

TRANSACTIONS
OF THE
ROYAL SOCIETY OF NEW ZEALAND

ZOOLOGY

VOL. 9

No. 2

25 MAY 1967

The Gannets at Cape Kidnappers. 2. Dispersal and Movements

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[Received by the Editor, 9 March 1966.]

Abstract

A total of 7,940 gannet chicks was banded between 1951 and 1964 at the following New Zealand gannetries: Kidnappers Plateau, Hawke's Bay; Horuhoru, off Waiheke Island; Mahuki, off Great Barrier Island; Bush Island, Hauraki Gulf; and White Island, Bay of Plenty; an attempt was also made to recapture or identify all gannets banded as chicks at Kidnappers Plateau on their return to breed at this colony.

Of the recoveries of banded birds at Horuhoru 79% were less than one year old, demonstrating a very high mortality in the first year: the corresponding figure for Plateau birds was 88%. At the four northern gannetries the juvenile birds disperse earlier than at the Plateau. Kidnappers Plateau juvenile gannets on their dispersal follow three routes of decreasing importance round North Cape, through Cook Strait, and south via Foveaux Strait. Most gannets banded at the four northern gannetries take the northern route and few disperse to the south. The Australian recoveries of birds less than a year old from all five gannetries range from Northern Queensland to Tasmania in the south and Western Australia in the west. The distances travelled up to 6,700km, are greater than those travelled by South African and North Atlantic Gannets. However, most juvenile birds are recovered on the Australia east coast between 31° and 37° S where landfall is made after crossing the Tasman.

Contrary to previous findings evidence is advanced that some of the chicks spend their first year in New Zealand waters; and that some adult birds which were recorded breeding upon their return to their gannetry showed a strong dispersal urge as they were subsequently recovered in Australia.

The return of young gannets to the colony is gradual: the sighting of two-year-olds is exceptional and most return when five years old. They show a remarkable attachment to their gannetry which they have seen from the sea only once during their initial flight. Of 276 recaptures only six birds (2.1%) banded as chicks at Kidnappers Plateau were found nesting at one of the two adjacent colonies, and most returned to the same cluster of nests where they were hatched.

INTRODUCTION

A long-term ecological study of gannets (*Sula bassana serrator*†) at Cape Kidnappers, New Zealand, was carried out between the 1945-46 and 1964-65

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† Following the New Zealand Check List (Fleming, 1953: 28) Australian gannets are considered conspecific with the North Atlantic and South African gannets.

nesting seasons. The population changes during this period are the subject of the first paper (Wodzicki, 1967). The present paper describes the movements of juvenile and adult gannets banded as chicks between the 1950-51 and 1964-65 nesting seasons.

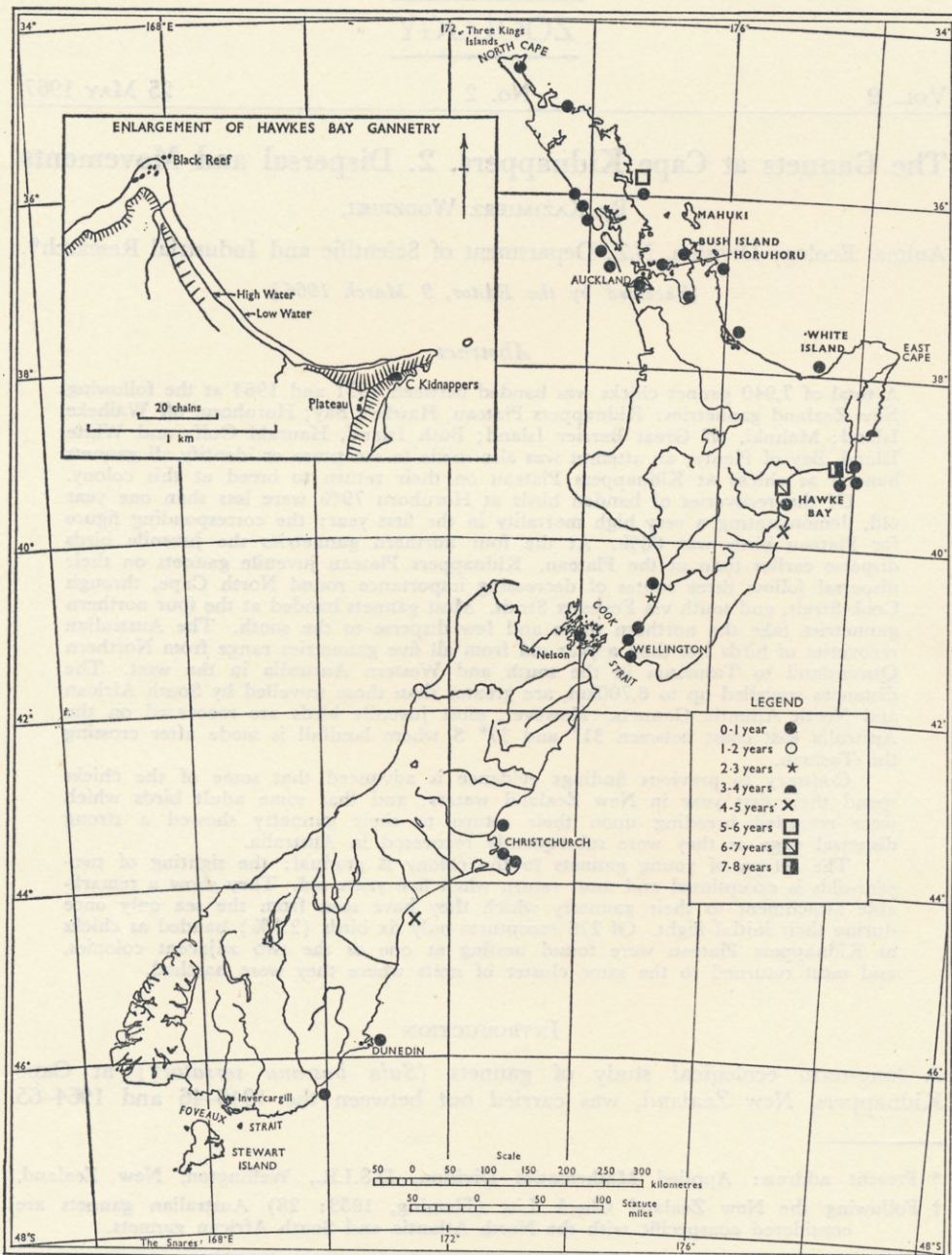


FIG. 1.—New Zealand recoveries of gannets banded as chicks at Kidnappers Plateau 1950/51-1964/65.

It has been known for some time (Stein and Wodzicki, 1955: 61–64; Wodzicki and Stein, 1958: 305) that juvenile gannets when fully fledged migrate to Australia and remain there until two or three years old. Less is known about the movements of adult birds except that from the third year onwards most recoveries are made in New Zealand.

The present study is based on twice as many birds as were available for the first analysis in 1958. In addition recoveries of gannets banded at the Horuhoru, Mahuki, Bush Island and White Island colonies have also been examined, and the movements of these birds compared with those from Kidnappers Plateau.

MATERIAL AND METHODS

Table I shows the numbers of young and adult gannets banded at five gannetries. The history and other aspects of these have been described by Fleming and Wodzicki (1952: 44–45), and Figure 1 shows their location. At the Plateau colony, part of the Cape Kidnappers gannetry, an effort was made to band the whole crop of chicks each year since the 1950–51 nesting season. The 1955–56 and 1964–65 seasons were exceptions when it was not possible to band all the chicks. In all 2,513 chicks and five adults were banded.

No banding was carried out at the two adjacent colonies (the Cape and Black Reef) in an attempt to find out whether any birds banded as chicks at the Plateau colony would settle as adults on one of the other colonies. Also the numbers of chicks at the Cape and Black Reef were too large for all to be banded.

Since the first banding of chicks at Kidnappers Plateau in 1951 regular observations have been made every year at all three Hawke's Bay colonies to identify returning birds. Initially the number of the band was read using binoculars. However, this procedure was time-consuming and since 1955–56 a gannet catcher (made by Mr R. L. Edgar) has been used to lift individual birds from the colony for examination without much disturbance to other birds. A total of 276 birds was sighted or caught, and rebanded if necessary, between 1954–55 and 1964–65.

TABLE I.—Number of Gannets Banded 1950/51–1964/65.

Nesting Season	Plateau		Horuhoru		Bush I.		White I.		Mahuki	Total	
	Chicks	Adults	Chicks	Adults	Chicks	Adults	Chicks	Adults	Chicks	Chicks	Adults
1950/51	142	1	27	—	—	—	—	—	—	169	1
1951/52	106	1	195	3	—	—	—	—	—	301	4
1952/53	144	1	253	6	—	—	—	—	—	397	7
1953/54	142	1	624	9	—	—	—	—	—	766	10
1954/55	116	—	705	2	50	—	—	—	—	871	2
1955/56	80	—	627	11	99	1	—	—	100	906	12
1956/57	126	—	633	—	100	—	—	—	—	859	—
1957/58	108	—	181	48	—	—	—	—	—	289	48
1958/59	214	1	200	77	—	—	—	—	—	414	78
1959/60	281	—	—	77	—	—	98	1	—	379	78
1960/61	134	—	101	1	54	—	211	—	—	500	1
1961/62	249	—	—	30	9	—	7	1	299	564	31
1962/63	228	—	70	1	139	—	19	21	—	456	22
1963/64	266	—	—	—	43	2	29	5	—	338	7
1964/65	177	—	—	3	118	—	132	—	—	427	3
Total	2,513	5	3,616	268	612	3	496	28	399	7,636	304

Throughout the investigation New Zealand Dominion Museum size 8 bands were used, cut to obtain a close fit. Since 1959 ordinary aluminium rings have been replaced by duralumin rings. Any bird recaptured was banded on the other

leg to indicate that it had already been recovered. From 1960–61 onwards plastic colour rings were used in addition to aluminium bands. Although the colour rings were subject to considerable wear and had to be replaced fairly often, their use increased the number of sight records of live birds at the gannetry.

At the Horuhoru gannetry 3,616 chicks and 268 adults were banded as part of a long-term study of this gannetry by Mr P. A. S. Stein of Auckland between 1951 and 1964.

Finally, smaller numbers of both chicks and adults were banded during shorter periods at Bush Island, Mahuki and White Island (Table I). A grand total of 7,940 gannets including 304 adults was banded between 1950–51 and 1964–65 at the five gannet stations.

RESULTS

(a) *Initial Flight*

Further observations on the departure of fully-fledged chicks at Kidnappers Plateau confirmed the description of the initial flight given by Wodzicki and Stein (1958: 297). However, on 18 February 1960, different behaviour was noted by Mr S. N. Beatus (*in litt.* 1960) who saw one of four fully-fledged chicks, swimming on water outside the breakers at the Black Reef colony, fly a circuit and then re-settle on water near the gannetry. This colony is on low stacks and possibly some chicks that fall from the rocks remain near the gannetry until able to leave the colony.

TABLE II.—Recoveries Arranged According to Age and Country.

Age	Kidnappers										Total Recoveries	
	Plateau		Horuhoru		Bush I.		Mahuki		White I.		N.Z. Aust.	
	N.Z. Aust.	N.Z. Aust.	N.Z. Aust.	N.Z. Aust.	N.Z. Aust.	N.Z. Aust.	N.Z. Aust.	N.Z. Aust.	N.Z. Aust.	N.Z. Aust.	N.Z. Aust.	N.Z. Aust.
Up to 1 year	29	75	28	92	3	18	1	6	1	12	62	203
1–2 years	1	5	2	15	2	—	—	—	—	—	5	20
2–3 years	1	1	1	7	—	—	—	1	—	—	2	9
3–4 years	1	—	5	3	—	—	—	1	—	—	6	4
4–5 years	2	—	7	1	—	—	—	—	—	—	9	1
5–6 years	1	—	3	—	—	—	—	—	—	—	4	—
6–7 years	1	—	4	1	—	—	—	—	—	—	5	1
7–8 years	1	—	1	—	—	—	—	—	—	—	2	—
8–9 years	—	—	1	1	—	—	—	—	—	—	1	1
9–10 years	—	—	1	—	—	—	—	—	—	—	1	—
10–11 years	—	—	1	1	—	—	—	—	—	—	1	1
Adult	—	—	5	—	—	—	—	—	—	—	5	—
Total	37	81	59	121	5	18	1	8	1	12	103	240

(b) *Locality and Age of Birds Recovered*

Table II shows the recoveries from the five gannetries between January, 1951, and May, 1965, arranged according to age and country. The table demonstrates the heavy mortality sustained by birds less than one year old amounting to 88% of all recoveries of birds banded at Kidnappers Plateau and 79% of all recoveries for the whole sample. Three times as many birds less than one year old were recovered in Australia as in New Zealand. It is only for birds three years old or more that the New Zealand recoveries begin to exceed those made in Australia, though several birds more than four years old have been recovered in Australia. The table omits the recaptures of live birds made at Kidnappers Plateau, which will be discussed separately below.

There is no significant difference in the total recovery rate between the two gannetries (Plateau 4.7% and Horuhoru 4.6%) but the percentages of recoveries of birds less than one year old differ: at Plateau it is 4.1% and 3.2% at Horuhoru. This different recovery rate of young birds is difficult to explain: the Plateau gannet population has been growing at a rate of 5.3% per annum (Wodzicki, 1967) while the Horuhoru population is reported to be static (P. A. S. Stein *in litt.* 1965).

TABLE III.—Distribution of Recoveries Throughout the Year of Birds Less Than and Over One Year Old.

Month	Kidnappers Plateau		Horuhoru		Bush I.		Mahuki		White I.		Total	
	Under 1yr	Over 1yr	Under 1yr	Over 1yr	Under 1yr	Over 1yr	Under 1yr	Over 1yr	Under 1yr	Over 1yr	Under 1yr	Over 1yr
January	—	2	8	18	—	1	—	—	1	—	9	21
February	—	1	20	7	8	1	4	—	3	—	35	9
March	35	4	27	6	5	—	1	1	7	—	75	11
April	31	3	9	3	3	—	—	—	3	—	46	6
May	20	—	5	1	1	—	—	—	—	—	26	1
June	6	—	6	3	—	—	—	—	—	—	12	3
July	3	2	8	3	—	—	—	—	—	—	11	5
August	1	—	8	2	1	—	—	1	—	—	10	3
September	1	1	4	—	1	—	—	—	—	—	6	1
October	2	—	8	4	2	—	—	—	—	—	12	4
November	3	1	10	7	—	—	2	—	—	—	15	8
December	1	—	6	6	—	—	—	—	—	—	7	6
Total	104	14	120	60	21	2	7	2	14	—	266	78

(c) *Seasonal Distribution of Recoveries*

In Table III the recoveries of birds banded at all the five gannet colonies have been arranged according to months. The table shows that approximately two-thirds of the recoveries of birds less than one year old occur during the first five months of the year. This is the period when young fully-fledged gannets begin to disperse at the end of the nesting season and cross the Tasman Sea on their way to Australia. The largest number of recoveries of birds banded at Kidnappers Plateau have been made between March and May, rather later than at Horuhoru gannetry. This is probably associated with the earlier nesting in the north. Too few birds over one year old were recovered to ascertain whether the apparent trend of more birds recovered in the last three months is real.

(d) *Recoveries of Birds Less Than One Year Old in New Zealand*

Figure 1 shows the New Zealand recoveries of 29 birds less than one year old banded at Kidnappers Plateau. Their distribution suggests the existence of three dispersal routes: the most frequented northern route round East and North Capes, the Cook Strait, and the southern route. Of the five birds recovered from the east coast of the South Island two (Nos. M-9480 and M-1092) were recovered on 16 March 1964 and 6 March 1960, another (M-5183) on 11 April 1963 and two (Nos. M-3002 and 35,123) on 7 May 1962 and 8 May 1957. Judging by the recovery dates it is therefore likely that some first-year birds do not go to Australia but remain for their first winter in New Zealand waters.

The dispersal pattern of less than one year old gannets banded at Horuhoru is different. Figure 2 shows that of 32 recoveries all but two were made within 200km of Horuhoru. The two exceptions are No. 28,435 recovered in 1956 (exact date not known) 40 miles off Invercargill and No. 35,948 on 26 June 1957 in Wellington Harbour.

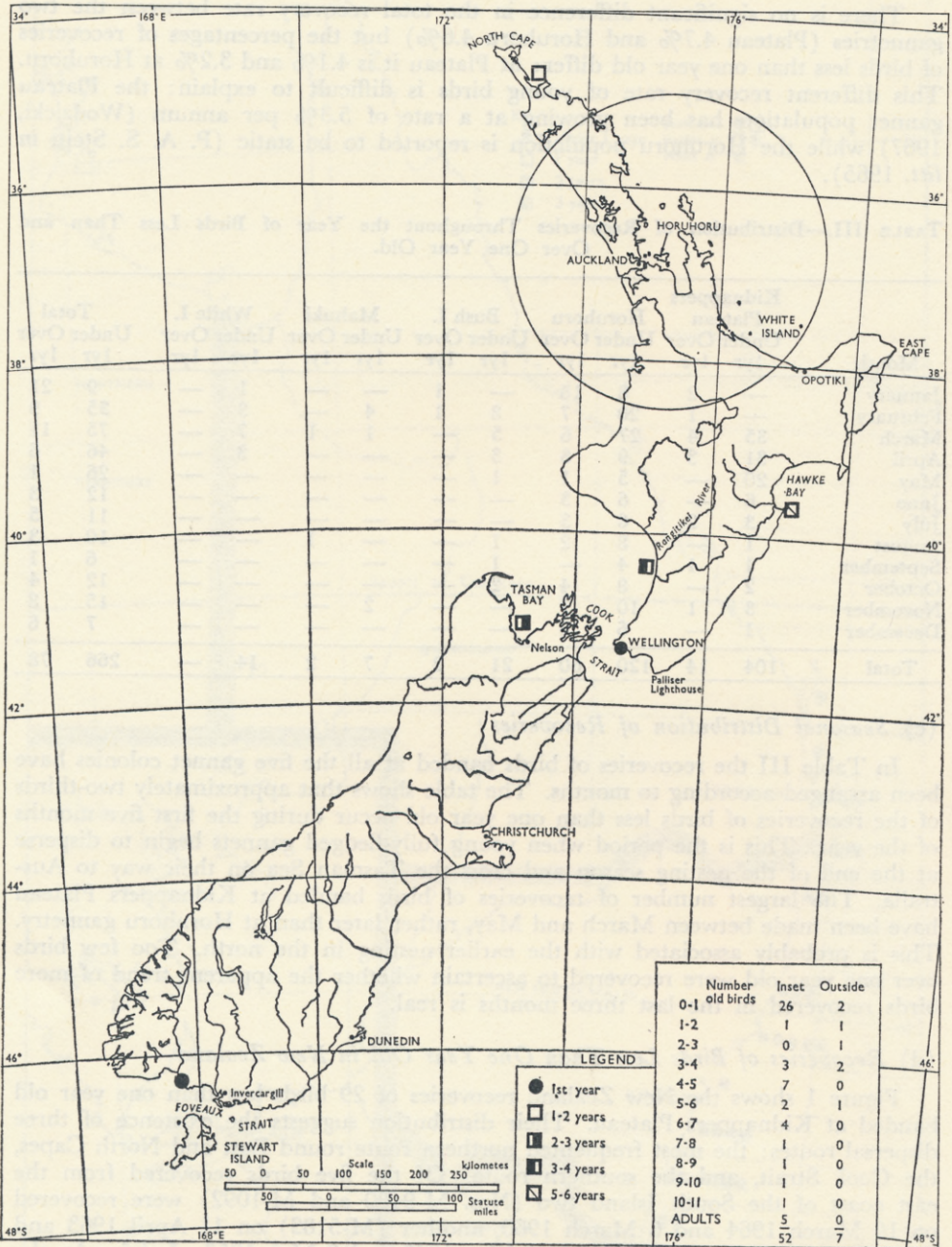


FIG. 2.—New Zealand recoveries of gannets banded as chicks at Horuhoru, 1950/51-1964/65.

There were only five recoveries of birds less than one year old banded at Bush Island, Mahuki and White Island and recovered in New Zealand. All but one were recovered on the east coast of the North Island north of Auckland. The exception is No. 28,962 which was recovered on 20 February 1956 at the Palliser Lighthouse, Cook Strait.

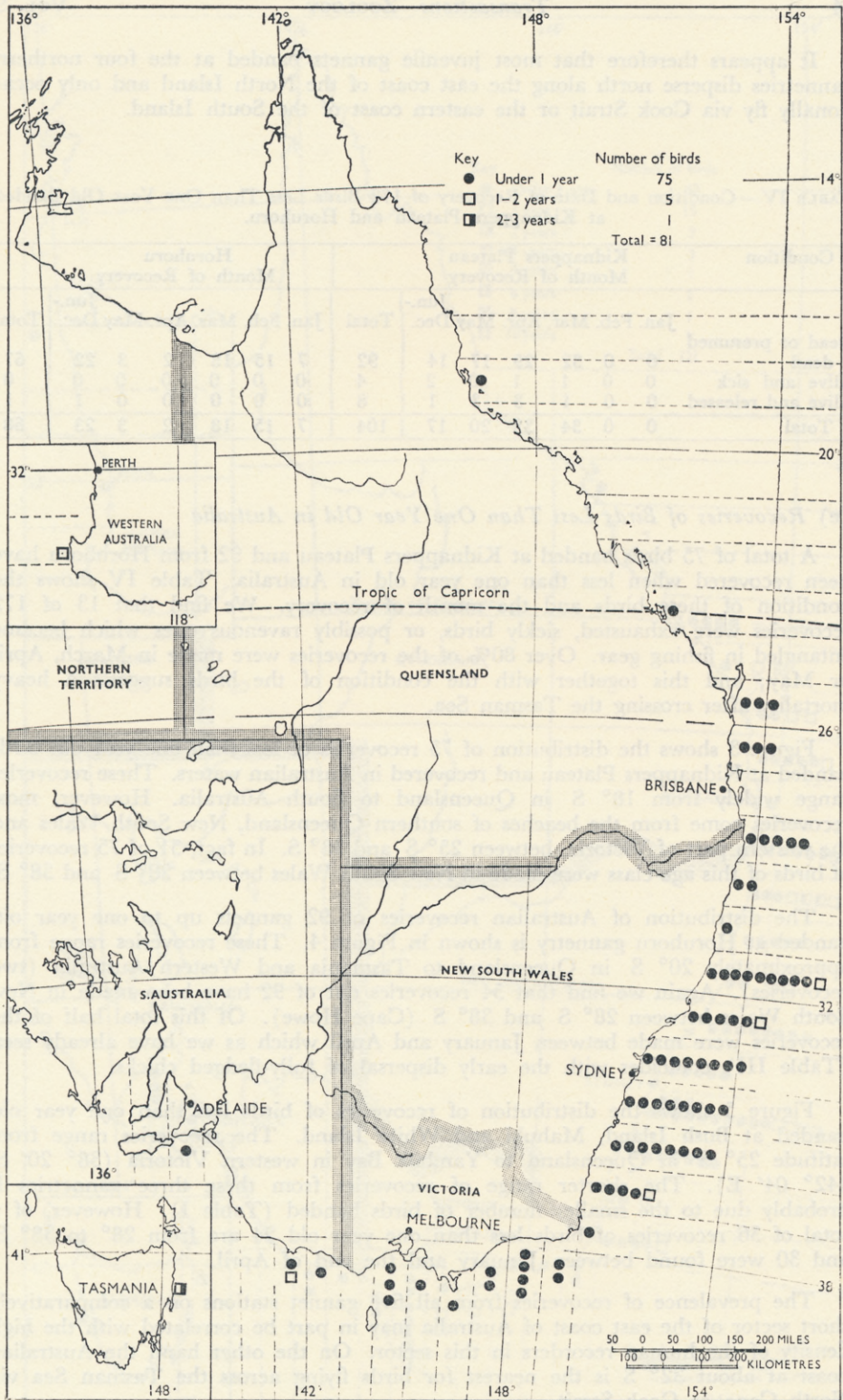


FIG. 3.—Australian recoveries of gannets banded as chicks at Kidnappers Plateau, 1950/51-1964/65.

It appears therefore that most juvenile gannets banded at the four northern gannetries disperse north along the east coast of the North Island and only occasionally fly via Cook Strait or the eastern coast of the South Island.

TABLE IV.—Condition and Date of Recovery of 172 Birds Less Than One Year Old Banded at Kidnappers Plateau and Horuhoru.

Condition	Kidnappers Plateau							Horuhoru						
	Month of Recovery							Month of Recovery						
	Jan.	Feb.	Mar.	Apr.	May	Jun.- Dec.	Total	Jan.	Feb.	Mar.	Apr.	May	Jun.- Dec.	Total
Dead or presumed dead	0	0	32	29	17	14	92	7	15	18	2	3	22	67
Alive and sick	0	0	1	1	0	2	4	0	0	0	0	0	0	0
Alive and released	0	0	1	3	3	1	8	0	0	0	0	0	1	1
Total	0	0	34	33	20	17	104	7	15	18	2	3	23	68

(e) *Recoveries of Birds Less Than One Year Old in Australia*

A total of 75 birds banded at Kidnappers Plateau and 92 from Horuhoru have been recovered when less than one year old in Australia. Table IV shows the condition of these birds and the month of recovery. We find that 13 of 172 recoveries were exhausted, sickly birds, or possibly ravenous ones which became entangled in fishing gear. Over 80% of the recoveries were made in March, April or May; and this together with the condition of the birds suggests a heavy mortality after crossing the Tasman Sea.

Figure 3 shows the distribution of 75 recoveries of less than one year old birds banded at Kidnappers Plateau and recovered in Australian waters. These recoveries range widely from 18° S in Queensland to South Australia. However, most recoveries come from the beaches of southern Queensland, New South Wales and the western part of Victoria, between 25° S and 38° S. In fact, 51 of 75 recoveries of birds of this age class were made in New South Wales between 28° S and 38° S.

The distribution of Australian recoveries of 92 gannets up to one year old banded at Horuhoru gannetry is shown in Figure 4. These recoveries range from approximately 20° S in Queensland to Tasmania and Western Australia (two recoveries). Again we find that 54 recoveries out of 92 have been made in New South Wales between 28° S and 38° S (Cape Howe). Of this total half of the recoveries were made between January and April which as we have already seen (Table III) coincides with the early dispersal of fully-fledged chicks.

Figure 5 shows the distribution of recoveries of birds less than one year old banded at Bush Island, Mahuki and White Island. The recoveries range from latitude 25° S in Queensland to Yambuk Bay in western Victoria (38° 20' S, 142° 04' E). The shorter range of recoveries from these three gannetries is probably due to the smaller number of birds banded (Table I). However, of a total of 36 recoveries of birds less than one year old 24 are from 28° to 38° S, and 30 were found between January and the end of April.

The prevalence of recoveries from all five gannet stations on a comparatively short sector of the east coast of Australia may in part be correlated with the high density of the human recorders in this sector. On the other hand the Australian coast at about 32° S is the nearest for birds flying across the Tasman Sea via North Cape or Cook Strait.

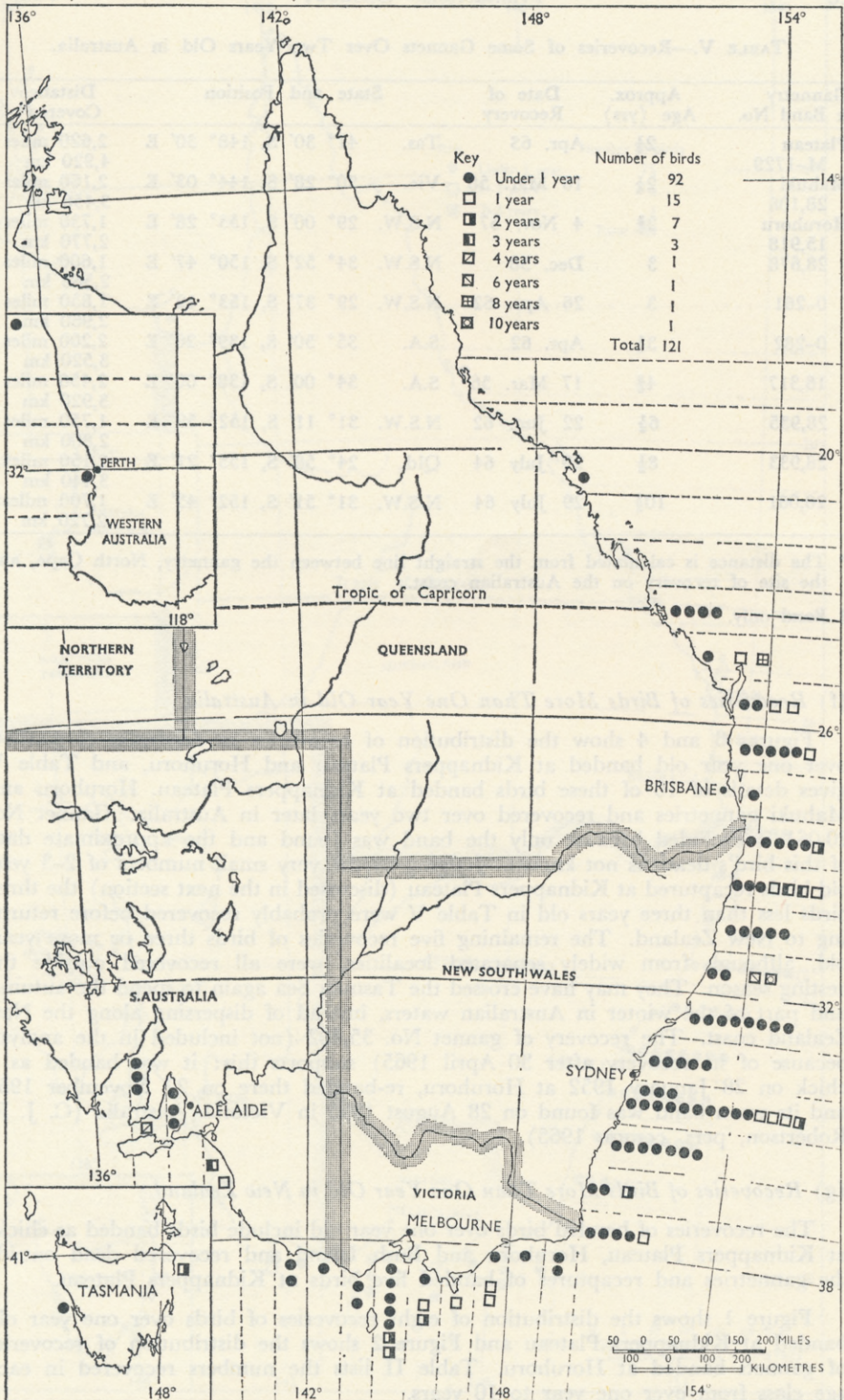


Fig. 4.—Australian recoveries of gannets banded as chicks at Horuhuru, 1950/51-1964/65.

TABLE V.—Recoveries of Some Gannets Over Two Years Old in Australia.

Gannetry & Band No.	Approx. Age (yrs)	Date of Recovery	State and Position		Distance Covered*
Plateau M-1729	2½	Apr. 63	Tas.	41° 30' S, 148° 30' E	2,620 miles 4,920 km
Mahuki 28,108	2½	16 Mar. 58	Vic.	30° 28' S, 144° 03' E	2,160 miles 3,456 km
Horuhoru 15,918	2¾	4 Nov. 57	N.S.W.	29° 00' S, 153° 28' E	1,730 miles 2,770 km
28,678	3	Dec. 58	N.S.W.	34° 52' S, 150° 47' E	1,600 miles 2,560 km
0-261	3	26 Apr. 62	N.S.W.	29° 37' S, 153° 12' E	1,850 miles 2,960 km
0-282	3¼	Apr. 62	S.A.	35° 50' S, 139° 20' E	2,200 miles 3,520 km
16,317	4¾	17 Mar. 56	S.A.	34° 00' S, 138° 00' E	2,450 miles 3,920 km
28,935	6½	22 Jun. 62	N.S.W.	31° 11' S, 152° 59' E	1,750 miles 2,800 km
28,933	8½	29 July 64	Qld.	24° 58' S, 153° 21' E	2,150 miles 3,440 km
20,061	10½	29 July 64	N.S.W.	31° 51' S, 152° 45' E	1,700 miles† 2,720 km

* The distance is calculated from the straight line between the gannetry, North Cape, and the site of recovery on the Australian coast.

† Band only.

(f) Recoveries of Birds More Than One Year Old in Australia

Figures 3 and 4 show the distribution of recoveries in Australia of gannets over one year old banded at Kidnappers Plateau and Horuhoru, and Table V gives details of 10 of these birds banded at Kidnappers Plateau, Horuhoru and Mahuki gannetries and recovered over two years later in Australia. Gannet No. 20,061 is excluded because only the band was found and the approximate date of this bird's death is not known. Judging by the very small numbers of 2-3 year old birds recaptured at Kidnappers Plateau (discussed in the next section) the three birds less than three years old in Table V were probably recovered before returning to New Zealand. The remaining five recoveries of birds three or more years old, although from widely separated localities, were all recovered outside the nesting season. They may have crossed the Tasman Sea again to spend the autumn and part of the winter in Australian waters, instead of dispersing along the New Zealand coast. The recovery of gannet No. 35,402 (not included in the analysis because of its recovery after 30 April 1965) supports this: it was banded as a chick on 28 January 1952 at Horuhoru, re-banded there on 27 November 1956 and its worn band was found on 28 August 1965 in Victoria, Australia (C. J. R. Robertson, pers. comm. 1965).

(g) Recoveries of Birds More Than One Year Old in New Zealand

The recoveries of banded birds over one year old include birds banded as chicks at Kidnappers Plateau, Horuhoru and Bush Island and recovered dead outside the gannetries and recaptures of banded live birds at Kidnappers Plateau.

Figure 1 shows the distribution of eight recoveries of birds over one year old banded at Kidnappers Plateau and Figure 2 shows the distribution of recoveries of gannets banded at Horuhoru. Table II lists the numbers recovered in each age class from over one year to 10 years.

The difference in the distribution of recoveries between those birds from Kidnappers Plateau and those from Horuhoru is similar to the dispersal pattern shown by the recoveries of birds less than one year old. Recoveries of Kidnappers Plateau birds are scattered along the coast of both North and South Islands. The majority of recoveries of Horuhoru birds (22 out of 26 recoveries of birds over one year old) come from the Hauraki Gulf or the northern part of the North Island and only five recoveries were made more than 200km from Horuhoru, including a 3-4 year old bird (No. 19,103) at Torere Beach, east of Opotiki, Bay of Plenty; two 2-3 year old birds (Nos. 20,062 and 0-225) at Tasman Bay, near Nelson, and north of the Rangitikei river mouth respectively; and a bird over five years old (No. 35,861) in the vicinity of Cape Kidnappers. This last recovery, made on 16 February 1962, is of particular interest as it could have been a Horuhoru bird which had settled at Cape Kidnappers. However, it was collected away from the Kidnappers gannetry and there is no evidence that it had settled there; with the earlier nesting season at Horuhoru it could just have completed breeding there and started on the winter dispersal.

Most Horuhoru birds more than a year old seem to remain during the autumn and early winter in the Hauraki Gulf area, and only a few wander further south than the Bay of Plenty or the west coast north of Auckland.

There are only two New Zealand recoveries of birds over one year old banded at Bush Island (Table II): one from Tutukaka ($35^{\circ} 36' S$, $174^{\circ} 32' E$) and another from Mangawhai Heads ($36^{\circ} 05' S$, $174^{\circ} 36' E$); both on the east coast, north of Auckland.

TABLE VI.—First Sightings of Gannets Banded at Kidnappers Plateau between 1951 and 1965.

Cohort	No. Banded	Number of Gannets first seen								Total No. Seen
		2	3	4	5	6	7	8	9 years old	
1951	142	1	3	9	8	5	8	3	1	38
1952	106	—	1	—	7	8	3	2	—	21
1953	144	—	2	1	15	11	5	1	1	36
1954	142	—	—	2	1	1	—	—	—	4
1955	116	—	1	4	11	1	3	—	—	20
1956	80	—	—	7	3	8	—	2	—	20
1957	126	—	1	3	16	4	3	2	—	29
1958	108	—	1	15	9	6	3	—	—	34
1959	214	—	9	8	20	10	—	—	—	47
1960	281	1	4	7	11	—	—	—	—	23
1961	134	2	—	1	—	—	—	—	—	3
1962	249	—	1	—	—	—	—	—	—	1
Total	1,842	4	23	57	101	54	25	10	2	276

(h) *Return of Banded Gannets to the Gannetry and the Breeding Age*

That gannets usually return to breed at the gannetry where they were born is already known (Wodzicki and Stein, 1958: 308). Considerable effort has been directed every year to the recapture of banded gannets at Kidnappers Plateau. At the same time the two adjacent colonies of Cape Kidnappers and Black Reef have been regularly searched for banded birds that might have settled there.

Table VI shows the age distribution at first sighting of banded gannets returning to Kidnappers Plateau. The age shown has been taken as the whole number of seasons between hatching and the first sighting at the gannetry.

The effort devoted to the identification of banded gannets was not the same every year and not all the banded gannets at the colony were identified. The first

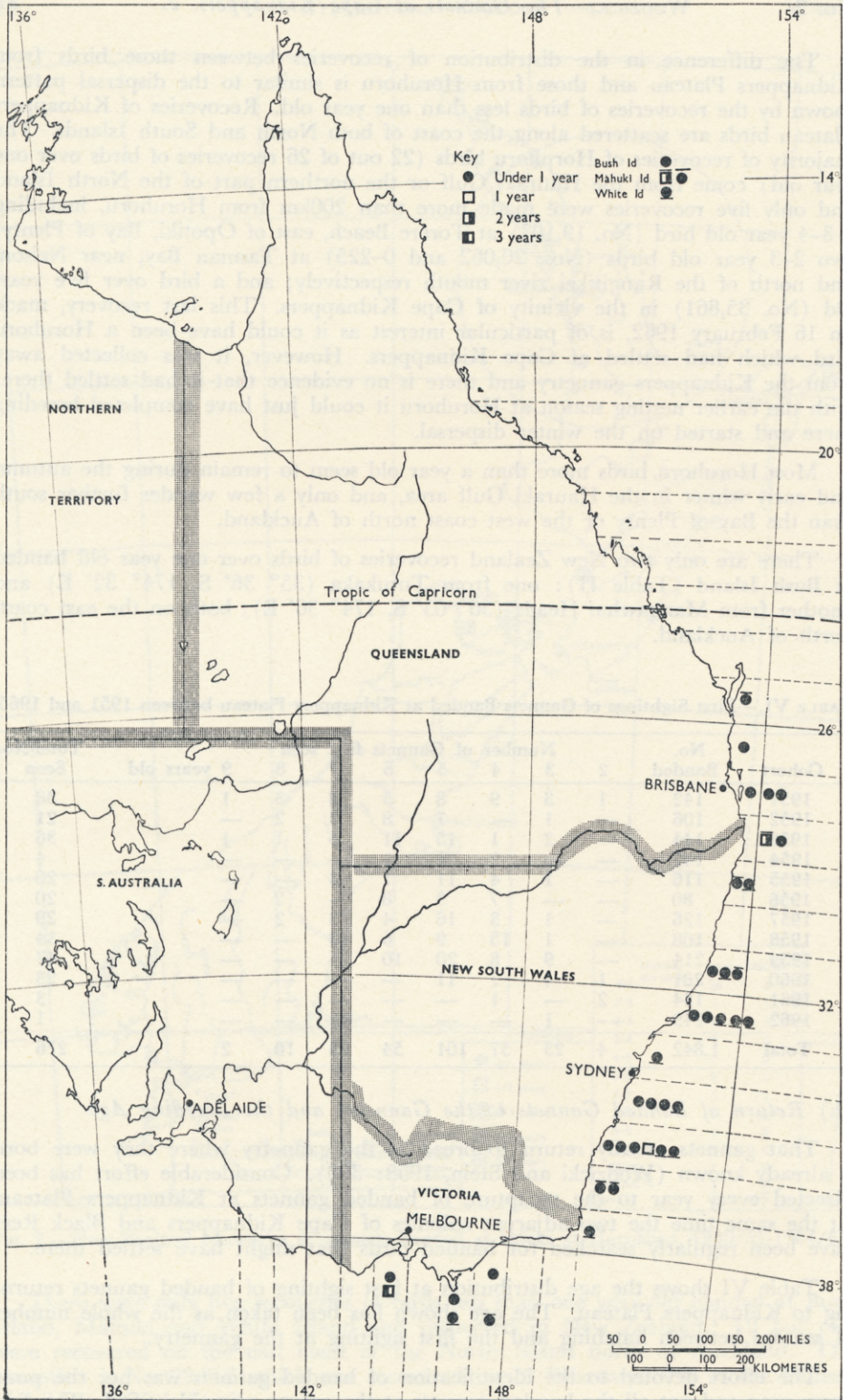


FIG. 5.—Australian recoveries of gannets banded as chicks at Bush Island, Mahuki and White Island.

recorded sighting of a bird is thus not necessarily the date of its first return to the gannetry and the distribution of first returns will not be exactly as shown in the last row of Table VI. It will, however, not be too different, and the numbers are large enough to show the general age at which young gannets return to the colony for the first time.

Two-year-olds returning to the gannetry are exceptional: only four were identified among 276 first sightings between 1951 and 1965, all resting on the outskirts of the colony. Of 23 three-year-old birds at the gannetry the status of 11 was not known, seven were resting, four occupied empty nests and only one (with a chick) was definitely breeding. Five-year-old birds made up the largest proportion of first sightings (36.6%) but smaller numbers were first recaptured as late as their eighth and even ninth year.

TABLE VII.—Recoveries of Gannets Banded at Kidnappers Plateau to 30 April 1965.

Year ending 31 March	Chicks Banded	Recovered away from Gannetry	Recovered at Gannetry				Total Recovered
			Dead Chicks	Live adults at			
				Plateau	Cape	Black Reef	
1951	142	5	2	37	1	—	45
1952	106	4	—	21	—	—	25
1953	144	5	—	35	1	—	41
1954	142	8	10	4	—	—	22
1955	116	5	1	19	—	1	26
1956	80	2	1	20	—	—	23
1957	126	4	—	28	—	1	33
1958	108	7	—	33	1	—	41
1959	214	16	24	46	1	—	87
1960	281	15	2	23	—	—	40
1961	134	3	3	3	—	—	9
1962	249	8	8	1	—	—	17
1963	228	16	1	—	—	—	17
1964	266	7	—	—	—	—	7
1965	177	12	—	—	—	—	12
Total	2,513	117	52	270	4	2	445

Table VII shows the number of chicks banded each season between 1950–51 and 1964–65 at Kidnappers Plateau, and their subsequent fate. The high juvenile mortality, shown by the relatively small numbers of birds returning to the gannetry to breed, will be the subject of a separate paper. The strong attachment of gannets to their “home” colony is shown by the very small number of birds banded on the Plateau that returned to breed in the adjoining colonies (six or 2.2%), including four at the Cape itself and two at Black Reef.

The Kidnappers Plateau colony consists of two separate clusters of nests (Wodzicki, 1967) called “old B” and “new B” in which the banding of chicks was recorded separately. Most gannets banded as chicks returned to their native cluster. Of 202 banded at “old B” 154 returned to settle there and 48 settled at “new B”, while of 38 banded at “new B” 17 returned and 21 moved to “old B”. Only five birds have definitely nested at both clusters although an additional seven may have done so.

DISCUSSION AND CONCLUSIONS

The results of the present investigation are based on birds banded between 1950–51 and 1964–65 at five gannetries, viz., Kidnappers Plateau, Horuhoru, Bush Island, Mahuki and White Island. A total of 344 recoveries was made outside

the gannetries which is 4.5% of those banded. This percentage, which supercedes the 3.3% for Kidnappers Plateau and 2.9% for the Horuhoru station found previously by Wodzicki and Stein (1958: 297), is very high compared with the 0.8% and 1% recovery rates reported by Rand (1959) and Broekhuysen, Liversidge and Rand (1961) respectively for the South African Gannet (*Sula b. capensis*). In addition 276 live birds, banded as chicks at Kidnappers Plateau between 1950-51 and 1964-65 were later recaptured or identified.

Young gannets begin to appear in Australia soon after their departure from the gannetry, i.e., towards the end of January for Horuhoru birds, of February for chicks banded at Bush Island, Mahuki and White Island, and early March for the Kidnappers Plateau birds (Table III). The recoveries of birds less than one year old are widely distributed from mid-Queensland in the east, down to Tasmania and South Australia in the south and Western Australia in the west. The suggestion of Wodzicki and Stein (1958: 303) that Horuhoru birds have a tendency to go further south than those banded at Kidnappers Plateau has not been confirmed.

The considerable distances flown by the birds a few weeks after fledging are comparable with those of the two other species of gannets. For birds recovered in southern Queensland or New South Wales the straight distance is about 2,400km (*c* 1,500 miles) for Horuhoru birds and 2,700km (1,700 miles) for birds from Kidnappers Plateau gannetry. The distances travelled by gannets recovered in South Australia are 4,300km (2,700 miles), and 6,700km (4,200 miles) for the three birds recovered in Western Australia. These exceed the distances travelled by North Atlantic and South African gannets: it is estimated that the furthest distance travelled by the former (Thomson, 1939; Dorst, 1956: 49) is over 4,900km (3,000 miles) and up to 5,800km (3,600 miles) for the latter (Broekhuysen *et al.* 1961).

ACKNOWLEDGMENTS

Like any long-term banding scheme the work described would not have been possible without the help of many people. All cannot be thanked but the author would like to record his special appreciation of help given by Dr John E. C. Flux, Juliet Fulton (now Mrs A. Gemmel), Diana Orwin, Rowland H. Taylor and David Ward. Christopher Robertson, Dominion Museum, in addition to helping on many occasions in the field kindly tabulated data from the files of the New Zealand Banding Scheme, Dominion Museum. The author is also grateful to the Cape Kidnappers Sanctuary Board and their Chairman, Mr H. R. Crisp, for their interest and permission to use the rest hut; to Mr Allan Cochrane for vehicular access to Cape Kidnappers and many courtesies; to Raymond L. Edgar, Animal Ecology Division, D.S.I.R., for devising a gannet catcher; and to Reginald Williams, Hawke's Bay naturalist, and his Wildlife Wardens for information on recoveries at Kidnappers Plateau gannetry in the absence of the author; to Dr Hamish R. Thompson, Director, Applied Mathematics Division, D.S.I.R., and Dr John E. C. Flux and Rowland H. Taylor for kindly reading previous drafts of the manuscript.

LITERATURE CITED

- BROEKHUYSEN, G. J., LIVERSIDGE, R., AND RAND, R. W., 1961. The South African gannet *Morus capensis*. I. Distribution and Movements. *Ostrich*, 32(1): 1-19.
- DORST, J., 1956. *Les migrations des oiseaux*. Payot, Paris, 422 pp.

- FLEMING, C. A., AND WODZICKI, K. A., 1952. A census of the gannet (*Sula serrator*) in New Zealand. *Notornis*, 5(2): 39-78.
- RAND, R. W., 1959. Conservation of the gannet. *Proc. 1st Pan-African Ornith. Congr. Ostrich, Suppl.* 3: 31-33.
- STEIN, P. A. S., AND WODZICKI, K., 1955. Dispersal of New Zealand gannets. *Notornis*, 6(3): 58-64.
- THOMSON, A. L., 1939. The migration of the gannet: results of marking in the British Isles. *British Birds*, 32: 282-289.
- WODZICKI, K., 1967. The gannets at Cape Kidnappers. 1. Population changes 1945-1964. *Trans. roy. Soc. N.Z., Zool.* 8(14): 149-162.
- WODZICKI, K., AND STEIN, P., 1958. Migration and dispersal of New Zealand gannets. *Emu*, 58: 289-312.

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