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The Gannets at Cape Kidnappers

1. Population Changes 1945-1964

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Abstract

A census of all three Hawke's Bay gannetries, Cape Kidnappers, Black Reef and Kidnappers Plateau was made in 1945, 1946, 1957 and 1964 using aerial photographs and ground counts. In addition nineteen annual counts of the Kidnappers Plateau colony have been carried out during the third week of December from 1945 to 1964.

The Cape Kidnappers gannetry, established about 1850, consists of a central saddle and two slopes. It showed a slight increase between 1945-46 and 1957 but has declined since by 365 pairs or 17%, and in 1964 it numbered 2,060 nesting pairs.

The Black Reef colony, which was colonised in 1937 consists of eight rocks occupied in 1964 by nesting gannets; it showed a spectacular 176% increase from 1945-46 to 1957 and a further increase of 18% between 1957 to 1964; and it grew from 320 in 1945-46 to 1,037 in 1964.

The Kidnappers Plateau gannetry was also established *c.* 1938. It initially consisted of one cluster of nests but since the 1946-47 nesting season a subsidiary nesting area has been added. This gannetry grew between 1945-46 and 1957 by 56% and by 75% between 1957 and 1964. Its population increased from 178 pairs in 1945-46 to 487 in 1964 at a rate of increase of 5.3% per annum.

The total population of the three gannetries increased between 1945-46 and 1957 by 27%. Between 1957 and 1964, however, the population remained steady.

A series of photographs of the Cape Kidnappers gannetry taken between 1890 and 1964 shows the pattern of establishment, distribution and numbers of birds in various parts of this gannetry throughout the period. Recent erosion of the northern part of the saddle and of both slopes has reduced nesting space on the main colony faster than the two younger colonies are growing.

Population trends are briefly discussed. Regular observations of the Hawke's Bay gannetries should be continued.

INTRODUCTION

REGULAR observations were made at the Hawke's Bay gannetries between 1945 and 1964 to determine the extent of inter- and intra-seasonal changes in the population through a significant period of time, as suggested by Fleming and Wodzicki (1952: 75). The methods used included counts on the ground or from photographs,

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banding of chicks and recapture of adult birds, and observations on breeding and behaviour. The present paper reports the results of three censuses of all three Hawke's Bay gannetries and nineteen annual counts of the Kidnapper Plateau colony and analyses the population changes of the Hawke's Bay gannetries in that period. Further papers, based on recoveries and recapture of banded birds will describe dispersal, movements and population dynamics of the Kidnappers Plateau gannets (*Sula bassana serrator*)†.

DESCRIPTION OF HAWKE'S BAY GANNETRIES

The history and a census of the Hawke's Bay gannetries in the 1946-47 breeding season were described by Fleming and Wodzicki (1952: 67-72). Fig. 1 shows the general layout of the three gannetries: Cape Kidnappers, Black Reef and Kidnappers Plateau.

According to Grant-Taylor (in press) Cape Kidnappers, Kidnappers Plateau and the area behind it are all composed of massive, sandy mudstone of Lower Pliocene Age. There is little secondary cementing and only a very thin cover of weathered and fritted mudstone. The Black Reef rocks are formed by limestone of Waitotaran Age and are secondarily cemented. The rocks forming the reef are subject to sea erosion but not as rapid as in the mudstone of Cape Kidnappers.

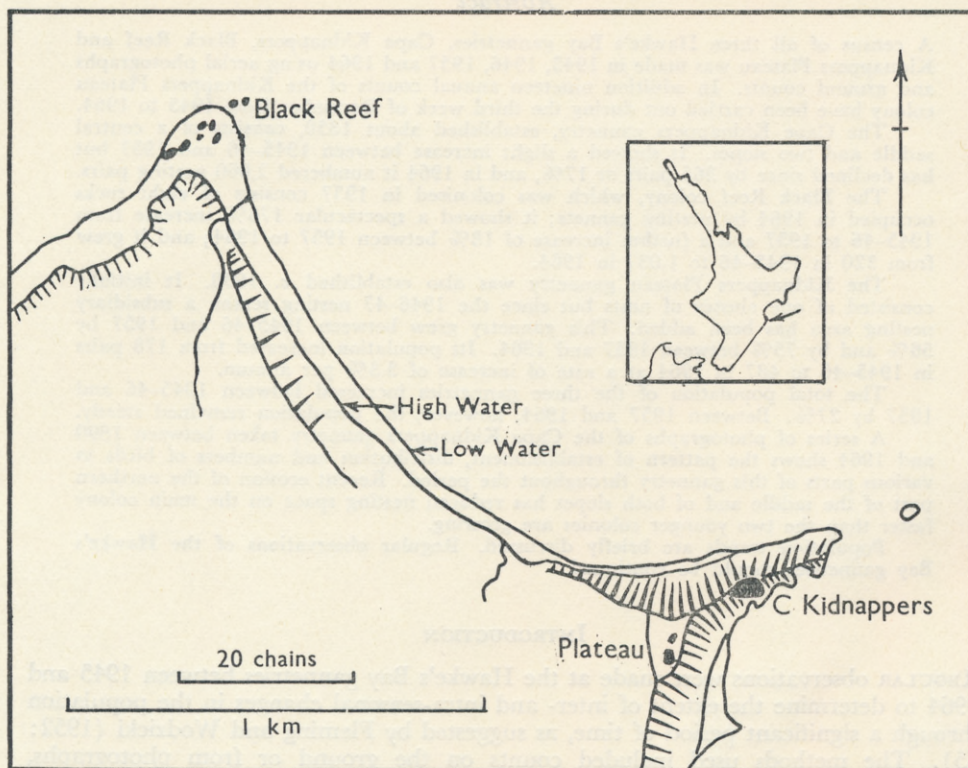


FIG. 1.—The three Hawke's Bay gannetries: Cape Kidnappers, Black Reef and Kidnappers Plateau.

† According to the New Zealand checklist (Fleming, 1953: 28) the Australian Gannet is considered conspecific with the North Atlantic and South African Gannets.

Cape Kidnappers, the largest and oldest gannetry of the Hawke's Bay group, was probably established in the middle of the nineteenth century, records being available from about 1880; it consists of a central saddle and an eastern and western slope (fig. 2). The Black Reef gannetry, about 1½ km north-west from Cape Kidnappers, consists of several low rocks (figs. 3 and 5). These stacks were unoccupied by gannets in the early thirties but a "growing colony" was reported by the late D. G. Williams in the 1937–38 nesting season. The Kidnappers Plateau, the most recently established gannetry, is on the mainland approximately 250 m south-west from Cape Kidnappers (fig. 6). This area is known to have been used as a roost for some years before 1939, and the first record of nesting was made in December, 1945 (Wodzicki and McMeekan, 1947: 435–436). At that time there was only one group of nests. The beginning of a second nesting site in the plateau a few yards from the first one was first noted in December, 1946 (Wodzicki and Robertson, 1953: 163–165).

METHODS OF ASSESSING THE HAWKE'S BAY GANNET POPULATION

Fleming and Wodzicki (1952: 73–74) discussed the sources of error in counting gannets and suggested that they arise from intra- and inter-seasonal fluctuations and to the shortcomings of census techniques. Since then Wodzicki and Robertson (1953: 165 and unpublished) have found that the number of birds at a gannetry varies according to the stage of the breeding cycle. This in turn is affected by the date of arrival at the gannetry, which may be as early as the beginning of July and as late as early August. From the latter date the number of gannets occupying nesting mounds gradually increases and the peak is reached three months later, usually some time in November. In December the number occupying nesting mounds decreases slightly but the number of birds roosting on the periphery of the gannetry begins to increase until it is sometimes difficult to separate nesting birds from the roosting ones.

Diurnal fluctuations were also found with peaks in the early morning and shortly before dusk. Early in the season 5–6% more birds are found in the early morning than in the afternoon. Later in the season, when grown-up chicks prevail and birds are less attached to the nesting sites the difference between afternoon and early morning counts may be 15% or more. Consequently, all our counts on the ground were made early in the morning or late in the afternoon.

The importance of inter-seasonal fluctuations in assessing gannet populations stressed by Fleming and Wodzicki (1952: 73) was confirmed by the present observations and will be discussed below.

The margin of error in counting varies with the size and configuration of the colony (Boyd, 1961: 121) and also differs with various observers. Contrary to the difficulty in clearly discerning paired birds found by Boyd (1961: 127) in some North Atlantic gannet colonies, on our photographs individual birds could be easily seen. Roosting or "unemployed" birds were not counted and the figures presented in the next section refer to breeding pairs.

Small gannetries up to 150–200 nesting pairs can be counted on the ground without a significant error, but large groups of nesting gannets without well marked boundaries, e.g., the dark saddle of the Cape Kidnappers gannetry or Lozenge Rock, Black Reef, require good photographs. The landward slope of Cape Kidnappers gannetry gave unreliable estimates when counted from the ground, but different observers produced close estimates from photographs (see Table I). Because of this only four complete censuses of all three gannetries were made in the third week of December of the 1945–46, 1946–47, 1957–58 and 1964–65 nesting seasons, when it was possible to count the smaller colonies on the ground and take aerial

and ground photographs of the larger ones. An attempt was made, however, to count the Kidnappers Plateau gannetry annually from the ground in the third week of December from the 1945-46 to the 1964-65 nesting season. In some years it was not possible to visit the gannetry during the third week in December, and an estimate was obtained by interpolation of earlier and later counts during the same season. In counting gannets on the ground or from photographs, only one adult bird per nesting mound was recorded: and if a nesting site was occupied by a chick only, this was counted as an adult.

TABLE I.—Cape Kidnappers December, 1964, Census.

Part of Gannetry	No. of Nesting Pairs Observers' Initials			Mean
Landward Slope	H.R.T.	K.W.		
Counts on the ground	405	319		362
	W.M.F.	K.W.		
Counts from photographs	372	374		373
Seaward Slope	H.R.T.	K.W.	S.N.B.	
Counts on the ground	115	102	108	108
	W.M.F.	K.W.		
Counts from photographs	95	104		100
On path: counts on the ground				42
Dark Central Saddle	W.M.F.	K.W.		
Counts from photographs	1,539	1,554		1,546
				1,546
			Totals	2,058
				2,061

RESULTS

CAPE KIDNAPPERS GANNETRY

Table I presents the results of the December 1964 census of the Cape Kidnappers gannetry. The landward and seaward slopes were counted both from the ground and from good photographs, the dark central saddle from good photographs only and the 42 nests on the path leading to this colony were counted from the ground only.

A hundred or more abandoned old nesting mounds in the north-eastern part of the dark saddle (fig. 2) were not counted.

Two counts on the ground may vary by up to 12% but the error in counting gannets from photographs is much smaller. The December, 1964, population was assessed at 2,060 pairs.

TABLE II.—Census of Cape Kidnappers Gannetry December 1945, November 1946, December 1957, and December 1964.

Part of Gannetry	1945*	Year		
		1946†	1957‡	1964‡
		No. of nesting pairs		
Landward/Western/Slope	475		521	368
Seaward/Eastern/Slope	200		202	104
		2,337		
On path	42		42	42
Central Dark Saddle	1,590		1,660	1,546
Total	2,307	2,337	2,425	2,060

* Counts on the ground only.

† Counts from photographs only.

‡ Counts on ground and from photographs.

Table II compares the four censuses of the Cape Kidnappers gannetry of 1945, 1946, 1957 and 1964. The table shows a slight increase in the number of breeding pairs between 1946 and 1957 followed by a decline of 15% between 1957 and 1964, due mainly to fewer occupied nests on the landward and seaward slopes and northern edge of saddle.

BLACK REEF GANNETRY

Black Reef was colonised *c.* 1937 and fig. 3 shows the location of the various stacks occupied by breeding or roosting birds.

The 1964–65 breeding population of this gannetry was estimated at 1,039 nesting pairs (Table III).

TABLE III.—Black Reef, December, 1964, Census.

Part of Gannetry	No. of Nesting Pairs				Mean
	K.W.	H.R.T.	W.M.F.	D.P.O.	
<i>Ledges on Mainland</i>	Roost				
Rock No. 1					
Count on ground	3				3
Count from photographs					(3)
Rock No. 2 (or "Chimney Rock")					
Counts on ground	322	304			312
Counts from photographs	305		329	321	318
Rock No. 3 (or "Bush Rock")					
Counts on ground					(121)
Counts from photographs	117		125	122	121
Rock No. 4 (or "Lozenge Rock")					
Counts on ground					(445)
Counts from photographs	431		439	466	445
Rock No. 5					
Counts from ground	1				1
Counts from photographs					(1)
Rock No. 6					
Counts from ground	73	82			78
Counts from photographs	77		83		80
Rock No. 7					
Counts from ground	54	52			53
Counts from photographs	59		59	62	60
Rock No. 8					
Counts from ground					(17)
Counts from photographs	17				17
				Totals:	1,031 1,045

Parentheses signify that no count on ground was taken.

In December 1964, occupied nesting mounds were found on rocks Nos. 1–8 (figs. 3 and 5). Of these stack No. 1 was in the past used as a roost and nesting was for the first time recorded in 1964–65; No. 2 which is well above the high tide mark had only eight nests in the 1945–46 nesting season (Wodzicki and McMeekan, 1947: 437) was almost fully occupied in 1964–65; rock No. 3 also above high tide mark has been fully occupied since 1957–58; rock No. 4, well above high tide mark, was one of the first occupied at Black Reef and has been filled for nearly twenty years. Stack No. 5 is slightly below the spring-tide mark and for many years served as a roost; this is the first season in which a single occupied nesting mound has been recorded there. Stack No. 6 is slightly higher than rock No. 5 and also served as a roost until the late 50's when a few nests were recorded for the first time. Stack No. 7 (fig. 3) is known to have contained nests since the

1945–46 nesting season, while the lower stack, No. 8, may become submerged at very high tides and has been occupied intermittently by nesting gannets in the period under review.

Table IV compares the results of the censuses of the Black Reef gannetry taken in December, 1945, 1946, 1957 and 1964, and shows a considerable increase, both in the number of rocks occupied by nesting pairs and their numbers, during this period. Rocks No. 1, 5 and 6, which in 1945–46 and 1946–47 were roosts carried over 80 nesting pairs in 1964, and more than compensated for the loss of the mainland nesting site (fig. 3). Stacks 2, 3 and 4 (figs. 3 and 5) filled to capacity, and the totals for this gannetry suggest a rapid and over three-fold increase between 1945 and 1964.

TABLE IV.—Census of Black Reef Gannetry, December 1945, November 1946, December 1957, and December 1964.

Part of Gannetry	1945	Year		1964
		1946	1957	
Ledges on Mainland	13	No. of Nesting Pairs		
Rock No. 1	Roost	Roost	Roost	Roost
Rock No. 2	8	5	163	316
Rock No. 3	30	30	119	121
Rock No. 4	300	216	444	445
Rock No. 5	0	0	Roost	1
Rock No. 6	Roost	Roost	60	79
Rock No. 7	18	12	59	56
Rock No. 8	7	Roost	38	17
Total	376	263	883	1,038 pairs

TABLE V.—Pre-Christmas Counts of Kidnappers Plateau Gannetry, 1945–1964.

Year	No. of Pairs		Total	Expected Number*
	"Old B"	"New B"		
1945	196	0	196	179
1946	159	1	160	189
1947	228	3	231	199
1948	210	1	211	209
1949	220	50	270	220
1950	258	18	276	232
1951	225	15	240	244
1952	197	14	211	257
1953	202	19	221	270
1954	234	20	254	285
1955	251	41	292	300
1956	240	64	304	316
1957	222	56	278	332
1958	335	111	446	350
1959	314	85	399	368
1960	257	95	352	388
1961	325	103	428	408
1962	331	112	443	430
1963	360	106	466	452
1964	359	128	487	476

* To give an annual population increase of 5.3%.

KIDNAPPERS PLATEAU GANNETRY

Initially a roosting area, the Kidnappers Plateau colony is the most recently established gannetry. The first record of nesting there was made on 16 December 1945 by Wodzicki and McMeekan (1947: 435). Since that date regular counts of nesting pairs have been made every pre-Christmas week between 1945 and 1964. The relatively small size of this gannetry made counting fairly accurate, and provided a valuable record of nineteen years of observations to assess inter-seasonal fluctuations.

The Kidnappers Plateau (figs. 1 and 6) consisted initially of one group or nests ("Old B") towards the southern end of the plateau. However, in 1946 another cluster of nests ("New B") appeared about ten metres north of the original group (Wodzicki and Robertson, 1953: 164) and fig. 6 shows the present location of this gannetry including the two groups of nests and the large roost round and north from the gannetry proper.

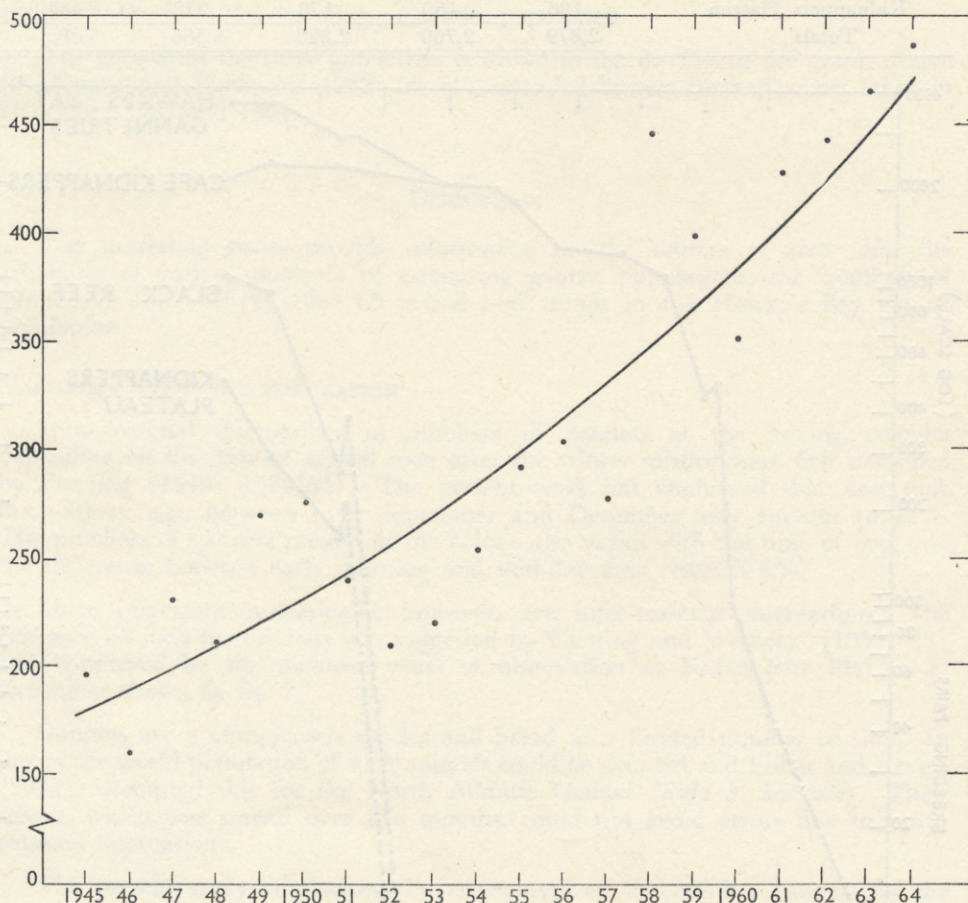


FIG. 7.—The growth of the Kidnappers Plateau gannetry from December, 1945, to December, 1964.

Table V and fig. 7 show the number of nesting pairs counted during the third week of December between 1945 and 1964, from which it can be seen that the total population increased some two and a-half times in 19 years. The best-fitting curve of geometric increase (which is a straight line if logarithms of numbers are plotted) is also shown in fig. 7; it has an annual rate of increase of 5.3% and is a remarkably good fit, the correlation being 0.91. The deviations from a steady rate of increase are presumably due to differing breeding and survival rates in different years. The population dynamics of this gannetry will be studied in detail in a later paper. The table also shows the development of the subsidiary nesting area ("New B") from its first nest in 1946-47, and it is interesting to note that while "Old B" has been increasing fairly steadily at 3½% per annum, the rate of increase at "New B" over the last few years has been 8%.

TABLE VI.—Comparison of the Hawke's Bay Gannetries Population in 1945/46, 1946/47, 1957/58 and 1964/65.

Gannetry	1945-46	1946-47	Year Mean No. of Nesting Pairs	1957-58	1964-65
Cape Kidnappers	2,307	2,337	2,322	2,425	2,060
Black Reef	376	263	320	883	1,038
Kidnappers Plateau	196	160	178	278	487
Totals	2,879	2,760	2,820	3,586	3,585

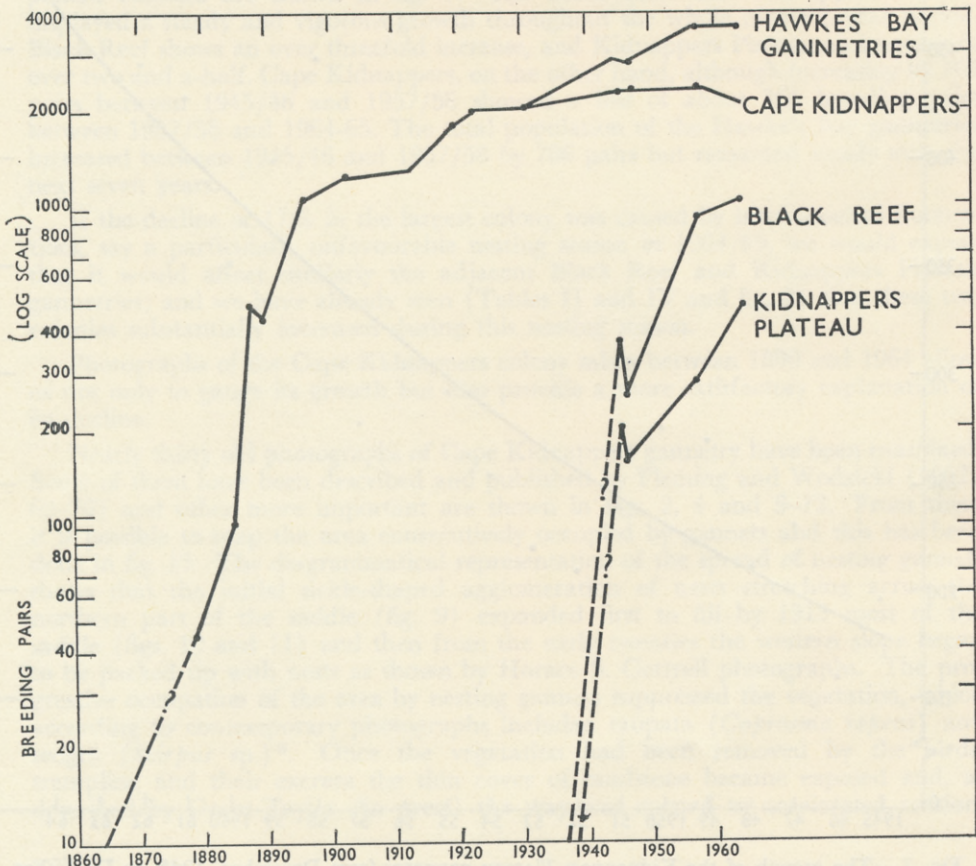


FIG. 8.—The population (in pairs) of Hawke's Bay gannetries from 1879 to 1964.



Photo: S. N. Beatus

FIG. 2.—Cape Kidnappers gannetry looking south: Western slope to the right and eastern slope to the left of central dark saddle. Note also that the northern part of saddle is with empty nesting mounds. This, and photographs shown in figs. 3–5, were taken on 14 December 1964.



Photo: S. N. Beatus

FIG. 3.—Black Reef gannetry looking north-west from the sea showing stacks 1–6 (centre), 7–8 (right) and roosting areas on mainland ledges (left background).

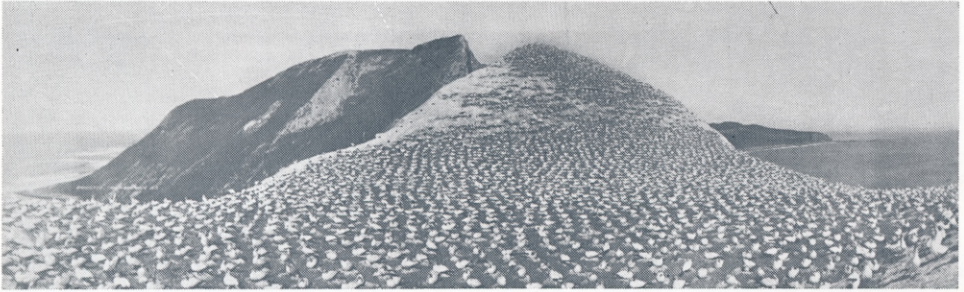


Photo: Alexander Turnbull Library

FIG. 4.—Cape Kidnappers looking west, *c.* 1939. Note most of the western slope packed up with nests.



Photo: S. N. Beatus

FIG. 5.—Black Reef gannetry looking north-west. From left to right, stacks 3 (“Bush Rock”), 4 (“Lozenge Rock”), 5 and 6. In December, 1964, stack 4 was filled to capacity, stack 5, which is below spring tides level and used hitherto as roost had one nest with egg and stack 6 was more than half-filled with occupied nests.



Photo: S. N. Beatus

FIG. 6.—Kidnappers Plateau gannetry looking south showing larger group of nests 1 (“Old B”) and smaller group 2 (“New B”), the main roosting area and lighthouse (foreground).



Photo: J. J. Whalan

FIG. 9.—Cape Kidnappers gannetry, *c.* 1890, looking east from a sketch by Augustus Hamilton.



Photo: L. G. Adkin

FIG. 10.—Cape Kidnappers gannetry. Northern part of saddle and eastern slope. 22 February 1913.



Photo: C. L. Beken

FIG. 11.—Cape Kidnappers gannetry. Eastern slope and central saddle, *c.* 1920.



Photo: Alexander Turnbull Library

FIG. 12.—Cape Kidnappers gannetry looking east, 1956. Note disappearance of nesting mounds on eastern slope and on saddle's northern edge.

TOTAL POPULATION 1945–1964

Fleming and Wodzicki (1952: 71) assessed the total population of the three Hawke's Bay gannetries at approximately 2,880 pairs in 1945–46 and 2,760 in 1946–47. Table VI compares these two censuses with those of 1957 and 1964.

It is doubtful whether the decrease in number of nesting pairs between December, 1945 and 1946, amounting to 120 pairs is significant. Mention has already been made of inter-seasonal fluctuations; also the fact that the December, 1945, count of all gannetries was based on ground counts only supports this suggestion.

On the other hand, taking the mean of the 1945 and 1946 counts to iron out these fluctuations, we find an increase in total population in the intervening period to December, 1957, of 766 pairs, or 27%. This increase, however, was not even: Cape Kidnappers increased by 4% and the Black Reef and Kidnappers Plateau gannetries by approximately 176% and 56% respectively.

The comparison of the December, 1957, census with the one seven years later in December, 1964, gave a different picture: Black Reef and Kidnappers Plateau continued to grow, though at a slower rate, and increased by 18% and 75% respectively, whereas Cape Kidnappers actually declined by 15% resulting in no change in the total Hawke's Bay gannetries population.

The growth of the three gannetries is shown in fig. 8. This is the graph drawn by Fleming and Wodzicki (1952: 68–71) extended by two further counts taken in December 1957 and 1964.

DISCUSSION

The preceding pages provide information on the sources of error and the reliability of various methods of estimating gannet populations, the numbers of gannets in the 1945/46–1964/65 period and trends in the Hawke's Bay gannet population.

VARIABLES AFFECTING POPULATION

Intra-seasonal fluctuations in numbers of gannets at the nesting colonies depending on the date of arrival soon after the winter solstice were first described by Fleming (1948: 152–154). The present work has confirmed this, and such fluctuations, e.g., between early September and December may amount to 42%. The numbers of gannets present at the colony also varies with the time of day, and the difference between early morning and mid-day may reach 5–6%.

More important numerically, however, are inter-seasonal fluctuations. The existence of such fluctuations was suggested by Fleming and Wodzicki (1952: 73) and confirmed by the nineteen years of observation at Kidnappers Plateau in December shown in fig. 7.

Gannets are a conspicuous species and breed at a limited number of sites. In theory the world population of such animals could be counted and Fisher and Vevers (1943) attempted this for the North Atlantic Gannet (*Sula b. bassana*). Their census, which was spread over five months, could not avoid errors due to intra-seasonal fluctuations.

The present study emphasises the error involved in counting gannets on the ground; even in small, distinct groups of birds observers differ in their counts by up to 28% (Tables I and III). Aerial or ground photographs, if available and of good quality, are a great help in almost eliminating this error.

THE HAWKE'S BAY GANNETRIES BREEDING POPULATION 1945/46-1964/65

With the above variables and margin of error in mind we can now assess the breeding population of the Hawke's Bay gannetries and its trends.

Table VI shows the changes that have occurred in the population of the three gannetries between 1945/46 and 1964/65 nesting seasons.

The first two censuses are not exactly comparable. The December, 1945, count was the first count of gannets in New Zealand (Wodzicki and McMeekan, 1947: 439-440) and was based on ground counts only. The 1946 count was made both on the ground (Black Reef and Kidnappers Plateau on 16 December) and from aerial photographs (Cape Kidnappers on 21 November). A decline of 119 nesting pairs was noted and it is thought that this small decline is probably an inter-seasonal fluctuation. The mean of the 1945 and 1946 census has therefore been accepted as the basic figure for the Hawke's Bay gannetries' initial population of the nineteen years studied.

It appears from Table VI that in the twelve years between December, 1945, and December, 1957, the total population of the Hawke's Bay gannetries increased by 27%. Over the next seven years, however, the total population showed no significant change.

The population changes of the Hawke's Bay gannetries and of each of the component colonies are shown in fig. 7. The Black Reef and Kidnappers Plateau displayed a steady and vigorous growth throughout the whole nineteen-year period. Black Reef shows an over threefold increase, and Kidnappers Plateau an increase of over two and a-half. Cape Kidnappers, on the other hand, although increasing by 103 pairs between 1945/46 and 1957/58 showed a loss of about 365 breeding pairs between 1957/58 and 1964-65. The total population of the Hawke's Bay gannetries increased between 1945/46 and 1957/58 by 766 pairs but remained steady over the next seven years.

If the decline of 17% in the largest colony was caused by inter-seasonal fluctuations, say a particularly unfavourable nesting season in 1964/65, we would expect that it would affect similarly the adjacent Black Reef and Kidnappers Plateau gannetries; and we have already seen (Tables II and IV and fig. 8) that these two colonies substantially increased during this nesting season.

Photographs of the Cape Kidnappers colony taken between 1890 and 1964 allow us not only to gauge its growth but also provide a more satisfactory explanation of its decline.

Nearly thirty old photographs of Cape Kidnappers gannetry have been examined. Some of them have been described and published by Fleming and Wodzicki (1952: 69-70) and other more important are shown in figs. 2, 4 and 9-12. From these it is possible to map the area consecutively occupied by gannets and this has been done in fig. 13. The diagrammatical representation of the spread of nesting gannets shows that the initial sickle-shaped agglomeration of nests stretching across the northern part of the saddle (fig. 9) expanded first to fill by 1913 most of the saddle (figs. 10 and 11) and then from the early twenties the western slope began to be packed up with nests as shown by Horace S. Cottrell photographs. The progressive occupation of the area by nesting gannets suppressed the vegetation, which according to contemporary photographs included taupata (*Coprosma repens*) and sedges (*Scirpus* sp.)*. Once the vegetation had been removed by the birds' trampling and their excreta the thin cover of mudstone became exposed and, as described by Grant-Taylor (in press) the way was opened to accelerated erosion.

* I am indebted to Mr Norman Elder for the identification of plants on the photographs.

In 1939 there was a reduction of area covered by nests in contact on the western slope and, in 1946, Fleming and Wodzicki (1952: figs. 33 and 34) first showed changes in the appearance of the surface at the northern edge of the saddle. Photograph taken in 1956 (fig. 12) and in 1964 (fig. 2) show progressive changes on the northern rim of the saddle (where about 100 old, empty nest mounds were counted in December, 1964) and on both eastern and western slopes (fig. 13). Erosion may therefore have led to the decline of the Cape Kidnappers gannet population (Table II).

POPULATION TRENDS

Fleming and Wodzicki (1952: 75) after careful examination of the results of the 1946-47 New Zealand census concluded that "the general trend of the New Zealand gannet population has been one of increase during the past century . . . perhaps due to fundamental changes in the ecology of the sea, possibly of cyclic nature". Since then, a new gannetry at Moutara Point on the East Coast has been established (Blackburn, 1956: 15) which supports this general upward trend, at least for the eastern coast of the North Island.

A similar trend was noted by Fisher and Vevers (1951: 467) in the North Atlantic Gannet whose East Atlantic population increased between 1939 and 1949 by 18%; and more recently by Barrett and Harris (1965: 203) in the large Grassholm gannetry.

The Hawke's Bay gannet population increased between 1945-46 and 1957 by 27% but remained steady over the next seven years. Probably this can be attributed to lack of nesting space at Cape Kidnappers caused by erosion which has accelerated since the vegetation has been killed by excreta. The large increases at Black Reef and Kidnappers Plateau gannetries might arise from immigration from the Cape Kidnappers colony; but a detailed analysis of recoveries and recaptures of banded birds at the Kidnappers Plateau (to be presented in a separate paper) indicates that growth probably results from young birds born at the gannetry returning and settling. Roosting generally precedes the establishment of a new gannetry (Wodzicki and Robertson, 1953), and some Black Reef stacks which served initially as roosts in 1945 but became nesting colonies by 1964 support this. The places selected by the birds for roosts are usually exposed stacks (fig. 3 and 5) or ledges on the mainland (figs. 3 and 5). It is not clear why some roosts develop into nesting colonies (e.g., rocks 1 and 2, fig. 3) but others do not. For instance the mainland roosting ledges at Black Reef had twelve nests in 1945 but since then have only once had a few nests.

Roosting birds are predominantly young, presumably unmated birds, and probably would eventually found a new colony at their former roost if this area is suitable. Adults that have lost nesting space at Cape Kidnappers may not breed at all, and the lack of increase in population from 1957 to 1964 may result from erosion proceeding faster than colonisation at the other gannetries.

Gannets feed mainly on small surface fishes such as garfish, herrings and young mullet, and squids are also caught (Oliver, 1955: 239; Wodzicki and Moreland, 1966). Unfortunately, there are no observations on the abundance of these fish nor on any other changes in the ecology of the sea in this part of the South-Western Pacific which could explain the general expansion of the gannet populations over the last half century or so. Further regular observations of the Hawke's Bay gannetries would undoubtedly be of considerable interest.

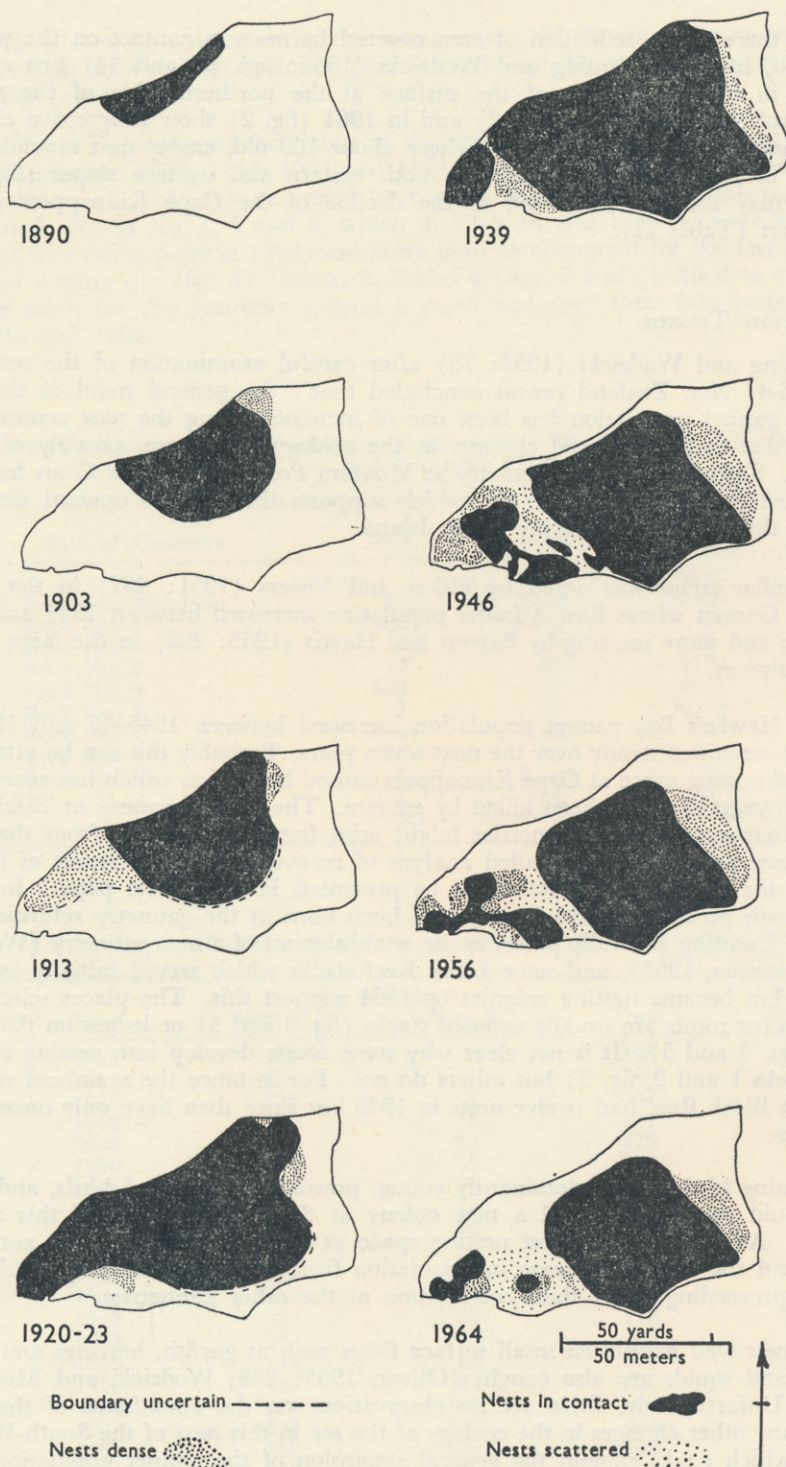


FIG. 13.—Diagrammatic distribution of areas occupied by nesting gannets between 1890 and 1964 at Cape Kidnappers gannetry, based on contemporary photographs.

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