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A FIVE-YEAR BANDING STUDY OF THE TAKAHE

(Notornis mantelli Owen)

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Though this species was rediscovered in 1948, banding was not begun until four years later, even though the use of the technique had been recommended in 1949. The main reason for this delay was an understandable reluctance to disturb the species any more than seemed absolutely necessary until more had been learned about its numbers, distribution and some of the more important aspects of its life-history. By 1952, in the light of information collected by expeditions to that date, it was decided that banding could safely begin, and in December of that year nine birds were captured and marked with poultry-type plastic wrap-on bands. Riney and Miers [6] have described the operation and the results obtained by observation over the next few days and have included a small number of observations made by another party about two months later. These gave some preliminary information on the extent of daily movements and the home range of one family group of two adults and a chick. Unfortunately, no numbered aluminium bands were available at the time, and it was soon found by other observers that not only were the plastic bands subject to serious loss but two of the colours being used were likely to be confused later. This was because the green faded to a yellow indistinguishable in the field from that of the yellow bands. These and similar difficulties also beset us but, as will be seen in due course, they have now been to some extent overcome.

Thirty takahe have been banded with a combination of aluminium and plastic bands up to the end of December, 1957. Of the nine birds banded with plastic bands *only* in 1952 four have been rebanded since with aluminium bands as well; but the other five have probably lost their original bands and may have since been unknowingly rebanded, for they have not been reported for four to five years. It is possible, of course, that they may even have died or emigrated from the main colony. In the summer of 1954-55 the plastic colour bands which were still being lost were closed with cement after fitting. Only two losses have been detected since. (The cement used is nitrocellulose lacquer which is smeared on all opposing surfaces of the celluloid and the bird is then held until the cement has partially set. This takes about three minutes.)

Because the chance of frequent recapture of a flightless bird in a limited area is greater than with most birds possessing the power of flight, we have an excellent opportunity in the takahe of comparing band wear and band loss in aluminium and plastic bands; and it is an added advantage in making these comparisons that all the evidence indicates that the species is a long-lived one. As far as we know no

Maps referring to this article see page 28

aluminium bands have been lost during the four years they have been in use (that is, no birds have been recorded over this time wearing plastic bands only). Nor have we found on any recaptured birds any that show sign of serious wear, springing open or the development of sharp edges or any feature that might lead to injury of the leg. And over the last three years in which the plastic bands have been cemented shut, though we have, so far, detected two losses, there does not seem to be any excessive wear among any of the remainder we have examined. However, the bands are becoming less elastic and badly-faded colours have had to be replaced.

Figures for the loss of the wrap-on (and a few spiral) plastic bands when used in the normal way, without the cement) are of some interest. Twenty of these were on birds seen again on one or more occasions after banding. After approximately one year, seven or 35% had been lost and only two (10%) are known to have remained on for as long as two years. Had it not been possible to recapture birds and read the aluminium bands such a loss would have caused a very serious gap in our knowledge. Wrap-on or spiral plastic bands used on birds able to fly may well have a longer life. We feel the losses among takahe are not caused by birds attacking bands with their powerful beaks, for the cemented ones would be almost as vulnerable; it is more likely that their continual proximity to ground vegetation and ground water weakens them and increases the chances of their being stripped off by catching on projections or on the claws of the other foot.

We soon realised that fading of some pigments was likely to cause difficulty in the positive identification of some combinations. To get an idea of which colours were likely to be unsatisfactory, a complete series was left to weather in the open in Takahe Valley and another submitted to ultra-violet radiation under controlled conditions. (For the making of this test we are indebted to the Paints Laboratory of the D.S.I.R.). The two experiments gave similar but not identical results: Fast colours in both cases were black, white, dark-blue, red and orange; those subject to serious change were pink, light-blue, mauve and yellow. Green was satisfactory in the ultra-violet test, but not in the field. Combinations are therefore now limited to the five fast colours and aluminium, and faulty combinations already in use will be changed wherever possible. Not only have combinations been devised that offer the least chance of confusion with each other but two-colour combinations on one leg are being made the critical identification key and both colours on this leg must be recorded before the observation will be regarded as satisfactory. We find it impracticable and inadvisable to try to use one key-colour for birds banded in a particular year.

A major difficulty in identifying birds is that of obtaining a good view of the leg bands in the thick ground cover in which the takahe spend most of their lives. Perching birds are often in clear view, shore and swamp birds spend at least some time on clear — or relatively clear — shorelines; but flightless birds living in thick undergrowth or tall grass pose a special problem: Takahe are greatly dependent for food, nesting and ordinary cover on two species of tall snow tussock, *Danthonia rigida* and *D. flavescens* and these grow thickly over most of the range that is not boggy ground or forest or sub-alpine scrub. These grasses have an average height in the Takahe and Point

Burn Valleys of 2-3 feet, that is, as tall as or taller than the bird itself; so to get a clear view of the legs of undisturbed birds in this habitat demands considerable patience; nor is stalking the birds in the forest an easy task. Wing tags and neck markers have been considered but not experimented with, for we feel that their use would involve the birds in too great a risk of being caught up in thick vegetation and injured. Two other marking methods are at present being considered: one is the use of a specially designed *tall* colour band, in effect a short tube, about 1½ inches high, which would fit quite comfortably on the bird's long tarsus, so increasing by about three times the coloured area available for observation; the other is the marking of the prominent frontal shield with a recognisable but, for obvious reasons, not too obtrusive pattern. It would be safer in the first instance to do this only after the birds have bred and, of course, the mark would not be permanent. However, the great abvantage would be its prominence. We have not seen this system suggested elsewhere, but it is a technique that might well be useful in the study of species with frontal shields or similar anatomical outgrowths.

BANDING RESULTS SO FAR

These are dealt with under three headings: those throwing light on (a) behaviour, (b) some aspects of physiology and (c) population size and survival.

(a) *Behaviour*

Territory and home range: The information most obviously arising from sight and recapture records is that on movement, home range or territory. If we accept Noble's definition[5] of territory as "any defended area" and Bourliere's definition[1] of home range as the undefended area over which the individual or the family group normally travels in search of food, then in the breeding season at least, takahe occupy a *territory*. At other times of year the same area may be mainly a *home range* for we have so far not seen any disputes except during the breeding season, though this does not mean, of course, that they do not occur — our visits are infrequent other than at this time. But it is likely, because of the relative permanence of occupation by takahe of certain areas, that a part at least is still defended as a *territory* at other times than when the birds are breeding. Should this be so, then the takahe's behaviour resembles that the American coot, *Fulica americana,*[3] and the European coot, *F. atra.*[2] If all the area under occupation *is* defended by fighting, threat-display or song throughout the year, then in this species we have an example of Hinde's "Type A" territory.[4] However, there are a few areas occupied by birds — those in the head basins of the Takahe and Point Burn valleys — which, as far as we can tell, just have to be given up during those months when they are heavily drifted with snow. For simplicity hereafter, we shall use the word "territory" whenever we are referring to areas that time may show to be either true territories or home ranges.

It seems that as long as a particular pair bond exists a given territory is occupied continuously, and even a change of partner does not necessarily presuppose a change of territory. Areas occupied over two seasons or more by a pair, or one of a pair, of birds give a good idea (like watching individually-marked takahe over a number of days) of the size of a territory, though we have found the actual boundaries

hard to define. Such areas are shown hatched in Map No. 1. From the data available the area of a breeding, or immediate post-breeding, territory seems to lie between the limits of 15 and 45 acres, (the grid squares on Map No. 2 have an area of approximately 18 acres). This territory includes forest and bog as well as open tussock country. To obtain these estimates we have used not only direct observations of marked birds but also what we consider to be reliable circumstantial evidence of the presence of these same birds in an area by means of the location of calls after the birds have been identified, always within the same observation period of course. Though the same birds have been recorded in these areas at other seasons our records are not numerous enough for us to be sure to what extent changes, if any, occur throughout the year. It seems reasonable to assume that during winter, when snow lies thick and long over the main feeding areas, birds have to range further afield than at other times. The observations given by Riney and Miers for the family group they watched during their sojourn in Takahe Valley indicate that a home range of at least 15 acres was being occupied by it at that time. Later observations made by another party suggest that the home range increased as the chick became bigger and more able to move about; and one year later we found one of these adult birds (White/Blue: Left) in occupation, again with a chick, ranging over about 30 acres. Riney's and Miers's reported movement of the family group on this area covering a distance of 375 yards in about 16 hours still stands as the greatest of which we have record within a single day. The movements of White/Blue: Left between 31st December, 1952, and 17th February, 1954, are shown on Map No. 2.

Within one particular period of observation the occasional sporadic foray such as that shown for No. 16388 is not regarded by us as taking place within the territory. Such an excursion seems more likely to result from "banding shock," disputes, the wandering of a chick and so on. (No. 16388, an adult, was banded at point No. 1 on 4th January, 1955, and seen one week later about 300 yards away with its mate in apparently the same territory. But in less than three days after this it appeared in copulation with an unidentified bird 1200 yards away across the valley at an altitude some 500 feet higher. Eight days later it was back close to where it was first captured).

On the other hand, all the records, except the first, for No. 16386 (the bird for which most records exist — there have been 11 between 30th December, 1952, and 1st May, 1955) have occurred, in our opinion, within the confines of one territory which therefore has an area in this instance of about 45 acres. No other pairs have been recorded within this area during the period under discussion.

Interseasonal movements with change of breeding territory are known; the one of greatest amplitude so far is that of No. 16380 banded as a chick at about three weeks of age above the tree-line in "M Basin" on 27th December, 1952, and then found incubating a nest in the clearing above the northern bluffs (grid square C5) almost exactly a year later. From the map it can be seen that the distance covered in a direct line is probably more than 2000 yards. Later movements of this bird up to 28th January. 1957, are also shown. Another emigration from a recognised breeding territory which may or may not have been permanent is recorded for an adult, No. 16385, which, incubating two fertile eggs in grid square C5 in November, 1955, was captured 12 weeks later in

grid square F9, some 1500 yards away and 500 feet lower. (Though the eggs had hatched, we cannot say whether any chicks accompanied this bird on the occasion of its capture).

From what is now known of such movements as have just been described, there seems no reason why an interchange of birds between Takahe Valley and the Point Burn Valley should not occasionally occur; but since banding has been begun no such interchange has been discovered.

Pair bonds and persistence of territories: Being able to recognise a number of takahe individually enables us to get some idea of the permanence of pair bonds and territories. The useful records of pair bonds are those which exist over two or more seasons and of these there are the following: (The use of *seen* implies that mating was not established beyond all doubt.)

No. 16378 (?F) was mated with "Blue right"* in square G10 in 1952/53.
was mated with No. 16386* (Black/Blue left) G11d in 1954/55.
was *seen* with No. 16394 in G11b in 1956/57.

As No. 16378 was captured in February, 1954, in H11 and in May of the same year in G10 and as no more than one pair of birds has been known to occupy this particular area south of the Tunnel Burn, we are confident that No. 16378 has occupied the same breeding territory in these two breeding seasons at least. As it has been captured, apparently mated, in G11 during the 1956/57 breeding season also, the presumption seems reasonable that it has occupied the same breeding territory for five consecutive seasons. The mate of the 1954/55 season, No. 16386, has not been recorded since 1st May, 1955.

No. 16380 (?M) was mated with No. 16381* in C4 in the 1953/54 season.
was mated with No. 16385 in C5 in the 1954/55 season.
was mated with No. 16385 in C5 in the 1955/56 season.
was mated with an unidentified bird in C5 in the 1956/57 season.

For reasons similar to those just given, the same breeding territory seems to have been occupied throughout these four seasons.

No. 16382 (?M) was mated with No. 16384* in G13 in the 1953/54 season.
was mated with No. 16383 in G11a in the 1954/55 season.

No. 16383 was the chick of the previous season. As No. 16382 was first banded in G13 in late 1952 and was recorded twice there that year and in the same square or G12b for a total of three times in 1954, we once again feel confident that the same breeding territory was occupied throughout for three consecutive seasons.

No. 16389 (?M) was mated with No. 16395* in G15 in the 1954/55 season.
was *seen* with an unbanded bird in G15 in the 1956/57 season.
was mated with an unidentified banded bird in G15 in the 1957/58 season.

This appears to be a four-season occupation of the same territory.

* Not recorded since this season, "Blue right" may have lost its only plastic band and been unknowingly rebanded.

No. 16391 (?M) was mated with No. 16390 in J9 in the 1954/55 season.
was *seen* with an unidentified bird in J9 in the 1955/56 season.
was apparently mated with No. 16390 in J9 in the 1957/58 season, and still accompanied by a yearling from the previous season.

This appears to be a four-season occupation of the same territory by the same pair.

No. 16393 (?M) was mated with No. 16392 in J8 in the 1954/55 season.
was *seen* with No. 16397 in J8 in the 1955/56 season (the chick of the previous season).
was *seen* with No. 16392 in J8 in the 1956/57 season.

In the two latter seasons a third unidentified adult was also present and tolerated in the territory (this was after hatching time). It is possible (as with Nos. 16390 and 16391) that in the first of these instances at least, the whole family unit was still together even though the chick was now a year old. There was a nest that season containing an egg which had apparently hatched though no chick was positively ascribed to the territory thereafter. This seems to be an occupation by the same pair of the same territory over three seasons.

No. 16398 (?M) was mated with No. 16399 in M18 in the 1954/55 season.
was mated with No. 16399 in M18 in the 1955/56 season.

These observations suggest that the pair bond and the territory occupied by the pair are at least semi-permanent; and it is probably not entirely without significance that in the five fairly certain instances of change of partner the second bird has not been recorded since, though admittedly this does not necessarily mean that death is the cause of the apparent disappearance.

There are records of 22 birds being seen in different breeding seasons, though four of these observations are only ten months apart. The rest range from just over a year to five years. Of these 22 birds we regard only three as having moved without any doubt from one breeding territory to another and one of these, No. 16380, shifted before it had reached breeding age. There are two birds whose movements are such that we cannot be certain whether a change of territory is involved. One of these, too, was in its first year at the time of its change, or apparent change. The remaining 17 birds have not obviously changed their breeding territories over the periods for which we have records and in one instance already quoted, that of No. 16378, loyalty to a territory has lasted five seasons. Four, Nos. 16380, 16385, 16390 and 16391 have remained on the same breeding territory for four seasons; and five, Nos. 16382, 16386, 16389, 16392 and 16393, have remained for three. The remaining seven have occupied their known breeding territories for two seasons so far. We have made one major assumption in reaching these figures and that is, that if a bird was reported in a territory in one season, missed the next but found there again in the following then it is regarded as having been in continuous occupation provided that no other pair has been seen in the same place in the meantime and it has itself not been recorded elsewhere.

If takahe normally show an extended attachment to a breeding territory and perhaps to a mate, then the implication is that maturing young must generally move over much greater

distances than older birds in search of a territory or a mate. As most of the valley floor territories in the Point Burn and Takahe Valley (if not those in the head basins, too) seem to be fairly constant in number and position from year to year (see Map No. 1) surviving young could have a fair way to go in their search and No. 16380 is probably a good example of this. But as the total number of adults in the main colony is about 50 and only about one chick survives on the average to leave the nest for every 2-3 nesting pairs, then, even if first-year mortality is as low as 50%, only about five chicks on an average will be competitors for territories each year within the main colony. It is this marked territorial behaviour that seems the principal factor regulating the number of takahe in the main colony at least[8]. Food and cover seem always to be more than sufficient.

Incubation behaviour: Observation of banded birds has proved that the task of incubation is shared. In this, takahe resemble most other rails. Because we feel that our provisional method of sexing is not yet fully established, we are not prepared to apportion particular behaviour of any kind to either male or female. Birds of a pair will even take turns in sitting on an empty nest that has apparently never contained eggs and one such nest is known to have been "incubated" for about eight weeks.

Very little is known about the length of spells at the nest except that in one instance a bird relieved its mate at least once a day over a period of observation lasting a few days.[7]

(b) *Physiology*

Breeding age: One bird banded as a chick is regarded as having bred at one year. This may or may not be a general rule. It was found in its first breeding season after hatching sitting on a nest containing two eggs. This was the bird No. 16380. Another yearling, No. 16397, was twice recorded in one breeding season with one of its parents, No. 16393, in grid square J8 in which a nest and egg were found close by. We would be happy that this was another example of a bird breeding in its first year if it were not for the fact that an unidentified adult was seen in the territory at the same time and that No. 16393 was apparently mated with its original mate No. 16392 in the following season. Under these circumstances it is rather more likely that a family group has been maintained in the territory, or a yearling tolerated there, until after the parents had laid.

Double brooding: There is one clear case of this. Takahe No. 9 of the 1952/53 season (White/Blue: Left) was seen with a chick on 16th December, 1953. On 15th February, 1954, it was seen again by us with a chick only a few days old in the same territory and almost exactly in the same place. The fate of the first chick is not known. Evidence of *renesting* has not been based upon banding studies so will not be reviewed here. However, it has been discussed elsewhere.[8]

Sex differences: Because the sexes are alike in plumage and body sizes are very similar, we have found it impossible to sex takahe on sight. This is a great disadvantage, but by individually marking birds of a number of known pairs it should be possible to get some clues from behaviour (supported by other evidence) that would allow a number to be sexed as time went on, especially when changes in mate occurred.

All birds captured for banding are weighed and measured and, because in rails the male is generally the larger, we have provisionally assumed that one bird of a pair is a male so long as the culmen has a length of 86 mm. or more and the weight is 2.6 kg. or greater. This may seem a rather arbitrary division but inspection of our data (see table) plus our register of known mates indicates, so far at any rate,

TABLE No. 1

PROVISIONAL MALES			PROVISIONAL FEMALES		
Band No.	Mean Culmen	Mean Weight	Band No.	Mean Culmen	Mean Weight
16376	87mm.	2.85kg.	16378	86mm.	2.30kg.
16377*	89	2.30	16379	83	2.50
16380	87	2.60	16381	83	2.30
16382	88	2.75	16383	86	2.50
16386	89	2.70	16384	85	2.30
16388	89	2.70	16385	84	2.25
16389	90	2.60	16390	81	2.15
16391†	87	2.25	16392	82	2.10
16393†	86	2.45	16395	82	1.85
16394	86	2.65	16396	82	2.35
16398	88	2.85	16399	85	2.60
18488	86	2.80	16400	85	2.30
18490	91	3.25	18491	81	2.10
			18492	82	2.15
Means ..	88mm.	2.65kg.	Means ..	83mm.	2.25kg.

Culmen lengths (including frontal shield) taken to nearest mm.

Weights taken to nearest 0.05kg.

* Though the weight of this bird is below 2.60kg., the culmen length is so far outside the female range that it seems safe to regard it as a provisional male.

† For comments on these birds see Table 2.

Banded birds Nos. 16387, 16397 and 18489 have, so far, been weighed and measured only as chicks.

that only a small overlap occurs; and in the five changes of mate the new bird's provisional sex has been that required every time. The reliability of our standard of division can be tested only by the slow collection of more data on measurements and mated pairs. But as a further check on its possible accuracy in the meantime, we have used measurements of the same two characteristics in the related pukeko or swamp hen *(Porphyrio p. melanotus)* to see if it is possible to get a reliable separation of the sexes there. Thirty-eight birds were measured and sexed by dissection. Then with a set of standards similar to those used in the takahe we provisionally sexed another 41 pukeko and checked our forecast by dissection. We were correct in 38 instances, wrong in two and one bird was a "border-line case." In the whole 79 birds there were only four that would have been wrongly sexed by the weight-culmen standard for this species, an accuracy of about 95%, which is a fairly satisfactory standard. An account of this investigation is now in press[9].

Weights: Ideally it should eventually be possible to obtain sufficient weight records to get some idea of growth rates and seasonal

TABLE No. 2

KNOWN PAIRS OF PERMANENTLY-BANDED BIRDS

(The provisional male is given first)

16380	with	16381	
	&	16385	
16382	with	16383	
	&	16384	
16386†	with	16378	(In the 1954/55 season, see 16394)
16388	with	16396	
16389	with	16395	
16391*	with	16390	
16393*	with	16392	
	&	16397*	(There is some doubt about this pair, see text)
16394	with	16378	(In the 1956/57 season)
16398	with	16399	
18488	with	16400	
18490	with	18491	

* 16391 should be a male according to its size proportional to its mate and its culmen measurement of 87mm., but a female according to its weight of 2.25kg. Its mate, 16390, is a good female.

* 16393 would have been classed as a female had it not been mated with an even smaller 16392. Its culmen measurement is 86mm. and its weight 2.45kg. Its mate, 16392, was a good female.

* 16397: there are no adult measurements at present available.

† Not recorded since 1/5/55.

changes. In this there is still a long way to go but there are a few miscellaneous figures that may be of some interest in the meantime since they give a rough idea of growth-rate in this species: A chick at an estimated age of about one month weighed 440 grams, one week later it weighed 480gm. Two other chicks or juveniles of an estimated age of less than two months weighed 710 gm. and 850 gm. respectively. A juvenile approximately three months of age weighed 1.85kg.; eleven months later it weighed 2.5 kg. Adult birds recaptured at different times have not shown weight variations in excess of approximately 10% either way of previous weights and we have insufficient records to discover whether any consistent seasonal variations occur.

(c) *Population size and survival*

Population size: Because of all the provisos that hedge about the use of the Lincoln Index and because of the small number of banded birds available (though nevertheless they certainly make up an appreciable part of the population with which we are concerned), we have used our population estimates of adults in the best-studied and most accessible parts of the Takahe Valley-Point Burn area (those two enclosed by the heavy boundaries in Map No. 2) merely as a check on a figure obtained by the following method:

Eight years' familiarity with these parts of the main colony has convinced us that the maximum number of pairs occupying breeding territories in any one season has never exceeded fifteen. Our yearly counts, which we feel are of considerable accuracy in more recent seasons, have always set a figure of between ten and twelve pairs and we are certain that any error in these estimates could not exceed 20%

either way. Therefore the number of breeding birds (or *mated* birds on territory, since some may not breed) in these areas lies in the vicinity of twenty-two and it appears fairly constant from year to year. We have no estimate for the number of unmated birds, but whatever the figure may be it is certainly not high and could not approach that for mated birds for such a proportion could not possibly be missed. In fact the general impression is that unmated adults are distinctly uncommon at any time. Thus we would fix the adult population in these areas at something between 22 and 30 birds.

Though it may be a chance agreement it is nonetheless gratifying to find that Lincoln Index estimations of the adult population in these same areas gave in the 1954/55 season a figure of 29 and in the 1955/56 season a figure of thirty-three. For these estimations only birds bearing aluminium bands were used and all the usual necessary assumptions have been made. From other criteria we know that the aluminium bands are permanent and that the birds are long-lived; and from knowledge of the territories of pairs and the likely range of diurnal movement we are likely to be fairly correct in our assumption that no birds were counted twice. Of course, deaths or emigrations favouring banded birds would make any estimates too high.

We have no Lincoln Indices to compare with our population estimates for the great cirques at the head of the Takahe and Point Burn valleys (see the stippled areas on Map No. 2) but four adults and one chick were banded in the Point Burn cirque in January, 1955. No birds have been banded in the Takahe Valley cirque though five different unbanded birds have been seen there on one day. Although our knowledge of the difficult country in these two cirques is not as intimate as that for the rest of the colony, we feel certain that the total number of adults in them is far less. Thus the total of adults in the main colony as a whole does not seem to have exceeded 50 over at least the last five years and the birds occur only rarely outside the areas marked on Map No. 2. Although the Takahe Valley — Point Burn area has, as far as is known, the main concentration of takahe, the species is spread sporadically throughout the whole of the Murchison Range, of which the area covered by the map is but a small part. Other characteristics of the population of the main colony have been dealt with in the earlier paper.

Survival: Naturally, with only 30 birds banded with at least semi-permanent bands and the passage of only five years' observation since banding was begun, very little in the way of a life table can be expected—especially since it seems that takahe are long-lived. Preliminary figures on the population dynamics of the species suggest that the average expectation of life in birds of one year of age or more may approach ten years.[8] Because our total period of observation is well short of this estimate a satisfactory life table is not likely to appear for a very considerable time. No banded birds have yet been found dead and only two unbanded adults. These were discovered before banding was begun. Eighteen of the maximum number of 35 takahe banded up to December, 1957, have been positively identified between one and four years after their first capture (five years being the time since banding was begun). Since some of the earliest-banded birds, through loss of uncemented plastic rings, can no longer be identified or identified

only by capture and reading of the aluminium band, the number surviving at least one year after banding must be higher than the known total of eighteen.

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SUMMARY

(i) Banding of takahe *(Notornis mantelli)* was begun in December, 1952, and has been continued since. Results are described up to and including December, 1957.

(ii) Thirty-five birds have been banded but of these only thirty bear a combination of aluminium and plastic colour bands. The other five birds, which were banded in 1952 with plastic colour bands only, have apparently lost them since.

(iii) A comparison is made between the durability and the resistance to wear of the aluminium and the plastic colour bands, and a recommendation is made that plastic wrap-on bands be cemented closed with a nitrocellulose lacquer whenever such bands are used. Some data on the fading of the colour bands are given.

(iv) Pairs of takahe show year-round territorial behaviour and extended attachment to the area they occupy — frequently lasting over a number of years. The size of this occupied area lies between 15 and 45 acres. Diurnal, seasonal and other movements are discussed.

(v) Usually takahe appear to pair for life and this bond persists throughout the year. The histories of some marked pairs and some territories are described.

(vi) Both birds of a pair take part in incubation; the breeding age is one year in at least some birds; double brooding and renesting are known.

(vii) There is no obvious external difference between the sexes but a provisional method of separation based on marked birds of known pairs depends upon the use of a combination of culmen and weight measurements.

(viii) Population estimates for the number of adults in the main colony indicate a figure of about 50. However, the species does occur elsewhere in the Murchison Range but nowhere in such concentration as in the Takahe Valley-Point Burn area.

BAR-TAILED GODWITS CHASING SKUA

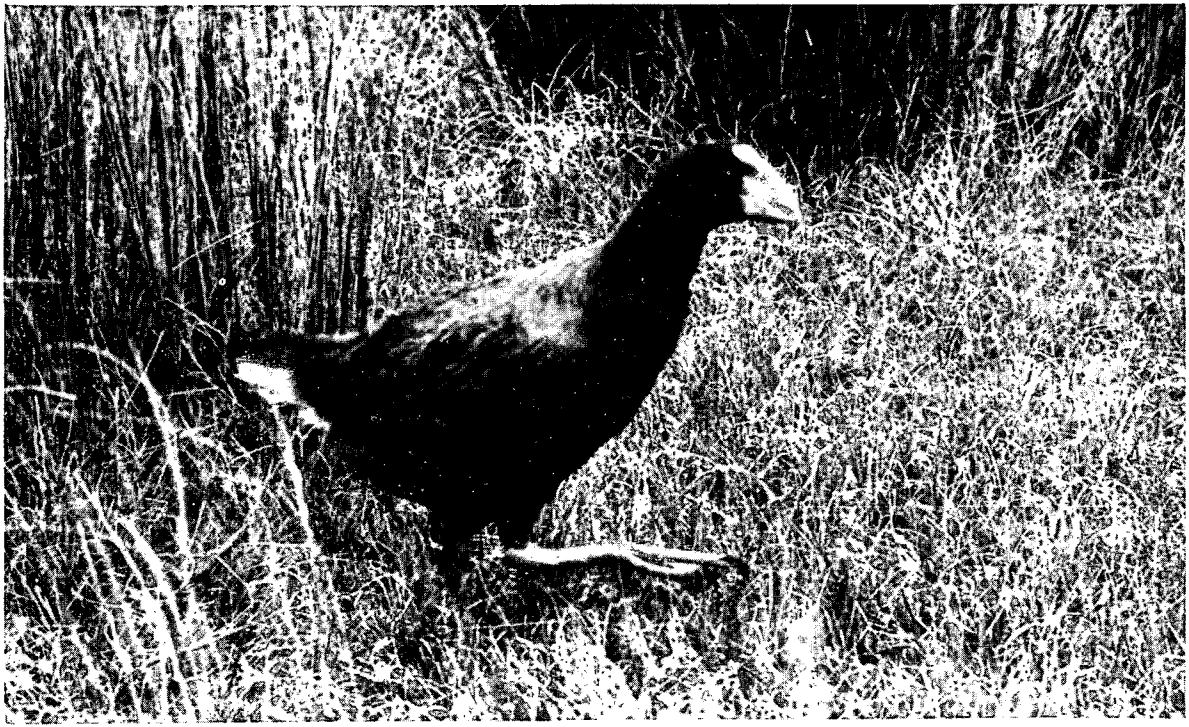
On 7/4/57, as the tide rose, we were watching shore-birds gathering on a shellbank near Miranda in the Firth of Thames. More than 400 S.I. Pied Oystercatchers, together with some Stilts, Caspian and White-fronted Terns, were already at the roost and some hundreds of Godwits and Knots were just arriving. Suddenly all the resting birds rose at the approach of a Skua *(Stercorarius ? parasiticus)*, rather a dark specimen without any conspicuous white in the wing and very like one seen on the same coast a year before *(Notornis 7, p. 89)*.

One close flock of about fifty Bar-tailed Godwits *(L. lapponica baveri)* refused to be intimidated, but with a few Knots drove the raider far out over the Firth, pressing home the attack for more than a mile and up to a height of about a thousand feet.

As less than 2% of the Godwits seen on this date were in red plumage, it is likely that the attackers were for the most part immature non-breeders, moved by an inherited antipathy to a traditional enemy. On the Arctic tundra where they breed, Godwits may well have to be on their guard against predatory Skuas. In the Handbook of British Birds, Vol. V, p. 134, the young of Whimbrel, Lapwing and Redshank, as well as several of the smaller waders, are listed among the prey taken by Arctic Skuas.

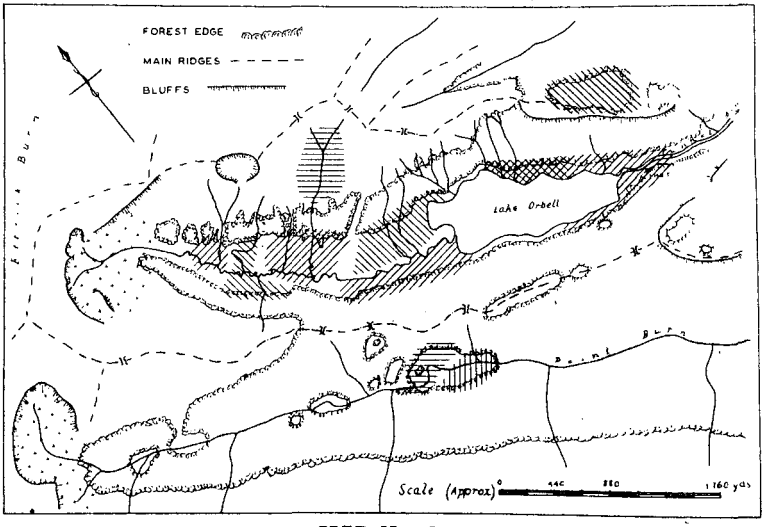
Another point of some interest is that the roosting birds rose when the Skua was still some way off. Though it was flying low, they were able to recognise it as a threat to their security and to distinguish it from a young Black-backed Gull *(Larus dominicanus)*, a species which they generally ignore, though when it flies close to the water, its silhouette and colouring are not unlike those of a Skua.

B. D. HEATHER
R. B. SIBSON



TAKAHE An adult takahe moving over open, boggy ground. The deliberate goose-stepping gait is well shown in this photograph.

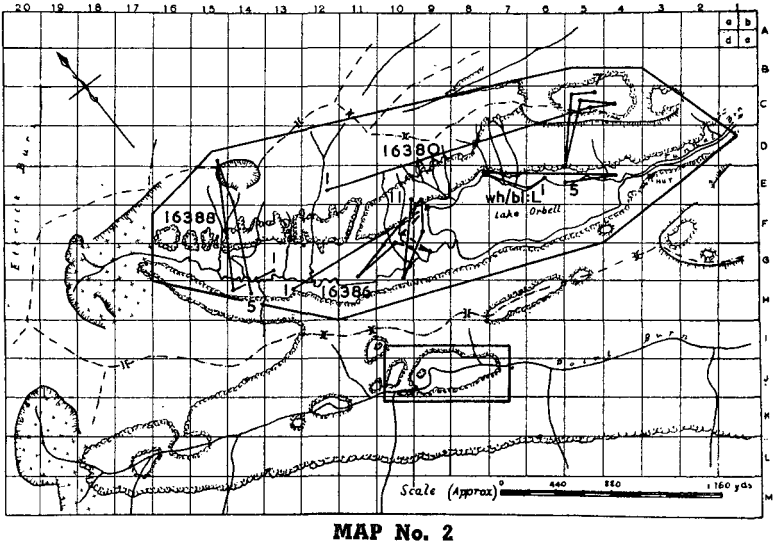
Red tussock *(Danthonia rigida)* growing between the mountain beech forest and the northern shore of Lake Orbell. This picture gives some idea of how difficult observation of takahe can be — the tussock is about twice the height of the birds living in it.



MAP No. 1

Line hatching shows approximate extent and boundaries of the "permanent" takahe territories. The cross-hatching of part of the N.E. shore of L. Orbell indicates a territory occupied in some years. When it is not, one pair ranges over the whole eastern part of the shores of the lake.

Stippled areas show the other occupied parts of the main colony. Territorial distribution is not well known in these because of the difficult terrain.



MAP No. 2

Movements of four selected takahe. Digits indicate first and last observed positions and thus the total number of observations. For details see the text.

The two areas enclosed in heavy lines are those that have been censused. The two stippled areas are the remaining permanently occupied parts of the main colony.