SEASONAL MOVEMENTS OF NEW ZEALAND PIGEONS FROM A LOWLAND FOREST RESERVE

By M.N. CLOUT, B.J. KARL & P.D. GAZE.

ABSTRACT

Radio-tagging of 54 New Zealand Pigeons (*Hemiphaga novaeseelandiae*) captured at Pelorus Bridge Scenic Reserve, Marlborough, showed that about half of the birds which fed there in spring on deciduous foliage moved away from the reserve from early summer onwards. They travelled 2-18 km to other areas of native forest. Most remained away for 2-9 months and at least some bred at their summer destinations. Individual birds tracked in different years provided strong evidence for their using traditional seasonal ranges, although the timing of movements varied between years, depending on fruiting phenology and breeding success. Some birds made up to three return movements from and back to Pelorus Bridge within a year, visiting different destinations in different seasons. Late summer and autumn movements were apparently linked to feeding on miro (*Prumnopitys ferruginea*) fruit. Five of 25 radio-tagged pigeons which moved to known destinations away from the reserve occupied areas of privately owned native forest during the breeding season.

INTRODUCTION

New Zealand Pigeons (*Hemiphaga novaeseelandiae*) are large (c. 650 g) pigeons which live in lowland forests throughout New Zealand. They feed on the fruits, leaves, buds and flowers of a variety of plants (McEwan 1978) and are major seed dispersers in native forests (Clout & Hay 1989). Despite their apparent ecological importance and their intrinsic interest as a characteristic bird of the New Zealand lowlands, little is known about their population dynamics, behaviour, and movement patterns. This information is needed because native forests in private ownership continue to be logged and the numbers of New Zealand Pigeons have apparently declined in areas where they are illegally hunted.

New Zealand Pigeons are often assumed to be highly mobile. This assumption is based largely on seasonal changes in the numbers of pigeons counted in native forests (Dawson *et al.* 1978, Clout & Gaze 1984, Wilson *et al.* 1988) and their influx to farms, suburban gardens and riverbanks in spring to feed on leaves of leguminous and deciduous plants. In an earlier study using radiotelemetry, Clout *et al.* (1986) found that in spring pigeons moved up to 11 km at Lake Rotoroa in the Nelson Lakes National Park. This paper reports on the results of a long-term study in a more diverse area of lowland native forest. We attached radio transmitters to 54 New Zealand Pigeons to monitor their breeding behaviour, diet and seasonal movements.

STUDY AREA

Our central study area was at the Pelorus Bridge Scenic Reserve in Marlborough (41°18′ S, 173°35′ E). The reserve (1750 ha) contains a tongue of lowland tawa/podocarp forest (50 m a.s.l.) extending across the valley floor of the Pelorus River near its junction with the Rai River (Figure 1). This remnant of lowland forest contains stands of matai (*Prumnopitys*

taxifolia) and kahikatea (*Dacrycarpus dacrydioides*) with miro (*P. ferruginea*), totara (*Podocarpus totara*), rimu (*Dacrydium cupressinum*) and hinau (*Elaeocarpus dentatus*), mixed with dense areas of tawa (*Beilschmiedia tawa*), and stands of kamahi (*Weinmannia racemosa*) and beech (*Nothofagus* spp.) on drier sites. The reserve is contiguous with the Mt Richmond Forest Park to the south – west, containing large areas of tawa/podocarp, beech/podocarp and pure beech forest extending to over 1300 m on the steep hillsides of the Richmond Range. To the north, east and west, the reserve is adjoined by pastureland, scrubby hillsides and exotic conifer plantations. Riverine vegetation within and alongside the reserve includes kowhai (*Sophora microphylla*) and introduced willows (*Salix fragilis*) and poplars (*Populus* spp.).

The forest understorey and subcanopy within the reserve contain species such as *Coprosma rotundifolia, parsonsia heterophylla, pseudowintera axillaris* and *Lophomyrtus bullata* on the alluvial flats and areas of pigeonwood

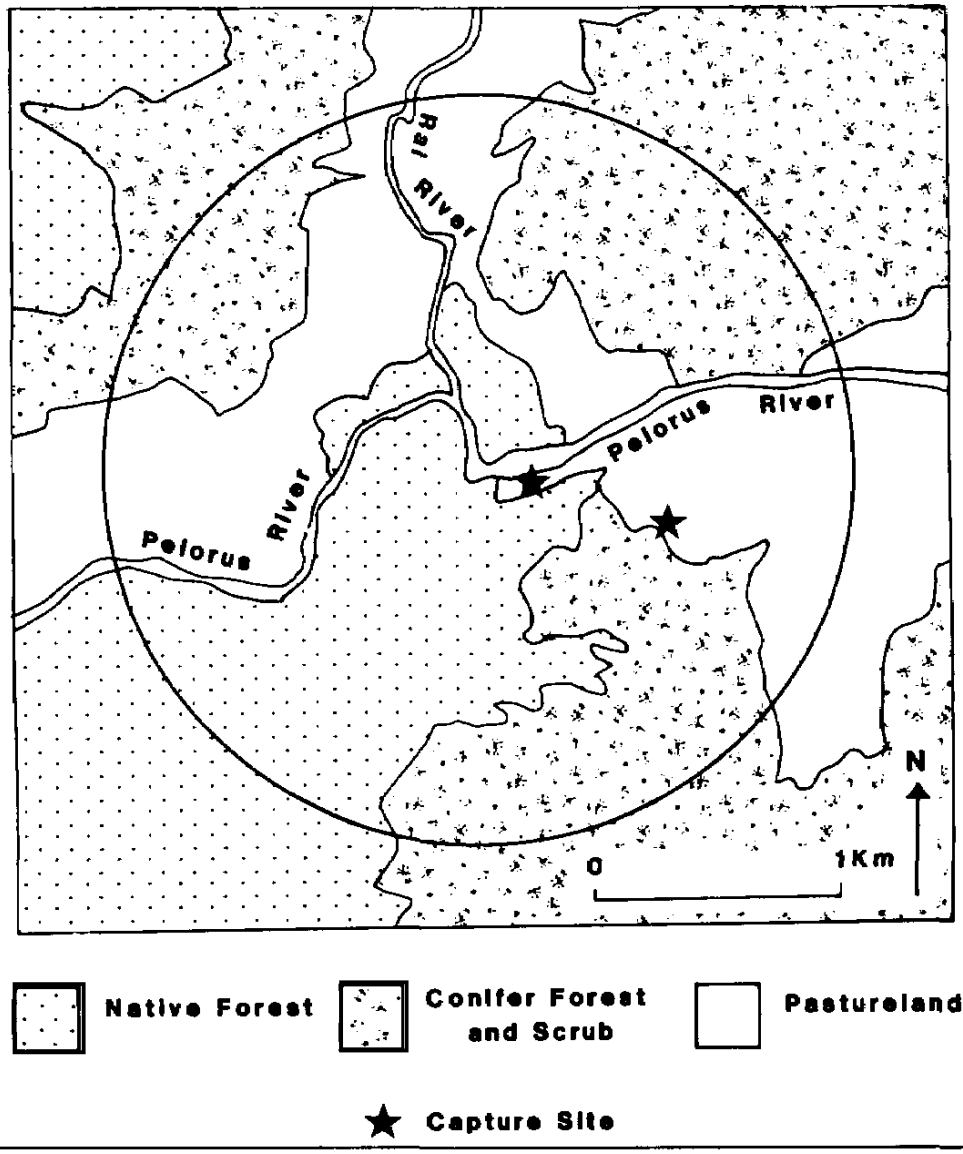

FIGURE 1 — Pelorus Bridge study area (delimited by a circle of radius 1.5 km). All native forest in the study area is part of a Scenic Reserve, which extends for a further 3 km to the south-west and adjoins the Mt Richmond Forest Park.

(*Hedycarya arborea*) and supplejack (*Ripogonum scandens*) on the hillslopes above about 200 m. Fuchsia (*Fuchsia excorticata*) and wineberry (*Aristotelia serrata*) grow in gaps and along forest edges and roadsides in the lower part of the reserve.

METHODS

Capture: The pigeons were caught in mist-nets (10 cm mesh 'wader' nets) mounted on poles or hanging ropes and set near known feeding sites in or close to the Pelorus Bridge Scenic Reserve. Most birds were caught from September to November, when they congregated in loose flocks to feed on the spring foliage of deciduous trees (*Salix*, *Ulmus* and *Prunus* spp.). The two main capture sites were among willows alongside the Pelorus River and in a grove of elms (*Ulmus carpinifolia*) on a farm c. 1 km east of the reserve (Figure 1). At other times of the year the birds were more widely scattered and their feeding sites were less predictable and often unsuitable for mist-netting.

Radio-tagging: The pigeons were weighed, banded, and individually marked with one or two coloured leg jesses of PVC-coated nylon. Birds were named from their jess colours. We could not assign sexes reliably from size or appearance, but could sometimes deduce them from behaviour. A small radio transmitter package (weighing c. 25 g) was mounted on the back of each bird by a special harness of nylon and cotton (Karl & Clout 1987). The transmitters were on different channels on the 160 MHz waveband and delivered pulsed signals which were received on AVM or 'Merlin' receivers via a hand-held, collapsible, three-element yagi antenna. Early in the study (1984-85), most transmitter packages had lives of less than 6 months. With improvements in both transmitter and battery technology, by 1988 the life of our new packages ('Sirtrack' transmitters with 2/3 AA lithium cells) was more than 18 months. Packages were usually less than 4% of the body weight of a pigeon. The birds rapidly adjusted to carrying them and behaved normally and bred successfully.

Radio-tracking: Birds carrying active transmitters were usually located and followed on foot, although we located some which had left the reserve by radio-tracking them from a light aircraft. When a pigeon's centre of activity was within 1.5 km of the centre of the Pelorus Bridge study area (Figure 1), we located and watched the bird at least twice a month (and often much more frequently). How often we located birds which moved outside this 1.5 km radius depended on how accessible they were. Those birds which moved into very remote or inaccessible areas were usually located and seen only once or twice over a period of up to 6 months, and a few were radio-tracked only from the air and were not seen.

The date of departure of a radio-tagged bird from the Pelorus Bridge study area was taken as the median date between when it was last located in the study area (Figure 1) and when it was first known to be absent. The first sign of a departure was usually that we had no radio signal from the transmitter at Pelorus Bridge. Sometimes several weeks (or even months) would elapse before we found missing birds again, either by searching in places away from the study area or by detecting the radio signal when a bird returned to Pelorus Bridge.

The date of return was taken as the median date between the last day when the bird was known to be absent from the study area and the first day when it was located again within it.

RESULTS

Tracking periods

Between February 1984 and November 1988, we attached 65 transmitters to 54 New Zealand Pigeons captured at Pelorus Bridge. Two were radio-tagged as chicks on the nest; the rest were adults caught in mist-nets. As some were recaptured and equipped with new transmitters, 8 of the 52 adults were radio-tracked over two consecutive summers. Fifty of the 65 transmitters were fitted in the period September to December.

As the equipment was improved during our study, the tracking periods for birds increased from an average of only 3 months for those caught in 1984 to more than a year for those caught in 1988. Only 11 birds carried active transmitters continuously for over a year – 10 of these in 1988-89. Apart from short transmitter lives, tracking periods were shortened when we occasionally failed to relocate birds which had moved from the study area; when functioning transmitters were shed; and when some birds died. Nine pigeons died while carrying active transmitters, four of which were at the same location in late 1987.

Movements

New Zealand Pigeons undertake movements ranging in scale from regular foraging flights of tens or hundreds of metres to seasonal migrations over kilometres or tens of kilometres. We were concerned, not with normal daily movements within a bird's seasonal home range, but with the longer-distance movements between ranges. From our knowledge of normal daily movements of pigeons at Pelorus Bridge, we defined a long-distance movement as one which took a bird more than 1.5 km from the centre of the Pelorus Bridge study area (Figure 1).

We know that long-distance movements were undertaken by 28 of the 52 adult birds which we radio-tracked, including 6 of the 11 birds carrying active transmitters for over a year. (Neither of the radio-tagged chicks moved more than 600 m from their nests before their transmitters failed.) These results show that at least half of the New Zealand Pigeons using the study area (especially in spring) were not permanent residents.

At least 25 of the 28 pigeons which moved away from Pelorus Bridge were radio-tracked at least once to a new location. The other three birds travelled to unknown locations but later returned to the central study area. The 27 known destinations of the 25 birds located away from Pelorus Bridge were 2-18 km distant (Figure 2). All were in areas of native forest (tawa/podocarp or beech/podocarp) and most were within the Mt Richmond Forest Park. The destinations of 5 of the 25 birds were in privately owned native forest with no reserve status.

Two birds were each tracked to two separate destinations away from Pelorus Bridge. Each of the other 23 birds was tracked to, essentially, one destination (i.e., within an area of 1 km^2 or less).

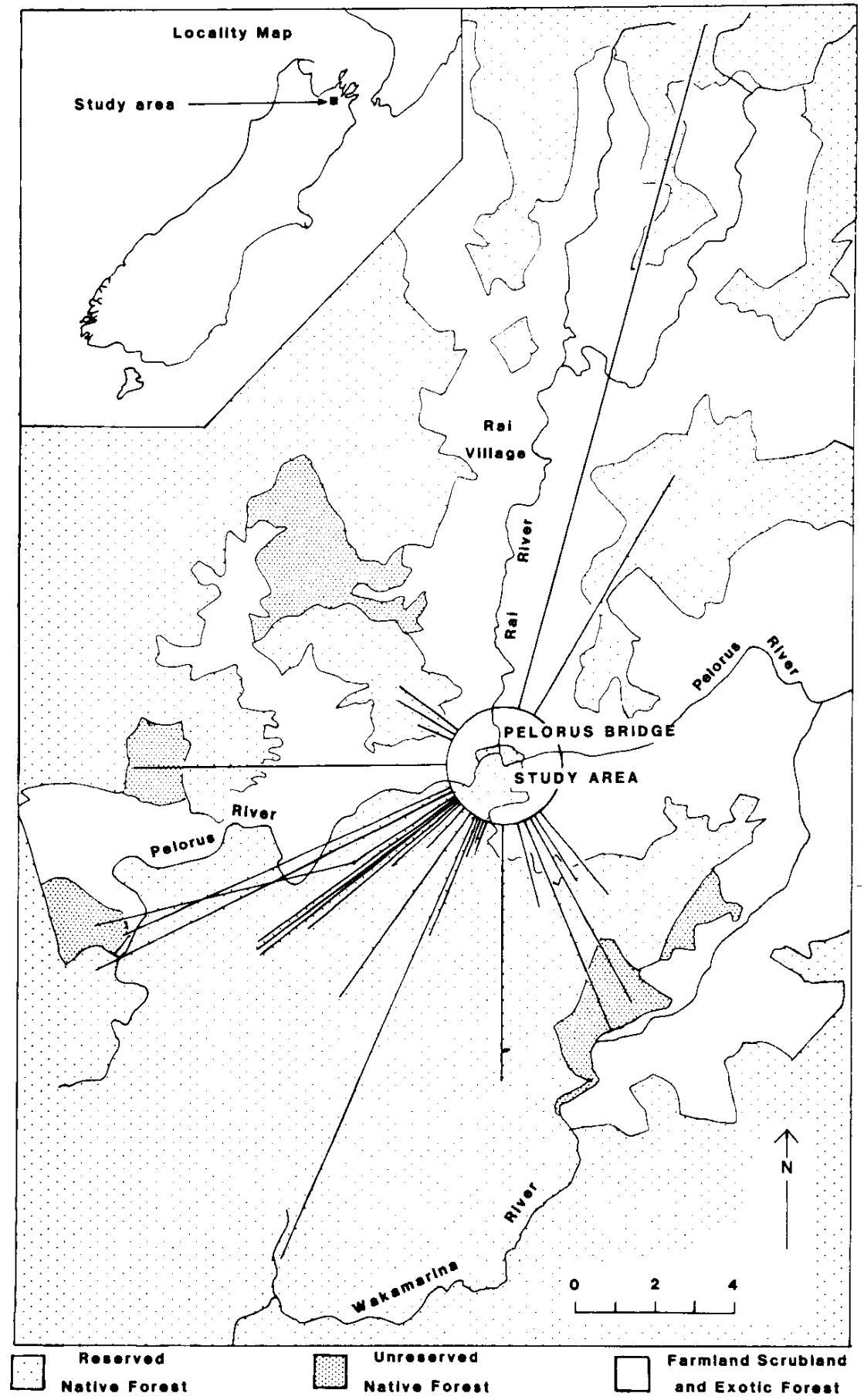

FIGURE 2 — Destinations of New Zealand Pigeons which moved outside the Pelorus Bridge study area. (Repeated movements of individuals to the same destination in successive years are not distinguished.)

TABLE 1 — Seasonal movements of New Zealand Pigeons departing from and returning to the Pelorus Bridge study area (years 1984-1989 combined)

	MONTH											
	J	F	M	A	M	J	J	A	S	O	N	D
No. of departures	4	2	4	4	2	2	0	0	0	0	6	17
No. of returns	2	2	4	1	2	8	1	2	3	0	0	0

TABLE 2 — Duration of absence from the Pelorus Bridge study area for radio-tagged New Zealand Pigeons with known departure and return dates (years 1984-1989 combined)

Month of departure	Duration of absence (months)									
	<1	1-2	2-3	3-4	4-5	5-6	6-7	7-8	8-9	>9
November	-	2	-	-	2	-	2	-	-	-
December	-	1	2	1	-	3	1	-	2	1
January	1	-	-	-	-	-	-	-	-	-
February	1	-	-	1	-	-	-	-	-	-
March	-	-	-	-	1	-	-	-	-	-
April	-	1	2	-	-	-	-	-	-	-
May	-	-	1	-	-	-	-	-	-	-
June	1	1	-	-	-	-	-	-	-	-
TOTALS	3	5	5	2	2	3	2	0	2	1

TABLE 3 — Monthly distribution of the start of incubation by nesting New Zealand Pigeons radio-tagged in the Pelorus Bridge study area (years 1984-1989 combined)

	MONTH							
	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun
No. of nests started	1	7	11	5	3	0	0	1

Timing of movements

From 1984 to 1989 we recorded 41 departures from Pelorus Bridge, involving 28 radio-tagged pigeons. The seasonal distribution of these departures (Table 1) shows that birds left in every month from November to June, with a marked peak in December. The 25 known return movements to Pelorus Bridge (Table 1) show a very different seasonal distribution, with a peak in June. Samples were too small to analyse for differences between years in the patterns of departures or returns.

Length of absence

Birds undertaking long-distance movements (>1.5 km) for which return dates were known stayed away from Pelorus Bridge for periods ranging from less than a month to over 9 months (Table 2). Our data tend to emphasise shorter absences because, with the shorter transmitter lives early in the study (1984-86), we often could not get precise return dates for birds which were absent for longer periods. Overall, 25 known return movements were recorded for 16 birds. Five of these 16 birds made two or three known movements from and back to Pelorus Bridge within a year. The destinations of these five were no closer to Pelorus Bridge than those of birds which were absent for a single continuous period during the year. They included the bird which travelled farthest, to 18 km away from Pelorus Bridge.

One pigeon travelled to a site 2.5 km from Pelorus Bridge on 21 November 1988, nested there, hatched an egg, and a few days later (on 8 January 1989) started to commute frequently between the study area and its nesting site while continuing to feed the chick. This bird had an unusual movement pattern, and its return movements to Pelorus Bridge after 8 January 1989 (until it shed its transmitter in mid-February 1989) are not in the data of Table 2.

Our results show that most birds leaving Pelorus Bridge stayed at their destination for several months, typically from early summer until mid to late winter, but that some birds returned briefly to Pelorus Bridge (often in autumn) before departing again for a second or even third sojourn at another locality. Birds leaving in the peak month of December tended to stay away longer than those leaving in other months. Ten of the 11 departures in December for which a return date was known were for longer than 2 months, and seven of them (64%) were for longer than 5 months. In contrast, only one of 14 departures in other months (7%) was for more than 5 months (and this was for a bird leaving in late November).

Differences between years in movements of individual birds

Eight pigeons carried active transmitters through all or part of two summers (seven of them in consecutive years), and so we could compare their patterns of movement and habitat use in different years. Three of these birds were not recorded outside the Pelorus Bridge study area; they each used approximately the same home range for 2 years and nested in the same general area in consecutive summers, with varying success. The other five pigeons undertook at least one long-distance movement from Pelorus Bridge. Their tracking histories, summarised below, reveal differences between years in

the timing of movements, but provide strong evidence for traditional use of seasonal ranges.

The first is perhaps the best example of repeated movements. This bird ("Pink/Blue"), tracked in the summer of 1984-85 and from summer to spring in 1985-86, travelled to the same probable breeding site 5.1 km away in both summers. It was seen feeding in the same group of willows and poplars and roosting in the same totara at Pelorus Bridge every spring from 1984 to 1989. It obviously had a traditional spring feeding site, but the date of its return to this site varied from as early as 8 June (in 1987) to as late as 18 September (in 1986).

Two other birds showed similar year-to-year consistency in their seasonal destinations. "Double Pink" occupied a well-defined home range at Pelorus Bridge from September 1987 to mid-February 1988 but did not breed. It left for an unknown destination in mid-February but returned on 17 March 1988 and was seen in the study area on 23 March 1988, feeding on elm foliage with a huge flock of about 100 pigeons. It had gone again by 30 March 1988 and was located on 5 May over 8 km away in a forested valley, where it remained until its return to Pelorus Bridge at the beginning of August 1988. "Double Pink" occupied its usual home range at Pelorus Bridge from mid-October to 24 November 1988, when it again departed. It was found over 8 km away in the same forested valley as before and remained there until mid-June 1989, when it returned to Pelorus Bridge. "Double Pink" therefore visited the same destination in successive years, but the timing of its movements differed significantly between years.

The third bird known to have visited the same destination in successive years was "Double Green", which carried active transmitters from September 1987 to at least November 1989. This bird consistently used a part of the Pelorus Bridge study area from September 1987 until late December 1987, when it disappeared. It was found 4.5 km away in early January 1988 in an area of beech/podocarp forest, where it nested in late January and was seen feeding on pigeonwood fruit. The nest failed and by 8 March 1988 "Double Green" had returned to Pelorus Bridge. It departed again within 2 weeks and moved over 8 km to a different forested valley, beyond its previous destination, where it remained until at least May 1988. It was recaptured at Pelorus Bridge (with an inactive transmitter) on 28 September 1988, and remained there, within its previous range, until 13 December 1988, when it flew about 5.5 km to an area of beech/podocarp forest c. 1 km from where it had nested the previous summer. We do not know whether "Double Green" nested in this area, but it remained there until late May 1989, when it returned to Pelorus Bridge and stayed until at least November 1989.

The other two birds which moved from the Pelorus Bridge further illustrate that the timing of movements may vary greatly between years.

One of these ("Double Brick") was tracked for 10 months from October 1986 and again for over a year from November 1988. In 1986-87 it stayed (without breeding) within a well-defined home range at Pelorus Bridge until early April 1987, when it disappeared to an unknown location, returning in mid-May 1987. In 1988-89 it behaved quite differently, departing to an

unknown location from 30 November 1988 to 13 January 1989 and again from 20 January 1989 to 8 February 1989. It departed yet again on 26 February 1989 and was eventually located 18 km away (at a site not previously searched) on 16 May 1989. It returned from this site in early June 1989 and remained in its usual range at Pelorus Bridge until at least November 1989.

Another bird ("Fluorescent Green") was tracked continuously from 2 February 1988 to November 1989. Throughout 1988 this female stayed at Pelorus Bridge, often closely associated with another marked bird ("Double Orange"). It moved up to 1.5 km to the edge of the study area in late autumn 1988 to feed on miro fruit with other pigeons, but was otherwise sedentary. In 1989 it mated with "Double Orange" and made three unsuccessful attempts to breed at Pelorus Bridge. The last nest failed when a predator ate the young chick on 8 March 1989, but the bird remained in the central part of the study area until about 9 April 1989. It was eventually located over 8 km away, where it stayed until it returned to its usual range at Pelorus Bridge in mid-June 1989. The tracking history of "Fluorescent Green" shows that even apparently 'local' birds which breed at Pelorus Bridge may move several kilometres to feed when breeding has finished.

DISCUSSION

Context of movements

The December peak of departures from Pelorus Bridge (Table 1) was just before the January peak in laying dates (1984-1989) for known nests of radio-tagged pigeons caught at Pelorus Bridge (Table 3). In addition, at least 10 of the 28 birds leaving Pelorus Bridge are known to have nested at their destinations. Therefore, the surge of long-distance movements in late spring and early summer probably represents the seasonal movement of pigeons between spring feeding sites and summer breeding areas. Late December is also the start of the fruiting season, when ripe fruits of wineberry and fuchsia become available and New Zealand Pigeons at Pelorus Bridge switch their diet from foliage to these fruits and then to the fruits of tawa and various podocarps (unpubl. data). The peak of breeding behaviour and nesting seems to be closely linked with the onset of the fruiting season (December/January), and the loose spring flocks break up as breeding pairs occupy their summer ranges. From our data, approximately half of the pigeons in the spring flocks feeding in deciduous trees at Pelorus Bridge have summer ranges elsewhere.

At least five birds which left Pelorus Bridge in November or December made brief($<$ 1 month) return trips between January and March, before leaving again. Three of these birds are known to have had failed nesting attempts at their original destination.

The movements of birds from Pelorus Bridge between February and June were presumably associated with feeding on miro fruit. Some birds that departed then had already been away once and returned briefly, and at least one other ("Fluorescent Green") had nested locally before departing. These later, post-breeding, movements were made during the miro fruiting season and those birds seen feeding at their destinations from late February to June were all taking miro fruit.

Ripe miro fruit were consistently the main food of radio-tracked pigeons in the autumn and early winter of every year from 1984 to 1989 (unpubl. data). Birds leaving Pelorus Bridge at this time of year were apparently visiting seasonal miro feeding sites, whereas those staying away after an earlier migration to their summer breeding ranges were also using miro fruit (which became available at their destination after the breeding season). Miro fruit was also available at Pelorus Bridge, but pigeons often defended fruiting trees (pers. obs.), providing an incentive for those birds denied access locally to move elsewhere.

At the end of the miro fruiting season, most pigeons switched from fruit back to foliage, together with a return movement to Pelorus Bridge by birds which had been away. In spite of the small samples, it was noticeable that in 1987 and 1989, when miro fruiting finished by late April and June respectively, birds tended to return to Pelorus Bridge earlier than in 1986 and 1988, when miro fruiting continued until August (unpubl. data). The mean date of final return movements to Pelorus Bridge was 15 June for 1987 and 1989 combined (n = 9) and 5 August for 1986 and 1988 combined (n = 5).

Birds returning to Pelorus Bridge after miro fruiting had finished fed mainly on old leaves of kowhai, *Parsonsia heterophylla,* and *Coprosma* spp., until the new foliage of deciduous trees such as willow, plum, poplar and elm became available from September onwards (unpubl. data).

Conservation implications

This study has shown that about half of the pigeons that feed in spring on leaves of deciduous trees in or near the Pelorus Bridge Scenic Reserve move away from the reserve from early summer onwards. They travel up to 18 km to summer breeding ranges in native forest and remain away for up to 9 months. There is strong evidence that individual pigeons are traditional in their use of seasonal ranges, although the timing of movements may vary from year to year, depending on factors such as fruiting phenology and breeding success. Some birds make up to three return movements in a year and may visit different destinations in different seasons, with late summer and autumn movements apparently being linked to feeding on miro fruit.

Our results confirm that the scale of seasonal movements of New Zealand Pigeons recorded in our previous study in the Nelson Lakes National Park (Clout *et al.* 1986) was not unusual. Another brief radio-tracking study of three pigeons caught on the Waimea Plains near Nelson in 1985 revealed a movement of 25 km by one bird between its spring feeding site in plum trees on agricultural land to its summer range in beech/podocarp forest in the Richmond Range (unpubl. data). Where seasonal food resources are widely scattered, pigeons are quite capable of moving long distances between them, crossing the boundaries of national parks and other reserves.

One implication of our study for managers of reserves such as Pelorus Bridge is the importance of retaining introduced deciduous trees (e.g. willows) as a seasonal food source for New Zealand Pigeons. Another implication is that habitat changes (e.g. logging) or illegal hunting of pigeons outside a reserve may affect the pigeons that inhabit it for part of the year.

ACKNOWLEDGEMENTS

We thank the many people (often volunteers) who helped with catching or radio-tracking pigeons, especially Cathy Fitzsimons, Alistair Freeman, Rod Hay and Graeme Taylor. We also thank Mike and Judy Edridge of Pelorus Bridge for their continued support and Brian and Rita Pilbrow for their cheerful co-operation in giving us permission to catch pigeons on their land. The Department of Conservation partially funded the study from 1987. Merle Rae typed the manuscript. Rod Hay and Hugh Robertson reviewed the paper.

LITERATURE CITED

CLOUT, M.N.; GAZE, P.D. 1984. Effects of plantation forestry on birds in New Zealand. J. Applied Ecol. 21: 795-815.

CLOUT, M.N.; GAZE, P.D.; HAY, J.R.; KARL, B.J. 1986. Habitat use and spring movements of New Zealand pigeons at Lake Rotoroa, Nelson Lakes National Park. Notornis 33: 37-44.

CLOUT, M.N.; HAY, J.R. 1989. The importance of birds as browsers, pollinators and seed dispersers in New Zealand forests. NZ J. Ecol. 12 (supplement): 27-33.

DAWSON, D.G.; DILKS, P.J.; GAZE, P.D.; McBURNEY, J.G.R.; WILSON, P.R. 1978. Seasonal differences in bird counts in forests near Reefton, South Island, New Zealand. Notornis 25: 257-278.

KARL, B.J.; CLOUT, M.N. 1987. An improved radio transmitter harness with a weak link to prevent snagging. J. Field. Ornithol. 58: 73-77.

McEWAN, W.M. 1978. The food of the New Zealand pigeon (*Hemiphaga novaeseelandiae novaeseelandiae*). NZ J. Ecol. 1: 99-108.

WILSON, P.R.; TAYLOR, R.H.; THOMAS, B.W. 1988. Effect of topography on seasonal distribution of forest birds in the Ohikanui, Lower Buller and Inangahua Valleys, North Westland. Notornis 35: 217-243.

M.N. CLOUT[1], B.J. KARL, P.D. GAZE[2], *DSIR Land Resources, Private Bag, Nelson*

[1] *Present address: Department of Conservation, P.O. Box 10420, Wellington*
[2] *Present address: Department of Conservation, Private Bag, Nelson*