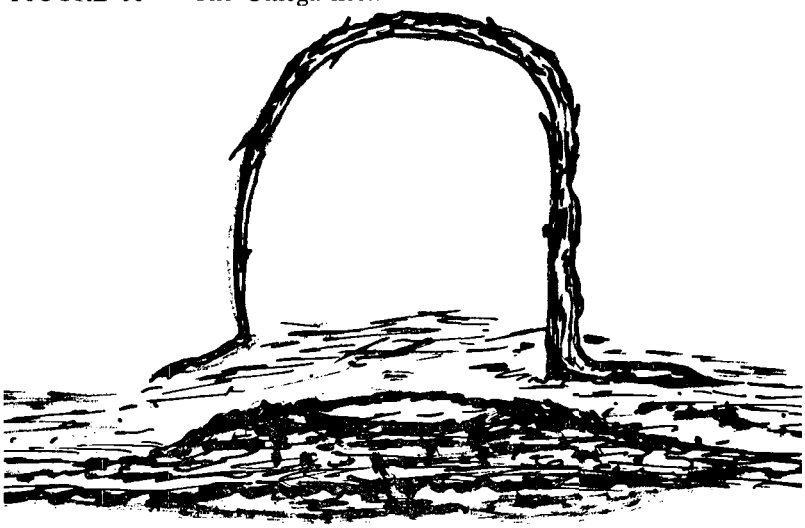
[E. H. Driver

FIGURE 9 — Gannet Tail Feathers: from a sub-adult aged four years, returning from Australia.

Returning to Appendix C, in (6) mention is made of the Omega Nest. This shows how something noticeable may give rise to a "nickname" that persists. In Tc at position 3.9, there was a long stalk, that in times past had been a small taupata. The strong west gales across North Ridge had bent it over until the top nearly touched the ground. When it died because of the gannets, in passing they slowly snapped off the branches, until only one remained at right angles to the trunk. On the far side, a surface root still showed above the ground, and the whole looked like a Greek capital Omega. The nest alongside was called the Omega Nest, and it will be seen when we come to Fig. 15. A bird had just laid an egg in it on 3/9/53, and was banded 15787 on its right leg; when lifted, the bird was still noticeably damp from the laying process. There is no mention of its "tail feather code," because it did not exist then. On 23/11/57 it was caught again. This time it had just laid an egg, but the nest was nearly a metre to the NW of the Omega Nest, which was occupied by another bird. Another ring 35426 was placed on its left leg. It flew off, and ten minutes later

another bird alighted by the nest, and covered the egg. It was banded 35425. The rings had been rather out of order, and this was later found to be very confusing. If 35426 had been 6+ in 1953 it was now 10+. When it was caught in 1953, its egg was found to have hatched on 17/10/53, and to make it easily recognisable, on 2/1/54 it was banded 15793 on its left leg, and 15792 on the right; it was then 76 days old. A week later it was recorded as "tufted" (12 weeks old): exact age was 83 days. That unfortunately was the last we saw of it. It disappeared.

FIGURE 10 — The Omega nest.



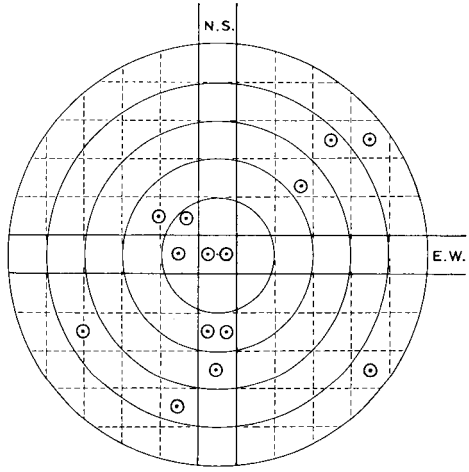
The next season there was a ringed bird on the Omega Nest, and another standing by. When I approached, one flew off, and then the other. I tried again half an hour later with the same result. On our next visit, I put the gannet catcher down near the nest and went away on other business. When both birds had returned, I wandered across not looking at them, but when I stooped to pick up the catcher they were off again. In all, I tried eight times in the season. But on 12/9/59 I caught the bird on Tc 3.9 and found it was 35425/15787. On 23/11/57 its tail code had been 3+6+3, on 12/9/59 it was 3+2+3, it had an egg, and it was over 12 years old. From records such as these, we were able to trace the movements of some of the birds from one year to another.

SLIGHT MOVEMENT IN NESTING SITES

In the 1958-1959 and 1959-1960 seasons there were 23 gannets whose nest positions in Ta, Tb, Tc, and Td were recorded each season (there were more in Te but no more room on the graph paper). The two positions of their nests are joined in Fig. 15, and will be discussed in detail later. In another area we caught 14 birds in similar circumstances. Twelve had made slight movements, but two had not moved at all. This is generally due to some formation of the ground which prevents even a slight displacement. Gertie's nest,

for example, was on a slight projection from the western edge of area G, and any movement to the north, south or west, would have caused the nest to drop into space. In some cases the nest is between the roots of a tree, or near one, as in the case of the Omega Nest. Twelve pairs had made a slight movement, but two had not moved at all.

FIGURE 11 — Movement of nests in one year.



In Figure 11 these short moves are shown in a series of concentric circles, varying in radius by one foot, which are drawn on a one-foot grid. Two pairs of vertical and horizontal lines a foot apart, cross at the centres of all the circles, and in the square so formed there are the two nests that had not moved at all. The centre of each nest is indicated by a dot within a small circle. Movement to the east and west is shown horizontally, and north and south vertically. The 1958 position of each nest is the centre of the concentric circles. We have then three nests which showed no lateral movement, but moved to the south, two of them by two feet, and the third by three feet. If the middle of a somewhat wobbly row of nests running north and south were shown by the heavy vertical line to the left of N.S., these eight nests would all be in it, as would be the ninth, that has moved one to the west and four to the south. The other five could be included in two other rows running north and south, but 30″ to the east, and 30″ to the west. The two most distant nests, by using right-angled triangles of the 3-4-5 shape, would both be under five feet away from their 1958 positions. In most cases then, the movement of pairs within an area, is comparatively small.

GANNETS NESTING IN GROUPS

In the Hauraki Gulf gannets have been banded on Horuhoru, Mahuki, Motu Karamarama, Motu Takupu, in the Bay of Plenty on White Island and in Hawke Bay at Cape Kidnappers, yet it all our recoveries on Horuhoru, we have not yet found a single bird that had originally been banded on any of these other rookeries. Among our recoveries of sub-adults on Horuhoru over 95% have been birds that spent their original 15½ weeks in the area in which they were found breeding for the first time. In that area too, many of

those that were neighbours when first banded, are found quite close together when they begin building nests. It has been suggested that they are homing on some prominent landmark. This is indubitably true so far as the whole " area " is concerned, but within it, the most prominent marks are our little " fences." It may be that some material purpose is involved: there may be some pairs who provide too much food for their own chick, and are generous in giving away the surplus. I find it much easier to believe that they enjoy the company of their group. Cases like that set out in Figures 12 to 14 illustrate this:—

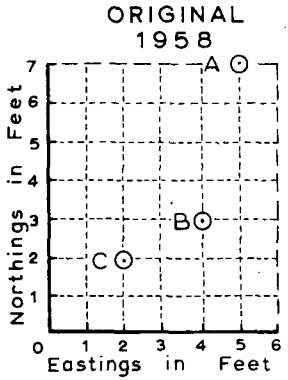


FIGURE 12

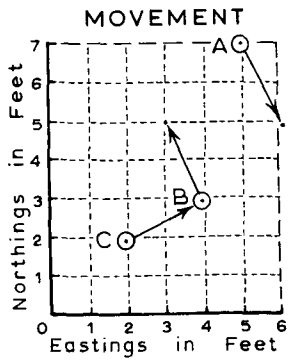


FIGURE 13

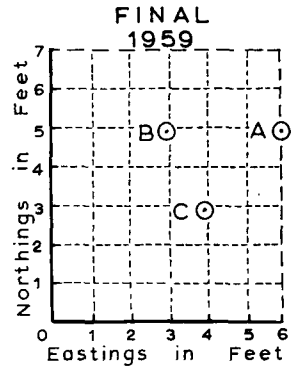


FIGURE 14

In Fig. 12, taking O as the origin, A = 5.7, B= 4.3, C = 2.2 were the positions of three nests in 1958.

When they started building in 1959 A moved 1′ to E and 2′ to S, B moved 1′ to W and 2′ to N, C moved 2′ to E and 1′ to N, see Fig. 13.

Their final positions in 1959 were A = 6.5, B = 3.5 and C = 4.3, so that from a boomerang formation reading clockwise ABC, they have changed to a cosier triangular formation, reading clockwise ACB. There is of course no proof that this means anything.

Small movements in any direction do not seem to be resented by gannets who find other pairs in the nesting space they had in the year before. There does not seem to be anything of " defending territory " among gannets.

A DISAPPOINTING SEASON, 1960 - 1961

After our increasing success 1958-1959-1960 we looked forward hoping that 1960-1961 would reveal even more. Everything went wrong. Gales for most week-ends in the spring; a few fine week-ends came when there was insufficient manpower to make a good sweep. To do a sweep across North Ridge at least five, preferably six workers are required. The first uses the catcher and two take care of the birds as they are caught, a fourth prepares the rings and gives them to the bander in their correct order, calling out the number as he does so. The fifth man, who bands the birds, has a lot to do. He first calls out the number on the ring, and states which leg he is putting it on, at the same time the catcher

who has used his long instrument to measure the exact location of the nest, calls this to the recorder too, with the status of the bird. He then moves on with No. 3 to catch another bird which No. 3 will hold. Meanwhile No. 2 is holding his bird by the head with his gloved hand and by one wing with the other. Suppose the bander has named the left leg as the one to receive the new ring, he then says " Right leg ring No. 15 623 " giving the number of the ring already on that leg and finally " Tail code 3+4+3." The recorder, who has entered all this data in the lined and columned Whakatane Board, which we have mentioned before, now calls back to Nos. 1, 4 and 5, the new ring used, where the nest was, what was on the other leg, and what the tail-feather-code was. No. 2 then takes his bird some distance to the rear, and as he releases it, tosses it high up into the air, where it becomes airborne without damaging any chicks in the neighbourhood. At this stage No. 3 brings forward the bird the catcher has secured to be banded, No. 2 follows No. 1 to the third bird, and so on to exhaustion point.

CHICKS BANDED JANUARY 1961

The first day on which we had fine weather and sufficient workers was 21/1/61. On landing we found that the chicks were so far advanced, that their parents considered they needed no more protection, and were themselves not eager to be caught. Such a thing as a good sweep was out of the question, so we banded on T 100 chicks using 0 601 to 0 700. Three of these were heard of quite soon. Departing on 25/1/61, 0 656 was found dead on a beach near Woolongong on 1/3/61, after 35 days' absence. Leaving a week later, 0 607 was found dead on a beach in South Tasmania, on 11/3/61. More interesting was 0 673, which on being banded and placed back on the ground, decided to depart. It made a particularly poor start, falling into the water quite close to Horuhoru and, tail awash, paddling and flapping along towards Kawau, but in the next 27 days it covered 2400 miles, nearly reaching Adelaide. Very high waves on Surfers Beach, three miles south of Port Elliot in South Australia, battered it to death on 17/2/61.

Only one adult was banded on 21/6/61, 36760. It was singled out because it was attending a 10 day old chick in area P. This was a very late laying, about 27/11/60. (It hatched on 10/1/61.)

On 25/2/61, we went out to see how it was progressing. We did not manage to get in sight of him. So steep were the breakers at both south and north ends of Horuhoru, that after creeping up to the north-west in its shelter, we came close in to the Rock, but failed to reach the western side, and were forced to turn back. On the next morning we tried again, and although we managed to sail round the island, we could not land. We saw 36371 (36370's chick) still in P, a well-developed " trace.' There were still six other chicks on Horuhoru, none on either North Stack or South Ridge.

On 1/4/61, we made a final attempt to visit him, but after getting through the inner passage at Kauri Point, we ran into the full force of a north-west gale, and could not proceed with safety. So ended a very disappointing season. But our next landing on 30/8/61, made up for it all.

SEASON 1961 - 1962

There were enough helpers to make a full-scale sweep across North Ridge. We made a good landing on the wave platform at the foot of the Terraces, and immediately spotted a ringed bird in Area A. It had been banded first on 28/1/52; the ring was in a fair condition, so we left it in position and rebanded this gannet on the left leg, 36301. Completing the climb up to G, we approached the " fenced " rectangles that fill area T.

We started our " sweep," and succeeded in catching another sixty-one birds. Of these 23 had been banded once before, 10 twice and one three times. Six had been banded in 1952, 1 in 1953 and of the thirty-seven banded in the past three successful seasons, 3 had been banded in 1957, 16 in 1958 and 18 in 1959. We used only 52 rings from 36 301 to 36 352; all nine of the double-ringers did not need any fresh bands.

As our decision to assume that adults breeding for the first time are probably at least six years old, seems to be fully justified, we shall now continue to class these as six-year-olds. Among those which have been caught as adults at least once before, there were 25 over eight years old, namely; 8 eights, 10 nines, and 7 ten-year-olds. The remaining eight birds had been banded as chicks and their ages in years/months/days were: 4/11/8, 8/11/7, 8/11/7, 8/11/7, 8/11/8, 8/11/29, 9/10/25 and 9/11/11, which gives an average of 8 years and 8 months. We had hoped to make a sweep in August 1960, and it is conceivable but not likely that seven of these eight birds might all have been caught then. In that case the average would have been reduced to 7 years and 8 months. Conceding this point, it is still clear that many, perhaps most of the gannets that return to Horuhoru, may delay breeding until they are six or seven years old.

NESTING CHANGES

We now have to examine again the slight changes that some pairs make from year to year, in their nesting sites. In the 1958-1959-1960 sweeps across North Ridge, we found over twenty pairs in Ta, Tb, Tc, and Td had moves from one to five feet. The moves are indicated in Fig. 15. We have here the " fences " bounding these four sub-areas. There were more in Te and in U, some of which are mentioned in Table X, but there was not enough room to get them on the graph. The positions occupied by the nest in 1958 is shown by a cross, and an arrow shows the movement to the 1959 position shown by the large dot. Opposite the crosses in the margin are the numbers of the 0 300 series of bands used in 1959, and Table X shows the number of the band found on one of the pair in 1958.

In banding throughout area T, we do not follow an absolutely fixed course. We start in Ta and move north through Tb, Tc . . . and in each fenced rectangle we move from east to west. The rings are used in strict numerical order, to make them easy to check, and to help the recorder, who has them already written up on his WhakaBoard. Neighbouring nests therefore tend to get numbers in numerical order. Years later in banding recoveries, we adopt the same procedure using a new thousand group each year. Thousands up to 20,000 were used in 1951 to 1954, 35 thousand in 1957, 37 in 1958 and 45 in January 1959. Later came Os and finally Ms.

FIGURE 15 — Fenced Sections in Area T.

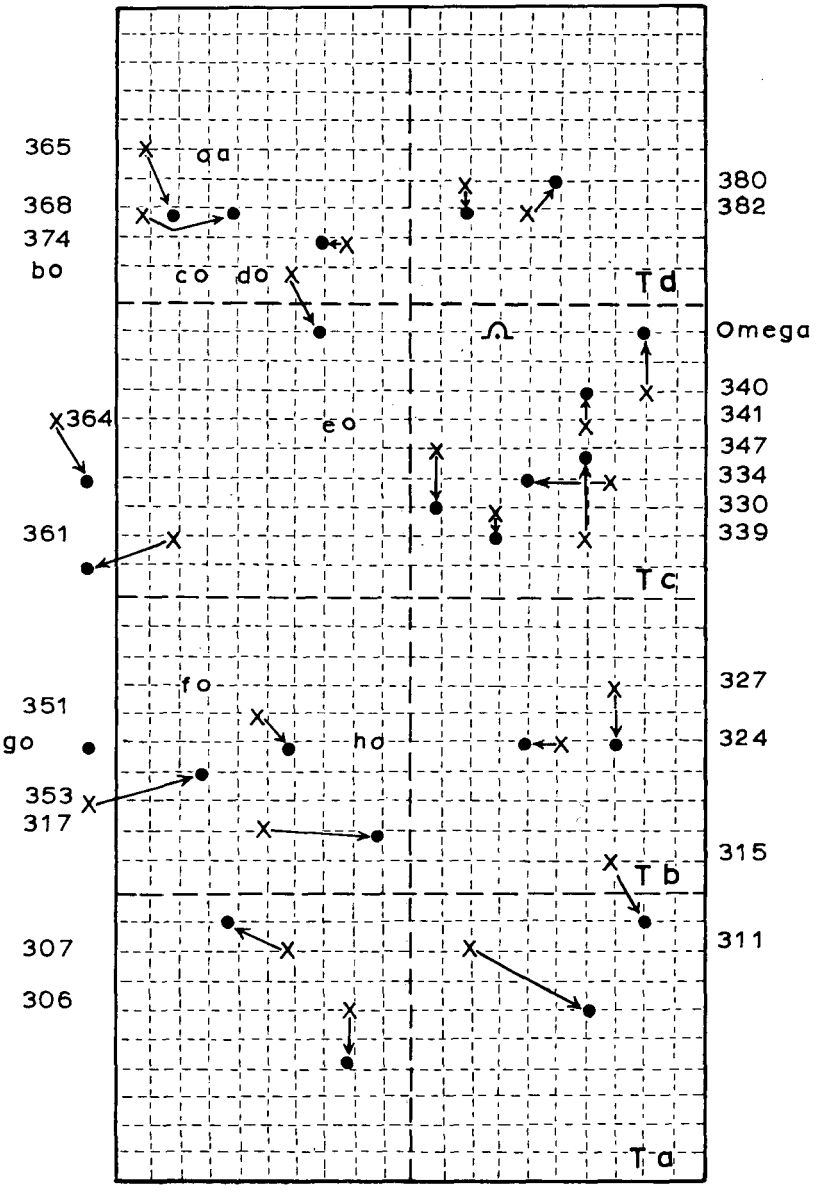


TABLE X

Band Recovered	New Band "O" series
35 428	301
37 007	302
37 010	306
37 014	307
37 011	311
35 425	312
37 032	315
19 104	317
35 461	318
37 031	314
37 036	327
37 040	330
37 043	334
37 050	339
37 051	340
37 049	341
37 041	347
37 020	351
15 544	353
15 567	361
16 060	364
16 044	365
37 065	368
16 348	369
37 056	380
45 026	382
35 471	385
35 449	399
45 003	400
15 621	401
19 965	403
19 137	404
16 174	405
15 686	406
16 330	407
15 908	409
16 070	411
28 535	416
35 107	16 129

here followed the other two-ringers

TABLE XI

	Band number	Used in	"O" series number	Co-ordinates of nest
a	16 348	1952	369	Td - 7.5
b	16 060	1954	364	Td -12.1
c	16 044	1954	365	Td - 7.1
d	16 208	1951	359	Td - 5.1
e	15 567	1952	361	Tc - 2.6
f	15 632	1952	418	Tb - 7.7
g	15 644	1952	353	Tb -13.5
h	19 104	1954	317	Tb - 1.5

TABLE XII

Band	Hatched	Age Yr	Mth	Status
35 407	1951	8		On nest
16 169	1951	7	10	Egg
16 348	1951	7	9½	10-day chick
16 174	1951	7	9	Nest
15 632	1952	7		7-day chick
15 635	1952	7		Egg
15 686	1952	7		Egg
15 621	1952	7		Nest
15 637	1952	7		Building
15 631	1952	6	10	Egg
15 622	1952	6	10	Egg
19 104	1953	5	11	Egg
19 137	1953	5	11	Egg
19 965	1953	5	10	Egg
19 956	1953	5	10	New nest
16 060	1954	5		New nest
16 044	1954	4	11	Egg

Notice the long runs of the 37 thousands, and the shorter 35 thousands, and the two substantial groups from the early fifties. Another point to remember is that there were two gannets to a nest, so that some of the 37 thousands of 1958 would be away fishing in 1959. The numbers missing from the "O" series were put on birds that had no other band. Notice the eight open dots lettered from a to h. These birds were banded as chicks somewhere in T, but their exact co-ordinates then are not on record. Whatever else we know about them is given in Table XI.

Besides the two points already mentioned, (1) Gannets show some form of memory in returning to the area in which they spent

their first three months and (2), having settled there they show some form of associating with certain members of a group, we found (3) sites where nests appear early one year are first to be occupied the next, but (4) if birds find that their usual site is occupied by another pair, they do not seem to mind moving a short distance. (5) Younger birds seem to settle on the outer edges of the area, sometimes right outside the "fences," but when opportunity occurs they move in. (6) Some pairs do not build every year.

There is no need to try to explain any of these points, but we seem to be better pleased if we can see a reason for what happens. Suppose the older birds took first pick, and the younger used what remained, then when one of the older pairs decided to take a year off, a younger might take their place. To see if there were anything in this, I took 17 birds of which we knew the ages and arranged them in order, eldest first, and finally added their status in 1959. The result is seen in Table XII. Unfortunately nine of them are stated to be "on egg," so for a period of six weeks we can make no differentiation, and in the remaining cases there is nothing remarkable; only the 3rd and 5th have chicks, and the oldest still has not laid an egg; the pair may have lost their first one of course.

To get anything worthwhile, we would have to make a sweep when all the nests held chicks; the adults would be much harded to catch. In any case this would be more an ingenious exercise than a quest after useful knowledge.

STEALING NEST MATERIAL

The only unfriendly aspect in the whole nesting process, is the stealing which so frequently takes places. There is no unpleasantness, because the theft is made while the owners of a heap of nesting material are away collecting more. A bird from a nest some distance away, will hurry over when the birds depart, and pick out from their store a piece that suits him. He will exert considerable energy in pulling it out of the heap. He immediately takes it over to his own nest and has it worked in securely before its rightful owners return.

Some strange things happen during nesting. One year when area V had about six rows of 8 or 9 heaps of nesting material, I examined it to see how many would be there. About a week later, when I had a second look, the whole area had been trampled over and individual nests were hard to trace. A fortnight later still I came a third time, and found six rows of 10 or more, nearly completed nests. This area is particularly restricted: on three sides there are overhanging edges of steep cliffs, and on the fourth there is a steep slope up to a thick hedge of taupata; there is no room for expansion. Room had been made for several additional nests. I was so surprised that I noted it in my diary; I wonder what the real explanation was.

Another incident surprised me even more. There was a stiff breeze from the SE: the wind met the incoming tide at the south tip of Horuhoru, raising endless close rows of steep-sided thin-tipped waves. As I watched, a gannet flew by holding a huge piece of seaweed by a long thin but strong stalk. It trailed out nearly two

metres beyond his tail. He had taken off to the SE against the wind, and when he was up three metres he wheeled to the east, then north, to approach North Stack from the north. Gaining height slowly, he cleared North Stack, but would hit the cliff below North Pocket about half way up. He banked away to the east again, and settling softly on the water, had a little rest.

Then he set out again. This time he flew about a metre above the waves, weaving up and down so that his trailing weed smacked loudly against the tip of every fourth or fifth wave. As he passed Waitangi, I could see a shower of drops pour off at each slap. He covered a good two hundred metres before he circled round east, and then north, and this time he was well to the north of North Stack as he commenced his approach. He cleared it easily, but just skimmed over the taupata behind North Pocket, to land somewhere in area V. How many nesting adults were buried when he came to ground level, I do not know. There must have been some angry cries as they freed themselves, and he would have to chop it up, before he could use the seaweed in his nest. How many trips he saved himself by this endeavour I do not know — I cannot bring myself to believe he planned that part of the operation, but I did see him shake off the excess of water, before completing his second attempt to get the weed up to North Ridge.

We made another trip to Horuhoru on 11/11/61, but the wind got up and it became so cold that we had to clear out after banding only nine adults in area T. This was not the end of operations for the season. A fortnight later we were able to get to Mahuki again, and there we banded 300 chicks.

TO MAHUKI WITH THE NAVY

In the early sixties, the Navy had moored in Westhaven, a 65 foot Harbour Defence Launch, which with three officers and a Chief Petty Officer as engineer, was used at week-ends to carry out training. We had once before been taken over to Motu Karamarama in this vessel in appalling weather, to visit the rookeries there, and now we learned they were organising a week-end exercise at the Great Barrier.

In the Hauraki Gulf an operation involving a few ships from the Australian Navy, and some from ours, had been hunting a British submarine. At the same time, a battalion of our troops had been engaged in an exercise which took them through the wilder wastes of the Barrier. We were to be near Port Fitzroy at dawn on 25/11/61, to pick them up and ferry them out to the Royalist, in which they were to return to Auckland.

We left Auckland very late on the night of Friday the 24th, so that we could make our way through Governors Pass in daylight, deliver the Commodore's mail, and do our ferrying. The trip across was interesting and exciting, the ferrying hilarious, but we finished early, and I was allowed to act as Pilot through the archipelago of islets to the south of Wellington Head, and into the Boat Passage to the north of Mahuki, where we moored ship and prepared for a welcome mid-day meal.

In the afternoon the Captain and several of the crew came ashore with us, and climbing over the intervening hills, arrived at

West Promontory, where we have the cleanest and tidiest rookery in New Zealand. I proceeded to catch 299 chicks, while R. F. Attwell assisted by his team of sailors wearing heavy gloves, banded them from M 4502 to 4800. This brought our Mahuki tally up to 399.

With the help of Douglas Guthrie's crew of the Isle of Arran, we had banded 1 adult and 99 chicks on 26/11/55. On 2/1/60 we had visited them again, and saw 28 101 with a chick on exactly the same spot, where he had been ringed as an adult in 1955. There was no sign among the breeding adults of any of the chicks which had been ringed with him in 1955, but two were standing unemployed on the bank to the north.

We were able to make a careful count. (The figures in parentheses were obtained at the "Terraces" on Horuhoru a week later.) 351 Complete (H 406), 46 Tufted (48), 23 Advanced (16), 18 Trace (30), 27 Fluffies (43), 7 White (4), 4 Black (6), and 10 eggs (3) a total of 486 (H 556). In early November the Horuhoru total had been 1063. A total of 900 in early November would thus be reasonable for Mahuki.

Some of the birds were ready to fly off — this begins in mid-January at Horuhoru. Twice with the help of Isle of Arran, I have managed to cross to Mahuki a day after counting the birds on Horuhoru. On most occasions the number of birds and their distribution, have been almost the same as on the Terraces at Horuhoru, but twice there have been over 1000 eggs plus chicks. On all occasions the development at Mahuki has been a little more advanced than at Horuhoru. Mahuki is the only rookery I have visited in New Zealand, where the stage of development at that time, has been slightly ahead of what we had found at Horuhoru. If we take Horuhoru as the standard, I would place the Colville rookeries as a week later, the Sugarloaf to the north of the Hen and Chickens as a fortnight later, and the one at Oaia a fortnight to three weeks. From talks with Dr. Wodzicki, I think that Kidnappers is from a month to five weeks behind.

On 7/11/64, 28 101 was not on his former nest, and we have not seen him since. One ringed bird flew round and round our heads for over twenty minutes. The gannets build on a slope that extends from a cliff running from east to west along the northern side of the promontory. The western end drops down to the sea, but at the eastern end, the land widens out to the south east and the north east and rises up on an open grassy slope. The prevailing breeze from the south west meets the cliffs to the south of the rookery, and rising, makes a beautiful up-draft in which the gannets play for hours. They come along from Anvil Island which is out to the south east, glide over the saddle at the eastern end of the rookery and along the cliffs there. An abrupt break in these cliffs, opens into a small inlet with a pebbly beach, on which it is most convenient to land when the S.W. wind is not too strong. The birds pass this gap and disappear into the Boat Passage as they swing away to the north east. Three or four minutes later, they come back over the saddle from the other direction, and disappear out towards Anvil Island, which strange to say, looks like an anvil. It rises straight up out of water forty metres deep, to a height of fifty metres, leaving a passage thirty metres wide between it and Mahuki. While I lay

on my back in soft long grass on the slope above the saddle, a long string of from two to three hundred gannets passed over me, perhaps twenty metres up, and twice in every five minutes, for upwards of half-an-hour one passed showing a leg below its feathers, so that I could see that it had a ring on that leg. It is no wonder that the gannets of Mahuki seem cleaner than they are elsewhere: the green stripes on their feet are a brighter colour too. Later while I walked slowly through the rows of nesting birds, they made no movement except to turn their heads. Alongside the nests there were four birds with rings. If I had had my thick gloves I could have caught them. I did manage to hold one by his beak to read his number, 28 156. He had been hatched about 10/10/55 and on 26/11/55 when we banded him, his brown tail feathers were just over ½" long. Now he was 9 years and 1 month old, and had a 30-day-chick in his nest.

There was no sign of any of the 1961 birds. Several from both groups have been reported from Australia. They all seem to be following the same programme as the Horuhoru birds; one of them had crossed to New South Wales in six days. We have recently had news of three of them in New Zealand. On 30/7/68 M 4741 was found dead near Whangarei Heads, and on 27/10/68 M 4595 was found dead in Te Kouma Harbour, 20 miles to the east of Horuhoru. The latest one M 4580 can be seen in the 1971 recoveries. On 21/1/71 it was found dead on Muriwai Beach by our Auckland Regional Representative. It was then 9 years and 5 months old. What it was doing on the West Coast, two miles from Oaia, and over 400 by sea from Mahuki, is hard to imagine.

In 1963 we decided to stop banding juveniles. We had over ten years results from our operations, and further results seemed to be repetitions of what we had learned before. Assistance was not always available as the younger members of our band were accepting more responsibilities of their own. We felt that the manpower available should be concentrated on finding out more about the adults that had returned to Horuhoru.

We would not be giving up all work with young birds. Every time we went to Horuhoru, we passed close to the Frenchman and, without slowing down, we could see exactly what was going on among the fifty to sixty Blackbacks established there, with their developing young of two or three seasons. The Reef Herons, too, and an occasional Caspian Tern, would show up. It remained a yearly institution, to take the young folk from Arran Bay to do the banding sometime between Christmas and the New Year.

On 17/1/63 then, we banded the 70 chicks still growing up in area T, using 0 501 to 0 571. This brought the total we had banded on T to over 700, of the 1200 odd that had departed from it since 1951. (More about this will be given later in connection with Appendix G.)

MORE NEWS OF ADULTS

There were still reports coming through from Australia, and our visits to Horuhoru still continuing, gave us more up to date news of the great number of birds we had ringed there. On each visit we caught a few birds. Most were quite friendly and did not mind being caught. There was no need to use the catcher all the time.

Often I went round wearing one glove and holding out my thumb for one to bite. Many refused to peck me, and my invitation, " come along, bite it," would have sounded strange to anyone passing, but if the bird stood up to take my thumb, I simply closed my hand round its head and beak, and taking advantage of its spring upwards, I continued its movement and there it was under my left arm, with its two wings pressed in close to my side. I held it there until one of the others took hold of its left leg, to attach a new band if it needed one, and to read out the other ring's number, to the recorder.

SEASON 1964 - 1965

After our trip to Mahuki in November 1964, we again visited Horuhoru on Boxing Day. The weather was lovely. As we passed the Frenchman we could see that we had better get on with the Blackback banding, as some of the chicks were in the water. We anchored off Horuhoru, and climbed up the Terraces to North Ridge. What we found there is outlined in Table XIII. We used bands M4301 to 4310. The first three birds ringed had not been banded before, but the other seven were " repeats." M 4301 and 4302 were in T and 4303 in U. The next three repeats in U, had all been banded as chicks in some other area. M 4304 had been banded 28 559 in area M on 7/1/56 a 76-day-chick; it was therefore 9 yrs 2 mths old. It was not on a nest. The other two had been banded 0 170 and 0 186 as 100-day-chicks on 3/1/59, so they were 6yrs 3 mths old. One was on an egg, the other had a 35-day-chick.

The next one was most interesting. On 7/1/58 it had been trying to hatch an egg in Ta. This was very late, but on 30/1/58 it was still trying. It was banded 35 441 on the left leg.

Ten months later and still in area Ta, it had had more success, for there was an 18-day-chick in the nest; we banded it 37 013, and opposite the date 22/11/58, recorded it as being 7+. Another six years had passed when we found it still on Ta, but this time without an interest in any nest. At 13+ it seemed to be taking a year off. It was then banded M 4307.

When we came opposite the higher taupata to the east of area V, we found a dead gannet hanging down among the branches. It had a ring 0 103. Hatched in U on 25/10/58 it had been banded on 3/1/59. Now at the age of six years it was back at Horuhoru. It had been away on some business and when it was shot, had not enough strength to get home.

Two more were caught in T on the way back to the Terraces. M 4308 had been hatched in T on 25/9/58 and banded as a 70-day-chick on January 3rd 1959. Now at the age of 6 yrs 3 mths it was building on the extreme western edge of Tb, and had a 100-day-chick in its nest. The final one in area T had been there a long time. It was one of our first chicks to be banded on 8/3/52 No. 16 342 on its right leg. It had been a recovery on 30/8/57, when caught near an empty nest. It had been banded on the left leg 35 408, tail 343, age 5 yrs 9 mths. When it was a repeat now on 26/12/64 it was 13 yrs and 1 mth old, had a 4-day-chick in its nest, had changed its tail code to 334, had lost its original ring 16 342 and so was given a new band M 4309.

And finally we came to M 4310. In 1963 when we were climbing up to band the final set of chicks in T, we found in G an adult with tail code 344, trying at that late date (17/1/63), to hatch an egg; now with tail code 334 we find him still in G with a 30-day-chick.

TABLE XIII

BANDS		26 / 12 / 64			Banded before 26/12/64			Present Age
Left leg	Right	Status	Where	Tail	When	Where	Age	Yr / M /Day
M 4301		Nest	Tb -14.6	332				6
M 4302		30 dc	Ta 16.2	443				6
M 4303		6 dc	U	434				6
M 4304	28 559	Not	U	343	7/ 1/56	M	76dc	9yrs2mth0dys
O 170	M 4305	Egg	U	243	3/ 1/59	T	100dc	6yrs3mth0dys
O 186	M 4306	35 dc	U	353	3/ 1/59	T	100dc	6yrs3mth0dys
35 441					7/ 1/58	Ta	6	
		Egg			30/ 1/58	still on egg		
	37 013	18 dc			22/11/58	Ta	7	
M 4307		N	U	434				
35 411	removed							
				Hat	25/ 9/58	T		
O 160					3/ 1/59	T	100dc	
	M 4308	90 dc	Tb -10.1	243	26/12/64			6yrs3mth0dys
	16 342*		T		8/ 3/52		0/3/7	
35 408		M T	T	343	30/ 8/57	T	5/9/0	
	M 4309	4 dc	T	433	26/12/64			13yrs1mth2dys
O 501		Egg	G	344	17/ 1/63	G	7	
	M 4310	30 dc	G	334				9
O 103				Hat	25/10/58			
					3/ 1/59	U	70dc	
	Found shot Nth U				26/12/64			6 2 ?
		*Later lost						

30 dc on nest with 30-day chick
Not near a nest but apparently having a year off
N near a nest but relationship uncertain
N T empty nest
Hat date of hatching
Age in "Banded before 26/12/64"
age is 100dc or 0/3/7

The 30, 35, 90 dc are reliable estimates of the chicks' ages but 100 dc seen here three times, is not so accurate. If a chick lives 88 days and has a 6″ tail, the tail will grow as he gets older. But if he wanders about "gossiping," and leaning back on his tail on jagged rocks, a 100 dc is one that has a good 6″ but there is a row of untidy spikes jutting out further. At Mahuki there are many with 7½″ tails, because they have a wide promenade between the rows of nests and the cliffs, which comes from many years of nesting gannets. When a parent is away fishing for the 100 dc, on return, while still airborne, he utters a long call-sign which all the chicks can hear, but only one answers it. If you are in the way, that one chick will brush past your legs as he hurries back to the nest in which he has spent the last few weeks, for he knows that the chick on that nest is the one that will be fed when the fisherman alights.

A QUIET PERIOD UNTIL 1968

During 1965, 1966 and 1967 the Blackback banding on the Frenchman near Christmas continued, and gannet recoveries continued to be reported from Australia and New Zealand, but there was nothing sensational at Horuhoru until we landed on 9/11/68. The spring had been so mild and the gales so few that we expected a count nearly 1600. Instead, strewn round in irregular groups, there were some 300 occupied nests. The oldest chicks were 24 days, instead of from six to seven weeks old. Every egg laid before the first week in September, and every egg hatched, had vanished in some catastrophe. There were lots of well made nests lying empty, and a few adults were standing doing nothing. Birds that were on the point of laying about 7th September, may have laid after the disaster, and some of those that had laid and lost their egg, may have managed to make a fresh start in October (there were a number of nests with new eggs in them). These, and the 24-days-old chicks, would have a good chance of surviving.

What had happened ? Was this caused by man or by Nature ? I asked for information from other rookeries, but no one had anything to say. We did a sample run from the landing to North Ridge; 1 in A and G, 10 in T and 8 in U using 36 801 to 36 820. Only one had a ring ! He had been caught on 17/1/63 in U, banded 0 534 aged 94 days, so now he was 5 yrs 3 mths 2 days old, an early layer.

We returned on 26/1/69 and caught 17 in T and U. Seven of them had rings, but there was still evidence of some upset, and the birds we found having a second try in November 1968, seemed to have given up ! Of the banded birds, one was an old friend. He had been banded as a chick in area T and had been found there three times sinces. Hatched on 21/10/52 he was now 16 yrs 4 mths

TABLE XIV

BANDS					BEFORE 29/1/69			
Left leg	Right	Status	Where	Tail	When	Where	Age	Present Age
0 510				334	17/ 1/63	G	6	
	36 268	14 dc	Tb - 4.6	342	26/ 1/69			12
36 350					30/ 8/61	T	6	
	36 267	9 dc	Te - 2.9	433	26/ 1/69			13
0 270					3/ 1/59	T	0yrs 3mths 0ds	
	36 272	20 dc	Td - 8.8	334	26/ 1/69			10yrs 0mths 2ds
36 345					30/ 8/61	T	8	
	36 274	egg	U - 3.4		26/ 1/69			14
36 275	Mate of 36 274		U - 3.4	343	26/ 1/69			6+
28 252			Za		3/12/55		0yrs 2mth 10ds	
	36 279	12 dc	Ta - 14.6	343	26/ 1/69			13yrs 3mths 6ds
15 552*					30/12/52	T	0yrs 3mths 10ds	
	37 037*				22/11/58	T	6yrs 2mths 2ds	
	36 309	9 dc	Td - 6.3	224	30/ 8/61	T	8yrs 11mths 10ds	
36 280		100 dc	Td - 6.3	234	26/ 1/69			16yrs 4mths 5ds
36 349*		egg		444	30/ 8/61	T	6	
	36 281	9 dc	Td - 16.8		29/ 1/69			14

* 15 553 getting thin was replaced 26/1/69
37 037 was lost between 1958 and 1961

Note: (1) 28 252 charged area from North Stack to North Ridge
(2) All the abscissae are negative!

6 days old, the oldest bird of which we knew the exact age. Banded 15 553 on his left leg on 30/12/52, he had an 18 dc in his nest when caught in one of our first sweeps in 1958, and received on his right leg, 37 037. This was a faulty ring for it had disappeared by 30/8/61 when he was banded 36 309 on that same leg. He was in Td –6.3 with a 9 dc and tail code 234. On 26/1/69 he was in the same nest Td –6.3, had the same tail code 234, but a 100 dc. His original ring could still be read, but it was getting thin, and so he received his fourth ring 36 280. Additional data is shown in Table XIV. The four birds caught first as adults in 1961 to 1963 and credited with 6 years as their ages then may be older than 36 280.

OLD AGE

Over the past twenty years of study, we have often wondered when a gannet feels Old Age coming on to slow up his reactions, and his desire to produce more young gannets to follow after him. They are increasing very, very slowly, for how long must they bring up families to accomplish this. Some years we have seen as few as ten per cent succeed in raising their one chick until it could try to reach Australia. And after that, how many perished on the crossing. Many people writing about gannets which they have seen trying to come ashore, through the high surf that runs up on so many of their east coast beaches, have told of their poor condition. N. R. Lawson, manager of the Aboriginal Station at Jervis Bay, where my first " recovery " came ashore, photographed the bird and, dissecting it, wrote that the stomach was absolutely empty. When they succeed in landing, most of our gannets seem to do well enough, but how do they fare when they face the equally perilous journey back across the Tasman ? Many have been found dead on the final section down our East Coast. Judging by the numbers that return to North Ridge, five per cent would be above the general average rate of survival. Taking into account the fact that most gannets wait for six or seven years before their first attempts at breeding, an average pair may well be over ten years old before they raise two chicks to replace themselves, and to effect the slow but steady increase that is seen in some of the colonies, some of the birds must be well over twenty years old.

A LADDER AT THE LANDING

We felt that another major sweep across North Ridge was due, but no opportunity came in the summer of 1969-1970. In the May holidays, however, on a calm afternoon when we were experiencing very low spring tides, we undertook a project which we had planned for years. I had bought a steel ladder heavily galvanised. The sides were of heavy flat-iron with holes into which ½" round rungs had been welded. We prepared half-a-dozen sugar bags of cement and shingle, a six-foot hexagonal crowbar with a point at one end and a wedge at the other, two heavy cold chisels, a sledge hammer and a gallon of cement-fast-setter. When we arrived at the landing below the Terraces, we stacked three of the sugar bags on the bow, and slowly guided the launch in until the bow was within two metres of the rock face. As the tide was running out quite swiftly, the launch moved sideways along the coast of Horuhoru at speed. We

TABLE XV

BANDS Left leg	Right	Status	Tail length inches	Feather Code	Age 31/12/70 Yr/M/Days	First banded	Age then days
36 890		12 dc	6	342	6yrs		
36 891		egg	7½	343	6yrs		
36 892		35 dc	7	443	6yrs		
36 893		10 dc	6	443	6yrs		
36 894		egg	7	414	6yrs		
36 895		35 dc	7	343	6yrs		
	17 016					20/ 2/54	63
36 896		10 dc	8	424	17y0m16d		
0 113						3/ 1/59	46
	36 897	10 dc	8	343	12y1m 9d		
36 349*						30/ 8/61	6 yrs
	36 281	16 dc				26/ 1/69	13 yrs
36 898		20 dc	7	323	15yrs		
	28 538					7/ 1/56	76
36 899		15 dc	7	333	15y2m 9d		
	28 619					10/ 1/56	80
36 900		10 dc	8	444	15y2m10d		

* lost

Caught first as chicks — 17yrs 16days; 15yrs 2mths 10days; 15yrs 2mths 9days; 12yrs 1mth 9days

Caught first as adults — one at least 15 years old; six at least 6

had selected a place for the ladder, where there were no out-lying rocks, and where the slope down to the sea was about 60°. As Waitangi came near the selected place, Peter started to hurl sugar bags ashore, and when he had finished, they lay six metres apart on the rock face. We backed out, got three more bags up onto the bow, and went through the same performance again. Then it was the ladder's turn. On each of the flat sides, we had welded three long projecting spikes. They made it much harder to handle, but when its turn came to be hurled at the sloping rock face, it slid down a bit, and then stuck fast in some cracks. Had it continued to slide, it would have landed on the sea-bed forty metres below us.

After this performance we anchored the launch a little further out and took all the rest of our gear ashore in the dinghy. Two hours of jabbing and hammering gave us six holes to take the six projections on the ladder. By the time the cement was mixed and

in, the tide had started to flow again. When the holes were full, we placed the empty sugar bags on top, and weighted them down with all the rocks we could find.

Next time we went out we breathed sighs of relief, for there the ladder stood. We have since had news from thankful yachtsmen, who have been using it, too. At high tide in a heavy swell, it covers over, but if you choose your tide, it will serve you well.

SEVENTEEN

The spring of 1970 gave us no chance to land again, but after gales at Christmas, there came a better spell, and on 31/12/70 we went out past Kauri Point, and crossed to Horuhoru. There was a big swell over the ladder, but we took the launch close in, and after three trips in the dinghy, we had a working party ashore. It was blowing up again, so we made a hasty trip up through the Terraces, and across North Ridge. We caught and banded only eleven birds, but four of them had one ring, and one had two. Best of all, one of the birds was just over seventeen years old. We did not take co-ordinates this time, but we measured all the birds' tails, and recorded their tail codes as is set out in Table XV.

The finding of this seventeen-year-old bird made us feel that we had passed a milestone in our quest. The editor of our Journal asked that an account be written of what had happened since, twenty years ago, our Society asked us to make periodic counts of the gannets on Horuhoru. Months have gone by since I started this account, and as I described one aspect of the subject, another would arise that had to be explained to make some point quite clear. At times I felt that I was getting further from my conclusion, instead of nearer it. The delay, however, has made it possible to include two items of great interest: (1) the Computer disclosed that since the beginning of 1971, seven recoveries had been made in New Zealand, of gannets originally banded in the Hauraki Gulf, and (2) in September the chance came of making a Major Sweep across North Ridge.

RECOVERIES 1971

The oldest bird in the seven recoveries had been banded in area U at the beginning of 1953. In September 1959, it had been found again with a chick in area G, at the top of the Terraces. A second ring was added to its other leg. And now on 7/1/71 it became a "repeat" as it was found dead, still in Waiheke, with both rings safe, and their numbers legible. For 18 years it had been dipping the older ring in salt water, many times a day, and it itself was 18 years 3 months and 7 days old. How much happier it would have been to find it home on Horuhoru. The second bird in order of age, was 17 yrs 1 mth 15 days old. While diving in choppy water near Whangarei Heads on 29/12/70, it had struck a rock just below the surface.

Then there were two birds that had been tangled in fishing nets at Awaaroa Bay, on the south coast of Waiheke Island. Their dates were well apart. The elder bird had been ringed on the Terraces in January 1954, and had been found to be dead when the net in which it had been entangled, had been hauled again to the surface. The younger was more fortunate. Early in 1956, it

had been banded on the North Promontory of Motu Karamarama, and when the net in which it was caught came to the surface on 4/8/71, the gannet was found to be alive. After being released, it was able to paddle slowly away. The fifth bird was found dead in Waipu Cove. Banded on North Cliff in January 1956, it was over 50 miles from home.

TABLE XVI

1971 Recoveries

Band No.	Banded	Where	Area	Age	Recovered	Age	
19 801	14/ 1/54	Horu	Terr	12 wks	1969	15+	Awaaroa Dr in net
19 005	8/ 1/54	Horu		56d	29/12/70	17yrs 1mth 15ds	Wh Heads Kld Diving
28 217	3/12/55	Horu	Za	40d	26/ 2/71	15yrs 4mths 4ds	Waikanae Dead on Bch
28 715	20/ 1/56	Horu	V	90d	17/ 1/71	15yrs 2mths 26ds	Waipu Cv
28 976	21/ 1/56	MotuK	NthPrm	98d	4/ 8/71	15yrs 5mths 2ds	Awaaroa Net/Relsd
15 621	7/ 1/53	Horu	U	14wk	7/ 1/71	18yrs 3mths 7ds	Waiheke Dead on Bch
0 401	13/ 9/59	Horu	G				
M 4580	25/11/61	Mahk	East	Juv	24/ 1/71	9yrs 5mths 0ds	Muriwai Dead on Bch

Horu	Horuhoru
Terr	Terraces
MotuK	Motu Karamarama
Wh Heads	Whangarei Heads
Nth Prm	North Promontory
Waipu Cv	Waipu Cove
Mahk	Mahuki
Juv	Between 6 & 14 weeks old
Dr	Drowned
Net/Relsd	Tangled in net but released alive.

TABLE XVII

AGES OF GANNETS

Horuhoru December 1971

Banded as chicks		Age for sure		
1952 - 1953	2	19 years		
1954 - 1955	2	17 years		
1955 - 1956	3	16 years		
1958 - 1959	5	13 years		
1962 - 1963	2	9 years		
Adults first banded				
1959 - 1960	3		Possible age 17 years	Much more likely 18+
1964 - 1965	1		12	13+
1968 - 1969	8		8	9+
Totals	14	12		

The other two gannets were found on the West Coast hundreds of miles by sea from home. One was a " fluffy " when banded on North Stack in December 1955. Over fifteen years of age, it was found dead on Waikanae Beach on 26/2/71. The other, banded M 4580 on 25/11/61 at the eastern end of the main group on Mahuki, was 9 yrs and 5 mths old when found dead at Muriwai on 24/1/71.

SUCCESSFUL SWEEP — SEPTEMBER 1971

Several circumstances made possible the very successful sweep across North Ridge on 25/9/71. At the eastern end of Waiheke, there were still two uncompleted squares in the New Zealand Mapping Scheme, and the upper one included Horuhoru. The Auckland Regional Group engaged on this work, had planned to travel to Orapiu at the south-eastern corner of Waiheke, by the steamer which runs to Pakatoa on Friday nights. They were to work through the week-end from the Friday until Sunday, 26/9/71. We had undertaken to get a party of them out to Horuhoru on the Saturday, if it were at all possible.

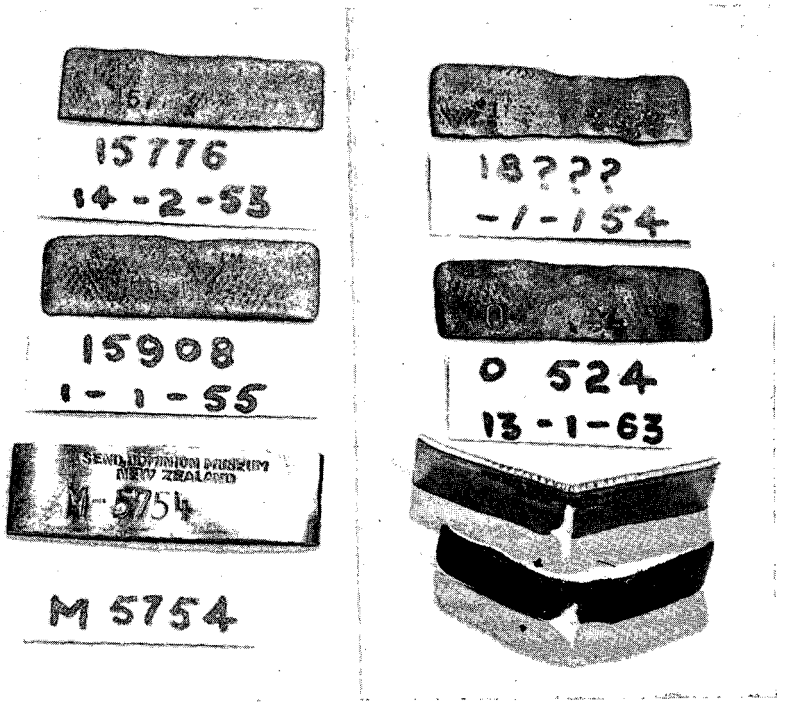
The weather up to Thursday had consisted of a series of minor gales with rainy intervals between. It cleared enough on the Friday afternoon for us to go by launch to Arran Bay, and we spent the night there. When Mrs. Reed rang through early on Saturday morning it had brightened still further, so we arranged for them to walk over from Orapiu to Arran Bay, counting and recording their findings as they came. Peter arrived by plane in the morning and when all 10 assembled before noon, we decided to make the attempt. As we travelled to Kauri Point the sea went down even further, so we crossed to Horuhoru and made a slow circuit of the island.

There was great activity on South Ridge; we counted 29 nests in area S. The Terraces were crowded with what seemed to be a record number of nesting gannets. North Stack was also full of birds, and a double row of " Spotties " after a good morning's fishing, were sitting drying themselves in the sun.

On completing our circle round the rock, we came close in to the landing again, and in four trips of the dinghy, had the banding gear and all nine members of the party safely ashore. After carrying the dinghy well up on the wave platform, they began the climb to the top of the Terraces. There were many birds showing one band, and one two. As the weather was threatening to break again, they decided to catch only banded birds.

From the landing up to " A," and again from " A " to " B," there is a steep rise, and it is often possible to catch a glimpse of a ring from the lower level as you approach; two birds were caught, one in " A " and the other in " B," and they were banded 44 401 and 44 402. From area G the passage to area T has become very wide, as birds in finding new nesting sites have trampled the scrub right down. Since the landing on 3/12/70 another twenty square metres have been cleared, and a fair number of nests have to be passed before we come to the " fences."

Ron went well ahead and using the reversed catcher, he raised each sitting bird a little until he could see its legs. Most of the sitting birds were quite apathetic to this procedure; there were few protests. Having located a ringed bird he would reverse the catcher



[N. M. Gleeson

FIGURE 16 — Rings from banded Gannets after from 12 to 18 years at sea.

and get the loop in place to bind the bird's wings closely to its sides. Then he swung the gannet slowly round to Peter who, following close behind, secured it by its beak and one wing. Mrs. Reed entered on the ruled Whakaboard all the details required. The remainder of the party, Win Mitchell, Brigit Pike, Connie Schischka, Pen Smith, Stan Brown and Tony Wilkins, in turn, performed the operations needed to complete a good day's banding. One prepared the next ring while Stan Brown called its number to the Recorder. Peter gave the bird's position, and with Connie Schischka, its tail feather code. When the additional band had been closed round the bird's leg, all moved on to where Ron had looped the next bird. In this way, starting from 44 421, they banded 19 birds in T and 4 in U. On the way back to the landing they banded the 26th gannet in B, using 44 434.

Some of the bands were so worn that they were removed and brought back to Auckland for identification. Some of them are shown in Fig. 16, with a new band (M 5754) for comparison. An end view to show how thin some of the rings had worn, is also included.

While this was going on, I had circled the island eight times, slowly counting the nests in all the areas that slope down to the sea, at an angle of 30°. I was able to get that A+B+C = 148, and P = 41 and S = 29. I thought that there were well over 1550 nests occupied. At the same time Mrs. Reed counted the nests with eggs in T and found:— Ta 21, Tb 18, Tc 28, Td 56 and Te 73; Total 196.

I brought the launch in to the landing again and using the ladder to embark, we soon had the Regional Party back at Orapiu. We returned to Arran Bay feeling that the day had been well spent. Peter returned to Horuhoru on 24/10/71 and caught 28 588 by hand; banded when it was three months old on 7/1/56, it was now just over 16 years old. He reported that the " cloud burst " on the 18th had washed a number of eggs out of nests in area L, and that they had fallen onto the rocks at the landing, and been smashed. When we passed close in on 1/11/71 during the Hauraki Gulf outing with the 70th Congress Party of the R.A.O.U., there was no marked gap in the nesting birds in area L.

It was only when we returned to our records in Auckland, that we could work out all the details. There is a book for each year back to 1951. In most cases the area in which the bird was banded is stated, and in every case the bird's age is given, up to 1954 in weeks, but after that in days. In the period 4/12/54 to 8/1/55 we banded 707 birds on Horuhoru and in the space " where " it says " Horuhoru "; the area letters were omitted. Some of the records took hours to trace. In the case of the bird rebanded 44 424 on the old ring only the first two digits, 28, were recognisable. One hundred of these had been used at Mahuki and also at Motu Karamarama and 642 at Horuhoru. The oldest of these was 90 days old on 7/1/56, and the youngest 40 days on 3/1/55; this made them only a week apart in age, 15 yrs 11 mths and 16 days, and 15 yrs 11 mths and 23 days. Unfortunately there was a further complication. There were nine adults banded in that period, 1 in B, 1 in G, 2 in H, 1 in M, 1 in U and 3 in Z. If the adult in U, 28 973, be selected and credited as being 6 years old then, he would now be 22 ! Apart from this, the oldest contender was banded 15 685 in H on 22/1/53 and recovered in Te on 23/11/57 when just over five years old, and rebanded 35 423. On 25/9/71 it was still in Te, and then 18 yrs 10 mths and 26 days old. The older ring was removed and replaced by 44 427.

The next in order of age was 98 days old when banded in T on 14/2/53, and now in B was almost 19: 18 yrs 10 mths 18 days. The other two-digit ring was also a problem. At Motu Karamarama on 10/1/55 we had used 18 437 to 18 486, and at Horuhoru from 27/12/54 to 8/1/55 we had used 18 501 to 18 997. The youngest, which was 64 days old on 1/1/55 was now just over 16 yrs old. Those banded as adults on 12/9/59 were all in area T both then and now, and if 6 years old then, were now over 18 years old. All the other information that we have about these birds is given in Appendix E. After a great deal of paper work, we found that we had banded again 14 originally banded as chicks and on 25/9/71 two were over 18 years old, one nearly 17, two over 16 and two

just under it, two exactly 13, three more near it and two over 9. These ages are known exactly, and their average was over 14 years and 4 months. Of those banded as adults, three were over 18, one 13, seven over 9 and one over 7: the total average is almost 12 years, an admirable record.

THE UNDISCLOSED BALANCE

The adults breeding in area T may be divided into three classes, (1) those that started their lives there, and have been to Australia and back, (2) a very few that have come in from other areas on Horuhoru and (3) those that were in the area before we started serious banding in 1952. These must now be twenty years of age and older. If we accept as fact that very few gannets start breeding before they are six of seven years old, we need not consider in our figures any fledglings that have departed since the 1964-1965 season. It is possible to get quite a good idea of what fraction we have banded of those who have left during this period, and it is outlined in Appendix G.

In most of the banding schedules, the area in which each chick was banded is stated on the sheet, but there are some exceptions. In 1955 the space headed "where" says "Horuhoru," and in 1958 and 1961 three schedules* in each year say "North Ridge." Again in 1960, 1962 and 1964, no chicks were banded in area T. If we make allowances for these gaps in the records, using the very accurate figures recorded for the other periods, we arrive at 739 out of 1523, or 48%, for which a working fraction of ½ is reasonable.

Some of the chicks departing with bands returned without them. There are two causes of this failure in our plans: (a) Fair wear and tear and (b) the ill-considered zeal of anglers who on finding living gannets on their spinners, remove the ring and post it back to Wellington, instead of making a note of the number and freeing the bird with band in place, so that it could return to Horuhoru a recognisable member of the community, instead of an unnumbered prodigal, among many other unbanded birds.

(a) The number lost by fair wear and tear, includes rings which lose their tension and open out, so that they can be knocked off. There are very few of these. Among two-ringed birds we have only two records of one of the rings being lost, before we caught the gannet for a third time. In one case when a ringed bird was recovered† its ring was found to be very much worn, so a new one was placed on its other leg. When it became a repeat‡ the worn ring had disappeared and so a third one was added. In the other case it was the new ring that disappeared; probably the pliers had

* Nos. 123, 124 and 125, and 131, 132 and 133.

† When a banded bird is caught again, a second ring is placed on its other leg. When it is caught a third time, the older ring is replaced by a new one.

‡ When a bird that has already been banded is caught for a second time, it becomes a "recovery." When caught for a third time it is a "repeat."

failed to close the gap completely. Only one ring has been found lying among the nests on Horuhoru. It was in the area in which it had originally been used.

(b) Of the rings returned, well over 90% were from dead birds. When a living bird had become entangled with a spinner, in about two-thirds of the cases reported, the angler had removed the ring. After this had happened a number of times, I wrote to several papers and people about the correct procedure; some of the more interesting results are set out in Appendix L.

THE BALANCE

I shall now attempt to show that when all allowances have been made for the birds which have returned to area T, from those raised there during the years from 1951 to 1965, there is still a considerable balance of additional birds, whose presence has not yet been explained. It is true that a few of them may have come in from other areas, but these will have little effect, for some will also have gone away. Of the birds caught in T on 25/9/71 and previously banded as chicks, 1 came from H, and 2 went to B. Of the 12 banded first as adults, 6 stayed in T, 1 went to A, and 5 came from U which is the adjoining area. We have found, too, that over 90% of the birds banded as chicks on Horuhoru, returned to their old area to breed. Of the many imponderables with which we will have to deal, this will be a very minor one. I shall have to make some arbitrary choice in some of the ratios with which we shall have to deal, but I can show, that if we select other ratios, the Undisclosed Balance will become greater. If my calculations can be trusted, I shall give evidence that a considerable number of the birds in area T, were there before we started banding in 1951, so that they must now be over twenty years of age. I shall now show that by using calculations like those made in the Insurance profession, we can get some idea of what those ages may be. Proof, of course, must wait until further work is done on Horuhoru.

THE THEORY

On 25/9/71, we found in area T, 19 birds with a ring each, in 197 nests containing an egg each; this may be taken as 10%, but we will call it 12% to allow for the rings lost by fair wear and tear, and by zealous anglers. Now we come to the hardest part of the problem. If 12% here have, or had rings, what about the other 200 birds away fishing ?

Suppose we take ten nests each with a bird sitting on an egg, and use ten bands to ring them. There are another ten birds without rings away on other duties. If we return in a day or two, we would be astonished to find either ten banded or ten unbanded birds on the nests. Nine to one would also be impossible, even eight to two fairly unlikely. Three to seven is possible and four to six or five to five are quite likely. We shall choose two to eight, because the more likely ratios can be shown to increase the Undisclosed Balance. Our 19 ringed birds in the nests mean that if none had been lost 22 ringed birds would be present. On the assumption that choosing 22 in the nests means 88 at sea, or a total of 110 ringed. Assuming that the birds banded (birds without rings on the way to Australia, is followed by a fifty:fifty ratio in the returning birds, 110 ringed birds in this area now, means that 220 of the birds here now

have been reared here since 1951. But 197 nests require 394 breeding birds, so that 394 — 220 birds in this area now, were not reared here in the period 1951-1965; 174 birds have to be accounted for. Again it is true that some of these have come from other areas but these are very few and are probably balanced by a few going out. In any case, there is a large section that must have been in area T before 1951, who are still there. They must be twenty years of age or older.

PERIODS OF DECLINE

In constructing Insurance Tables actuaries deal with the lives of human beings, who after a short period of relatively high infant mortality, come to longer periods when most individuals settle down to healthy life during which a few die from accident. After a certain stage, they died from natural causes, and during this period the numbers that live on, decrease in Geometrical Progression after this style:— ar^3 ar^2 ar a. The values of a and r have to be determined, and the periods defined. Suppose we take periods of six years. Our gannets spend one period of six years before they breed; on Horuhoru there are now a number of unemployed birds at this stage. Then for two periods of six years they live robust lives and breed. Of the 26 we rebanded on 25/1/71, 10 are in the second period (7 years to 11) and 12 in the third (12 to 17) and four have entered the fourth (18 to 23). Any unemployed birds were in the first period, and the 180 (or 174) unbanded birds, are in the fourth and later periods.

How are they distributed in these later periods? Let us try a couple of cases. Suppose $a=12$ and $r=2$. Then of the 180 birds 96 are in the fourth period (18 to 24 years) and will die before its close, 48 are in the fifth period (25 to 30), 24 in the sixth will die before they are 36, 12 in the seventh (37 to 42 years). On the other hand if $a=14$ and $r=3$, the figures will be 126 in the fourth, 42 in the fifth, and 14 in the sixth (31 to 36 years). In the first case $96 + 48 + 24 + 12 = 180$ and in the second $126 + 42 + 14 = 182$. Only further work on Horuhoru will test these and other theoretical life tables. If someone is prepared to band all the chicks on North Ridge yearly from 1972 until 1977 and to make sweeps such as ours across areas Tc, Td and Te every two or three years from now until 1983 he, or she, will have the answer. If my ratio for the number of banded chicks compared with the number that depart, is too high, the balance will be reduced, and if my proportion of ringed birds found in the nests be taken as 3 to 7, or 4 to 6, or 5 to 5, the Undisclosed Balance will be greater.

THANKS

This work could not have been attempted without a great deal of help. I have already thanked by name, the host of friends and relations who have helped at Horuhoru; I thank them now again, collectively. In connection with this paper I have special thanks, for the excellence of their photography, to Ron Attwell, to Ted Driver, and to Noel Gleeson, to Don Branch for his clear and helpful diagrams and graphs, to my children for their great work and forbearance, to Dick Sibson for his wholehearted co-operation, and to Charles Fleming and my dear wife for their kindly criticism, gentle restraint and continual encouragement.

APPENDIX A

Field name	Age of chick in days	More scientific name
Black	0 – 15	Naked
Whitish	15 – 20	Down appearing
White	20 – 30	Early down
Fluffy	30 – 42	Down fully white
Trace	43 – 60	Early fledgling
Advanced	60 – 80	Mid-feathered
Tufted	80 – 90	Late-feathered
Complete	90 – 108	Completely feathered

APPENDIX B

No	Area	Date laid	POSITION feet	Direction from	Reference point	Description on 23/10/54
I	A	E 9	8	S	1953 red Mk 3	Hatching: ½" hole
II	B	L 8	2	W	" " " 3	Addled
III	C	9	4	NNW	" " " 3	Cracked ¾ way round
IV	DE	L8E9	1½	SSW	Flat rock	4-day old chick!!!!
V	DE	"	3½	SSW	" "	Hatching
VI	Q	"	1½	NNW	Green stump	Just hatched
VII	Q	"	3½	ENE	" "	Just hatched
VIII	Ta	9	2	SSE	Red rock	Addled
IX	Ta	L8E9	6	SW	End fence one	Gone: nest deserted
X	U	8	6	E	Umbrella tree	Died hatching 22nd
XI	U	8 – 9	1	S	Mid/fence 17	Just over one-day chick
XII	Ta	8	4	NE	XIII	Hatching
XIII	Ta	8	1	E	Red rock	One-day chick
XIV	Ta	8 – 9	3½	SW	XIII	Gone: nest deserted
XV	Ta	7	3	E	XII	Two-day chick
XVI	Ta	8	5	N	XV	1 2-day chick
XVII	Ta	7	1	S	Fence one	Two eggs: one old
			10	N	Red rock	one new
XVIII	Ta	8?	2	S	Sth end fence one	
			3	WSW	XVII	One-day chick
XIX	Ta	9	2½	W	XIII	Hatched early to-day
XX	Za	9	1	E	Rock face	Hatching: almost out
XXI	Za	9	4	E	" "	Hatching: egg tooth showing

Day laid was either 8/9/54 or 9/9/54.
E 9 means early on the 9th.
L 8 means late on the 8th.
L8E9 means from noon on the 8th to noon on the 9th.
8-9 means somewhere between 6 a.m. on 8th to 6 p.m. on 9th.
7 probably late on the 7th.

APPENDIX C

Recoveries: 1959-1960 Nos (1), (2), (3), (6) and (45)

(1)
35 428 left leg

29/12/57 On Gertie's nest in G
Age 6+ Tail 2+6+2
Thought to be G's mate
12/ 9/59 On G's nest
Age 8+ Tail 2+4+2

(2)
37 007 left

27/10/51 Egg laid in V
9/12/51 Hatched
28/ 1/52 Ringed 16 166 right
8/ 3/52 Seen in V
26/ 3/52 Departed; very late
22/11/58 In "I" overlooking "D"
M T nest
16 166 very worn
Replaced by 37 007(1)
7/10/3 Tail 3½+3½+3½
12/ 9/59 Point nest in "I" Nearly 8
on egg Tail 3+3+4
Ringed 0 302 (right)

(3)
37 010 left

22/11/58 Ta -2.6 6+
19-day chick Tail 3+7+2
12/ 9/59 Ta -2.4 7+
new egg 3+7+2

(6)
35 425 right
3/ 9/53 Tc 3.9 (Omega nest)
By new laid egg 6+
Tail still wet Ringed 15 787 left
23/11/57 On egg (new laid) 3' NW Omega
Ringed 35 425 Tail 3+6+3
The ringed bird then flew off; ten mins later its mate landed to stand by nest
Caught. Found it was 15 787 left
Placed 35 425 on right leg
Pair now 35 426 male
15 787/35 425 female
1958/59 season 8 unsuccessful attempts to catch.
12/ 9/59 Tc 3.9 on egg Tail 3+2+3

(45)
35 407/16 129
12/11/51 Hatched very top of "G"
28/ 1/52 Ringed 16 129 right

30/ 8/57 Recovered 5yrs 9½mths
16 129 very little/35 407 left
Now 2nd nest in "A" 10' from cliff
Now 50' west & 40' down from "G"
Photographed tail 3w 1v 2b 1v 3w = 10

Oct 57 On egg
23/11/57 Egg gone: nest deserted
Another egg laid
30/ 1/58 On chick tail 3w+3b+2 small +3w
22/11/58 2nd nest in "A" Age 7yrs 3days
With chick tail 3w 1v 2b 5w = 11
12/ 9/59 2nd nest in "A" Age nearly 8
tail 4w 1v 1b 4w = 10

APPENDIX D

Contents of Gannet Nest

Carpophyllum flexuosum	275	
" maschalocarpum	36	
" plumosum	65	376
Sargassum sinclairii	50	
Mesembryanthemum australe	23	
Feathers	25	
Twigs of Metrosideros excelsa	19	117
6 stalks	6	
5 each of Salicornia australis, torulosa	10	
4 each of grasses, Cystophora retroflexa, Laurencia distichophylla	12	
3 each of bone, Chalina racemosa Hormosira banksii, Parietaria debilis	12	
2 each of animal, Coprosma repens, Halopteris hordaceae, gannet foot	8	
and 1 Norfolk pine bract	1	49
		542

APPENDIX E

BANDS Left leg	Right	AGES Chick	Adult	Date	Where	Tail	Present Age
18 ???	say 44			1/ 1/55	T		
	44 401			25/ 9/71	B	444	16yrs 10mths 7days
36 811			6 yrs	9/11/68	Ta 2.2		
	44 402			25/ 9/71	A	354	9yrs
36 802			6 yrs	9/11/68	U	444	
	44 411			25/ 9/71	Tc	453	9yrs
0 319			6 yrs	12/ 9/59	Tb -4.2	423	
	44 412			25/ 9/71	-Ta	524	18yrs
0 363			6 yrs	12/ 9/59	Tc -12.5	344	
	44 413			25/ 9/71	-Tb 1	444	18yrs
0 133		86		3/ 1/59	Tb		
	44 414			25/ 9/71	-Tc	424	12yrs 11mths 16days
36 273			6 yrs	26/ 1/69	Ta		
	44 415			25/ 9/72	Td	454	9yrs
0 234		96		3/ 1/59	Tb		
	44 416			25/ 9/71	Td	424	12yrs 11mths 26days
0 184		98		3/ 1/59	Tc		
	44 417			25/ 9/71	Td	453	12yrs 11mths 28days
0 394			6 yrs	12/ 9/59	Te -10.5	243	
	44 418			25/ 9/71	Td	363	18yrs
36 277			6 yrs	26/ 1/69	U		
	44 419			25/ 9/71	Te	434	9yrs
M 4302			6 yrs	26/12/64	T-U	444	
	44 420			25/ 9/71	Te	444	13yrs
36 275			6yrs	26/ 1/69	U	(mate of 36 274)	
	44 421			25/ 9/71	-Te	443	9yrs
36 278			6yrs	26/ 1/69	U		
	44 422			25/ 9/71	Te	444	9yrs
36810			6yrs	9/11/68	U	224	
	44 423			25/ 9/71	Te	544	9yrs
	28 ???	90		7/ 1/56	Te		15yrs 11mths 16 days
		40		3/12/55	Te		15yrs 11mths 23 days
			6yrs	3/12/55	Te		22yrs
44 424				25/ 9/71	Te		
	28 594	90		7/ 1/56	Te		
44 425				25/ 9/71	Te	444	15yrs 10mths 28 days
18 ???	say 64			1/ 1/55	Te		
	44 426			25/ 9/71	Te	443	16yrs 0mths 21 days
15 685 *		84		22/ 1/53	H		
	35 423		5yrs 0mths 24days	23/11/57	Te		
44 427				25/ 9/71	Te	363	18yrs 10mths 26 days
.0 199		100		3/ 1/59	T-U		
	44 428			25/ 9/71	U	444	13yrs 0mths 0 days
0 230		100		3/ 1/59	T-U		
	44 429			25/ 9/71	U	444	13yrs
0 504		56		17/ 1/63	U		
	44 430			25/ 9/71	U	444	8yrs 9mths 2 days
15 908*		70		1/ 1/55	U		
	0 409		5yrs 2mths 26days		U	343	
44 431				25/ 9/71	-U	444	16yrs 11mths 2 days
0 525		84		17/ 1/63	T		
	44 432			25/ 9/71	-Te	242	8yrs 10mths 0 days
36 819			6yrs	9/11/68	Ta -6.1	444	
	44 433			25/ 9/71	-Te	444	9yrs
15 776		98		14/ 2/53	T		
	44 434			25/ 9/71	B	434	18yrs 10mths 18 days

*removed

APPENDIX F

Gannet Counts in the Spring of 1954.

	Terraces		South Ridge		North Ridge		Cliff Stack		Total	Stk	Clf	Rdg	Ter	SR	Total
	A-G	H-P	QR	S	T	U	VW	XYZ							
9/ 9/54															
Nests	244	269	120	18	124	113	54	179	1121	179	54	237	513	138	1121
Eggs	37	27	22	9	22	12	7	32	168	32	7	34	64	31	168
Total	281	296	142	27	146	125	61	211	1289	211	61	271	577	169	1289
Adults Present	225	350	134	34	140	121	68	165	1237	165	68	261	575	168	1237
23/10/54															
Eggs	219	383	122	18	100	119	55	198	1195	198	56	219	582	140	1195
Hatching	6			3			1	4	14	4	1		6	3	14
Black	19	11	9	6	8	9	2	26	90	26	2	17	30	15	90
Whitish		1	1		3	1	1	4	11	4	1	4	1	1	11
White	4	2	3	2	1		1	4	17	4	1	1	8	5	17
Fluffy					1				1			1			1
Total	248	377	135	29	113	129	61	236	1328	236	61	242	625	164	1328
Adults Present	318	471	171	41	163	161	68	230		230	68	324	789	212	1623
	A-G	H-P	QR	S	T	U	VW	XYZ		Stk	Clf	Rdg	Ter	SR	Tot
4/12/54															
Eggs	25	19	18		12	3	3	27	107	27	3	15	44	18	107
Black	9	25	16		11	12	6	13	92	13	6	23	34	16	92
White	64	70	42	10	30	36	17	75	344	75	17	66	134	52	344
Fluffy	91	72	29	8	35	39	20	69	363	83	20	74	163	37	363
Trace	20	13	12	7	19	5	4	27	107	27	4	24	33	19	107
Advanced	2	1	2	1	2				8			2	3	3	8
Tufted		1			1			2	4	2		1	1		4
Complete															
Total	211	201	119	26	110	95	50	213	1025	213	50	205	412	145	1025

APPENDIX G

GANNETS BANDED in HAURAKI GULF

	A-P	QRS	T	U	VW	XYZ	Other Islands	Total	Adults	AREA Chicks banded	AREA Total Chicks
1950-1951			28					28	4	28	
1951-1952	64	36	27	22	13	36		198	3	27 out of	29
1952-1953	87	27	64	51	7	14	10 a	270	4	64	70
1953-1954	235	84	70	57	40	148		634	6	70	90
1954-1955	239	109	90	83	42	145	50 b	758	6	90	96
1955-1956	338	94	76	68	38	126	100 c	840	7	76	84
1956-1957	308	98	107	9	32	72	100 b	726	4	107	118
1957-1958	50		42	47	10			149	75	42	68
1958-1959			113	87				200	123	113	148
1959-1960									114		90
1960-1961	11		52	38			300 c	401	-	52	70
1961-1965			70					70	110	70	660
1965-1971									156		
Totals			739				560	4274	612	739 out of	1523

a Motu Takupu b Motu Karamarama c Mahuki

APPENDIX H

Adult Gannets banded on Horuhoru

	A	B	C	D	G	HI	JK	MNO	PR	Ta	Tb	Tc	Td	Te	TU	U	VW	XYZ	?	Total	T	TU	U	North Ridge
55 56																		1	29	30				
56 57		1			1				1				1							4				
57 58	4	2		6	4			4	1	4	3	2	7	12	1	22				75	28	1	22	51
58 59			1	2	1	1				2	5	4	5			1			102	123	16		1	17
59 60					4	5	1	1		13	18	35	27	4		1	2			114	97		1	98
60 61	A	B	C	D	G	HI	JK	MNO	PR	Ta	Tb	Tc	Td	Te	TU	U	VW	XYZ	?	Total	T	TU	U	North Ridge
61 62					1										60					61		60		60
62 64																			29	29				
64 65	2				1						1	2	3	2		9				20	8		9	17
65 68	2				2					1	1	2	3	2	60	9				82	9	60	9	78
68 69	1				2					1	6	2	[illegible]	5		11				37	33		11	34
69 70	A	B	C	D	G	HI	JK	MNO	PR	Ta	Tb	Tc	Td	Te	TU	U	VW	XYZ	?	Total	T	TU	U	North Ridge
70 71	2	1	1	3	1							1	1				1			11	2			2
71 72	1	2								3	1	2	4	10		4				26	19		4	23
Total	12	6	2	11	17	6	3	5	2	23	35	50	60	35	121	57	4	3	160*	612				

* In the schedules from which these numbers were taken the "Area in which banded" was not indicated.

APPENDIX J

SHETLAND SANCTUARY

In Shetland Sanctuary* Richard Perry has three chapters about the gannets of Noss, which build on the Noup, a great cliff-face on the southern coast. Here there are thousands of hollows, shelves and pockets, where countless other sea-birds build. The gannet nests are from 20 metres above the sea, up to over 100. From a rocky projection he could observe six, level with his eye, only 10 metres away, but three dozen more were on a ledge 20 metres below him. For over four months he watched at intervals from 3 a.m. to after midnight. He describes their nest building: when dozens of birds plucked large mouthfuls of grass from the pasture at the upper edge of the Noup, while others gathered bladder weed from a reef out of range of his binoculars, and many more went to the Mainland to bring back tangle. He was so close that the rustle of the pages of his field book disturbed the birds. Yet after the egg was laid, the two parents attended it so closely, that it was up to five days before he was sure an egg had hatched. On Horuhoru our attention is drawn to hatching chicks, by the little puppy barks they make, as soon as they have a ½" hole cut through the egg shell.

In his second chapter "Nine Weeks a Growing," he speaks of the birds being fed for 8 and 9 weeks but it is not clear how long the parents attend them, although many stay for weeks after the chick departs.

In Chapter 3 "The Young Go Down To The Sea," he tells of gannet chicks exercising their wings facing the rock for some days before they leave, but on the day it is to leave, the chick does its exercising facing the sea. In spite of his close attention, he missed the first half dozen flights, and did not observe the chick until he saw it floating on the water, *tail awash,* travelling short distances by paddling, but mostly drifting about with the tides for several days, during which the parents still stayed at the nest. At times when a chick fell from the nest or wandering, was trampled down by careless neighbours, the adults took no notice but still roosted at the empty nest.

Perry has only three names for the young. During our black, whitish, white and up to "fluffy" they are "nestlings," then they become "chicks," but on the instant they leave the ground when they cast themselves into space, they are "fledglings" — so much for our attempt at using feather-stage-names, acceptable to European ornithologists.

* Faber and Faber Ltd., 42 Russell Square.

APPENDIX K

"DOWN TO THE SEA" FROM MOTU TAKUPU

One morning, 5/4/53, when we were bound for the Coromandel Rookeries, Margaret noticed a young gannet on the water, only a short distance north of Motu Takupu. After we had run up towards the Little Barrier we found it, *tail awash,* making slow progress by paddling a while, and then making short spurts by flapping along the surface of the water for half a dozen beats of its two wings, then taking a long rest. We tried to pick it up by stretching out from the cockpit but it eluded us three or four times, so we lowered the dinghy and tried again. This enraged it, and it ran and flapped along the surface of the sea, and bit the dinghy savagely in the side.

Catching it, we banded it 15 778, placed it back on the surface of the sea, and went on to Motu Takupu. When we climbed up the ridge there, it was clearly visible like a pale mooring buoy, less than a kilometre to the north: but after we had finished our short visit of about 20 minutes, we could not find it: it had vanished.

We ran north for 2 to 3 kilometres and from 1 to 2 out on each beam, but there was no sign of it. Some large fish had swallowed it. We have had news of this happening several times before. With one of our very early "recoveries" we had news from some shark fishermen working out of Two Fold Bay on the coast of N.S.W., who had caught a nine-foot tiger shark, and when they opened it up, they found one of our rings in its stomach, but no trace of the gannet. Off Kawau, another early recovery was picked up without a tail. It could not rise from the surface of the sea, and although it was fed on yellow-eyed-mullet, it died next day. During the 70th Congress of the R.A.O.U. we made one trip to Ohope Beach, and with a dead Buller's Shearwater and a Grey-faced Petrel, found a gannet which had lost its tail, too. Seagulls also are often seen with one foot bitten off. I think that many of our seabirds, floating asleep on the surface of the sea, must often fall victims to sharks.

APPENDIX L

BANDS REMOVED FROM BIRDS TRAPPED ALIVE

After I had news of rings removed from birds caught on spinners, I wrote to several papers and people to pass on the news, that these rings should be left on the birds when they were released, but that a careful note should be made of the number; the tag reads "Send Dominion Museum New Zealand." There was a fair bit of publicity. Australian papers make far more comment than is made in New Zealand.

There were several interesting results: "People" paged me between Winthrop Rockerfeller's wife Bobo, and Phar Lap the famous racehorse. From the Queensland Marine Department I received a copy of their "Quarterly Gazette" containing an "Advice to Masters of Trawlers." In New Zealand one sensible angler from Whitianga made a note of the number on the white painted counter of his friend's launch, using his wife's lipstick.