OBSERVATIONS ON POPULATION, MOVEMENTS AND FOOD OF THE KEA (NESTOR NOTABILIS)

By C. M. H. CLARKE
Forest Research Institute, Rangiora

SUMMARY

Movements, numbers and foods of Keas are recorded from observations from June 1964 - July 1966 at Cupola Basin, and August - September 1965 and 1966 at Mt. Robert. Of 35 Keas captured (24 at Cupola Basin, 11 at Mt. Robert), only six birds resident in Cupola Basin were frequently recovered; all others were seen only occasionally, or not at all. Banded birds dispersed up to 12.5 miles from Cupola Basin.

At Cupola Basin Keas were seen between 2,500 and 7,000 ft. altitude, most frequently at 4,000 - 4,500 ft. Seasonal movements were related mainly to snow and availability of food.

Forty-seven different items of food were seen being eaten. The fruits of **Coprosma pseudocuneata** were the commonest food taken. Voided seeds of five fruiting species germinated after being covered with soil, showing that Keas disperse some alpine plants.

INTRODUCTION

A study of the population, movements and food of the Kea was made between 1964 and 1966 at Cupola Basin and Mt. Robert, Nelson Lakes National Park. Apart from one recent paper (Jackson 1960) little has been published on these aspects of the Kea's life history. Cupola Basin, described by Christie (1964), is a mountainous 3,000 acre tributary catchment of the Travers River (Fig. 1). Forested slopes rise from 2,500 feet to approximately 4,500 feet and above this a zone of grassland broken by extensive screes extends to 6,500 feet

FIGURE 1 — Cupola Basin. Hut is indicated by arrow.

and merges with a further zone of steep rock and scree slopes to the ridges at 6,500 - 7,396 feet. Similar mountainous terrain extends to the south, east, west and 10 miles north where the range terminates at Mt. Robert, overlooking the Buller River valley.

METHODS

Twenty-four Keas were captured at Cupola Basin from June 1964 - July 1966 and 11 at Mt. Robert during 24 days in August - September 1965 and 1966, in box traps, nets, or by hand. Captured birds were aged and sexed by morphological characters (Oliver 1955), and notes were kept of numbers, distribution and activity throughout the year. Most observations were made at Cupola Basin between 3,500 and 6,500 ft., over an average of nine days a month at irregular intervals. Faeces found (especially near the hut) were examined and undigested seeds and fibrous parts of fruits which they contained were identified by comparison with fresh berries.

POPULATION

Twenty-four birds were banded during the period of observation at Cupola Basin. The monthly numbers banded, observed and re-sighted are given in Table 1.

TABLE 1 — Summary of birds banded, observed and " recaptured " at Cupola Basin, June 1964 - July 1966

	1964							1965											1966							
	J	J	A	S	O	N	D	J	F	M	A	M	J	J	A	S	O	N	D	J	F	M	A	M	J	J	A
Cumulative No banded	0	1	1	1	4	4	5	5	8	15	15	15	15	15	15	15	20	20	20	20	21	23	23	23	24	24	24
Total observed	2	0	2	6	5	7	8	4	44	1	16	2	3	5	11	40	10	19	9	13	45	9	5	6	-	13	-
Total "recaptures"	0	0	1	2	1	3	4	1	35	1	6	2	3	5	11	26	10	19	7	12	43	9	5	4	-	13	-
Days effort	5	6	9	8	2	13	16	13	24	1	8	2	8	8	4	13	7	9	12	9	13	11	16	5	0	6	-

N.B. "recaptures" include all observations of identified marked birds.

The Kea population was estimated by Lincoln index for 16 of the monthly periods (Fig. 2) and the 95% confidence limit of each estimate (Bailey 1951) was computed for units of more than 20 observations. The estimates suggest the population increased from 10 to 25 during the 18 month period for which the Lincoln index was applied. This trend is very close to the accumulated number banded (Table 1), and since relatively steady numbers were observed near the hut, it appears that the 3 - 4 fold difference between the minimum number estimated and Lincoln index estimate is due to a high proportion of banded birds visiting the area rarely, i.e. the tenet of Lincoln index — random mixing of the population — is not met.

The minimum number of individual Keas present was also estimated for each month from June 1964 - July 1966 (Fig. 2) by

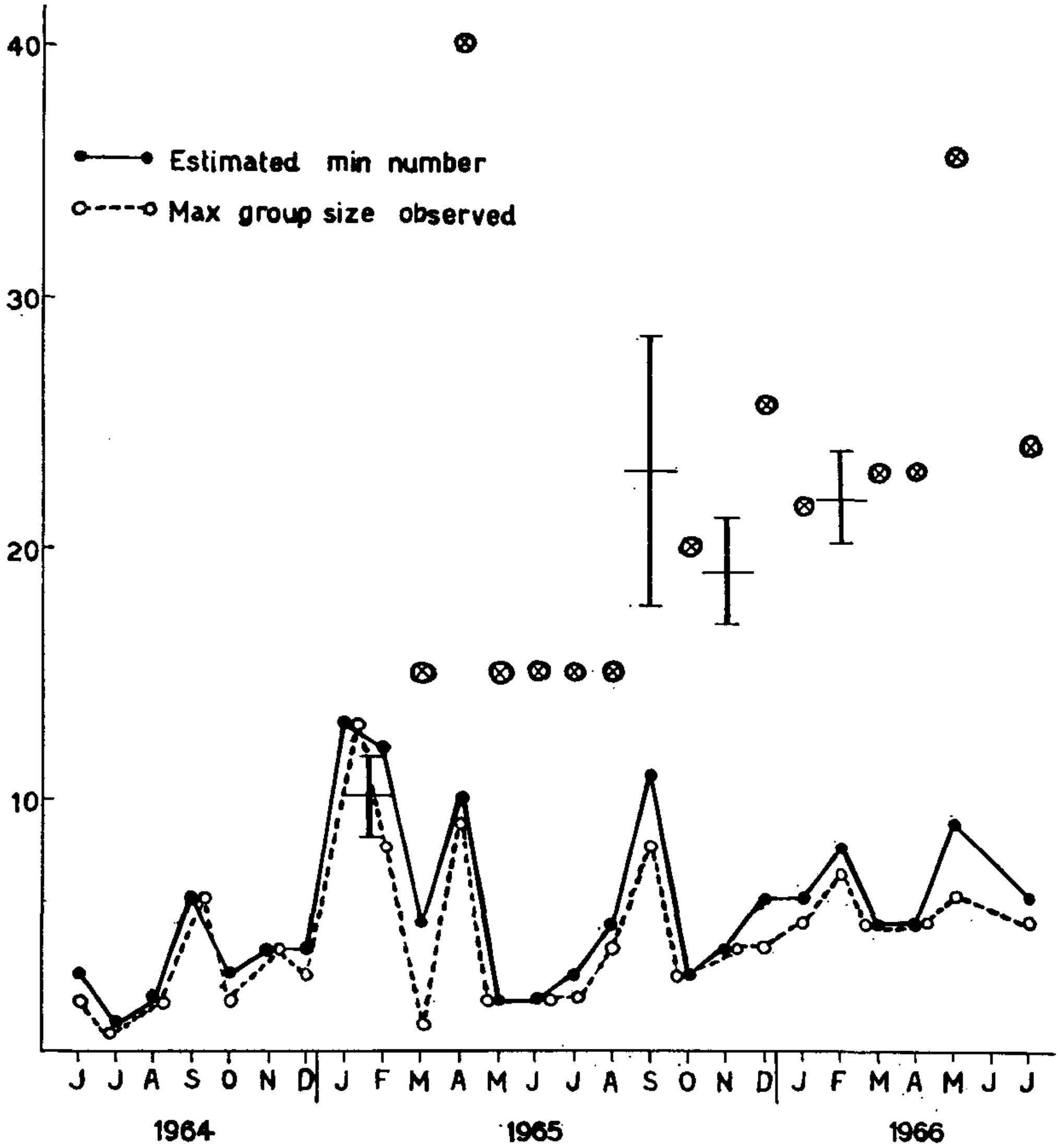

FIGURE 2 — Estimated and observed numbers of Keas at Cupola Basin. Encircled crosses designate Lincoln index estimates from samples of less than 20 units. Standard error is shown only for samples of more than 20 units.

identification of marked birds and numbers of unmarked birds seen. These numbers fluctuated between one bird in July 1964 and 13 in January 1965, and averaged 5.5 over all months.

The number of times each bird was resighted each month from the date of first capture allowed resident and transitory birds to be identified (Fig. 3). Six birds, Nos. 2, 6302, 6304, 6308, 6318 and 6319, were seen more than once a month; all others were resighted fewer than 0.35 times per month. Numbers 6318 and 6319 were juveniles reared by the pair Nos. 2 and 6304 and would probably disperse following separation from their parents. It is clear, however, that the adult pairs Nos. 2 and 6304, 6302 and 6308 were resident birds, whereas all others were visitors whose home range included Cupola Basin. This suggests a resident density of one bird per square mile, plus juveniles, comparable to that recorded by Jackson (1960) at Arthur's Pass, Canterbury.

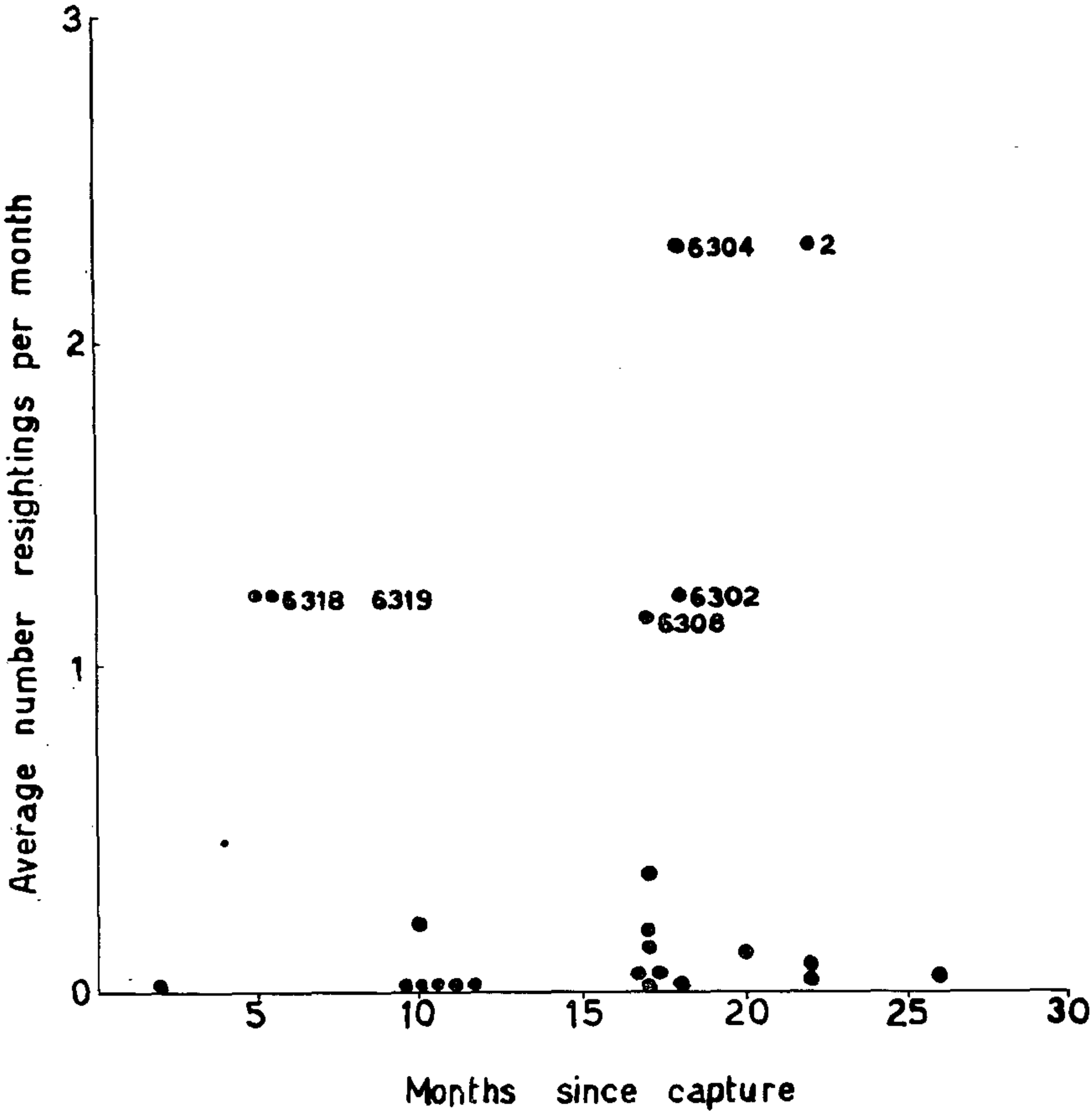

FIGURE 3 — Average number of resightings each month of Keas banded at Cupola Basin.

MOVEMENTS AND GENERAL BEHAVIOUR

The peak numbers of birds seen at Cupola Basin from time to time (Fig. 2) were attributable to visiting groups. Most groups appeared during January, February and September and remained in the area for 2 - 3 weeks. Transitory groups were seen on isolated occasions during other months, e.g. nine in April 1965.

At Cupola Basin Keas were most frequently observed about the mountain beech *(Nothofagus solandri var. cliffortioides)* forest timberline at 4,000 - 4,500 feet and the adjoining scrub zone dominated by *Dracophyllum uniflorum, Phyllocladus alpinus, Podocarpus nivalis, Coprosma pseudocuneata* and *Hebe* species. Besides this, birds were frequently observed over the altitudinal range of 2,500 - 6,500 ft., and occasionally to 7,000 ft.

Seasonal movement was generally similar each year. In the winters of 1964 and 1965 snow cover at Cupola Basin was heavy

and few Keas were seen above timberline. Those that remained scavenged from the waste food dump, but were also present when no waste food was available. Several sightings were made and calls frequently heard in the forest, particularly on warm northerly aspects between 2,500 - 4,000 ft. During September flocks of 6 - 8 birds were frequently seen between 4,000 - 5,000 ft. but from October - December they were seen singly or in groups of two or three. In January and February they congregated in groups of 6 - 13 about the 4,000 - 6,000 ft. level and at this time young birds were attracted by human activity. The groups were active at night, often feeding, and on several occasions they did not return to the forest to roost but remained in rock bluffs 500 - 1,000 ft. above the hut. Flocks disbanded during autumn and groups of two or three were observed about bluffs between 5,000 - 6,500 ft. Keas returned to the forest in autumn or early winter after onset of heavy frosts or snowfalls.

TABLE 2 — Summary of Observations at Mt. Robert

Period	Adult	Juvenile	Total	Cumulative Number Marked	Number marked Observed
22-27/8/65	4	4	8	0	2*) Ski
28/8-4/9/65	11	18	29	0	2*) School
5-12/9/65	9	31	40	8	1*) Period
18-19/9/65	3	0	3	8	2
14-20/8/66	6	6	12	11	1) Ski
29/8-3/9/66	6	14	20	11	4) School period
17-18/9/66	1	0	1	11	0

* banded at Cupola Basin

At Mt. Robert Keas congregated at the ski lodges when Ski School was in progress during August - September 1965 and 1966. The number present in both years (Table 2) increased as the three-week Ski School period progressed, as juvenile birds joined the flock. Birds were attracted by waste food dumps and human activity at Mt. Robert; most dispersed soon after Ski School closed.

DISPERSAL OF BANDED BIRDS

Resightings of banded birds further than two air miles from the two capture points are given in Table 3. Eighteen of the 35 birds were resighted and identified since banding and a further four banded but not identified were also sighted. Sixteen of the 18 were banded at Cupola Basin; nine were seen only in the first month after capture. Only two of the 11 birds marked at Mt. Robert were resighted. One unidentified bird was resighted 12.5 miles from the nearest capture point, Cupola Basin.

TABLE 3 — Resightings of Banded Birds Further Than Two Miles from Capture Point

Band No.	Banded	Resighted	Distance
3	Cupola Basin 23/9/64	Mt Travers /11/64	2.8 miles S
6301	Cupola Basin 20/11/64	Mt Robert car park 22/8/65	11.1 miles NE
6302	Cupola Basin 20/11/64	Mt Robert ski fields 5/9/65	9.5 miles NE
3	Cupola Basin 23/9/64	Upper Travers Saddle 4/1/65	4.0 miles S
6309	Cupola Basin 5/2/65	Hopeless Creek Travers River 8/5/66	3.1 miles NE
unidentified	-	Mt Franklyn, Sabine River /2/67	6.0 miles S
unidentified	-	Head of D'Urville River /3/67	12.5 miles SW
6355	Mt Robert 9/9/65	Rangimarie Tarn, Mt Robert range 24/10/66	3.4 miles S
unidentified	-	Mt Travers Hut 12/66	3.4 miles S
unidentified	-	East Sabine River 25/3/67	6.0 miles S

FOOD

One hundred and ninety-nine items of food seen to be taken by Keas were recorded (Table 4). Fruits of *Coprosma pseudocuneata* were frequently eaten (68 occurrences), although this may be related to availability. Up to 53 seeds of *C. pseudocuneata* were counted in some faeces, with seeds of other species less abundant. During peak fruiting periods of *C. pseudocuneata* most faeces consisted entirely of these seeds and fibrous parts of the fruit.

Voided *C. pseudocuneata* seeds germinated on moist soil. In February 1965 following this observation, faeces containing seeds of *C. pseudocuneata, Cyathodes fraseri, Muehlenbeckia axillaris, Pentachondra pumila, Podocarpus nivalis* and *Astelia nervosa* were collected and covered with soil in an enclosure to determine the general effects on viability of passage through the Kea's gut. All except *A. nervosa* germinated within two months but all died soon after a heavy snowfall in April. *A. nervosa* had not germinated after 18 months.

DISCUSSION

Differences between numbers observed at Cupola Basin and the Lincoln index estimates of P (Fig. 2) probably arise from unbanded birds coming in from surrounding areas, their subsequent capture,

TABLE 4 — Food Eaten

Food eaten	Species	Spring Sep-Nov		Summer Dec-Feb		Autumn Mar-May		Winter June-Aug	
Fruits	Astelia nervosa				*	3	*		
	Coprosma pseudocuneata	22	*	14	*	31	*	1	*
	C. pumila	1	*		*		*		
	C. serrulata				*	6	*		
	Cyathodes colensoi	1	*	1	*	1	*		
	C fraseri				*	3	*		
	Gaultheria depressa		*		*	2	*		
	Muehlenbeckia axillaris			1	*	2	*		
	Pentachondra pumila	1	*	3	*	2	*		
	Podocarpus nivalis			9	*				
Seeds	Aciphylla colensoi			1	*	3	*		
	A. ferox				*	1	*		
	A. monroi				*	2	*		
	Astelia nervosa				*	1	*		
	Hebe ciliolata			1	*				
	Pimelea oreophila			1	*				
	Pittosporum anomalum			1	*				
	Plantago raoulia			1	*				
Roots (succulent)	Anisotome pilifera					1			
	Celmisia coriacea	1				9			
	Gingidium montanum					2			
	Notothlaspi australe					1			
	Ranunculus insignis					4			
Leaves and leaf buds	Euphrasia zelandica			1					
	Gentiana bellidifolia			3					
	G. spenceri			1					
	Gnaphalium traversii	1							
	Hebe pauciramosa	2							
	H. vernicosa	1		3					
	Lagenophora petiolata			1					
	Nothofagus solandri var cliffortioides	6						2	

TABLE 4 — Food Eaten (Continued)

Food eaten	Species	Spring Sep-Nov	Summer Dec-Feb	Autumn Mar-May	Winter June-Aug
Flowers	Celmisia coriacea		5 *		
	C. discolor var ampla		2 *		
	C. spectabilis var angustifolia		1 *	1 *	
	Cotula pyrethrifolia	*	2 *	*	
	Gentiana bellidifolia		*	3 *	
	G. patula		2 *	1 *	
	G. spenceri		*	1 *	
	Haastia pulvinaris		7 *	3 *	
	Luzula campestris	*	1 *		
Entire plant	Anisotome aromatica var aromatica	1			1
	Ourisia sessilifolia	1			
	O. caespitosa	1			
	O. macrophylla	2			
	Ranunculus insignis	2			
Insects	Adult Grasshoppers. (Brachaspis collinus)		2		
Larvae			1		6

* Observed fruiting, seeding or flowering period.

and infrequent sightings after banding. This results in an estimate which is substantially higher than the numbers observed and also in a rising trend during the study period. This is consistent with the fact that 18 of the 24 banded at Cupola Basin were seen only occasionally (less than 0.35 times per month, Fig. 3) and undoubtedly spend most time in other areas. Nearly all of these were captured and marked soon after being sighted and only one bird remained unmarked by July 1966. By February 1966, 21 birds had been banded and the population estimate was 22. It is therefore evident that the Lincoln index figure is simply the sum of all birds living

within at least 12.5 miles, which appeared in Cupola Basin since June 1964, whereas the estimated minimum number (Fig. 2) comprises the four residents, their offspring and 2 - 3 visitors from contiguous gullies.

Two points on movement warrant comment:

Throughout spring and summer of all years Keas were observed about the alpine scrub and grassland zones at 4,000 - 5,000 ft., where food was most plentiful; in autumn, Keas were frequently seen between 5,000 - 6,500 ft., eating berries and fossicking in moist ground. The movement probably reflects the later flowering and fruiting of plants at high altitude.

During August - September 1964 and 1965 at Cupola Basin and August - September 1965 and 1966 at Mt. Robert, Keas congregated above the timberline. The formation of flocks coincided with pleasant weather during the snow thaw period and numbers fluctuated according to snow conditions. For example, 40 Keas were observed at Mt. Robert (Table 2) during August - September 1965 when heavy snowcover existed above 4,000 ft. In August - September 1966 when there was only light snowcover above 4,500 ft. only 20 birds were present. An unusually heavy snowfall occurred at Cupola Basin in August 1964 and persisted as a heavy snowpack during September. Six birds were seen, compared with 11 in September 1965 when the snowpack was considerably less.

Visiting Keas scattered from the banding stations following the break-up of flocks during late September. Jackson (1960) has recorded a dispersal of juvenile Keas at this time. At Mt. Robert in September 1965, adult and juvenile birds combined into a large flock before they dispersed. Initially, the flock contained equal numbers of juveniles and adults (Table 2), but within three weeks juveniles outnumbered adults by more than 3 to 1. The juveniles became noticeably gregarious and were attracted to food dumps and by human activity on the ski fields. Adults were less gregarious and apart from occasional visits to the food dumps, they remained in adjacent bluffs. This parting appeared to signal separation of young from their parents, and they dispersed independently soon after.

Except for the resident juveniles (6318, 6319), no other juveniles marked at Cupola Basin were seen there again. This reinforces the impression of movement outside family range. Two of the most distant resightings made were the juveniles 6301 and 6305 at 11.1 and 9.5 miles respectively from the banding point, Cupola Basin. The dispersal of most Keas from Cupola Basin was to the south; resightings were made at Mt. Travers 3.2 miles S, Mt. Franklyn 6.0 miles S, Sabine River 6.0 miles S, and in the headwaters of the D'Urville River 12.5 miles SSW. Only three Keas banded at Cupola Basin were seen to the north, despite more opportunities to observe birds in these areas.

The frequency with which some foods are eaten (Table 4) does not necessarily reflect preference. *Coprosma serrulata*, for example, is rare at Cupola Basin, but was observed being eaten six times; it could thus be ranked as a preferred food. Conversely, *C. pseudocuneata* is widespread throughout Cupola Basin, it bears fruit between September and June (subject to snow conditions) and

is the most prolific berrying plant in the area. High use may therefore reflect availability rather than preference. At Arthur's Pass, Canterbury, Jackson (1960) notes that the fruits of *C. pseudocuneatas* are unattractive to Keas.

Often only a small part of the food selected was eaten. On the isolated occasions when Keas were seen catching grasshoppers (Table 4), they ate few in relation to the numbers caught. Similar wasteful behaviour occurred when flowers, branchlets and entire plants were removed.

The Kea has often been criticised as a sheep killer in some districts (Marriner 1908; Myers 1924; Aspinall 1967).

Keas at Cupola Basin appear to play a beneficial role in dispersing several soil binding plants as shown by germination of voided seeds of succulent fruiting species, *C. pseudocuneata, Cyathodes fraseri, Muehlenbeckia axillaris, Podocarpus nivalis* and *Pentachondra pumila.* When only the seeds were eaten, e.g. *Pimelea oreophila, Aciphylla colensoi, Hebe ciliolata,* they were crushed and it is probable that most were destroyed during digestion. Bull (1965) records the present paucity of birds in alpine areas of the Nelson Lakes National Park and notes only four berry feeding species. In pre-European times there were probably even fewer species since the Kea was not sighted in the area until 1903 (Marriner 1908) and no introduced species were present. However, some locally extinct species such as the Kakapo *Strigops habroptilus* may have occupied this alpine feeding niche. Today, apart from the infrequent summer visits to alpine areas of Cupola Basin by introduced species such as Redpolls *Carduelis flammea,* Blackbirds *Turdus merula* and Chaffinches *Fringilla coelebs,* the Kea is the only significant berry-eating species present.

ACKNOWLEDGEMENTS

I am especially grateful to Mr. C. L. Batcheler of New Zealand Forest Service, Lower Hutt, for assistance and criticism of the manuscript; to Mr. A. H. C. Christie and Mrs. M. M. Davidson of New Zealand Forest Service, Lower Hutt, for comments; and to Mrs. M. Whitham and Mrs. A. E. Harvie of New Zealand Forest Service, Lower Hutt, for help in preparing the manuscript. Dr. J. E. C. Flux of Animal Ecology Division, D.S.I.R., Lower Hutt, assisted with the collection of data. I am also grateful to Mr. I. Davey of Forest Research Institute, Rotorua, for helpful editing.

REFERENCES

ASPINALL, J. C., 1967: Some Observations on Keas. N.Z. Tussock and Grassland Institut. "Revue" 12: 14-17.

BAILEY, N. T. J., 1951: On Estimating the Size of Mobile Populations from Recapture Data. Biometrika 38: 293-306.

BULL, P. C., 1965: "Birdlife." Nelson Lakes National Park Handbook. 90-96.

CHRISTIE, A. H. C., 1964: A Note on the Chamois of New Zealand. Proc. N.Z. Ecol. Soc. No. 11: 32-36.

JACKSON, J. R., 1960: Keas at Arthur's Pass. Notornis 9: 39-58.

MARRINER, G. R., 1908: "The Kea. A New Zealand Problem." 151 pp.

MYERS, J. G., 1924: The Kea or Mountain-Parrot. N.Z.J.Agri. 29: 25.

OLIVER, W. R. B., 1955: "New Zealand Birds." 541-546.